Research Article

The Voicemail Elicitation Task: Functional Workplace Language Assessment for Persons With Traumatic Brain Injury

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Purpose: Politeness markers (PMs) are words that enhance cooperativity in dialogue and are an essential component of professional/work communication. Persons with moderate/severe traumatic brain injury (TBI) underuse PMs in connected speech and have employment stability issues. The voicemail elicitation task (VET) is a standardized computerized language sampling procedure measuring PM rate in role-play tasks. Our purpose is to provide preliminary data establishing the potential of a screening assessment tool for professional/work communication.

Method: We measured VET performance using spoken PMs per minute (PMpM). We present data from 63 persons. Forty-three participants with TBI (22–65 years old, ≥ 1 -year postinjury) worked in midlevel jobs before their injury and attempted work return after injury at the same job level. Twenty participants with TBI did not maintain work > 1 year (unstable employed), and 23 did maintain work for ≥ 1 year (stable employed). Twenty controls without history of neurological impairment working at the same job level

also completed the VET protocol. We analyzed the data using between-group comparison with 1-way analysis of variance and post hoc analysis. We used receiver operating characteristic curve analysis to calculate sensitivity and specificity, as well as an optimal cutoff value for a screening measure.

Results: Group differences, $F(2, 60) = 19.59, p = .0001, \eta^2 = .376$, were identified between unstably employed persons with TBI performing with lower PMpM scores than the stably employed TBI group and the control group. Receiver operating characteristic curve analysis indicated a cutoff score of 11.55 PMpM. There was acceptable specificity (0.700, 95% CI [0.499, 0.901]) and sensitivity (0.696, 95% CI [0.508, 0.883]) for a screening tool indicating further assessment of social communication.

Conclusion: The VET holds promise as a clinical screening tool to identify persons at risk for social communication-related job instability after TBI and the need for a more comprehensive social communication assessment.

Moderate-severe traumatic brain injury (TBI) often results in diffuse neuropathology to regions linked to social (pragmatic) communication impairments, including the frontal and ventral cortices (Togher, 2011). Social communication is essential for interpersonal activities, including social interactions in the workplace, referred to as *soft skills*. TBI-related pragmatic

deficits have been linked to unemployment and underemployment after injury (Brooks, McKinlay, Symington, Beattie, & Campsie, 1987; Hajfey & Abrams, 1991; Sale, West, Sherron, & Wehman, 1991). Approximately 60% of persons with moderate-severe TBI do not return to paid employment, and many of those who resume work do so in volunteer positions, sheltered employment, or low-paying part-time work (Machamer, Temkin, Fraser, Doctor, & Dikmen, 2005; van Velzen, van Bennekom, Edelaar, Sluiter, & Frings-Dresen, 2009a). The comprehensive annual cost of TBI to the U.S. economy including direct and indirect costs was \$252.2 billion in 2017 (Maas et al., 2017). Most of this cost was related to long-term wage loss (Thurman, Coronado, & Selassie, 2007).

Communication is a fundamental workplace skill of high value to employers of all levels of work (Burton, Chavez, & Kokaska, 1987; Holmes & Stubbe, 2003; Keyton et al., 2013; Koester, 2006; Schnurr, 2013). Effective social communication in the workplace enables more efficient

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problem solving (Handford, 2010), builds social capital (Holmes & Stubbe, 2003; Schnurr, 2013), and is the most important component for many jobs (Vine, 2004). For example, social communication skills are important in the service sector, which comprises 80% of all U.S. jobs (Bureau of Labor Statistics, 2012). However, work-related communication issues have not been effectively addressed by speech-language pathology or vocational rehabilitation professionals working with TBI (Meulenbroek, Bowers, & Turkstra, 2016; Phillips, Deiches, Morrison, & Kaseroff, 2015). Work return after TBI has been associated with preinjury demographic and injury-related variables including age at injury, severity of injury, and neuropsychological variables such as memory, attention, awareness of deficit, speed of processing, and executive functions (Howe et al., 2018; van Velzen, van Bennekom, Edelaar, Sluiter, & Frings-Dresen, 2009b). Unfortunately, few studies have examined communication and work outcomes in persons with TBI in part because valid instrumentation for measuring social communication is relatively lacking (Douglas, Bracy, & Snow, 2016; Isaki & Turkstra, 2000; Meulenbroek & Turkstra, 2016; Rietdijk, Simpson, Togher, Power, & Gillett, 2013).

One study that examined social communication and work return used the La Trobe Communication Questionnaire (LCQ; Douglas et al., 2016). The LCQ is a social communication questionnaire using both self-report and other-report forms. This study retrospectively assessed dyads of 46 adults with moderate-severe TBI and 46 relatives. Half of the participants with TBI ($n = 23$) returned to and maintained employment; the remaining 23 did not. No control sample was used in this study. There were no significant differences between groups in injury or demographic variables, nor in preinjury occupations. However, the unemployed group reported more communication deficits, and the discrepancy between self- and other-ratings was greater in the unemployed group indicating a poorer metacognitive awareness of their social communication deficits than their employed counterparts with TBI.

Another study by Meulenbroek and Turkstra (2016) used logistic regression to identify the predictive value of a communication test battery to postinjury employment stability in a group of 31 persons with TBI. Sixteen individuals had stable work outcomes, and 15 had unstable work outcomes. No control sample was used in this study. The communication battery was developed using a qualitative inquiry into relevant workplace communication skills (Meulenbroek et al., 2016) and included measures of auditory comprehension, reading comprehension, verbal reasoning speed, and social cognition. The battery was predictive of work stability after injury. However, predictive power of the battery significantly improved when a measure of spoken social communication called the *voicemail elicitation task* (VET) was added. These findings support the proposition that there is a relationship between social communication competence, in particular spoken social communication, and the ability to maintain a job after TBI.

Social Communication and Politeness Markers

Persons with TBI have difficulties using language to negotiate, collaborate, advocate, teach, and persuade others (Byom & Turkstra, 2017; Evans & Hux, 2011; Togher, 2011; Ylvisaker, Szekeres, & Feeney, 2001), which are important social and transactional aspects of workplace communication (DeKay, 2012; Drew & Heritage, 1992; Willing, 1992). During these types of workplace interactions, the appropriate use of politeness markers (PMs) is critical to ensure effective social communication (Holmes & Stubbe, 2003). PMs include modal verbs and adjuncts as well as other word categories that help improve cooperative aspects of communication use in connected speech (Halliday & Matthiessen, 2004). Because cooperativity is considered a cornerstone to pragmatic communication theory (Grice, 1975), use of PMs and their application in discourse have been a concentration of research in the field of pragmatic linguistics (Bargiela-Chiappini & Harris, 2006; Brown & Levinson, 1987; Culpeper, 2011). Togher and Hand (1998) found that persons with TBI used fewer PMs in connected speech than conversation partners without TBI in non-work-related spoken negotiation. As a discrete and measurable aspect of social communication requiring recognition and inferencing of social cues, PMs may provide a potential target for assessment of contextualized spoken language analysis. Assessment for PMs is done using discourse analysis, which is the gold standard of pragmatic assessment (Cherney, Coelho, & Shadden, 1998; Coelho, 2007). Unfortunately, discourse analysis is time consuming and requires extensive training to achieve acceptable reliability, making routine clinical implementation impractical (Coelho, 2007).

Cooperativity (Grice, 1975), a foundational component in workplace discourse, is conveyed verbally through PMs (Halliday & Matthiessen, 2004; Holmes & Stubbe, 2003). Culturally, workplace communication is characterized by demonstration of mutual respect through adherence to established social boundaries (Schnurr, 2013). For instance, small talk is important for establishing social capital in the workplace (Holmes, 2003; Thuesen, 2016), and transactional talk, using language to exchange goods and services, uses similar relational elements of linguistic politeness to facilitate negotiation (Drew & Heritage, 1992; Koester, 2006; Schnurr, 2013). For instance, when managers interact with staff, they often minimize status as a barrier through use of PMs in discourse (Schnurr, 2013; Vine, 2004). In order to correctly use PMs in context, the speaker must appreciate social boundaries that include social status, familiarity with the conversation partner, and level of imposition the transaction has on the conversation partner and not simply have linguistic awareness of the words they choose (Brown & Levinson, 1987; Halliday & Matthiessen, 2004).

To our knowledge, there is no tool to assess spoken workplace social communication. Verbal measures, such as the Functional Assessment of Verbal Reasoning and Executive Skills, have been linked to employment outcomes but were not developed specifically for workplace demands and do not measure spoken language (Isaki & Turkstra, 2000;

Meulenbroek & Turkstra, 2016; Rietdijk et al., 2013). The LCQ is also a valuable clinical measure of social communication linked to workplace outcomes. However, the LCQ is a response inventory requiring either intact awareness to complete the self-rating form or presence of a communication partner who is familiar with the subject's communication before and after injury to fill the other-rating form. This is difficult when the effects of TBI on communication are emerging and new deficits have not been routinely observed or when close familiar others are not available to assist with scoring. The VET measure used by Meulenbroek and Turkstra (2016) elicits and analyzes speech samples to provide a measure of spoken language. Because PMs are essential for cooperative workplace communication, the VET measures PMs per minute (PMpM) as a metric conceptually related to workplace social communication competence.

We hypothesize that findings will demonstrate group validity in that (a) persons with TBI will produce fewer PMpM in VET testing than controls and (b) persons with TBI who have unstable work histories after injury will produce fewer PMpM in VET testing than stably employed participants with TBI. If a difference is observed between unstably employed participants with TBI and controls, we propose that a meaningful cutoff score for the VET be calculated using a receiver operator characteristic (ROC) curve analysis.

The VET utilizes well-described sociolinguistic delimitations of the workplace (Handford, 2010; Koester, 2006; Schnurr, 2013) in its stimulus design. The VET elicits language samples through role play in order to create relevant workplace contexts to measure and examine PM use in speech. Workplace contexts in VET stimuli constrain the speech acts elicited and conversation partner status and familiarity. These contextual constraints limit parameters of acceptable professional workplace speech allowing assumptions to be made about word choice intentions (Terkourafi, 2005). For instance, when someone says "Excuse me" in a workplace context to a superior, we can assume this is spoken in deference rather than sarcastically. This study includes a control sample and expands previous VET reporting using a larger sample size to establish the instrument's criterion validity. In the absence of an equivalent test for spoken language sampling, we defined criterion validity as the outcome of a target measure (PMpM from the VET) being predictive of the outcomes found in a population sample (employment status). Using this method, we can propose a cutoff score for the VET that may indicate the need for in-depth social communication assessment. Previous reporting on the VET (Meulenbroek & Turkstra, 2016) presented only group data from a smaller sample of persons with TBI and was not analyzed outside a test battery context.

Method

Participants

We recruited participants through online resources, pamphlets, word-of-mouth, and outreach to relevant organizations (e.g., workers' unions for controls and support

groups for persons with TBI). We recruited three groups of participants from seven states in the Midwest and North Atlantic regions of the United States including (a) control participants, (b) persons with TBI with stable employment (SE) after injury, and (c) persons with TBI who have unstable employment (UE) after injury. We defined SE as gainful full-time employment (> 30 hr/week) for ≥ 12 consecutive months after TBI. UE participants did not maintain employment regardless of reasons for workplace separation for 12 consecutive months after TBI. All participants were employed at the same level of work, Job Zone 3, described below. Participants with TBI were employed in this level of work before and after injury. Controls were employed in Job Zone 3 jobs (National Center for O*NET Development, 2017) for more than a year at the time of enrollment.

We based recruitment eligibility using the U.S. Department of Labor's five-tiered "Job Zone" categorization system that segments work according to required levels of training (National Center for O*NET Development, 2018). Job Zone 3 jobs require 1–2 years of training with a specialized degree or apprenticeships and list communication skills as important for training and managing others. We focused on Job Zone 3 because persons with TBI attempt to return to midlevel professional occupations (Fraser, Dikmen, McLean, & Miller, 1988; Ip, Dornan, & Schentag, 1995; Johnson, 1987; Walker, Marwitz, Kreutzer, Hart, & Novack, 2006). Job Zone 3 jobs include building inspectors, electricians, plumbers, barbers, chefs, medical technicians, and phlebotomists (National Center for O*NET Development, 2017). Job Zones 4 and 5 are also communication intensive but were excluded because they require higher intellectual demands. We excluded Job Zones 1 and 2 because they do not include communication requirements in their descriptions.

Inclusion criteria for participants with TBI were as follows: (a) age of 22–65 years; (b) moderate–severe TBI as defined by the Mayo classification system (Malec et al., 2007) including a Glasgow Coma Scale score of 3–13, loss of consciousness > 30 min, and/or posttraumatic amnesia > 24 hr (per self/other report if medical records are not available); (c) English as the primary language; (d) employed in Job Zone 3 jobs before injury for more than a year; and (e) intelligible speech in connected conversation. These factors were determined by the first author in a screening interview and collection of medical records. Exclusion criteria included (a) positive history of neurological disease or injury affecting language or new learning (including attention-deficit/hyperactivity disorder or significant learning disabilities affecting instrumental activities of daily living), (b) return to part-time employment (< 30 hr/week), and (c) significant presence of dysarthria. We excluded students, homemakers, and persons unemployed at the time of their TBI.

VET performance data were collected from 63 participants (20 controls, 43 persons with TBI). Group performance of 31 participants with TBI was analyzed as one variable in a larger regression analysis as part of a larger study by the first author (Meulenbroek & Turkstra, 2016). Thirty-two new participants were recruited specifically for this study,

including all control data. There were no significant differences between participant groups for age, education, race, ethnicity, or sex (see Table 1).

For the two groups with TBI (SE and UE), there were no differences in time postonset or TBI severity. All participants with TBI had closed-head injuries. In the SE group, there were two falls, 14 motor vehicle crashes, and seven sporting injuries. In the UE group, there were one fall, 12 motor vehicle crashes, four sporting injuries, and three assaults. The research assistant coded for 31 transcripts and was blinded to participant group. The first author coded for all other transcripts and was not blinded to groups (see Table 2).

We calculated transcription reliability using two trained transcriptionists who reviewed 27 randomly selected transcripts (42.9%, 27/63). Transcript reliability was 98.07% (164 errors in 8,478 words) for this sample. Of the errors identified, 51.83% (85/164) were inaccurate transcription of filled pauses (uh, um, etc.). One error was of a PM (0.6%, 1/164). Nine of 27 transcripts were coded by both transcriptionists with an interrater reliability of 86.6%, with inconsistencies agreed upon through consensus.

Materials and Procedure

Approval to conduct the study was obtained from university and health institutions internal review boards. Data collection took place in various locations selected for privacy including participants' homes, local library study rooms, and university lab spaces.

Neuropsychological Measures

Neuropsychological measures were chosen based on the common data elements established by the TBI Outcomes Workgroup and from our previous research (Meulenbroek & Turkstra, 2016; Wilde et al., 2010). The neuropsychological variables we chose have literature to support their predictive nature in work return after TBI (Drake, Gray, Yoder, Pramuka, & Llewellyn, 2000; Girard et al., 1996; Howe et al., 2018; van Velzen et al., 2009b; Williams, Rapport, Hanks, Millis, & Greene, 2013).

The Processing Speed Index (PSI) from the Wechsler Adult Intelligence Scale–Fourth Edition (Wechsler, 2008) is a measure of response speed to visuospatial tasks. The

PSI includes two subtests: Symbol Search and Coding. Symbol Search required participants to search for two abstract designs in an array of five. Coding required participants to copy numbers paired with geometric shapes in a series of boxes. Participants were asked to complete both of these tasks as quickly as possible within 120 s. We transformed raw scores into age-corrected scaled scores using normative data. Higher scaled scores indicate better performance for Symbol Search and Coding ($M = 10$, $SD = 3$). The PSI score has a mean of 100 and an SD of 15.

For a measure of executive function, we selected the Color Word Interference Test (CWIT) and the Trail Making Test (TMT; Lezak, Howieson, Bigler, & Tranel, 2012) from the Delis–Kaplan Executive Function System (Delis, Kaplan, & Kramer, 2001). CWIT is a response-inhibition measure to elicit the Stroop effect, and the TMT is a version of Trails A and B, which includes measures of scanning and motor speed. We transformed raw scores for the CWIT and TMT into age-corrected scaled scores using normative data. Higher numbers indicate better performance. A composite measure of executive functioning was calculated using the process used by Sigurdardottir et al. (2018) as the mean of standardized scores from the CWIT and TMT.

Lastly, we obtained the immediate free recall and long delay memory measures from the California Verbal Learning Test–Second Edition (CVLT-II; Delis, 2000). The CVLT-II is a set of 16 list items presented orally five times. After each of the five presentations, free recall is tested. After the fifth presentation, a new list of 16 items (List B) is read and free recall is assessed. The first list (List A) is elicited as a short delay. Then 20 min later, free recall of List A is elicited again for the delayed measure. Trials 1–5 of List A are presented as a t score ($M = 50$, $SD = 10$), with higher scores indicating better performance. All other scores are listed as the raw number of items identified in free recall. Data for these measures are presented in Table 3. The number of participants with missing data included two participants (one UE and one control) for the PSI. One participant had partial data for TMT, and four participants (two UE, one SE, and one control) had no data. Three participants (one UE, one SE, and one control) had missing data for the CWIT. Three participants were missing data for the t score used from the CVLT-II (one UE, one SE, and one control). Missing data were primarily due to time constraints during testing.

The Voicemail Language Elicitation Task

The VET is composed of four role-play voicemail scenarios presented via computer. Participants provide a voicemail audio recording using a telephone handset as a microphone. Each voicemail scenario elicits two common workplace speech acts (i.e., spoken communication behaviors): (a) informing and (b) requesting (Austin, 1975; Bach & Harnish, 1982). For example, one scenario requires participants to tell a boss they are planning a vacation (informing) and to ask him to start the required paperwork (requesting). The voicemail role plays target four work-related

Table 1. Examples of politeness markers used by Togher and Hand (1998).

Politeness marker	Example
Finite modal verbs	Will, would, could, should, may, might, wish
Modal adjuncts	Probably, possibly, maybe, just, a bit, really
Comment adjuncts	Please, frankly, unfortunately, hopefully
Tag questions	..., Okay?; ..., Right?

Note. This table is a modification of a table appearing in “Use of Politeness Markers With Different Communication Partners: An Investigation of Five Subjects With Traumatic Brain Injury,” by L. Togher & L. Hand, 1998, *Aphasiology*, 12(7–8), pp. 755–770.

Table 2. Demographic and injury characteristics of participant groups.

Characteristics	Groups			Statistic	Significance
	TBI		Control (<i>n</i> = 20)		
	Unstable (<i>n</i> = 20)	Stable (<i>n</i> = 23)			
Age					
<i>M</i> (<i>SD</i>)	49.12 (9.83)	47.10 (11.04)	46.37 (12.01)	<i>F</i> = 0.338	.715
Range	24.9–60.8	26.0–64.0	25.2–63.7		
Education					
<i>M</i> (<i>SD</i>)	16.05 (3.45)	15.46 (2.44)	16.75 (2.61)	<i>F</i> = 1.102	.339
Range	13–26	13–22	13–26		
Male	12	14	13	χ^2 = 0.122	.941
Female	8	9	7		
African American	2	1	3		
Asian	0	0	1		
White	18	22	16		
Years post onset					
<i>M</i> (<i>SD</i>)	13.88 (12.27)	12.63 (11.96)		<i>F</i> = 1.063	.309
Range	1.0–46.0	2.0–52.0			
Moderate TBI	4	4			
Severe TBI	16	19			

Note. TBI = traumatic brain injury.

recipients based on status and familiarity level (subordinate, friend, colleague, and superior). An example stimulus is provided in the Appendix A and the protocol is available in Appendix B.

Participants were allowed to write notes to be used throughout the task while reading the written stimuli but

were not allowed to script a response for reading aloud. Scenario instructions were displayed on the screen continuously to assist with memory problems. Participants pressed the “space” key on the keyboard to indicate they were ready, which prompted a ring tone followed by an outgoing message from the fictional voicemail recipient. The VET

Table 3. Neuropsychological variables associated with return to work in the subject sample.

Measures	Groups			ANOVA <i>p</i>	Effect size	Post hoc comparison using Tukey HSD test		
	TBI		Control (<i>n</i> = 20)			UE vs. SE	UE vs. control	SE vs. control
	UE (<i>n</i> = 20)	SE (<i>n</i> = 23)						
WAIS-IV (scaled scores)								
PSI	90.47 (13.60)	97.61 (11.48)	106.60 (11.61)	<i>F</i> = 8.57	η^2 = .23	<i>p</i> = .001	<i>p</i> = .001	<i>p</i> = .21
Symbol search	8.05 (2.91)	9.30 (2.83)	10.55 (2.41)	<i>p</i> = .001				
Coding	8.42 (2.57)	9.87 (2.10)	11.80 (2.53)					
D-KEFS (scaled scores)								
Executive function composite	8.65 (3.04)	10.59 (2.41)	11.31 (2.32)	<i>F</i> = 40.14	η^2 = .12	<i>p</i> = .152	<i>p</i> = .001	<i>p</i> = .049
CWIT 1	7.37 (2.77)	9.55 (2.79)	10.85 (2.52)	<i>p</i> = .001				
CWIT 2	8.42 (3.29)	9.55 (2.92)	11.20 (2.71)					
CWIT 3 inhibition	8.26 (2.83)	11.09 (2.25)	11.35 (3.09)					
CWIT 4 inhibition switching	8.79 (3.17)	10.46 (2.30)	11.65 (2.43)					
TMT 1 visual scanning	8.67 (3.40)	10.27 (2.47)	10.85 (2.70)					
TMT 2 number sequencing	8.83 (2.88)	11.55 (2.06)	11.40 (1.73)					
TMT 3 letter sequencing	9.56 (3.54)	11.05 (1.70)	11.85 (1.66)					
TMT 4 number–letter sequencing	8.18 (3.01)	10.73 (2.82)	11.65 (2.41)					
TMT 5 motor speed	9.83 (2.28)	11.14 (1.52)	11.05 (1.32)					
CVLT-II								
List A, Trials 1–5 (<i>t</i> score)	50.26 (8.83)	52.00 (10.57)	57.65 (11.16)	<i>F</i> = 2.33	η^2 = .11	<i>p</i> = .85	<i>p</i> = .106	<i>p</i> = .253
List B, free recall number	5.20 (1.57)	5.17 (1.89)	6.06 (2.44)	<i>p</i> = .106				
Short delay free recall number	8.80 (4.31)	10.72 (2.56)	11.11 (2.81)					
Long delay free recall number	10.31 (3.60)	10.82 (3.25)	11.95 (2.91)					

Note. TBI = traumatic brain injury; UE = unstably employed; SE = stably employed; ANOVA = analysis of variance; HSD = honestly significant difference; WAIS-IV = Wechsler Adult Intelligence Scale–Fourth Edition; PSI = Processing Speed Index; D-KEFS = Delis–Kaplan Executive Function System; CWIT = Color–Word Interference Test; TMT = Trail Making Test; CVLT-II = California Verbal Learning Test–Second Edition.

took approximately 10 min to complete. Resulting four voicemail samples produced by the participants were re-recorded by VET software for preparation and analysis. The primary unit of analysis (dependent variable) for this study was PMpM performance.

Data Analysis Procedure

Rates of PM use (PMpM) were measured to control for the amount of time allowed for leaving a voicemail. Persons with TBI can be verbose, so a simple PM count was felt to potentially skew the data. No participants had significantly reduced speaking rates as dysarthria was a criterion for exclusion in this study. We collapsed the four voicemail conditions into a single PMpM score for each participant by compiling the sum of the speaking time (excluding silence before or after the VET recordings) and the sum of PMs and then dividing the number of PMs by the speaking time (in minutes) to produce the PMpM rate. Long pauses and slow speech rates were not adjusted, but no significant instances were observed. The primary issues with silence were pausing before leaving the message and delays indicating they were finished leaving the message. Collapsing the PMpM scores across conditions helped to stabilize the variance in role-play performance.

Participant data points were prepared and analyzed by both the primary author and a PhD-level research assistant. Audio recordings were transcribed verbatim and then coded for PMs using a codebook developed from sociolinguistic taxonomies for informing and requesting conditions (Halliday & Matthiessen, 2004; House & Kasper, 1981; Soler, Jordà, & Martínez-Flor, 2005; Trosborg, 1995). All recorded voice-mails were semantically appropriate, indicating that participants understood the scenario instructions. The research assistant trained using previously scored transcripts from an earlier study and assisted with codebook development. The codebook developed is available in the Appendix C. The primary author was not blinded to condition; however, the research assistant was. Between-rater reliability for total PM counts was at 90% agreement for seven out of 31 (23%) randomly assigned recordings after training. The remaining 10% were resolved through consensus.

We compared group performance using analyses of variance (ANOVAs) and post hoc Tukey testing to identify which groups were different from each other. We present effect sizes for ANOVAs using eta squared (η^2). We completed a sensitivity and specificity analysis and identified a cutoff score for the measure using an ROC curve.

Results

We used IBM SPSS Statistics v.24 for all statistics. Shapiro–Wilk tests were not significant, indicating we could assume normality for the dependent variable in each group (control, SE, and UE). Visual examination of histograms and boxplots supported this assumption.

Table 4 presents the mean PMpM and raw PMs according to group as well as data on recording times. There

Table 4. Descriptive group statistics on voicemail elicitation task performance.

Data points	Groups		
	TBI		Control (<i>n</i> = 20)
	Unstable (<i>n</i> = 20)	Stable (<i>n</i> = 23)	
PMpM, <i>M</i>	9.77	14.7	17.6
PMpM, <i>SD</i>	4.1	4.68	3.57
Range of PMs	5–30	11–59	18–68
Recording time (min)			
<i>M</i>	0.48	0.49	0.46
<i>SD</i>	0.21	0.21	0.19
Range of time (min)	0.23–1.34	0.23–1.31	0.18–1.05

Note. TBI = traumatic brain injury; PMpM = politeness markers per minute; PMs = politeness markers.

was no significant difference between groups in the amount of time (minutes) spoken during each voicemail group, $F(2, 60) = 0.087$, $p = .816$, $\eta^2 = .007$. However, a one-way ANOVA indicated significant differences between groups, $F(2, 60) = 19.59$, $p = .0001$, $\eta^2 = .376$, on PMpM performance. Post hoc Tukey tests revealed the UE group's PMpM performance ($M = 9.78$) was significantly less ($p = .001$) than that of the SE group ($M = 14.71$), with a 95% confidence interval (CI) between the means from 1.83 to 8.02. The UE group also produced significantly fewer ($p = .0001$) PMpM than the neurotypical controls ($M = 18.07$), with a 95% CI between the means from 5.09 to 11.49. The SE group produced significantly fewer PMpM compared to neurotypical controls ($p = .03$), with a 95% CI between the means from 0.26 to 6.46 (see Figure 1).

In order to establish sensitivity, specificity, and a cut-off point, we conducted an ROC curve analysis with the independent variable being PMpM performance and the dependent variable being TBI group membership, SE versus UE. We expected lower PMpM scores would indicate a positive test result (increased likelihood of UE). The area under the curve was 0.79 with a 95% CI of 0.66–0.93, indicating the PMpM measure from the VET preliminarily has good predictive value distinguishing employment outcomes in persons with TBI.

In identifying an effective cutoff point for the VET, we analyzed the coordinates on the ROC curve to identify the uppermost left-hand corner (Portney & Watkins, 2009) arriving at 11.55, as depicted in Figure 2. This cutoff has a sensitivity of 0.70 (95% CI [0.50, 0.901]) and a specificity of 0.70 (95% CI [0.51, 0.88]). This means the VET PMpM measure can potentially identify persons who are at risk for employment instability after injury with good reliability and a relatively low risk of false positives or false negatives.

Discussion

This article presents the development of an assessment tool for workplace social communication called the VET.

Figure 1. Comparison of mean politeness markers per minute measures between groups with standard error (SE). TBI = traumatic brain injury.

The VET can measure clinically and socially meaningful spoken aspects of workplace-related social communication. Hypothesis 1 was supported by our findings. Participants with TBI (both the SE and UE groups) produced significantly fewer PMs than neurologically healthy controls. This is consistent with the literature (Togher & Hand, 1998). Hypothesis 2 was also supported. UE participants produced fewer PMs than SE participants. This demonstrates criterion validity for employment outcomes between the three groups. We

Figure 2. Receiver operator characteristic curve with cutoff and sensitivity and specificity of the politeness markers per minute measure from the voicemail elicitation task (VET). AUC = Area Under the Curve; CI = confidence interval.

were able to establish a cutoff score for the PMpM measure obtained from the VET at 11.55. Scores below 11.55 PMpM would indicate a need for in-depth assessment of social communication.

We know of no spoken communication measure in the literature demonstrating predictive value for return to work, and there is a significant need to identify persons at risk of poor employment outcomes after TBI. This measure and these results may be considered a first step to identifying risk of occupational disablement due to social communication disorders after TBI. The cutoff score of 11.55 PMpM was established using ROC analysis. However, it is more prudent to err with false positives and identify more patients with TBI at risk of presenting with a social communication disorder. This is because the recommendation from the VET should be to complete a comprehensive assessment of pragmatic abilities specific to the workplace social demands of a specific workplace under consideration including the types of workplace communication expectations and cultural norms of that work setting (Devitt et al., 2006; Stergiou-Kita, Rappolt, & Dawson, 2012). Another method of identifying a cutoff score would be by visual inspection of the raw data. The mean VET score for the SE group was 14.71 PMpM. The majority (13) of control participants scored above 14.71 PMpM, with a mean of 17.30 PMpM (see Figure 1). With 15 PMpM as an alternate criterion, the instrument sensitivity is 95% and specificity is 57%. This measure demonstrates a 95% sensitivity of identifying persons with potential social communication deficits using a role-play task. Therefore, 15 PMpM is a possible alternative criterion predictive value of the VET as a screening tool for PM to indicate further in-depth assessment of pragmatic skills, although there will be a higher rate of false positives.

The literature indicates a mixture of social cognition and executive functioning abilities is the primary cause of social communication deficits in individuals with TBI (MacDonald, 2017). How these contributing factors manifest in spoken social communication has been hypothesized, but standardized elicitation measures are uncommon. The VET uses a unique elicitation approach based on constraining cultural and social contexts and then evaluates the effects on spoken expression. The VET can be used by researchers to empirically analyze sociolinguistic variables on everyday speech acts. The VET might also offer a tool for health care workers who are at a disadvantage in assessing and treating social communication disorders in adults with TBI. A contemporary review of pragmatic measures shows that, although there are 20 measures targeting aspects of social cognition (theory of mind, empathy, etc.), only five of these evaluate aspects of social communication (Sohlberg et al., in press). Our findings support previous research demonstrating that persons with TBI use fewer PMs in connected speech (Togher & Hand, 1998). We extended these findings by demonstrating an association with employment stability outcomes. Our study indicates that measureable word choice (PMs) under role-play conditions guided by sociolinguistic theory appears related to employment stability outcomes after TBI and differentiates persons with TBI from neurotypical controls.

Clinical and Research Application

Our proposed clinical cutoff of 11.55 PMpM is a potential rule requiring further validation using prospective sampling of persons with TBI. This cutoff, however, could be interpreted to indicate referral for a full pragmatic assessment especially if work return is planned. Unfortunately, only 44% of speech-language pathologists assess discourse after TBI (Frith, Togher, Ferguson, Levick, & Docking, 2014), even though discourse-level deficits are a significant contributor to disenfranchisement after TBI and reflect underlying pragmatic language impairments that speech-language pathologists are uniquely qualified to treat (Togher, 2011). This may reflect a combination of factors: (a) There are few published measures of pragmatics, (b) existing measures generally have poor validity and reliability (Frith et al., 2014; Turkstra et al., 2017), (c) pragmatic measures may not reflect the subjective evaluation of the patient's peer social group (Turkstra et al., 2017), (d) discourse is context dependent so manipulating the context undermines the ecological validity of the instrument, and (e) discourse analysis is the gold standard of pragmatic measurement but is time consuming and requires extensive training for reliability, making it not a viable option for routine medical speech-language pathology practice (Coelho, 2007). In order to address these issues, we have created a web app version of the VET. The VET web app automates stimulus presentation for language sampling to reduce problems with fidelity of administration associated with eliciting language samples. The VET web app transcribes and codes the spoken language sample using an editable speech-to-text function, intended to improve reliability of coding. The sociolinguistic theory that grounds the VET

addresses other issues of assessment. Here, constraining the context can be a positive factor in elicitation. The VET includes contextual variables including conversation partner status and familiarity, targets elicitation of requesting and informing speech acts, and situates task in a workplace genre. These contextual constraints should reliably elicit workplace politeness behavior where the descriptive research of workplace talk (Koester, 2006, 2010; Schnurr, 2013; Vine, 2004) can be used to identify social-linguistic strategies.

From a research perspective, the VET offers a standardized measure of spoken language performance with the potential for normative data collection. Using a theoretical description of social constraints, the VET minimizes the effects of an artificial context affecting ecological validity. The VET may offer researchers an innovative avenue for exploring social communication—using sociolinguistic theory to constrain contextual factors in language sample elicitation and enable examination of other genres of language such as romantic encounters and social introductions. In the current version, the VET analyzes PMs as words chosen according to social conditions, rather than for their semantic value, so the value of PMs in connected speech is social rather than informative. PM use in the workplace has been extensively described by sociolinguistics resulting in theories of language use based on social context. PMpM rates are a logical metric for measuring spoken social communication in the workplace due to the well-defined social role of PMs, so the VET is a potential measure to test these descriptive theories. More common social communication measures are observation measures, requiring multiple observations and extensive training to score reliably, or they are communication inventories that require self-report and/or other-report of behaviors. This means that existing measures cannot be given early on to predict social outcomes and that, when social communication deficits are identified by existing measures, these deficits may already be impacting social performance in workplace settings.

Limitations and Future Directions

Our findings are preliminary, and many limitations should be considered. Construct validity requires testing from multiple sources, preferably done by different researchers using various methods that are equally stringent (Messick, 1995). First, the theorized sociolinguistic mechanism of PMs has been studied, but this research has been largely descriptive in nature—not empirical—due to the methods traditionally used in the field of sociolinguistics. Although they are not equivalent measures, construct validity of the VET could be studied in relation to the LCQ. Second, social response to language sample recordings has not been examined, which would provide social validity of the PMpM measure. Third, the way in which we analyzed language samples with the VET only looks at word selection. Although this is a key component of spoken language, social communication is a multifaceted and dynamic process incorporating many aspects of cognitive functioning and sensory perception. People with TBI might have other social communication

deficits that significantly affect community reintegration but are not captured by PMpM scores.

Other limitations of this research reside within the study design. Participants were in the chronic phase of recovery, which may have very different social communication patterns than a patient in the acute rehabilitation phase of recovery. Persons with TBI in the acute phase would be expected to have poorer social communication skills due to the presence of a greater number of contributors to social communication deficits including more severe cognitive skills, reduced insight, and the increased stress of early adjustment to injury. This study collected data from a narrowly defined population with regard to employment outcomes and TBI severity. Such sampling may limit generalization to other work settings. Future studies should include a broader spectrum of cases. Participants in job zones that are both higher and lower than Job Zone 3 should be included. Professional communication skills are valued by employers at all levels (Hajfey & Abrams, 1991; Sale et al., 1991). Therefore, assessment and training of PMs in connected speech and social communication more broadly is a clinically relevant target to consider regardless of work setting. This study excluded persons with TBI who have dysarthria, which may affect social perceptions of conversation partners (Guo & Togher, 2008). Future studies should examine the biasing role that dysarthria may play on employment considerations in the population with TBI and the limitations dysarthria may present given the specialized role of the environment in many job settings. There were missing data in the neuropsychological measures. However, these missing data points were relatively evenly distributed between groups, and our data are consistent with the existing literature for persons with TBI who are unemployed. Lastly, not all language samples were coded using blinding conditions. However, 31 transcriptions were recoded by a trained blinded coder, and reliability rates were acceptable.

Future research directions for the VET should be to implement the VET in a prospective manner in persons with TBI before community reentry to see if early identification is linked to employment outcomes. In addition, the test-retest reliability needs to be measured. Since data collection for this study was completed, the VET has been adapted for the web and now provides automated transcription and scoring. A manual for coding PMs is currently under development, and its current version is presented as an Appendix C. This should reduce clinical administration and scoring time, but human scoring using the manual and unassisted automated scoring need to be examined to see if automated scores have acceptable reliability to human scoring. Although we did not examine whether location of testing (lab setting, library study, etc.) had any effect on performance, future implementation-dissemination studies will focus on this and other questions addressing usability and acceptability of the VET. Our neuropsychological measures were chosen based on their relation to return to work after TBI. They were not selected based on their relationship to use of PMs in work-related conversation. Future research will be undertaken to identify what cognitive abilities underlie the capacity to

modify language selection in workplace/professional conversation using the VET role plays.

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Appendix A

Example of a Stimulus From the Voicemail Elicitation Task as Presented on a Computer Screen

Your car just broke down and will be in the shop for the rest of the week. Now you need a ride to work. You recently got to know a coworker named Stanley because you are working on a project together. Stanley mentioned he drives by your house his way to work.

Call your coworker Stanley on his office phone. Tell him about your car and ask him for some help with getting to and from work for the next week.

Appendix B

VET Protocol Form
Voicemail Elicitation Task

We are going to do a role-play activity on this computer. In order to do this task, you will read situations on the computer screen and then leave voicemail messages using this telephone receiver. You have a pen and paper to take notes before you leave a message. Go ahead and start the task when you are ready. Do you have any questions?

Comments / Unusual Events: _____

How comfortable were you as you completed this task? *Scale of 1–10* _____

(1 = *very comfortable*, 10 = *very uncomfortable*)

Task order and checklist

Order	Task	Done	Comments
_____	STANLEY	☐	_____
_____	RANDY	☐	_____
_____	HECTOR	☐	_____
_____	WILLIAM	☐	_____

Appendix C (p. 1 of 2)

VET Appendix

Politeness Marker Coding Manual

Politeness markers are words used to strategically protect the speaker from harming the listener's pride or praise the listener. When informing and requesting, the listener might already know the information being conveyed or they might not want to grant the request. This means, when a speaker informs or makes a request, they take the chance they may threaten the autonomy and/or intelligence of the listener. The following words and phrases are common politeness markers that modify informing and requesting speech acts. There are two main types of politeness markers for coding VET recordings. These include softeners and positives. Softeners mitigate the force of a request by limiting the time, effort, or source of the request. Positives appeal to the listener's ego and self-worth. A subtype of positives would be intensifiers, which modify the intensity of a positive statement made to a listener.

Subtype	Example	Sentence	Definition	Purpose
Softeners				Soften or mitigate the force of a request
On Record Politeness	Please, thank you, sincerely, etc.		<i>Formulaic utterances</i> denoting politeness, appeal	
Understater	A moment, a second, a little bit	Can you free up <i>a little bit</i> of time?	<i>Adverbial modifiers</i> that underrepresent the proposition	
Downtoner	possibly, just, simply, perhaps, rather, maybe	Could you <i>possibly</i> provide some advice?	Sentence modifiers <i>allow speaker not to fully commit themselves</i> to the proposition	
Play-down	Subjectivity (I'm afraid, as far as I know) Temporal marker (I was wondering...) Negation (Mightn't it be a good idea...)		Syntactic devices that state limit subjective or temporal commitment or negating concepts	Soften perlocutionary effect
Committers	I think, I guess, I believe, I suppose, in my opinion		Sentence modifiers which lower the degree the speaker commits himself to the state of affairs in the proposition	Distance speaker from statement, make less personal
Hedges	kind of, sort of, somehow, and so on, more or less	Could you <i>kind of</i> give some time to me?	Adverbials used when a speaker wishes to avoid a precise propositional specification	
Consultative Devices	would you mind, do you think, would you object		Optional devices which seek involvement from the interlocutor	Appeal
Openers	<i>Do you think</i> you would consider? <i>Would you mind</i> filling this form?		Opening words and expressions which look for cooperation and modify the request.	Soften the illocutionary force
Forewarners	far be it from me, but...; you're a nice guy, but...; This may be a bit harsh, but...		Anticipatory disarmament device forestalling a possible negative reaction	Forestall a negative reaction
Tag Questions	It sure would be nice we had a meeting then, wouldn't it?		Appeal to the listener's ego or self-worth	
Positives				Balance the burden of request on listener
Gratitude	I really <i>appreciate</i> your effort.		Balance the burden of request on listener	
Deference	<i>Good job</i> on the report		A salutation to the listener	
Greeting	Hey, Hello	Hey, I like that idea!	Any word that conveys positive valence attributed to the listener	Convey praise
Positive Lexicon	Wow! That is a <i>great</i> way to do that.		Conveying good will to the listener	
Well-Wishing	Have the <i>most pleasant</i> day		Modifiers which intensify an expression of gratitude or praise that accompany a request	
Intensifiers				Sentence modifiers which indicate a heightened degree of commitment with a positive state of affairs referred to in the proposition.
I'm sure, certainly, obviously, really	You <i>certainly</i> know that already.			

These categories were compiled from the following references:

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- House, J., & Kasper, G. (1981). Politeness markers in English and German. In F. Coulmas (Ed.), *Conversational routine: Explorations in standardized communication situations and prepatterned speech* (pp. 157–186). Berlin, Germany: Mouton de Gruyter.
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- Danescu-Niculescu-Mizil, C., Sudhof, M., Jurafsky, D., Leskovec, J., & Potts, C. (2013). A computational approach to politeness with application to social factors. *Proceedings of Association for Computational Linguistics 2013*.

Appendix C (p. 2 of 2)

VET Appendix Politeness Marker Coding Manual

Additional Rules for Coding Politeness Markers in VET Samples

- If a modal and an embedding term are used in an external politeness strategy (i.e., consultative device) such as “would you think that...” only count as one politeness marker
- Do not count the modal verb “will” unless it is present in an external politeness strategy (i.e., phrase)
- If a politeness marker is repeated in a typical disfluency, then use the second instance of the politeness marker and don’t count the first:

I want to uh, see if you are available to come, and if you are, I was, uh,

Coding Example From VET: Message to Superior

Hello Hector. Uh, Yeah, this is (First Name). My sister has come up with a plan to get married in three months in Mexico and I need some time off to attend the wedding. You know how it is—family and weddings and what not. Uh, Last minute, so, if you could see way into letting me have time off I’d be very appreciative. Thank you very much. I will be looking forward to hearing from you shortly. Have the most pleasant day. Bye-bye.

Politeness marker	Category	Phrasal context (move)
Some	Play-down	I need some time off to attend the wedding
Could	Downtoner / opener	<i>if you could see way</i> into letting me have time off
‘d (would)	Downtoner	I’d be very appreciative
Very	Intensifier - gratitude	I’d be very appreciative
Thank you	On record politeness	Thank you very much.
Very	Intensifier	Thank you very much.
looking forward	Gratitude	I will be looking forward to hearing from you
Most pleasant	Well-wishing	Have the most pleasant day