Content analysis of tweets by people with Traumatic Brain Injury (TBI): Implications for rehabilitation and social media goals

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Abstract

In this Twitter research, 6874 tweets of six adults with traumatic brain injury (TBI) were analyzed qualitatively and quantitatively using content classification [1], inductive coding of content themes, socio-linguistic analysis, and computational analysis in KH Coder. The results reflected that participants used Twitter for: (i) supporting others, including people with TBI; (ii) discussing society and culture, popular issues, news, and personal interests; (iii) connecting with others; (iv) sharing their experiences of life after TBI; (v) knowledge via exchanging information; and (vii) advocacy. 'Emotional expression', and 'connection' were common threads running across themes. Attending to the expressions of people with TBI on Twitter provides important insights into their lived experiences and could inform the development of user-centered cognitive-communication and social participation goals for people with TBI.

1. Introduction

Social media, now entwined into the fabric of today's society, is used by more than one billion people worldwide [2] for both good and ill [3]. Since the early days of social media platforms in the late 1990s and early 2000s, including communities such as Six Degrees, Friendster, and MySpace, multiple platforms have emerged, evolved, and ceased [4]. Twitter is a popular microblogging site in which users post short messages or 'tweets' with a 280 character limit (originally a 140 character limit until September, 2017 [5]) which can include multimedia and links to content hosted on Twitter and other sites. Tweets have the potential to reach a wide audience through hashtags which form hyperlinks connecting tweets (e.g., #TBI). Since its launch in 2006, Twitter has grown to be used globally by 330 million active monthly users [2], including many people who have a traumatic brain injury (TBI) [6].

TBI is a leading cause of death and disability worldwide, with significant public health impacts and economic cost [7]. Occurring as a result of an external force on the brain [8], TBI is commonly associated with traffic accidents, falls, and trauma-related violence [9]. A TBI is sudden, emotionally traumatic, and has a long-term impact not only on the person with TBI but also on their families, friends, and community [10]. People living with TBI are a heterogeneous group, with a wide range of skills and difficulties needing individualized rehabilitation goals, interventions, and supports at different stages of their recovery [7]. Following injury, people with TBI experience changes in executive functioning, such as impaired working memory and attention; slowed information processing; difficulty in planning and problem-solving; and reduced self-regulation of their behavior [11]. It is not yet clear how far these impairments influences their use of social media.

Changes in cognition after a TBI can affect a persons' cognitive-communication skills, resulting in them having difficulty engaging in conversations and participating socially [12]. People with TBI may present with either 'impoverished' communication (using shorter phrases with difficulty elaborating ideas), or 'excessive' communication (speaking at length yet with limited content) [13]. People with TBI are often aware of their difficulties communicating, and interacting socially is often an anxiety-provoking activity [14]. The person's altered cognition, personality, and behaviors associated with his or her TBI are often misunderstood in the broader community [15]. People with cognitive-communicative disability struggle with changes to their self-image after TBI [16] and experience stigma

URI: https://hdl.handle.net/10125/59870
ISBN: 978-0-9981331-2-6

[15] associated with what is described as an 'invisible injury' [11].

Using social media enables people with TBI to form and maintain social connections with friends, family, health professionals, and people all over the world [6, 17]. Prior research on the use of social media by people with TBI includes a Twitter hashtag study of TBI-related hashtags (e.g., #TBI, #concussion) which revealed the use of Twitter to express feelings of frustration, vulnerability, and trauma related to TBI [6].

Commonly employing a 'go it alone' approach, and lacking support from family or friends for using social media, people with TBI report learning how to use social media through trial and error [17]. They also report experiencing confusion and cognitive fatigue when using Twitter, resulting in a tendency to lurk (i.e. observe or watch others, like or retweet) rather than write original tweets [17]. Although people with TBI are keen to use Twitter to access information about their condition, some have reported difficulty navigating the platform and keeping track of the high volume of tweets appearing in their timelines [17]. In order to identify what would help people with TBI to participate in and be included in Twitter communities, it is important to examine the tweets of people with TBI who already use Twitter, to understand more about the content of their tweets and the patterns of their tweeting. Information drawn from the tweets of people with TBI could help to guide strategies to improve social media communication goals during rehabilitation after TBI. Therefore, the aim of this study is to determine the ways people with TBI use Twitter to communicate, the socio-linguistic features of cognitive-communication disability evident in their tweets, and any aspects of their use of Twitter that could inform the development of social media rehabilitation goals for people with TBI.

2. Method

This research was ethically approved by the University of Technology Sydney, the University of Newcastle, and the University of Sydney. Twitter handles and direct quotes from tweets are not reported to protect the identity of the participants [18]. The first author was responsible for all data collection and leading the analysis and reporting of results, in all stages consulting with the other authors to reach consensus on qualitative coding and clinical implications. The second author was responsible for computational analysis using KH Coder software.

2.1. Participants

Six adults with TBI were recruited from a larger study relating to the use of social media by people with TBI [17]. In that larger study, all participants were recruited through Twitter and a TBI registry. Background recruitment interviews were used to determine observational measurements of functional cognitive-communicative skills and participant-generated narrative reports of their TBI. All of those in the larger study who were Twitter users gave informed consent for their tweets to be collected and analyzed in this study [17].

2.2. Tweet data

Participants' tweets were collected from Twitter using NCapture [19] in a web browser, imported into NVivo11 [20], and then exported to Microsoft Excel [21] for analysis. In Excel, tweets were analyzed using multiple methods to enable the integration of quantitative and qualitative data within and across participants' tweets [22]. The mixed methods approach employed has been used previously in research investigating the tweets of people who use Augmentative and Alternative Communication (AAC) [22] and a TBI Twitter hashtag study [6].

2.3. Content classification of tweets

Tweets were coded using Dann's content classification [1] as follows: (i) Conversational, tweets, where the @user tweets directly to another Twitter @user; (ii) News tweets, where tweets contain identifiable news content (i.e. journalism and reporting on real-time events); (iii) Pass-Along tweets, intended to share information (e.g., retweets or sharing links); (iv) Social Presence tweets, which show a connected presence with other Twitter users; or (v) Status Broadcast tweets, which express the @user's thoughts, feelings, or experiences [1]. A research assistant conducted consensus coding of 100% of tweets, with any discrepancies resolved through discussion between the first author and the consensus coder. This was done to provide context to identify and then conduct an in-depth qualitative inductive content coding of Conversational and Status Broadcast tweets [6, 23].

2.4. Qualitative content analysis of conversational and status broadcast tweets

As in previous research [6, 23], tweets coded as 'Conversational' and 'Status Broadcast' tweets were extracted from the sample for further analysis, read and re-read by the first author, and coded inductively

in Excel [24]. Coding of the tweets proceeded iteratively with reflective discussion between the first and the final authors until agreement was reached on both the individual tweet codes and the content categories. Following this, connecting themes within and across the categories were also discussed and identified. Computational analyses of the tweet texts using KH Coder provided a means of comparing and verifying the inductive hand coding of tweets, to triangulate the findings of the coding categories [24]. The qualitative content analysis of all tweets also included a reading of the hashtags used to identify any new themes or hashtags, confirming the themes identified in the tweet text using other methods.

2.5. Computational analysis

The text analytics visualization software package KH Coder [25] was used to analyze and conceptualize the text content of tweets collected [26]. KH Coder supports a range of text data analysis and visualization methods. A KH Coder English stop word list was developed between the first and second authors, whereby common words that occur frequently in written English are ignored in the text analysis [27]. This is done as frequently occurring words such as 'a', 'and, 'it', and 'the' may potentially obscure more meaningful words from being reflected in the analysis [28]. The co-occurrence network (CON) algorithm was used to compute the co-occurring frequency and distance of words that appeared in the tweets [29]. The Jaccard distance measure [27] was used to determine the co-occurrence for word pairs. Words are displayed as circles in a network based on the Fruchterman-Reingold layout algorithm [30], with the size of the circle indicative of the relative frequency of the terms and the thickness of the connecting lines indicative of the relative strength of the association between the words. Additionally, the multidimensional scaling (MDS) plot was used to compute the similarity between words in the tweets [29] using the Jaccard distance measure [27] and the Sammon distance scaling method [31]. The MDS plot mapped the computed 'distances' between all word pairs into two dimensions to display the clustering of words within the text. Words appear as circles in the MDS plot, with the size of the circle around the words reflecting the relative frequency of the terms. Words clustered close together in the plot occur more frequently close together in the tweet data, which may reveal key themes within and across the data sample. A color-coding schema was used to emphasize different term clusters within the network, however it is indicative only, based on the distances between terms in the MDS plot.

2.6. Socio-linguistic analysis

The 'Conversational' and 'Status Broadcast' tweets were analyzed socio-linguistically to observe communicative function and any cognitive-communicative difficulties [6]. Tweet content was screened for spelling or grammatical errors, and for cohesive adequacy and completeness (i.e. whether the tweets made sense) [32]. Additionally, the frequency and type of hashtags used in tweets were examined to observe participants' social communication awareness of using hashtags appropriately [6].

3. Results

3.1. Participants

All participants were adults with TBI and cognitive-communication disability who used Twitter and were able to give informed consent. In total, four females (67%) and two males (33%) took part in the study. Background recruitment interviews with participants reflected that Participants A, C, D, E, and F were 'excessive' in their communication styles, and Participant B had an 'impoverished' communication style [33]. Participant characteristics are presented in Table 1.

Table 1. Participant characteristics.

Characteristic	Detail
Age (years); mean (SD), range	40 (SD = 18.38), 26-72
Male gender, n	2 (33.3%)
Female gender, n	4 (66.7%)
Cause of Injury: Motor vehicle accident, n	3 (50%)
Cause of Injury: Sporting accident, n	3 (50%)
Age at injury (years): mean (SD), range	22 (SD = 6.26), 13-31
Years since injury: mean (SD), range	18 (SD = 23.01), 2-59
Communication mode: Speech, n	5 (83.3%)
Communication mode: Augmentative and Alternative Communication (AAC), n	1 (16.7%)
Excessive communication style, n	5 (83.3%)
Impoverished communication style, n	1 (16.7%)
Employed and/or Student, n	3 (50%)
Unemployed or Volunteer, n	3 (50%)

3.2. Tweet data

Participant tweets were collected from Twitter between February and September 2017, using NCapture [19] in Google Chrome, imported into

NVivo11 [20], then exported to Microsoft Excel [21] for analysis. The total data sample contained 6874 tweets, 322 of which were posted by Participant A (PA), 51 by Participant B (PB), 3210 by Participant C (PC), 43 by Participant D (PD), 3208 by Participant E (PE), and 40 by Participant F (PF). Thus, PC and PE's tweets accounted for over 90% of the data collected.

3.3. Content classification of tweets

The main category of tweets posted by participants was Pass Along tweets (*n* = 4840, 71%), comprising mostly retweets (*n* = 3036, 63%), with the remainder including links to other content (*n* = 1804, 37%). The next most common category of content was Conversational tweets (*n* = 1864, 27%), with few Status Broadcast tweets (*n* = 139, 2%), News tweets (*n* = 15, 0.2%), and Social Presence tweets (*n* = 16, 0.2%) appearing in the sample. PB and PD used mostly Conversational tweets (78% and 74% respectively), while PA, PE, and PF used mostly Pass Along tweets (89%, 82%, and 82% respectively). PC's were distributed primarily across two content classifications, with 42% being Conversational tweets, and 57% being Pass Along tweets. These results reflect some under-utilization of the platform by people with TBI, with a reliance on Pass Along tweets, and little use of the Status Broadcast form of expression in Twitter.

3.4. Qualitative content analysis

Connecting themes appeared within and across the tweet content categories, in emotional expressions of a sense of connection, hope, advocacy, the hardship of living with TBI, and generosity. The participants were tweeting with others to connect. They commented on other people's posts and tweeted with others to connect. They tweeted with humor and candor about things of interest to them, such as the arts, politics, and living with disability after TBI. Similar to Brunner et al. [6], few tweeted about rehabilitation and when they did it was with frustration as they were bored, wanted to get better quicker, or wanted more access to services. There were also tweets sharing opinion and advocating on behalf of people with disability and other people who are vulnerable, particularly in support of better health care reforms and services. Some participants expressed their experiences of living with pain and fatigue, and some shared their anger and frustration with missing out on social events due their injury. Messages of empathy, hope, and encouragement were tweeted, along with tweets sharing strategies that had worked for them to improve their quality of life.

The content analysis of the Conversational and Status Broadcast tweets reflected that people with TBI were using Twitter for a variety of purposes to: (i) support others, including people with TBI and those with other forms of acquired brain injury; (ii) discuss society and culture; (iii) connect with others ; (iv) provide personal narratives of living with a TBI; (v) knowledge: to seek and share or exchange information; and (vii) advocacy, for themselves or other people (e.g., in terms of social change). The frequency of tweets across these topic categories is displayed in Figure 1.

Tweets sent by PA, PB, and PF reflected that they wanted to engage with others in Twitter but were mostly unsure how to do so. PD's tweets reflected her anger and frustration with the current political climate, as did PE's. However, PE's tweets also displayed enthusiasm and encouragement in advocating for issues she felt strongly about. PC's tweets also reflected positivity, sharing information and providing acknowledgement and encouragement to other users in her networks.

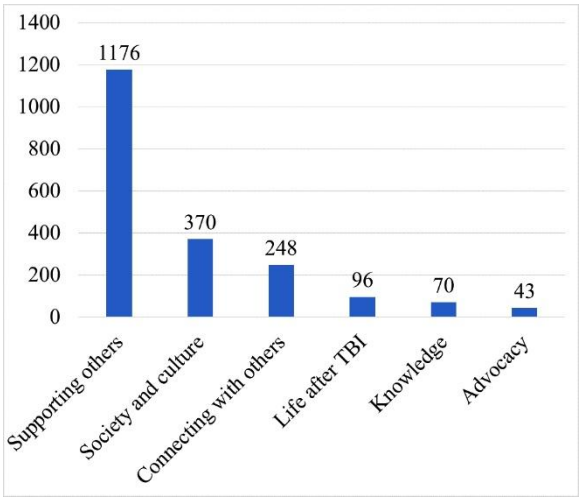

Figure 1. Frequency (*n*) of tweets according to topic category.

3.4.1. Supporting others. In supporting others, the participants shared links to blog posts and news articles, most of which were TBI-related. PC and PE both tweeted links to their published blog posts, in which they shared their experiences of life after TBI, the challenges living with an invisible disability, and strategies that had helped them. PC and PE were the active tweeters in the sample, with PC's tweets predominantly devoted to promotion of her blog and providing follow up support, information, and empathy to those who were commenting or asking

questions about blog content. PC's tweets often included statements whereby she hoped that sharing her experiences would be of benefit to others with a TBI and their supporters.

3.4.2. Society and culture. The participants discussed society and culture in their tweets, referencing popular issues, news, and personal interests such as music, sport, television, and other entertainment. Tweets sent by PD and PE were heavily influenced by political happenings, and they used the platform to express their disbelief, frustration, and anger with politicians whose agendas and actions they felt were reprehensible. PA, PB, and PF tweeted more about what they were doing in life, such as the music or podcasts they were listening to, the television shows they were watching, or the social events they were attending.

3.4.3. Connecting with others. Participants were using their tweets to connect with other users and engaging in online conversations. They were asking questions about other people's lives, commenting on other users' posts, inviting them to comment on issues, and making suggestions of other people (who may have similar interests) to connect with in Twitter. In one tweet, PA invited a celebrity to come visit their country. In another tweet, PB responded to an organization's call-to-action tweet by saying they were keen to be involved. PC frequently responded to users who commented or shared her blog tweets by thanking them for their support.

3.4.4. Life after TBI. A smaller number of tweets shared personal narratives of life after a TBI. The participants shared that they experienced ongoing experiences of anxiety, cognitive overload and fatigue, sleeping issues, and difficulty coping in busy or noisy environments. PA tweeted about using music to help him get to sleep and PE shared that she takes a nap every day to cope with cognitive fatigue. PC tweeted about her changed vision, cognitive fatigue, and that anxiety was a 'massive' issue for her.

3.4.5. Knowledge. Tweets were also sent by participants to seek and share information and knowledge. PC and PE discussed and shared strategies that have helped them after their injury, such as PC tweeting that she had used mindfulness and meditation to cope with feelings of information overload and anxiety. PE also sent tweets asking others if they had seen information or news items and also asked Twitter users for information, such as where to find a good podcast on mental health.

3.4.6. Advocacy. One participant actively sent tweets advocating for people in need, such as those living with a TBI, disability, and mental health issues. PE was vocal in her tweets about issues relating to health care reform and services, often including high profile political handles in her tweets to draw their attention to the particular issues being addressed. PB also sent one tweet in support of another user for 'standing up' for themselves, and acknowledged that he was in a similar challenging situation due to his disability.

3.4.1. Hashtags. The hashtags that were used most frequently in the data sample also reflected these purposes of use, such as giving and receiving support and information (e.g., #TBI, #braininjury, #ABI, #concussion, #inspiration, #motivation, #recovery), sharing life experiences after TBI (e.g., #mentalhealth, #depression), and discussing society and culture such as political issues and opinions (e.g., #Trump). The frequencies of the main hashtags as identified in the participants' tweets are shown in Figure 2. Some hashtags reflected participants' use of automated tweets based on their activities (e.g., listening to music and use of specific brain training apps). Less frequently used hashtags included other health (e.g., #psychology, #memory, #PTSD), political (e.g., #debatenight, #womensmarch), advocacy (e.g., #braininjuryawareness, #hats4headway), and entertainment related hashtags (e.g., #thebachelorette, #Oscars). Poetic hashtags were also used in participants' tweets to convey feelings of confusion and disorientation, and a changing sense of self-identity after TBI.

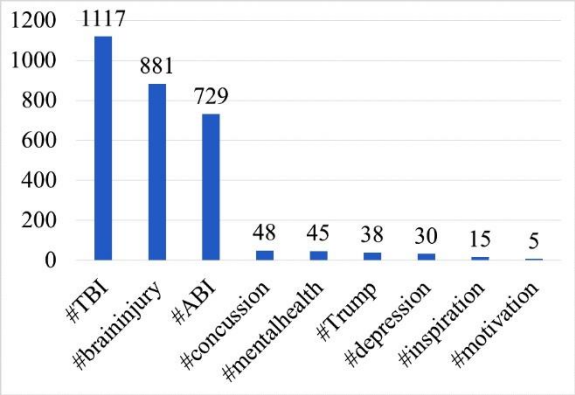

Figure 2. Frequency (*n*) of hashtags used.

3.5. Computational analysis

The KH Coder [25] visualizations (Figure 3 and Figure 4) confirm the themes identified in the hand coding of content. Individuals and celebrities appearing in the visualizations, as expected with a sample containing primarily Pass Along and Conversational tweets, have been de-identified and labelled (e.g., 'individual01' 'celebrity01'). The clusters of words and concepts present in the visualizations reflect tweets sent by the participants

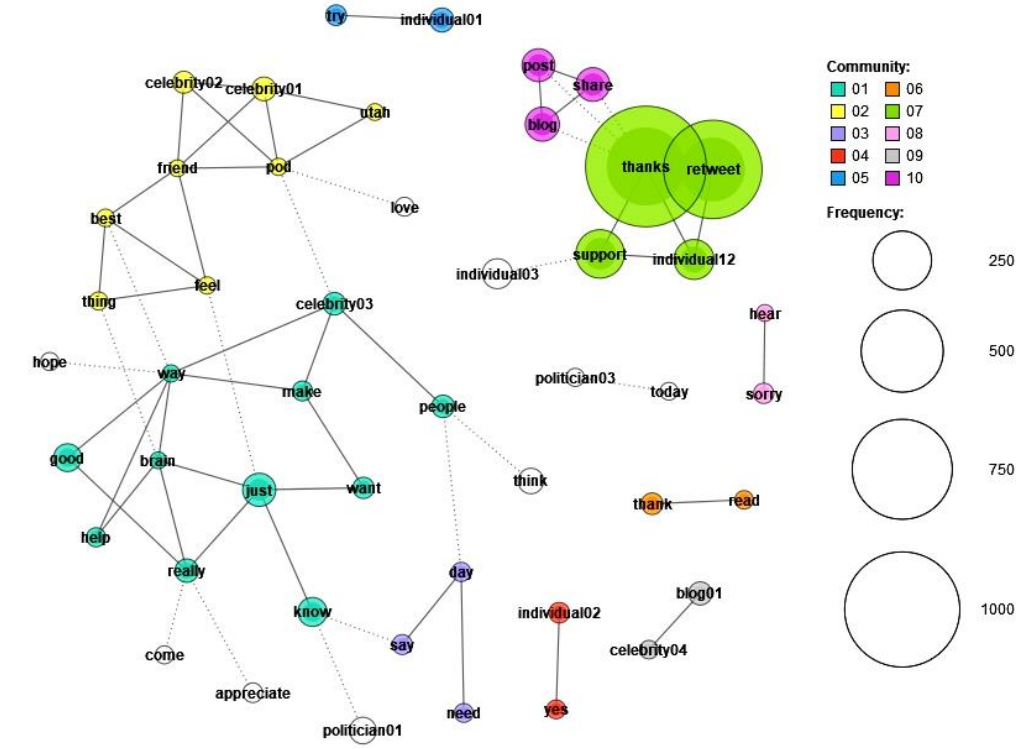

Figure 3. KH Coder visualization of tweet content concepts: Co-Occurrence Network (CON).

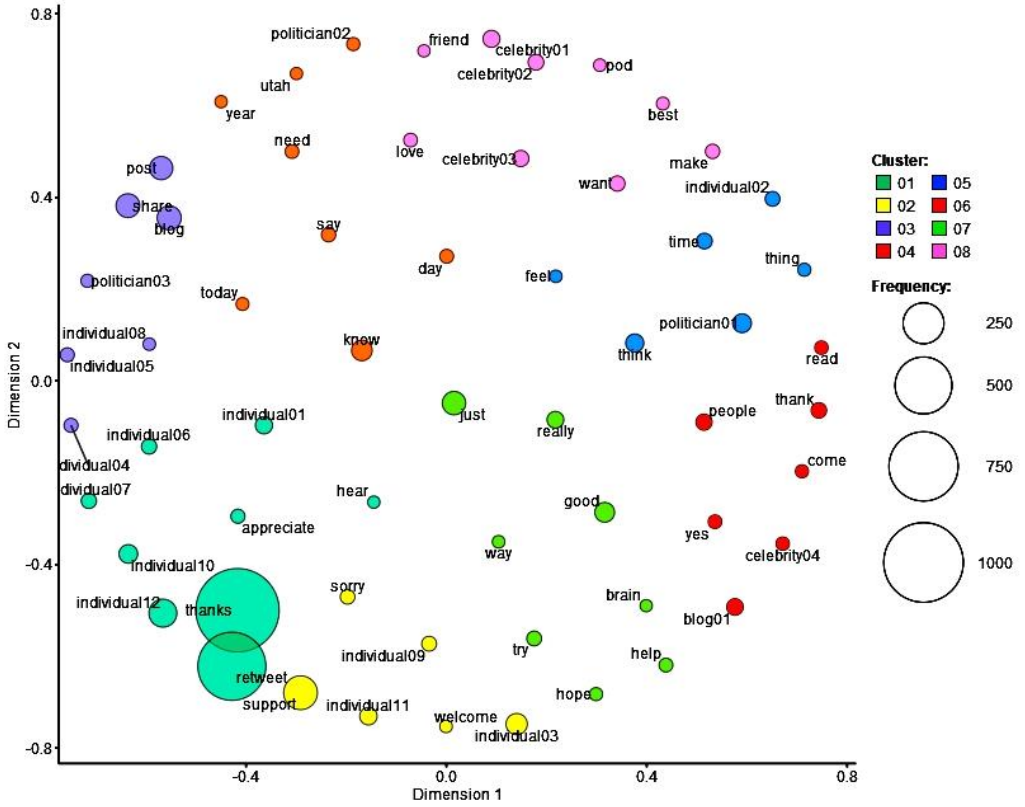

Figure 4. KH Coder visualization of tweet content concepts: Multidimensional Scaling (MDS) plot - Jaccard distance, Sammon method.

with TBI to the world, individuals, celebrities, and politicians. The KH Coder CON visualization of the tweet text analyses (Figure 3) shows several concepts including 'share/blog' 'hear/sorry' 'thank/support', 'try' 'brain/want/help', 'need/say', and 'think/feel'. The concept clusters shown in the MDS plot (Figure 4) are: (01) expressions of connection and thankfulness; (02) empathy and messages of support; (03) statements of political opinion; (04) sharing of TBI-related information; (05) emotional responses to current events; (06) advocacy; (07) hope and a willingness to keep trying; and (08) commentary on society and connecting with high profile Twitter users including celebrities. These overall groupings of concepts confirm support those identified in the hand coding of the qualitative inductive analysis. The computational analyses provide further insights into the relative strength and connectedness of the component themes. For example, the word concepts of emotions appear close to the relatively large number of tweets sent by PC thanking her blog supporters (as seen in the large circles around 'thanks/retweet' in Figures 3 and 4).

3.6. Socio-linguistic analysis

The Conversational and Status Broadcast tweets examined for linguistic features contained limited errors of spelling (n = 9, 0.4%), grammar (n = 13, 0.6%), and punctuation or typographical errors (n = 58, 2.9%). Typographical errors typically related to use of the period: lack of spaces between words and period markers, lack of period markers, or duplicate period markers. Only one percent (n = 20) of the tweets were 'incoherent or incomplete', where the message was unclear due to the tweet missing key information (e.g., ambiguous or incomplete phrases and/or missing links).

Only one participant (PE) consistently used acronyms and emoticons in tweets, and two participants emphasized words in tweets by using capitalization and additional letters in words (e.g., 'yesssss'). A small number of tweets reflected their difficulties in cognitive-communication (n = 15, 0.7%) – specifically word finding difficulties, cognitive fatigue, wanting to communicate more effectively – and their difficult experiences of TBI being an 'invisible disability'. PE eloquently expressed in her tweets the view that people in her community could not see her difficulties, and they had no idea how hard life was for her. PB tweeted having a need to learn how to use Twitter to communicate in another way; and PF expressed confusion over sending a tweet, writing that she had been pondering how to send a single tweet for over an hour.

Two of the participants (PC and PE) were active tweeters, whose tweets overall were cohesive with minimal errors (range 0.1-4.1%). Of the four participants who tweeted less frequently (PA, PB, PD, and PF), only one (PB) consistently had a relatively large proportion of tweets containing errors (range 6.9-41.8%), were incomplete (n = 11, 25.5%), or did not convey a message (n = 15, 34.8%). Over 50% of PA's conversational and status broadcast tweets (n = 14) appeared to be automated (i.e., the content of the tweet was generated by another platform outside of Twitter). Although tweets posted by PA and PF did not contain many errors, the content of their tweets shared their uncertainty in the tweeting process and feelings of pride when tweeting was recognized by users in their networks.

Only thirteen tweets (0.6%) included three or more hashtags (range 0-7), and most of these tweets were written by two participants (PD and PE) in expressing strong political opinions.

4. Discussion

The results of this research, as shown using mixed methods analyses, reflect that Twitter is a valuable source of social and information-rich 'connection' for people with TBI. The content categories and emotional themes of tweets show that Twitter provides a way for people with TBI to voice their opinions and feelings on a wide range of topics, including issues specific to TBI (e.g., living with disability). Using different methods of analysis enabled verification and triangulation of the findings, and strengthened the interpretations of the content analysis of the participants' tweets. At least for the more active tweeters in the sample, cognitive-communication difficulties did not appear to affect the linguistic construction of tweets, supporting the findings in a TBI hashtag study [6]. The use of automated tweets composed from other platforms might have enabled participants with linguistic difficulties to participate more frequently in tweeting than they would have otherwise. Twitter itself may assist in enabling people with TBI to do this given its ability to host synchronous and asynchronous conversations using hashtags [34]. The character limits on each tweet may support people with TBI and 'impoverished' communication styles to use Twitter by affording them permission to be 'brief', and support those with 'excessive' communication styles by limiting their expressions.

Whilst use of Twitter was not overtly problematic [35] for the people with TBI in this study, the content classification reflected that the several affordances (e.g., the character limit of tweets) of Twitter were

under-utilized by most (n = 4) of the participants. In fact, the frequency of tweets according to content classification echoed percentages found in a larger tweet dataset [6]. This finding supports previous research including adults with communication disability [6, 22], in that even when they know how to tweet, people with TBI do not always use Twitter to interact conversationally or write Social Presence and Status Broadcast tweets very frequently. The active tweeters in this study displayed more strategic use of Twitter, consistently mentioning other @users in their tweets to connect. Participants who were less active in Twitter in this study might have been unsure of who to connect with in Twitter, or how to best approach use of the platform to express their thoughts, feelings, or experiences in Status Broadcast tweets. The two more active participants in this study tweeted far more frequently than the four less active tweeters and contributed over 90% of the tweets examined. Furthermore, with such a small sample of participants with TBI (N = 6), it is not possible to generalize the findings of this research to adults with TBI more broadly.

Previous TBI-related Twitter content analysis [6] studied only tweets that contained a hashtag. This study analyzed all tweets sent by participants, providing further insights into how and what people with a TBI may tweet. Studies including a larger number of people with TBI, and that also include their mentions data in Twitter (i.e., tweets that mention their Twitter handle) are now needed. However, the results provide important insights into topics discussed by adults with TBI who use Twitter, how they communicate in online communities, and their use of Twitter for support and exchanging information. Many of the participants used Twitter to voice their opinions on topics that were personally meaningful, as well as to advocate for others. The results, including four less active tweeters, suggest that adults with TBI need not be particularly active to obtain value from the platform. These less active users might use Twitter with greater success and influence with support from health professionals addressing their cognitive-communication skills and goals in a context that is personally meaningful and relevant. Even active tweeters with TBI might need support to use all features of the platform.

5. Clinical implications

Tweets sent by the participants in this study support a 'figure it out' approach in their statements about not knowing how to send a tweet and wanting to learn how to tweet. These results support the findings of previous research, in that people with TBI report not receiving support from their family, friends, or health professionals beyond setting up their social media accounts [17]. Their willingness to persist through confusion, using a 'trial and error' approach, indicates a willingness to learn and actively engage in online communities, but some difficulties in doing this [17]. In order for people with TBI to use Twitter and other social media platforms meaningfully, they may need support to know how to tweet more confidently, more frequently, and be able to connect with others for a wider variety of purposes. To date, there is little evidence in the literature that TBI rehabilitation services currently provide any form of structured support in the use of social media platforms for people with cognitive-communication disability.

One participant in this study who had an 'impoverished' communication style [13], used short, often incomplete phrases in tweets and had difficulty elaborating on topics. While this did not prevent him from tweeting, his tweets reflected several linguistic errors and problems with cohesion and completeness. The other five participants with varying degrees of 'excessive' communication styles [13], predominantly characterized by speaking at length yet with limited content, did not display an excessive communication style in their tweets, and the majority of their tweets were cohesive and complete. Therefore, the results of this study show that using Twitter may enable the more appropriate social participation of people with TBI with either impoverished or excessive communication. It may enable greater opportunity and less pressure to initiate and elaborate on topics of interest for those with impoverished communication, who may have limited opportunities or support for participating in face-to-face conversations [14]. For people with TBI who display more excessive communication profiles and have difficulty interpreting turn-taking cues [14], the character limitations in Twitter may enable active practice in communicating key concepts within a smaller number of words.

This research focused on the tweets written by people with TBI, but the views and experiences of people with TBI on their use of Twitter are not yet known. An important finding of this study is that Twitter is being used to obtain support, something that people with TBI might lack in loss of social relationships after their TBI. Therefore, an in-depth understanding of their Twitter experiences would help to extend the findings of this research, specifically to determine: (a) the nature and impact of any provision of 'support' obtained in Twitter, and (b) how adults with TBI locate and join in with supportive communities in Twitter. This information could be used in designing social supports for adults with TBI

throughout their rehabilitation. Further research is warranted to explore how people with TBI use Twitter safely, as even though this research did not detect evidence of cyberbullying [36], people with disability are at increased risk of experiencing online abuse [3, 37, 38]. A deeper understanding of the views and experiences of adults with TBI who use Twitter, particularly for those who tweet infrequently, is essential to explore these issues.

Further research is also needed to examine: (a) how people with TBI either learn to use or recover their use of Twitter after a TBI, including their views on what training or supports are needed to use Twitter safely and effectively; (b) the views and experiences of health professionals working in TBI rehabilitation services on how social media is considered during rehabilitation after TBI; and (c) the views and experiences of families who may actively support or attempt to limit the use of social media by the person with TBI. Such research would help to identify barriers to or facilitators for supporting adults who wish to use social media safely; and inform policies and procedures on the use of social media in organizations providing services to or employing people with TBI.

6. Conclusions

Twitter is used by people with TBI to connect, find and provide support, and communicate about their life and interests. The microblogging site offers a global online community that is supportive of conversations including people with TBI, and hence provides a way for their voices to be heard. Listening to the experiences of people with TBI through reading their tweets could inform TBI rehabilitation targeting socio-linguistic skills, cognitive-communication, and social participation goals. Using multiple methods of analysis yielded additional insights into how people with TBI use Twitter and these methods could be used in future socio-technical research examining use of social media. When discussing TBI rehabilitation goals, online communication contexts including the use of Twitter should be considered for people with TBI, whether they have impoverished or excessive communication styles.

7. Acknowledgements

The authors wish to acknowledge and thank the research participants for their contributions to this study; Lucy Bryant for assistance in consensus coding in data analysis; and the University of Newcastle for administration of funding and support in the conduction of this study. The research was supported by an Australian Government Research Training Program scholarship to the first author, and a Discovery Early Career Research Award from the Australian Research Council to the final author.

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