Quasi-Contextualized Speech Treatment in Traumatic Brain Injury Inpatient Rehabilitation: Effects on Outcomes During the First Year After Discharge

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Objective: To evaluate the effect of providing quasi-contextualized speech therapy, defined as metacognitive, compensatory, or strategy training applied to cognitive and language impairments to facilitate the performance of future real-life activities, on functional outcomes up to 1 year following traumatic brain injury (TBI). **Setting:** Acute inpatient rehabilitation. **Participants:** Patients enrolled during the TBI-Practice-Based Evidence (TBI-PBE) study (n = 1760), aged 14 years or older, who sustained a severe, moderate, or complicated mild TBI, received speech therapy in acute inpatient rehabilitation at one of 9 US sites, and consented to follow-up 3 and 9 months postdischarge from inpatient rehabilitation. **Design:** Propensity score methods applied to a database consisting of multisite, prospective, longitudinal observational data. **Main Measures:** Participation Assessment with Recombined Tools-Objective-17, FIM Motor and Cognitive scores, Satisfaction With Life Scale, and Patient Health Questionnaire-9. **Results:** When at least 5% of therapy time employed quasi-contextualized treatment, participants reported better community participation during the year following discharge. Quasi-contextualized treatment was also associated with better motor and cognitive function at discharge and during the year after discharge. The benefit, however, may be dependent upon a balance of rehabilitation time that relied on contextualized treatment. **Conclusions:** The use of quasi-contextualized treatment may improve outcomes. Care should be taken, however, to not provide quasi-contextualized treatment at the expense of contextualized treatment.

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CURRENT RESEARCH is focused on identifying the active ingredients in inpatient traumatic brain injury (TBI) rehabilitation to determine what treatment approaches are associated with better outcomes.[1–5] The content and substance of what comprises time in therapy have been identified as critical ingredients.[3,5] The challenge in studying the content of therapy sessions in inpatient TBI rehabilitation—a treatment process as varied as the survivors it serves—is in identifying a classification scheme to capture the differing approaches to therapy conducted by rehabilitation providers. There is ongoing scholarly debate aimed at developing consistent rehabilitation treatment terminology to study the interventions employed in rehabilitation.[6]

Classifying therapeutic approaches as contextualized versus decontextualized has been proposed as a method to study the content of therapy sessions[7] and may be best suited to meet clinician-driven treatment plan decision-making needs.[2,3,5,8] The binary classification of contextualized and decontextualized treatment also has historical support from the developmental, pediatric, and educational populations.[9] Contextualized treatment incorporates real-life activities to target holistic function, whereas decontextualized treatments tend to target specific impairments. Contextualized therapy plans take a top-down approach, emphasizing whole-task performance, whereas decontextualized therapy plans take a bottom-up approach, emphasizing reduction in impairments.[10,11] Decontextualized activities are therefore not typically encountered in daily life. Therapy sessions composed of meaningful, real-life activities, or contextualized treatment, may be more effective than decontextualized treatment.[3] Using propensity score methods, Bogner and colleagues[3] found with increasing proportions of treatment time comprising contextualized activities during inpatient TBI rehabilitation, better community participation was noted over the course of the first year of recovery following injury. Small, but significant, effects were found for overall community participation, being out in the community, and in motor function. These findings coincide with another study that found similar associations between function-based treatments during inpatient stroke rehabilitation.[12]

Within the field of speech-language pathology (SLP), contextualized and decontextualized language interventions have been studied in the developmental and pediatric populations.[9] Contextualized interventions applied to multiple, simultaneous language impairments have demonstrated successful outcomes in various age groups, in early intervention programs designed to overcome environmental disadvantages, and in literacy programs.[9,13–15] In the school-based SLP setting, contextualized approaches apply specific training steps to curriculum targets or skills in the context of meaningful activities whereas decontextualized approaches are clinician-driven and focused on specific skills with minimal continuity across activities.[9] The few studies comparing contextualized versus decontextualized language interventions demonstrate a trend for greater efficacy with contextualized approaches,[9,16] although continued research is required.

Classifying treatment activities as contextualized or decontextualized may appear on the surface to be relatively straightforward. However, there are activities and interventions that defy binary classification. These forms of treatment activities have been referred to as metacognitive training, compensatory training, or strategy training.[11,17,18] Most of these treatments are applied to impairments associated with cognition and language. In the scheme of contextualized and decontextualized, these treatments fall between the 2 classifications; that is, these activities can be considered quasi-contextualized.[19] Quasi-contextualized treatment references real-life functional or meaningful activities to the individual but does not incorporate the actual real-life activity. An important component of this approach requires the therapist to explicitly explain and actively promote the relationship and relevance between the targeted task and the patient's everyday functioning and real-world goals.[20] The therapist must ensure the patient can draw the connection between the treatment activity and the real-life activity. Examples of quasi-contextualized treatment include learning compensatory or metacognitive strategies, verbally rehearsing the steps for toilet transfers, hypothetical daily problem-solving, and verbalization of safety precautions in the kitchen. The quasi-contextualized or metacognitive approach is not uncommon in TBI rehabilitation, particularly in treatment plans targeting impaired cognition (eg, memory deficits) that negatively impact function (eg, self-management of daily activities).

The purpose of the current study was to evaluate the effect of quasi-contextualized treatment delivered during speech therapy (ST) on inpatient TBI rehabilitation outcomes. We hypothesized quasi-contextualized treatment would have a positive impact on rehabilitation outcomes, including participation, functional independence, and subjective well-being. We also evaluated the relative contributions of contextualized and quasi-contextualized treatment to the outcomes. We hypothesized that contextualized and quasi-contextualized treatments were comparable in their effects on outcomes

such that when considered in combination their effects would be additive.

METHODS

Study design

The TBI-Practice-Based Evidence (TBI-PBE) observational data set, built from 2008 to 2011 and containing medical records and point-of-care (POC) data on patients with TBI, was utilized for the analyses.[21] Propensity score methods were employed to identify associations between quasi-contextualized speech treatment and patient outcomes at 3 different points in time–inpatient hospital discharge and 3 and 9 months post–inpatient discharge. Stakeholders, including persons with TBI, family members, and providers, assisted in the design of the research through their collaboration on the formation of questions, interpretation of results, and dissemination of findings. Stakeholders were also intricately involved with defining and classifying the treatments delivered during therapy sessions. Each site's institutional review board approved the data collection for this study.

Setting

The 9 US inpatient rehabilitation facilities that participated in the TBI-PBE are described in detail elsewhere.[22] The facilities typically delivered 3 hours of physical therapy (PT), occupational therapy (OT), and ST per day, and a median of 0.3 hours of PT and OT and 0.2 hours of ST were also delivered on the weekends. The mean session length of time for ST during the weekdays was 32.5 $\pm$ 6.1 minutes.[1]

Participants

Participants were enrolled in the TBI-PBE data set if they were (1) 14 years or older; (2) experienced a TBI (moderate, severe, complicated mild); (3) received their first inpatient rehabilitation admission at one of the participating sites; and (4) consented to follow-up. Of the 2120 enrolled, 1760 were included in the current analysis. Participants from the original data set were excluded from the current analysis if they (1) were enrolled at the Canadian site due to substantive differences between US and Canadian rehabilitation care; (2) did not consent to follow-up; (3) did not receive treatment following the first 3 days of rehabilitation; or (4) did not receive ST.

Intervention classification

Treatment was classified as contextualized when the therapeutic task involved real-life activity; that is, an activity likely performed by the individual at home or in the community. Treatment was classified as decontextualized when the therapeutic task did not reflect a real-life activity or was only associated with a clinical setting.[3] Generally, decontextualized tasks focus on the amelioration of specific impairments that underlie functional activities. Treatment was considered quasi-contextualized if the focus was on the development of compensatory strategies to use in the future to perform a real-life activity. In contrast to contextualized treatment, the actual real-life activity is not incorporated into treatment. During collection of data for the TBI-PBE database, data on ST treatment were collected via the POC forms completed by speech-language pathologists. The SLP representatives to the research team classified their therapeutic activities according to the operationalized definitions for contextualized, quasi-contextualized, and decontextualized treatments. Therapy peers who were not part of the research team were contacted and questioned to resolve the few classification dilemmas that arose during the process. These few instances occurred when the interpretation of the POC syllabus text and the operationalized definitions was unclear. Additional input was obtained from persons with TBI and family members. These individuals provided their perspectives on the extent to which an activity reflected "real life" or could generalize to "real life." The minutes of time in ST recorded on the POC forms were used to calculate time spent in each category of ST activity–contextualized, decontextualized, and quasi-contextualized. Proportion of time was calculated by summing time spent per type of activity across the duration of the rehabilitation stay and divided by the total number of minutes of ST received. Proportion of time was selected as it better reflects the content of the therapy session, whereas total time merely reflects quantity of therapy. Time in activities not considered treatment (eg, assessments) was not included in the time calculation.

The analysis in this study was confined to ST treatment activities and time as measured by minutes in the activity categories. Figure 1 outlines the 3 treatment time calculations corresponding to the 3 sets of analysis. The 3 analyses compared the effects of contextualized treatment-only, contextualized plus quasi-contextualized treatment, and quasi-contextualized treatment-only. First, we evaluated the effect of quasi-contextualized treatment. Next, we sought to determine the effect of contextualized ST minutes on outcomes. Then we sought to determine whether the effect changed when quasi-contextualized treatment was treated as being equivalent to contextualized; that is, quasi-contextualized was included in the numerator along with contextualized.

When developing the inverse probability weight, quasi-contextualized treatment was found to have an

$$\text{Unique quasi-contextualized treatment exposure} = \frac{\text{Quasi-contextualized activity minutes}}{\text{Contextualized activity minutes} + \text{Decontextualized activity minutes} + \text{Quasi-contextualized activity minutes}}$$

$$\text{Contextualized treatment exposure} = \frac{\text{Contextualized activity minutes}}{\text{Contextualized activity minutes} + \text{Decontextualized activity minutes} + \text{Quasi-contextualized activity minutes}}$$

$$\text{Additive quasi-contextualized treatment exposure} = \frac{\text{Contextualized activity minutes} + \text{Quasi-contextualized activity minutes}}{\text{Contextualized activity minutes} + \text{Decontextualized activity minutes} + \text{Quasi-contextualized activity minutes}}$$

Figure 1. Treatment calculations.

extremely skewed distribution. This skewed distribution prevented characterization of the treatment as a continuous dose. Analysis of quasi-contextualized treatment was therefore made binary; that is, participants with a proportion of treatment time comprising at least 5% of quasi-contextualized treatment were compared with participants who did not receive this minimum proportion of time.

Outcome measures

The primary outcome measure was the Participation Assessment with Recombined Tools-Objective-17 (PART-O-17) Total score at 9 months postdischarge as a measure of community participation. The PART-O-17 is a 17-item measure of community participation across 3 domains: Productivity, Being Out-and-About, and Social Relations.[23,24] Individual item scores and domain averages range from 0 to 5 points. The PART-O Total score comprises the average of these 3 domains and ranges from 0 to 5 points; however, the alternative unidimensional PART-O Total-Rasch with a range of 0 to 100 is considered more suitable for advanced statistical analyses.[25]

Community participation at 3 months postdischarge was a secondary outcome measure. Additional secondary outcome measures included the following: cognition and motor function as measured by the Rasch-adjusted Functional Independence Measure (FIM)[26–28] Cognitive (range, 5-35) and Motor (range, 13-91) subscores at discharge and at 3 and 9 months postdischarge; life satisfaction as measured by the Satisfaction With Life Scale (SWLS; range, 5-35)[29] at 3 and 9 months postdischarge; and depression as measured by the Patient Health Questionnaire-9 (PHQ-9; range, 0-27)[30] at 3 and 9 months postdischarge. The PHQ-9 was treated as a dichotomous variable—probable depression and no major depression—using the criteria of presence of 5 or more depressive symptoms present at least several days over a 2-week period accompanied by anhedonia and/or depressed mood.[31] As subjective measures, the SWLS and the PHQ-9 were only administered when the subject with TBI was able to complete the follow-up interview. When subjects with TBI were unable to complete the follow-up interviews, the objective measurement outcomes of FIM and PART-O were collected by proxy report.

Potential confounders

Potential confounders were controlled through propensity score methods. To ensure characteristics considered as potential confounders did not change due to treatment, only those measured at or before rehabilitation admission (first 3 days) or earlier were included (see Table 1 in Supplemental Digital Content [SDC], available: http://links.lww.com/JHTR/A402, for a full list of confounders). Premorbid medical and psychosocial history, injury characteristics, and rehabilitation admission functional status were abstracted from medical records. The Comprehensive Severity Index (CSI)[32,33] was included in the measures adjusting for injury severity. CSI defines severity as a function of physiological and psychosocial complexity based on the extent and interactions of a patient's disease(s). The CSI-Brain Injury calculation captured severity of brain-related conditions and the CSI-Non-Brain Injury calculation captured severity of all other patient medical conditions.[4]

Analytic methods

Data were analyzed using SAS version 9.3 and STATA version 14.0. To control for measured confounding, inverse probability weighting constructed from the estimated propensity score was utilized. For the binary variable, quasi-contextualized treatment, inverse probability weights were constructed from the propensity score estimated by logistic regression. For continuous treatment variables (contextualized treatment, quasi-contextualized plus contextualized treatment), the proportion of treatment was allocated evenly across 10 quantiles and inverse probability weights were constructed via cumulative logistic regression models.[34] The predicted probability of being in each quantile and inverse probability weights were constructed from the estimated probabilities. To achieve optimal balance across groups, interaction terms (pairwise and squared terms) were evaluated in the development of each propensity score model. Participants with extreme weights (>20) or who were dropped from the generalized propensity score models due to missing covariate data were not included in subsequent analyses. Reasons for missing outcome data included withdrew/refused, deceased, incarcerated, or lost to follow-up.

Adequacy of balance between the 2 quasi-contextualized treatment groups was assessed using absolute standardized differences (ASDs). The ASD is the difference in means between groups divided by the pooled standard deviation. In addition, variance ratios for continuous covariates were examined. For the continuous treatments, average ASD (ASD averaged across all pairs of quantiles) was assessed across the 10 quantile groups. Potential confounders with ASD exceeding 0.1 and variance ratios outside of the 0.8 to 1.2 range were considered not to be sufficiently balanced by the weighting and were included in the adjusted models for outcome analysis.

Marginal regression models with robust sandwich standard error estimates were used to evaluate the effect of each treatment (quasi-contextualized treatment-only, contextualized treatment-only, quasi-contextualized plus contextualized treatment) on outcomes, weighted by the stabilized inverse propensity weight (IPW). Analyses were conducted to answer the following questions: Does quasi-contextualized treatment have an effect on rehabilitation outcomes? Does the combination of time spent in quasi-contextualized treatment and time spent in contextualized treatment show stronger effects on outcomes than when contextualized treatment is considered alone? Sensitivity analyses included the use of multiple imputation (40 iterations) for missing outcome measures to examine the effect of attrition. Multiple imputation (40 iterations), by chained equations with predictive mean matching for continuous outcomes and K-nearest neighbors for categorical variables, was employed to accommodate missing outcome data. In these methods, we assume that the outcome data are missing at random, conditional on the measured covariates. In the multiple imputation models, all outcomes, treatments, and covariates, as well as the interaction between level of effort and compliance, and severity were included. The "treatments" included all interventions that were tested in the parent comparative effectiveness study including family involvement, advanced therapy, and compliance with the 3-hour rule. Analyses of the multiply imputed full data sets utilized Rubin's rules for effect and variance estimation. All reported 95% confidence intervals and *P* values are 2-sided. All reported *P* values have been adjusted to control the false discovery rate (FDR) for all 60 (20 outcomes for 3 exposures) hypotheses tested.[35]

RESULTS

Table 1 summarizes the demographic and injury characteristics for the cohort. The demographics and injury characteristics did not differ significantly across the 3 sets of analysis. Analysis of total time for each of the treatment conditions found a mean of 278.54 minutes for contextualized treatment (SD = 354.74; range, 0-3315), a mean of 278.02 minutes for decontextualized treatment (SD = 325.44; range, 0-4220), and a mean of 86.16 minutes for quasi-contextualized (SD = 110.37; range, 0-1250).

For all of the following analyses, no substantive differences in inference were noted after multiple imputation of outcomes. Refer to Table 2 in SDC (available at: http://links.lww.com/JHTR/A403) for data and statistical details that accompany the text associated with each of the following analyses.

Quasi-contextualized treatment-only analysis

The ASD between each quantile pairs ranged from 0.001 to 0.531, prior to weighting, with an average ASD of 0.13 and 53% were more than 0.10 (40/75). In addition, 5 of the 9 continuous confounders had variance ratios outside of the prespecified range of 0.80 to 1.20. This indicated a very poor balance. Following IPW, standardized differences ranged from 0.00 to 0.09, averaging 0.03. None of the ASDs were more than 0.10, and only one confounder was outside of the variance ratio range (admission CSI for non-brain injury factors), indicating a substantial improvement in balance.

When more than 5% of therapy time was spent in quasi-contextualized activities, at 9 months, participants showed significantly better scores on the PART-O Rasch-adjusted Total and PART-O Productivity, with a similar trend noted for PART-O Total. At 3 months, significantly better performance was further noted on PART-O Total, PART-O Rasch-adjusted Total, and PART-O Social Relations. Participants also demonstrated higher performance at discharge and at 3 and 9 months on Rasch-adjusted FIM Motor at discharge and 3 months for FIM Cognitive. No significant impact, positive or negative, was found for PART-O Out-and-About at 3 or 9 months, PART-O Productivity at 3 months, PART-O Social at 9 months, or life satisfaction and depression at either time point.

Contextualized treatment-only analysis

The ASD between each quantile pairs ranged from 0.05 to 0.45, prior to weighting, with an average ASD of 0.15 and 81% were more than 0.10 (61/75). This indicated a very poor balance. Following IPW, standardized differences ranged from 0.04 to 0.19, averaging 0.09 and only 27% of the confounders were more than 0.10, indicating a significant improvement in balance. The 20 covariates with an average ASD of more than 0.10 were included in the outcome models.

For patients receiving ST, those who received a greater proportion of contextualized treatment activities demonstrated higher PART-O Total scores and

TABLE 1 *Demographic and injury characteristics, minimum and maximum values across quantiles, and ASD before and after weighting*[a]

		Contextualized-only				Contextualized + quasi-contextualized				Quasi-contextualized-only			
Covariates	**Full sample**	**Min**	**Max**	**ASD before IPW**	**ASD after IPW**	**Min**	**Max**	**ASD before IPW**	**ASD after IPW**	**Quasi <5% before IPW**	**Quasi 5%+ before IPW**	**ASD before IPW**	**ASD after IPW**
Demographics													
Age at Adm, mean (SD)	44.41 (21.42)	36.41 (20.21)	51.07 (21.1)	0.24	0.09	37.98 (19.02)	48.08 (21.75)	0.17	0.08	40.7 (21.4)	45.5 (21.1)	0.22	0.05
Sex: Male, %	72	70	76	0.05	0.08	68	75	0.06	0.08	76	70	0.12	0.04
Race/ethnicity, %													
White	76	68	80	0.10	0.07	71	80	0.09	0.08	77	76	0.04	0.02
White Hispanic	6	4	12	0.11	0.08	3	10	0.09	0.08	5	7	0.05	0.01
Black	15	11	19	0.09	0.10	11	21	0.09	0.07	14	16	0.04	0.01
Asian, other, or unknown	3	0	5	0.11	0.13	1	5	0.08	0.11	3.8	2.5	0.07	0.02
HS or greater education, %	72	68	77	0.09	0.13	70	75	0.05	0.08	72.5	72.4	0.00	0.08
Insurance providers, %													
Private insurance, MCO, HMO	42	29	58	0.21	0.09	36	50	0.12	0.09	52.2	38.3	0.28	0.04
Medicare	21	11	31	0.20	0.10	10	28	0.16	0.08	16.2	22.1	0.15	0.06
Medicaid	17	8	24	0.15	0.07	15	22	0.08	0.07	12.8	19.4	0.18	0.01
Self, other, none	20	15	23	0.08	0.09	15	26	0.12	0.06	18.8	20.3	0.04	0.03
Preinjury alcohol misuse, %	35	28	45	0.13	0.10	31	41	0.09	0.06	26.9	39.1	0.26	0.02
Preinjury other drug use, %	22	19	25	0.07	0.08	14	29	0.12	0.07	15.4	24.5	0.23	0.01
Injury and status at rehabilitation admission													
Cause of injury, %													
Fall	31	22	40	0.15	0.11	20	43	0.17	0.09	29.6	30.6	0.02	0.04
Sports, other causes	5	3	8	0.08	0.07	2	7	0.11	0.07	5.6	5.2	0.02	0.01
Moving vehicle collision	57	45	65	0.15	0.07	42	66	0.17	0.08	57.1	58.1	0.02	0.01
Violence	7	5	8	0.06	0.08	5	8	0.07	0.08	7.7	6.1	0.06	0.04

(*continues*)

TABLE 1 *Demographic and injury characteristics, minimum and maximum values across quantiles, and ASD before and after weighting*[a] (Continued)

		Contextualized-only				Contextualized + quasi-contextualized				Quasi-contextualized-only			
Covariates	**Full sample**	**Min**	**Max**	**ASD before IPW**	**ASD after IPW**	**Min**	**Max**	**ASD before IPW**	**ASD after IPW**	**Quasi <5% before IPW**	**Quasi 5%+ before IPW**	**ASD before IPW**	**ASD after IPW**
CSI brain injury factors, mean (SD)	46.80 (23.2)	34.82 (19.2)	54.54 (22.76)	0.28	0.09	49.48 (20.8)	52.49 (20.83)	0.13	0.09	52.9 (25.0)	45.7 (21.5)	0.31	0.03
CSI non-brain injury factors, mean (SD)	17.71 (14.9)	11.51 (11.37)	21.71 (17.58)	0.26	0.07	12.92 (12.03)	20.83 (15.71)	0.19	0.08	19.1 (17.1)	17.4 (14.1)	0.11	0.01
Glasgow Coma Scale, %													
Intubated, missing	47	38	53	0.13	0.06	41	54	0.11	0.09	42.6	48	0.11	0.03
Mild (13-15)	14	10	23	0.13	0.06	10	21	0.10	0.05	10.9	15.4	0.13	0.00
Moderate-severe (3-12)	38	24	51	0.23	0.05	29	47	0.12	0.08	46.5	36.6	0.20	0.03
PTA cleared before rehab, %	35	25	50	0.15	0.06	29	38	0.07	0.08	26.7	36.6	0.21	0.06
Shorter session site, %	67	50	91	0.34	0.13	50	76	0.19	0.06	78.7	62.8	0.36	0.03
Days to rehab Adm, mean (SD)	27.0 (32.4)	20.1 (25.58)	32.68 (35.28)	0.14	0.07	22.5 (21.39)	32.11 (50.24)	0.11	0.08	41.9	27.6	0.27	0.01
FIM (Rasch) Motor Adm, mean (SD)	30.7 (17.5)	25.46 (18.41)	41.56 (13.49)	0.30	0.07	28.24 (17.3)	36.59 (17.27)	0.14	0.10	27.1 (19.4)	31.5 (16.5)	0.24	0.03
FIM (Rasch) Cognitive Adm, mean (SD)	35.8 (19.4)	29.72 (19.04)	44.99 (17.19)	0.26	0.08	31.68 (22.34)	41.54 (15.81)	0.16	0.07	30.9 (20.2)	36.5 (18.1)	0.29	0.02

Abbreviations: Adm, admission; ASD, average absolute standardized difference; HMO, health maintenance organization; HS, high school; IPW, inverse propensity weight; MCO, managed care organization; PTA, posttraumatic amnesia; Max, maximum; Min, minimum; Rehab, rehabilitation.

[a]The minimum and maximum values represent the smallest and largest means (SD) found for the treatment bins, or the smallest and largest percentages for categorical variables.

PART-O Total Rasch-adjusted scores at both 3 and 9 months post–inpatient discharge. They also demonstrated significantly better performance on the PART-O subscales Out-and-About at 3 and 9 months and Social at 9 months. These findings indicated more engagement and better social functioning within the community. No significant impact, positive or negative, was noted for FIM Rasch-adjusted Cognitive or Motor, PART-O Productivity, PART-O social at 3 months, life satisfaction, or depression at any time point.

Contextualized + quasi-contextualized treatment analysis

The ASD between each quantile pairs ranged from 0.05 to 0.23, prior to weighting, with an average ASD of 0.12 and 59% were more than 0.10 (44/75). This indicated a very poor balance. Following IPW, standardized differences ranged from 0.04 to 0.20, averaging 0.08 and only 10.7% of the confounders were more than 0.10, indicating a significant improvement in balance. The 8 covariates with an average ASD of more than 0.10 were included in the outcome models.

When quasi-contextualized minutes were added to the contextualized minutes, a greater proportion spent in this combination of treatment activities was not significantly associated with the primary outcome, PART-O Total, at 9 months. Higher performance was noted at 3 months for PART-O Total and Rasch-adjusted Total, Out-and-About, and Social Relations. In addition, the combination of contextualized + quasi-contextualized was associated with higher performance at discharge for Rasch-adjusted FIM Cognitive and FIM Motor. No significant impact, positive or negative, was found for PART-O Productivity, life satisfaction or depression at any time point, for Rasch-adjusted FIM Cognitive or FIM Motor at 3 and 9 months, or for any component of the PART-O at 9 months.

In comparison with the analysis examining only contextualized minutes (ie, no quasi-contextualized minutes included), these findings indicated a slight attenuation of the positive impact on participation at 9 months. This was specifically seen for the 5 PART-O outcome measures at 9 months (Total, Rasch Total, Out-and-About, Social, and Productivity). In contrast, the effects on functional independence motor at discharge were slightly better for the contextualized + quasi-contextualized treatment than for contextualized-only. Since the confidence intervals overlapped for all of the comparisons, any difference between the contextualized treatment and the contextualized + quasi-contextualized treatment was not considered significant.

DISCUSSION

Quasi-contextualized treatment delivered within ST sessions demonstrates a positive impact on patient outcomes at discharge from inpatient rehabilitation and at 3 and 9 months postdischarge. The impact on functional independence and community participation was observed at all time points, indicating that the effect was maintained through the first year. These results suggest that the makeup of inpatient ST treatment plans comprising at least 5% quasi-contextualized activities will have a positive impact on outcomes. While the estimated effect sizes found in this study were small, consumer stakeholders participating in our research team indicated that any improvement in outcome was considered meaningful and valuable, regardless of size. Furthermore, despite the relatively small effect size, the change can be impactful on an individual's daily life. By providing quasi-contextualized treatment at least 5% of the treatment time, there would be a 0.11-point increase in the PART-O Total score at 9 months. This increase can translate from being out in the community for 1 to 2 days per week to 3 to 4 days per week, a potential doubling of time spent in the community.

In analyzing contextualized treatment delivered by the combined therapies of OT, PT, and ST, Bogner and colleagues[3] found an effect size of 0.057, similar to the effect size of contextualized treatment delivered by ST only in this study (0.059). While the use of contextualized treatment by OT and PT contributed to outcomes, quasi-contextualized treatment was only delivered by ST. There is a caveat to these findings as it relates to contextualized treatment. When the proportion of contextualized treatment decreases as a function of a greater proportion of quasi-contextualized treatment, the effects on outcomes may be slightly attenuated. This was found in particular for participation at the 9-month time period. The attenuation of the effect on participation is not statistically significant, but the pattern of impact is generally consistent. The one exception to the pattern is the impact on motor function at discharge, which demonstrates the possibility of a better outcome in the combined treatment relative to contextualized treatment alone. Our hypotheses that contextualized and quasi-contextualized treatments were comparable in their effects were therefore only partially supported. The relationship between treatment approach and outcome appears to be more complex than originally hypothesized. The findings and the general pattern of attenuation of contextualized treatment effects on outcomes when quasi-contextualized is delivered in lieu of contextualized treatment indicate the need for additional investigation.

In addition to untangling the complex relationship between contextualized and quasi-contextualized

treatments, identifying unique effects of quasi-contextualized treatment that may contribute to functional outcomes is also in need of further investigation. The most recent systematic review of cognitive rehabilitation therapy indicated metacognitive strategy training, a therapy intervention categorized as quasi-contextualized in this study, has significant impact on improving select cognitive skills such as information processing speed.[20] Through improvements in component cognitive skills by applying metacognitive strategy training, functional everyday tasks are completed faster and with greater efficiency. The clinical implication is that quasi-contextualized treatment, such as metacognitive strategy training, has a unique contributing role to play in functional recovery.

Several limitations are identified, supporting the need for replication in a future prospective study. One limitation is the potential negative impact of attrition over time on the generalizability of the findings, though the rate of attrition in the data set was minimal (<20%) and multiple imputation for missing outcome data yielded findings consistent with the primary data analysis. Second, propensity score methodology is only able to mimic randomization. This introduces the possibility of limited control over potential confounders and the possibility that important confounders may not have been contained within the data set. Despite achieving appropriate balance with the confounders that were measured and available, the possibility remains that not all confounders were available for control within the current analyses. We attempted to address this weakness in design by using a conservative criterion (ASD <0.10), achieving this on the majority of confounders following IPW. In addition, we included variables that required additional control in the outcome analyses. Causal inference was further limited by the inability to evaluate a dose-response relationship with quasi-contextualized treatment. The potential for inflation of false-positive findings due to multiple comparisons restricts our interpretation of the findings; however, the corrected FDR *P* values did not substantially alter the inferences that could be drawn relative to the uncorrected values.

The classification of therapy as contextualized, decontextualized, or quasi-contextualized was performed on an existing observational data set. The conceptualization and operational definitions were created on the basis of the available data set, not on a prospectively designed data set that evaluated and identified critical features of therapy session content. It is therefore probable to have missed therapeutic features (eg, patient familiarity, patient preference, treatment target) in need of incorporation into the classification scheme. The TBI-PBE POC forms were not created with therapeutic content in mind, only time, activities, and interventions. Because of this lack of an a priori prospective approach to classification of therapy content, the amount of time patients engaged in contextualized or quasi-contextualized activities and the subsequent findings are likely underestimated.

The FIM is only a proxy measure of cognitive and motor function. FIM measures burden of care through assessing level of assistance needed to perform functional activities. It is possible that with more nuanced metrics assessing motor (eg, gait quality, walking speed) and cognition (eg, frequency of applied compensatory strategy), the association between therapeutic approach and outcomes could differ from the current findings.

A final limitation to consider relates to the treatment delivery. The current study identified quasi-contextualized as a treatment approach delivered by speech-language pathologists within the ST session. However, it is not unusual for occupational and physical therapists to instruct patients on compensatory strategies. Identifying time spent by occupational and physical therapists in quasi-contextualized activities would add a multidisciplinary dimension to this approach that was not possible to investigate with the current data set.

CONCLUSION

With the increased pressure on inpatient rehabilitation facilities to demonstrate maximum functional gain relative to time and financial cost, the need remains for providers and researchers to continue to investigate treatments that contribute to better outcomes. Time spent in contextualized treatment is associated with better outcomes; however, implementing treatment plans with contextualized therapies can be logistically challenging for inpatient settings. This study lends support for considering the use of quasi-contextualized therapy but not as a replacement for contextualized therapy. While contextualized treatment is associated with better outcomes, the use of quasi-contextualized treatment should be considered when logistics preclude the use of contextualized treatment rather than defaulting to the use of decontextualized treatment.

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