Journal of
Virtual Worlds Research
jvwresearch.org ISSN: 1941-8477

Volume 3, Number 1
October 2010
The Researcher's Toolbox

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dint u say that: Digital Discourse, Digital Natives and Gameplay

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Abstract

Discourse analysis has the potential of providing insight into gameplay dynamics and team success. However, because of factors such as interrupted sequences, gameplay discourse does not easily lend itself to discourse analysis. Therefore, in addition to traditional methods, new and modified discourse analysis methods were applied to a corpus of 858 discrete gameplay discourse events disclosing discourse characteristics during collaborative problem solving. Four teams of four digital natives each played PanelPuzzle, a limited-time span, goal-oriented game, in a virtual environment. Discourse both reflected and impacted team dynamics. It manifested leadership. To promote team success, gameplay digital discourse tone was serious, showing little evidence of fun although players reported enjoying gameplay. Brevity, ill-formedness and distorted syntax were chief characteristics, but, because it was goal-oriented, it differed markedly from reported social digital discourse. Digital natives used digital discourse effectively to communicate, build community, collaborate and accomplish gameplay tasks. We conclude that gameplay digital discourse constitutes a distinct linguistic register which prioritizes efficiency over well-formedness. We characterize this register in a taxonomy and a meta-taxonomy.

Keywords: collaboration, computer mediated communication, digital discourse, digital natives, discourse analysis, games, roleplaying, usability engineering, collaborative virtual environments, virtual worlds, video games

Acknowledgements: This work was supported in part by the Intelligence Advanced Research Projects Activity.

dint u say that: Digital Discourse, Digital Natives and Gameplay

Discourse analysis has the potential of providing insight into gameplay dynamics and team success. It also has the potential of uncovering whether digital discourse reflects players' in-game experiences and interactions with each other while impacting gameplay outcomes. However, gameplay discourse among digital natives does not easily lend itself to traditional discourse analysis.

Digital natives are people who have grown up surrounded by and using technology (Prensky, 2004). Lewis and Fabos (2005) note that a high degree of familiarity and comfort with technology can result in new ways of reading and writing while using technology. Digital natives enjoy a connectivity that fosters communication. Much of their digital discourse serves social purposes. With constant and immediate access to communication technologies such as cell phones, text messaging and instant messaging, they build community (Khoo & Zubek, 2002), e.g., by maintaining awareness of each others' locations and activities. This awareness manifests in gaming environments.

We examine gameplay experience from the perspective of digital discourse among digital natives playing PanelPuzzle, a game developed for this study. Steinkuehler (2003) demonstrates that massive, multiplayer online roleplaying gaming (MMORPG) is equivalent to engaging in discourse. Although our experiment was limited to 16 digital natives, playing under four independent conditions each limited to four players, characteristics that PanelPuzzle shares with MMORPGs make it possible to extend Steinkuehler's (2003) observations on MMORPG discourse to apply to PanelPuzzle. These characteristics include role playing; interactivity; dependence on internet connectivity; a persistent virtual environment (VE); competition among teams; a timed quest; and teammate collaboration. In these aspects, PanelPuzzle also qualifies as a collaborative virtual environment (CVE) which provided an opportunity to study the relationship between digital discourse and collaboration.

This work builds on two studies that examined in-game collaboration (O'Connell, Grantham, Workman & Wong, 2009; O'Connell, Choong, Grantham, Moriarty & Wong, 2008). Here, we focus on digital communication in American English (AmerEnglish) among digital natives using text chat during gameplay. In earlier analysis of data from this experiment, we saw that communication and roleplaying positively impact teams' success and players' satisfaction

(O'Connell, et al., 2009). Here, we investigate relationships between text chat and team dynamics; relationships between leadership and team discourse; and effective digital communication among teammates. We discuss characteristics of gameplay discourse.

Within this paper, we define discourse as communication between one source (person sending a message) and one or more sinks (people receiving a message) typing natural language during video gaming. By detecting topic shifts, it is possible to divide discourse into parts (Brown & Yule, 1983). However, in a simple chat message box, the usual markers, such as paragraph breaks, do not occur. Interspersed parallel threads impose interruptions that give the appearance of topic changes when topics actually persist. Therefore, we used a discourse model constructed of discrete segments we call discourse events (DE). By a **text chat DE**, we mean a discrete body of text that proceeds from a sole source at a time-stamped start point and ends at publication in a text chat window where it is received by one or more sinks. A DE is bounded by the first and last characters typed. Its purpose is to convey meaning from source to sink. We limited discourse analysis to DEs among teammates during timed PanelPuzzle gameplay.

Hypotheses

A rich body of literature on social digital discourse sometimes addresses technology-driven characteristics of digital discourse among digital natives (e.g., Lewis & Fabos, 2005; and Greenfield & Subrahmanyam, 2003). There is a less rich body of literature on discourse during gaming (e.g., Tychsen, Smith, Hitchens & Tosca, 2006; Steinkuehler, 2003), little of it referring specifically to digital natives. We applied insights from this literature as well as our own observations to construct four hypotheses about teammates' text chat discourse.

H1. **Text chat discourse will both reflect and impact team dynamics.**

By team dynamics, we mean interactions among teammates and the attitudes of teammates toward each other. We expected discourse to set the tone for team dynamics. Because team dynamics, in turn, would reflect team activities, we expected DEs to increase as players arrived at critical points in gameplay. We expected emotional statements to occur as players neared goal accomplishment. Building collaborative knowledge is characteristic of digital natives. Indeed, Prensky (2004) suggests that the motto of digital natives be "Sharing Knowledge is Power." We expected teams to build collaborative knowledge through discourse.

H2. When a team leadership role is played, text chat discourse proceeding from the team leader will promote and foster the team's goal to win the game.

Our earlier work aligned with the findings of Maybury (2001) who notes that a lack of leadership impedes successful group interactions in a CVE. Building on work showing that linguistic analysis can reveal social structures (e.g., Paolillo, 2001), we extended our earlier finding to a hypothesis that centers on team leaders' statements and the impacts of leadership or the lack thereof on team dynamics. We expected team leaders' statements to promote and foster winning by asserting authority; providing direction; organizing team activities; promoting construction of collaborative knowledge; and boosting morale. We expected leaders to build community. We expected a lack of leadership to coincide with a lack of community.

Studying leadership in virtual teams, Sudweeks and Simoff (2005) note that leaders' communication behaviors include firmness and early and frequent participation in team discourse. Therefore discourse can signal emergent leadership in conditions where leadership roles are not mandatory and disclose whether designated leaders do indeed exert leadership. We expected teammates' discourse to be goal-oriented if their leader's DEs manifested goal orientation. We expected that in conditions without a leader, discourse would not manifest an organized team strategy to win the game. We expected to see sequences of related DEs initiated by the team leader.

H3. **Text chat discourse during gameplay will be predominantly serious.**

We expected discourse to be predominantly serious, focusing on gameplay with little, if any, linguistic evidence of fun. H3 was based on our earlier observations of digital natives during timed gameplay; even when players were obviously having fun, there was little linguistic reflection of fun. Instead of banter and joking, we have observed serious task-oriented discourse.

H4. The structure and vocabulary of text chat discourse will resemble the structure and vocabulary of the electronic messages that digital natives typically exchange.

We expected DEs to exhibit properties discussed in literature on digital discourse. To inform H4, we examined computer-mediated communication (CMC) in general and five types of digital discourse: email; text messages (TM), including short message service (SMS) used for sending

TMs from cell phones; text chat, especially as used in MMORPGs; internet relay chat (IRC); and instant messages (IM).

Herring (1999) examines the disrupted turn adjacency properties of CMCs where transmitted messages appear, as they did in PanelPuzzle, linearly in the order in which the system receives them, rather than in a logical discourse sequence. Herring (1999) notes adaptation to the CMC medium with innovative mechanisms to offset potential incoherence when strands of conversations juxtapose and interweave, forming complex, multidimensional text where overlaps and intentional interruptions are impossible. Mechanisms include minimal responses; signaling the end of the DE with an end-of-turn character or simulated raised hand; and addressivity (using an intended sink's name).

During text chat, we expected players to import linguistic traits from emailing and TM, both popular in a survey of PanelPuzzle players. These included brevity, quick topic changes and deviations from Standard AmerEnglish (Khoo & Zubek, 2002; Zubek & Khoo, 2000). Aoki and Woodruff (2005) report that TMs are typically short. Causes include the difficulty of typing on small keypads and character limits imposed by service providers. Grinter, Palen and Eldridge (2006), studying teenage social use of SMS, report teens using short messages to plan and coordinate.

Examining text chat in MMORPGs, Steinkuehler (2007) posits that limited display space leads to abbreviations (*nvm* for *never mind*), acronyms (*lol* for *laughing out loud*) lexical truncations (*u for you*), omissions of syntactic elements; onomatopoeia; and using alphanumeric characters and punctuation marks to convey gestures. She observes typing and grammatical errors and vocabulary customized to the game. Citing emoticons, i.e., using alphanumeric characters and punctuation marks to convey emotion, Greenfield and Subrahmanyam (2003) report that text chat has a visual aspect exploited by digital natives to facilitate communication. Emoticons replace extralinguistic signals such as smiling. Studying collaboration, Gergle, Millen, Kraut and Fussell (2004) note that collaborators with a persistent view of text chat tend to use short sequential DEs to describe puzzle pieces; because of the view, they need not request repetition.

A linguistic register is a modification of language for a particular purpose or social context. Doell (1998) classifies IRC as a distinct register characterized by creative conventions that render it speechlike. Werry (1996) notes that IRC emulates paralinguistic traits of spoken

language through nonstandard capitalization for emphasis (*go NOW)*; nonstandard spelling in colloquialisms, *whutcha mean;* or letter reduplication for emphasis (*heeeeelp*). He cites substituting punctuation for spoken cues (*!!!)* for a raised voice. He notes coded expression of gestures (**hugs**). Working with multinational English, including AmerEnglish IRCs, Paolillo (2001) finds DEs of three to six words and sources interrupting each other. Khoo and Zubek (Khoo & Zubek, 2002; Zubek & Khoo, 2000) note similarities between competitive gameplay text chat and IRC: misspellings; disconnected discourse; frequent topic changes; and simultaneous threads.

Lewis and Fabos (2005) capture the structure of social IMs exchanged among digital native teens. They observe frequent use of visual elements to supplement discourse, e.g., ellipses to show that the source is thinking. They observe that correct spelling is important, but not proper punctuation or capitalization. Sources vary word choice and sentence structure to change conversational tone, e.g., they send shorter, more pointed answers to sinks with whom they are not interested in communicating. Sources often type several short, partial sentences in rapid succession to prevent topic changes.

Independent Variables

The source of a text chat message is always apparent, but the sink is not. Sometimes PanelPuzzle DEs addressed one teammate; other times, all three. So, the variables examined here were limited to the perspective of the source. The first independent variable was whether or not the source was playing the role of team leader. The second was whether the source's role was taken on voluntarily (RV) or if roleplaying was mandatory (RM). The third was whether all sources in a condition were allowed to communicate with the game master (GM).

Bravo Roles Voluntary (RV) All Sources Communicate with GM	**Charlie** Roles Mandatory (RM) GM Communicator/Leader Only Source to Communicate with GM
Delta Roles Mandatory (RM) GM Communicator/Leader Only Source	**Echo** Roles Voluntary (RV) All Sources Communicate with GM

to Communicate with GM	

Table 1. Independent variables pertaining to role playing and communication with the GM.

Players

Players were fourteen male and two female digital natives between the ages of 18 and 29. Game-playing experience varied among 11 players; five were not gamers. All gamers played interactive video games weekly: seven for 1-5 hours; three for 6-15 hours, and one for 16-25 hours. At the time of the study, all players were attending college or working in the US. All were fluent in AmerEnglish. One was a native speaker of French and three learned Spanish before English. All used telecommunication devices frequently. Chatrooms and forums, both important PanelPuzzle communication mechanisms, were among their least frequently used means of communicating with friends. Their favorite digital communication mechanisms were cell phones, Facebook®, IM and TM.

Playing PanelPuzzle

The goal of PanelPuzzle was to put together puzzles to earn points. The game was designed to cause players to communicate and collaborate. Players sought puzzle pieces distributed throughout a VE called Peninsula City. All teams experienced the same VE with the same 36 puzzle pieces for nine puzzles dispersed identically inside and outside of 100 buildings, 10 with interiors. Its 1,300 scaled kilometers spanned 36 city blocks, causing players to move independently throughout the city. Avatars walked or ran at a pace that scaled to real life. Teleportation immediately moved them to principal locations. Thus, avatars quickly dispersed beyond each others' fields of view, causing players to communicate about their activities. Once a player reported a piece's location and its unique numeric identifier to the team, that piece remained visible where it was found. Communication was necessary to promote gameplay efficiency, e.g., to prevent multiple reports of finding the same piece. Screens separated players to prevent eye contact, forcing players to depend on linguistic, rather than visual copresence during discourse.

We discuss two PanelPuzzle communication channels: text chat, which is the topic of this paper, and forums, which are reported only as they relate to text chat. Players communicated synchronously using text chat, or asynchronously using the players forum. Designated players

communicated with the GM using a GM forum. Players manipulated their avatars and composed and sent text chat messages using a keyboard. Therefore, they were not able to post to the text chat or forums while moving their avatars.

Teammates had to collaborate to learn which pieces belonged to which puzzles and to assemble pieces into panels in a horizontal, side-by-side arrangement. Peninsula City had no area large enough to display nine panels. Thus, the city center contained only three panels: each with sections to display only one three-piece, four-piece, or five-piece puzzle at a time. Each piece belonged in only one location within one panel. At any point during gameplay, teams usually had pieces for more than three puzzles. Therefore, they were forced to build collaborative knowledge about how pieces fit into both puzzles in view and puzzles that were not currently displayed.

Four teams, Bravo, Charlie, Delta and Echo, competed to earn the most points. Winning depended upon building collaborative team knowledge by coordinating individual players' distributed knowledge about which pieces were found and where those pieces fit into a panel. Four sessions each accommodated one team of four players. Players worked on any puzzle they desired at any point during 75 minutes of gameplay. had A random numerical identifier on each puzzle piece facilitated discussion. Notations on pieces indicated the size of the panels to which pieces belonged, but there was no indication of which puzzle a piece belonged to. Players had the option of displaying any piece in any panel at any point in gameplay by requesting insertion, movement or removal by the GM. For each panel size, there was one math, one word and one image puzzle. Common equations, e.g., the quadratic equation, appeared in the math puzzles. Everyday words or sentences constituted word puzzles. Image puzzles housed pictures easily recognizable by digital natives, e.g., a popular cartoon strip.

To protect anonymity, players received gameplay names, e.g., Golf_Echo; the first part of the name referred to the player and the second to the team/condition to which the player was randomly assigned. In RV conditions, Bravo and Echo, players could opt to adopt no role, any one role, or multiple roles. RM conditions, Charlie and Delta, obliged players to assume only one role. Across all conditions, players chose among the same four roles. A GM Coordinator communicated with the GM. A Communications Coordinator managed the players forum. A Map Coordinator organized puzzle-piece searching. A Puzzle Piece Coordinator directed puzzle assembly. Prior work demonstrated that the GM Coordinator became the de facto team leader

(O'Connell et al, 2009). In RV conditions, players had the option of adopting an unofficial leader. Before gameplay, there was time to select roles and discuss strategies.

A digital-native GM required players to communicate with him according to a strict format specifying the number of the puzzle piece, the panel size and the piece's location in the panel. The GM was not considered a player. In Bravo, any player could communicate with the GM, but, only by using a GM forum. In Charlie, only the GM communicator could communicate with the GM, using only text chat. In Delta, only the GM coordinator could communicate with the GM, using only the GM forum. In Echo, any player could communicate with the GM, using only text chat. When these rules were met, the GM inserted, moved or removed pieces, even if a request specified the wrong panel or section. When players considered a puzzle correctly completed, the GM was informed. Using the GM forum or text chat, depending on the experimental condition, the GM responded with the number of points won: 50 points for a correct three-piece puzzle, 100 for a four-piece puzzle, and 200 for a five-piece puzzle.

Experimental Environment

Each player had a desktop computer running Windows XP Professional, Service Pack 2. Peripherals included a standard 101/102 keyboard; a three-button click/scroll-wheel mouse; and two monitors (19", 20" or 21") set to maximum resolution. For each player, one monitor displayed Peninsula City; the other the forums. Players used the keyboard and mouse to input to the in-game text chat and forums. Other software included Microsoft Internet Explorer 7 Web browser and Forterra's On-Line Interactive Virtual Environment (OLIVE) version 2.0.1. OLIVE is a software platform for building persistent VEs for collaborating over networks. It employs a client-server architecture where PC clients connect to a central server via a network. OLIVE supports an array of capabilities and functionality in the baseline platform that support interactive VE operations, e.g., avatars, distributed physics, a session record and playback capability. The VE has a set of general three-dimensional art assets, e.g., avatar clothing, gestures, realistic faces, buildings and vegetation.

The OLIVE client and server applications were modified to log text chat events. The OLIVE client redirected text messages to the log file and to the OLIVE chat window. The client log output captured the timestamp, source (avatar name), and content of all DEs.

Figure 1. Text chat logs included three components: (A) date and Eastern Standard Time stamp; (B) text chat message identifier to separate DEs from other logged events; and (C) text chat message as seen by players, including transmission time and source's game name.

The text chat interface resided within the OLIVE graphical user interface. It comprised an input area for submitting and publishing DEs and a scrolling display of published DEs. Players activated the input area by clicking within it. A subsequent Enter keystroke submitted and published input. Nine lines of text, up to 40 characters wide, were visible at a time. It is characteristic of text chat that contributions to threads are not colocated or identified as belonging to any thread. Thus, it was possible for several interspersed threads to display at once. Text chat was persistent in that players could not delete each others' input and could scroll back to earlier messages. However, DEs scrolled out of view, giving text chat a temporary aspect.

Analysis Method

Data consisted of a corpus of 858 DEs, teammate text chat collected under four experimental conditions within 75 minutes of gameplay. This time span excluded DEs during pregame training and familiarization. Data included alphanumeric characters and punctuation marks. It excluded all DEs where the GM was source or sink.

Text chat does not easily lend itself to discourse analysis which focuses on coherent sequences of discrete communication acts. While PanelPuzzle DEs were discrete, four-way discourse among teammates who are sometimes collaborating and sometimes engaged in different activities is not always coherent. When possible, we applied traditional discourse analysis methods, isolating sources and sinks; examining DE function and pragmatic value in context; and analyzing DEs on the levels of morphemes and words (e.g., Brown, G. & Yule, G., 1988; Cook, 1969). In other cases, we devised methods to analyze the unique DEs that constituted typed communication among game-playing digital natives, e.g., treating emoticons as words and punctuation marks as having semiotic value beyond their traditional syntactic functions. We adapted traditional tagmemic analysis (Cook, 1969), treating sentence fragments as bona fide grammatical constructs and starting analysis at the level of the DE rather than the

sentence, then proceeding down to the morphemic level. Although PanelPuzzle DEs were not spoken, we examined their similarity to spoken AmerEnglish in seeking explanations of their deviations from standard written AmerEnglish. We applied a usability perspective, investigating efficiency, effectiveness and satisfaction (ISO, 1998).

Text chat functionality forced turn taking in a way that differed from AmerEnglish vocal discourse where social protocols discourage interruptions and confer the role of source on one person at a time. Text chat functionality made deliberate interruptions impossible. However, multiple sources could send DEs simultaneously. DEs displayed in the order in which the system received them, not according to which player started to type first. Thus, although the players' intent was synchronous communication, the technical reality was that in those cases where DEs were queued, text chat was asynchronous. In PanelPuzzle, with only four players and one GM active, this asynchrony was so minor that we could determine no effects such as forced pauses in gameplay or periods without discourse. Therefore, we considered text chat to be synchronous.

Cheering (Applauding/Encouragement) - Cheering by leader - Cheering by non-leader **Collaboration/Teamwork/Cooperation** - Acknowledgement - Addressivity - Agreement - Helpfulness - Lack of cooperation (disagreement) - Question answering by leader - Question answering by non-leader - Repair (correcting a misunderstanding) - Self-correction - Suggestion **Emotions** - Celebration - Excitement - Frustration/anger - Surprise **Emphasis** - All upper case - Exclamations **Fun** - Inside joke - Laughter - Playing around – being silly - Pop-culture references **Information Sharing** - Location information - Piece information - Solved puzzle announcement - Statement of information need - Status report	**Non-Standard Vocabulary** - Abbreviations/acronyms - Coded actions - Colloquialisms - Emoticons - Foreign language words - Lexical truncations - Onomatopoeia - Profanity - Slang words - Symbol substitutions for words **Questions** - About location - About pieces - Expressing confusion - Seeking confirmation - Seeking instruction - Seeking status - Other questions **Roles Leadership** - Contributing new ideas - Early presence in discourse - Firmness - Giving orders - Length of leader's DEs in words - Number of leader's DEs - Seeking opinions **Strategy** - Communication - Gameplan/gameplay - Leader giving strategy instruction - Non-leader giving strategy instruction - Puzzle solving

Table 2. A taxonomy of PanelPuzzle discourse event characteristics.

The non-sequential aspect of chat display made social protocols for turn allocation non-enforceable. In out-of-game everyday discourse, the source often uses addressivity to assign a sink the next turn as source and sinks often self-select themselves as the next source within social protocols for interruption. However, in text chat, the selection device for source was neither the current source nor self-selection. Source designation was confounded by DE length – of two DEs started simultaneously, the one that was completed first was published first. Because the text chat record was always visible to all teammates, even in those cases where the intent was one-to-one communication, the effect could be one-to-many. There is another confounding factor: we have no way of verifying that every player read every DE. Therefore, we always know who the source is, but rarely can identify the sink(s). Nor can we verify that every DE did indeed have a sink. Sink identification is usually limited to those instances when a sink takes the next turn as source and the DE's content indicates that it is a response. Thus, we argue that traditional discourse models that proceed from an identified source to an identified sink do not apply directly to text chat and, in discussing DEs, we usually refer only to the source.

Discourse was analyzed both by humans and programmatically. Chat log analysis started with human categorization of DEs according to content characteristics. Categories arose from literature searches and the data set content. DE category identification resulted in taxonomies of digital discourse characteristics (Table 2.) and meta-properties (Table 3.) during PanelPuzzle play. We report analysis within taxonomy categories, but, due to space constraints, do not address each subcategory. Instances of most categories were identified by both digital natives and non-digital natives, then counted using Excel formulas. When, during categorization, the meaning of DEs was not clear, two or three digital natives, gamers and frequent digital communicators who had not been players in this study, served as subject-matter experts (SMEs), providing clarification.

Flow	- DEs 15-20 words
- Cross-turn references	- DEs more than 20 words
- DE activity level when solved puzzles are reported	**Multifunctionality**
- Frequency of DEs	- DEs serving two purposes
- Frequency of topic changes	- DEs serving three purposes
- Peaks of discourse activity	- Total multifunctional DEs
- Sequences of related DEs	**Well-formedness**
- Sequential DEs from one source	- Alternate uses of punctuation
- Simultaneous threads	- Ellipsis – Unmarked omissions of words
- Topical thread organization	- Ellipsis with marks indicating word omissions
Length	- Irregular capitalization
- Number of characters in DE	- Lack of capitalization
- DEs under 3 words	- Lack of punctuation
- DEs 3-5 words	- Omission of syntactic elements
- DEs 5-10 words	- Truncation of DEs
- DEs 10-15 words	- Uncorrected misspellings

Table 3. A taxonomy of discourse event meta-properties.

A modified shareware tool used within MS Word counted spelling and grammatical errors (Maxey, 2008). When the utility confirmed there were a number of grammatical errors worth investigating, human counts and analysis followed. A Perl script counted DEs; words and characters (excluding spaces) in each event; punctuation marks; instances of lower case *i* for the first person pronoun as well as *i'* and *im*; uses of all upper case; and sequential same-source DEs. Words were considered to be strings of characters bounded by either the start or stop of the DE or by blank spaces between the strings. Therefore rogue characters and emoticons were counted as words. Each character within the emoticon was counted, e.g., a smiley face, :-) constituted three characters. Disagreements between players were noted non-automatically. Because of the small sample size (16 players), we did not perform extensive statistical analyses. In some cases, we derived averages to support study of differences among teams' discourse.

Results

We expected players to import linguistic traits from digital discourse technologies they commonly use. Chat analysis disclosed brevity, quick topic changes and deviations from Standard AmerEnglish. During gameplay, there were 858 DEs where source and sink(s) were

players. Bravo (0 points) had the least; this may be due in part to the fact that, early in gameplay, Bravo communicated with each other in the GM forum, a tactic not seen in other conditions.

	Bravo (RV)	Charlie (RM)	Delta (RM)	Echo (RV)
Unique pieces found	23	27	18	24
Puzzles solved	0	1	2	2
Points earned	0	200	250	250
Total DEs	142	227	324	165
Total words	962	1,303	1,736	1,040
Average words per DE	7	6	5	6
Total characters	3484	1303	6761	4032
Average characters per DE	25	6	21	24

Table 4. Characteristics of discourse events and team success.

We observed no statistical correlation between the number of words or types of discourse per DE, and solving puzzles throughout gameplay for any condition. However, human analysis of DEs gave insights into possible reasons for success. Although Delta tied with Echo in earning 250 points, Delta was considered the winning team because it was the most efficient, making the least number of placement requests (8), and the only team to make no wrong placement requests. Delta transmitted the most DEs and the most words; the length of their DEs was longer than those of other teams. Delta had the most instructional DEs (114); Bravo (57) the least. In Echo, the only condition where team dynamics were sometimes hostile and leadership was disputed, there were fewer DEs than in Delta or Charlie.

All conditions sent the same top four categories of DEs: strategy, informational, cooperation, and questions. Across all conditions, these categories had the same ordering in the number of DEs from most to least. In all conditions, the top four DE taxonomy categories had relatively the same linear slope, suggesting that we could average to generalize the trends for these four categories. An average of 89% of all DEs was in one of these four categories.

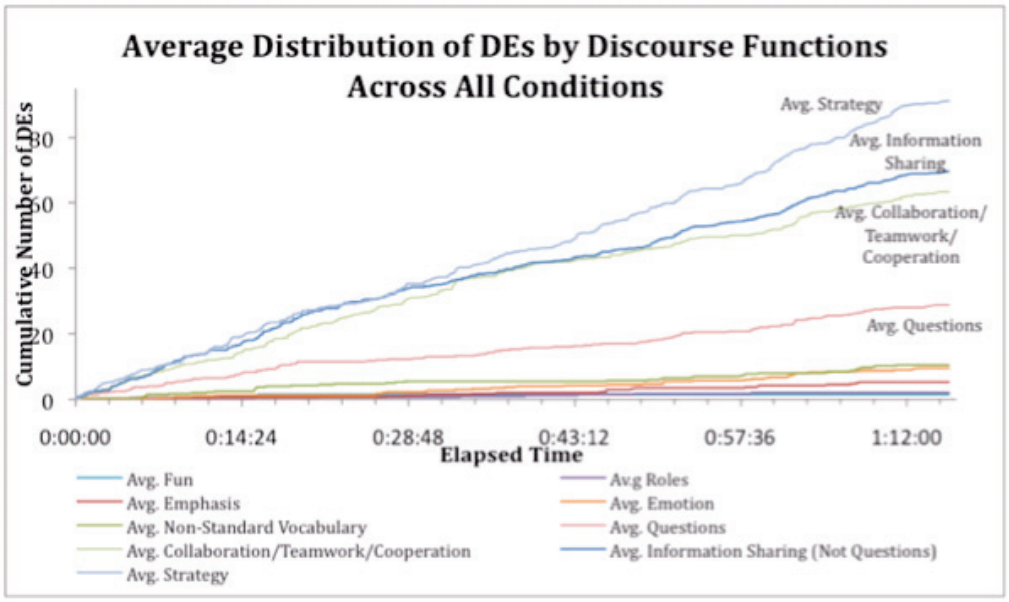

Figure 2. An average of DEs for all conditions across all categories shows that most DEs fell into one of four taxonomy categories: strategy, informational, cooperation or questions.

Roles/Leadership

DEs identified team leaders as they tended to send DEs early in gameplay. Even in Bravo (RV), with no official leader, Tango_Bravo evidenced emerging leadership by chatting first and firmly directing other players. In Charlie (RM), acknowledged leader, Lima_Charlie, was the second to chat at 12 seconds into gameplay. In Delta (RM), designated leader, Quebec_Delta, was first to chat with a sequence of three DEs. Zulu_Delta, who emerged to share leadership with Quebec-Delta, immediately responded with a sequence of two DEs. The cooperative leadership in Delta can be considered a bond between two players. Paolillo (2001) posits that such a bond can be measured by counting DEs. Out of 324 Delta DEs, 125 constituted purposeful, albeit not always exclusive, communication between Quebec_Delta and Zulu_Delta.

In Echo (RV), leadership was immediately evidenced in the first DE by Golf_Echo and challenged later by competing leader, X-Ray_Echo, who first used text chat at the sixth DE, one minute into gameplay. Golf_Echo sent the first DE at 10:40:57; early in gameplay, he gave instructions and clarified strategies. By 11:00:27, X-Ray_Echo began to give clarification. At 10:46:53 Zulu_Echo assumed the role of GM Communicator, sending two successive requests for piece insertions. Golf_Echo transmitted only 12 more DEs, four of them addressed

specifically to the new leader, X-Ray_Echo. In four sequential DEs between 11:01:50 and 11:05:43, X-Ray_Echo's style manifested as aggressively assertive. By 11:32:24, Golf_Echo had ceded leadership, asking X-Ray_Echo for direction. X-Ray_Echo used sequential DEs to control discourse. By game's end, X-Ray_Echo was clearly in control, dealing harshly with competing Zulu_Echo when he contacted the GM, requesting insertions.

In two conditions, leaders sent more sequential DEs than other players: Tango_Bravo (50 of a 76 team total) and Lima_Charlie (22/72). In Delta, DEs disclosed that Quebec_Delta (70/167) shared leadership with Zulu_Delta who had the most sequential DEs (77/167). In Echo, the earlier leader, Golf_Echo, had 13/70 and the later leader, X-Ray_Echo, had 24/70.

Length and Flow

Most DEs contained ten or fewer words across all content topics. The average words per DE was Bravo, 7; Charlie, 6; Delta, 5; and Echo, 6. In all, Bravo sent 962 words; Charlie 1,303; Delta 1,736; and Echo 1,040. Echo sent shorter, pointed answers to undesired sinks. Delta sent the most words, but its DEs had the shortest average length. Brevity promoted speed. DEs were often only one word.

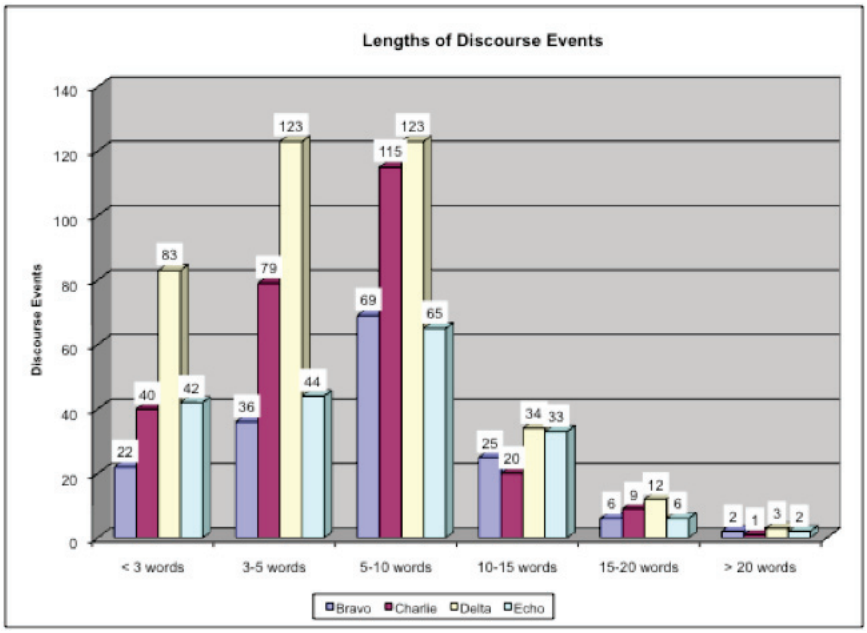

Figure 3. DEs were typically short.

Instead of a frenzy of activity immediately before puzzle submission and at gameplay's end, the highest peaks of discourse activity occurred during the first quarter for Charlie, Delta and Echo as they set strategies and started finding pieces, and in the third quarter for Bravo whose strategy was not highly organized. Immediately prior to puzzle solving, discourse addressed methods to report found pieces and locate them in panels. For Charlie (200 points) and Echo (250), DEs decreased after puzzle submission. Conversely, for Delta (250), the number of DEs increased after submitting puzzles. DEs typically peaked about ten minutes before game's end as emotions rose and players urged teammates to solve puzzles. Questions about piece locations increased as game end neared.

As expected, team leaders initiated sequences of related DEs. Conforming to Lewis and Fabos' (2005) findings, sources sent short DEs in uninterrupted sequence to focus discourse on topics of importance to the source. Sequential discourse was usually collaborative, e.g.,

11:11:06	Lima_Charlie	1 left on 4 piece, 1 left on 3 piece and 2 left on 5 piece
11:11:56	Lima_Charlie	hmm these don't look like they go together
11:13:09	Lima_Charlie	does anyone know the quadratic equation?
11:13:20	Hotel_Charlie	yes
11:13:33	Hotel_Charlie	i know it
11:13:34	Foxtrot_Charlie	i do

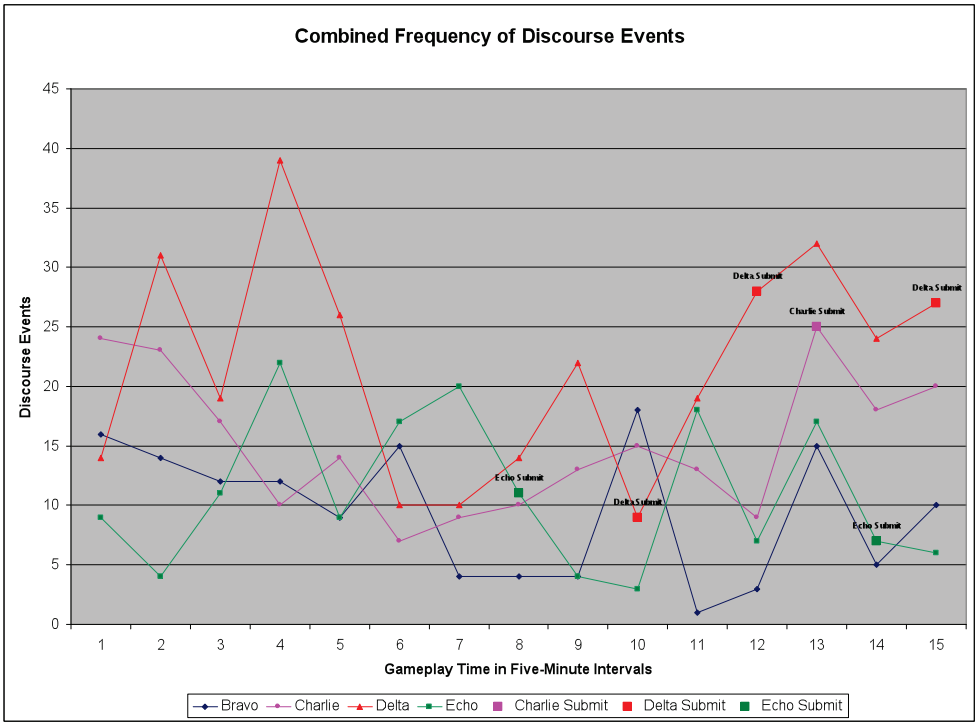

Figure 4. Squares indicate approximate points when teams submitted completed puzzles. Bravo completed none.

Collaboration and Cheering

Although seriously focused on gameplay, chat's tone was casual, usually reflecting cooperative interactions. Across 858 DEs, 227 evidenced collaboration over seven dimensions. There were few disagreements, one resolved in Bravo and one unresolved in Echo. There were 29 instances of repair, i.e., players correcting misunderstandings.

Message Categorization	**Bravo**	**Charlie**	**Delta**	**Echo**	**TOTAL**
Discourse Events	142	227	324	165	858
Points	0	200	250	250	
Repair	6	1	14	8	**29**
Self-correction	0	1	5	1	**7**
Answering Question	17	32	28	22	**99**
Agreement	2	9	7	10	**28**
Suggestion	12	3	18	15	**48**
Helpfulness	4	1	0	1	**6**

Acknowledgement	0	2	3	5	**10**
Total Collaboration	**41**	**49**	**75**	**62**	**227**

Table 5. Collaboration instances over seven dimensions.

Addressivity usually reflected collaboration. It occurred in Bravo 4 times; Charlie, 7; Delta, 21; Echo 14. In Echo, in at least two cases, addressivity was confrontational. In Delta, it always served team goals. When players perceived that Kilo_Delta was not participating in discourse, distorted addressivity paired with letter reduplication for emphasis, non-aggressively reengaged him.

15:26:05	Quebec_Delta	KILOOOOO
15:26:08	Zulu_Delta	Kilooooooooooo
15:26:16	Kilo_Delta	what happend
15:26:18	Zulu_Delta	Snake snake!!!!!!!!!!
15:26:18	Quebec_Delta	haha
15:26:21	Zulu_Delta	teleport to bank
15:26:36	Zulu_Delta	we are going to divide the map up
15:26:47	Yankee_Delta	ill take the northeast quad
15:26:48	Kilo_Delta	i'm in the bank

There was no cheering in Bravo. Cheering occurred in Charlie (8 times; 5 by leader Lima_Charlie), Delta (7/3) and Echo (6), once by leader Golf_Echo and four times later by leader X-Ray_Echo. Lima_Charlie cheered immediately after a puzzle submission, “yay 500 points for the quad good job guys.” In other conditions, after submitting, players remained seriously focused on solving more puzzles. Cheering often mimicked spoken AmerEnglish, using terms such as *yeah* and *sweet.*

Information Sharing

Informational DEs typically reported or requested locations or the status of finding pieces. With 236 solicited and unsolicited informational DEs, almost 25% of DEs were informational; Charlie

(76) sent the most and Bravo (42) the least. Questions were answered 99 times; the average response time was 23.24 seconds.

	Bravo	**Charlie**	**Delta**	**Echo**	**TOTAL**
Discourse Events	142	227	324	165	858
Points	0	200	250	250	
Statements					
Status report	36	52	52	33	**173**
Location	5	5	11	9	**30**
Piece	20	49	45	35	**149**
Information Need	3	5	10	0	**18**
Total Statements	**64**	**111**	**118**	**77**	**370**
Questions					
Confusion	10	5	18	8	**41**
Confirmation	7	4	9	5	**25**
Location	0	8	2	3	**13**
Pieces	5	12	9	10	**36**
Status	3	19	6	7	**35**
Instruction	15	7	7	1	**30**
Other	0	3	2	1	**6**
Total Questions	**40**	**58**	**53**	**35**	**186**

Table 6. Information-sharing discourse events.

Strategy

The 361 strategy DEs either directed or suggested that players take certain steps. Reflecting an understanding of communication's importance, Delta (250 points) had 21 and Echo (250) 23 DEs about communication strategy. Bravo (0) had two and Charlie (200) eight.

	Bravo	**Charlie**	**Delta***	**Echo**	
Total points	0	200	250	250	
Total DEs	142	227	324	165	858

Game plan	4	6	15	8	**33**
Puzzle solving	14	24	17	14	**69**
Question (what to do)	15	7	7	1	**30**
Communication strategies	2	8	21	23	**54**
Totals	**35**	**45**	**60**	**46**	**361**

Table 7. Strategy DEs.

Fun, Emotions and Emphasis

Khoo and Zubek (2002) find that emotional involvement is key to gameplay enjoyment. Observations during gameplay and post-game interviews disclosed that all players enjoyed PanelPuzzle and were satisfied with their gameplay experience. Prior to gameplay start, discourse manifested fun, but once gameplay started, discourse rarely reflected fun. Two of 142 DEs evidenced fun for Bravo; 2/227 for Charlie; 2/324 for Delta. In Echo, DEs showed no evidence of fun.

SMEs identified 38 expressions of emotions. Charlie celebrated twice after puzzle insertion. Teams showed excitement 16 times: Bravo; 1; Charlie, 5; Delta, 7; and Echo, 3. Charlie and Delta each expressed surprise once, using words from spoken AmerEnglish (*yikes*). Emotions did not rise as players neared goal accomplishment. However, as game end approached, emotions rose, use of upper case increased and profanity occurred. In Echo, discourse reflected discord. In 19 cases, the distinction between frustration and anger was not clear: Bravo, 6; Charlie, 2; Delta, 3; and Echo 8, e.g.,

16:43:47 Tango_Bravo Now please do it in the GM forum so we don't have to do double work and time is running out!!!

16:44:24 Tango_Bravo PLEASE!!!

Exclamation points emphasized DEs in Bravo (2); Delta (2); and Echo (2). Emphasis with all upper case letters occurred in Bravo (6); Delta (2) and Echo (1), e.g., as time ran out,

16:52:53 Tango_Bravo WE ONLY GOT 10 MINUTES LEFT, WE GOTTA TRY TO ORGANIZE SOME STUFF

Non-Standard Vocabulary

Contrary to the literature, players did not often use vocabulary common to social IM and TM. Abbreviations were rare: Bravo, 0; Charlie 5; Delta, 7; Echo, 6. Bravo had the only case of an acronym, *lol*. Indeed, players often chose to spell out words for clarity. Equations in the puzzles contained the values, b^2 and y^2; players invented words, *bsquared* and *ysquared,* to avoid confusion from typing *b2 or y2*. Profanity occurred only once in Bravo and three times in Delta. The main evidence of onomatopoeia was four uses of *haha*. Other than the consistent use of numerals instead of written numbers, substituting symbols for words was rare. There were only four occurrences of using + for *and*, all by Quebec_ Bravo. Only Tango-Bravo used *2* for *to*, "*try 2*". Golf_Echo and Yankee_Delta used # for *number*. Within 858 DEs, there were only nine emoticons (Bravo, 2; Charlie, 4; Delta, 2; Echo, 1) and two coded gestures, both in Delta. Players did not express gestures through alphanumeric characters and punctuation marks. DEs mimicked spoken AmerEnglish, using *ok*, *yea (*truncated *yeah)* for *yes* and distortions such as *gotta* for *have to* and *gotcha* for *got you [I understand you]*. This mimicry occurred in Bravo 14 times; Charlie, 56; Delta 97; Echo, 37. Of lexical truncations (Bravo, 6; Charlie, 7; Delta, 8; Echo, 4), the most common were *bros* for *Mario Brothers*, *k* for *ok* and *u* for *you*. Others, such as *cause* for *because* mimicked spoken AmerEnglish.

Well-formedness

DEs were not well-formed according to classic English grammar rules. Despite consistent access to a full standard keyboard, players rarely used initial caps or end-of-sentence punctuation. Discourse was characterized by missing punctuation (*whats on it kilo*); alternate uses of punctuation (*yes!!!*); and irregular capitalization (*12 MINUTES*). The pronoun *I* was typically typed in lower case (52 times each in Bravo and Charlie; 63, Delta; and 19, Echo); the only consistent exception was an occasional capital *I* starting a DE. While question marks occasionally appeared at the end of DEs, periods were rare (Bravo, 1, Charlie 4, Delta, 2 and Echo, 1). Players used ellipses, e.g., to indicate they were thinking, but often truncated them to two periods.

DEs were concise. DEs containing at least one lexical deletion, e.g., word omission, were common (Bravo, 33; Charlie, 67; Delta, 97; Echo, 54). Players, having invented terms such as *3 piece* or *3piece*, then deleted *piece*, typing only *3*. Although Lewis and Fabos (2005) observed that spelling correctness was important, we noted 415 misspellings: Bravo, 106 over 962 words; Charlie, 109/1,303; Delta, 139/1,736; and Echo, 61/1,040. Typing errors usually remained uncorrected. The SMEs reported a chatroom convention for marking self-corrected typos by prefixing or suffixing an asterisk. This clarification strategy occurred once in Charlie and Echo and five times in Delta, but never in Bravo.

16:16:19	Quebec_Delta	at trai
16:16:24	Quebec_Delta	*train

Discussion

Discourse analysis showed that Delta, the winning team, was more active in sending DEs and the characteristics of its DEs differed from those of other teams. Bravo, the team with the lowest score, typically performed the lowest in taxonomy categories.

H1. Text chat discourse will both reflect and impact team dynamics.

DEs proved integral to success because they reflected and drove community dynamics. DEs reflected interactions among teammates and teammates' attitudes toward each other.

This occurred despite the fact that, in PanelPuzzle, DEs competed with gameplay while facilitating it because players could not control avatars and chat simultaneously. Delta, the most efficient and effective team in using DEs to strategize and to share information, was the most efficient and effective in solving puzzles. Echo experienced distraction disputing leadership, losing time and failing to solve another puzzle in time.

Teams built collaborative knowledge in two ways.

All teams used text chat primarily for tactical discourse. While this contributed to building collaborative knowledge, text chat scrolling out of view had a transitory aspect that did not lend itself to storing collaborative knowledge. Therefore, the players forum became the locus for

building collaborative knowledge. Consequently, there was a strong relationship between text chat and forum. Players used text chat to remind each other to post to the forum and text chat referred to forum information during piece assembly.

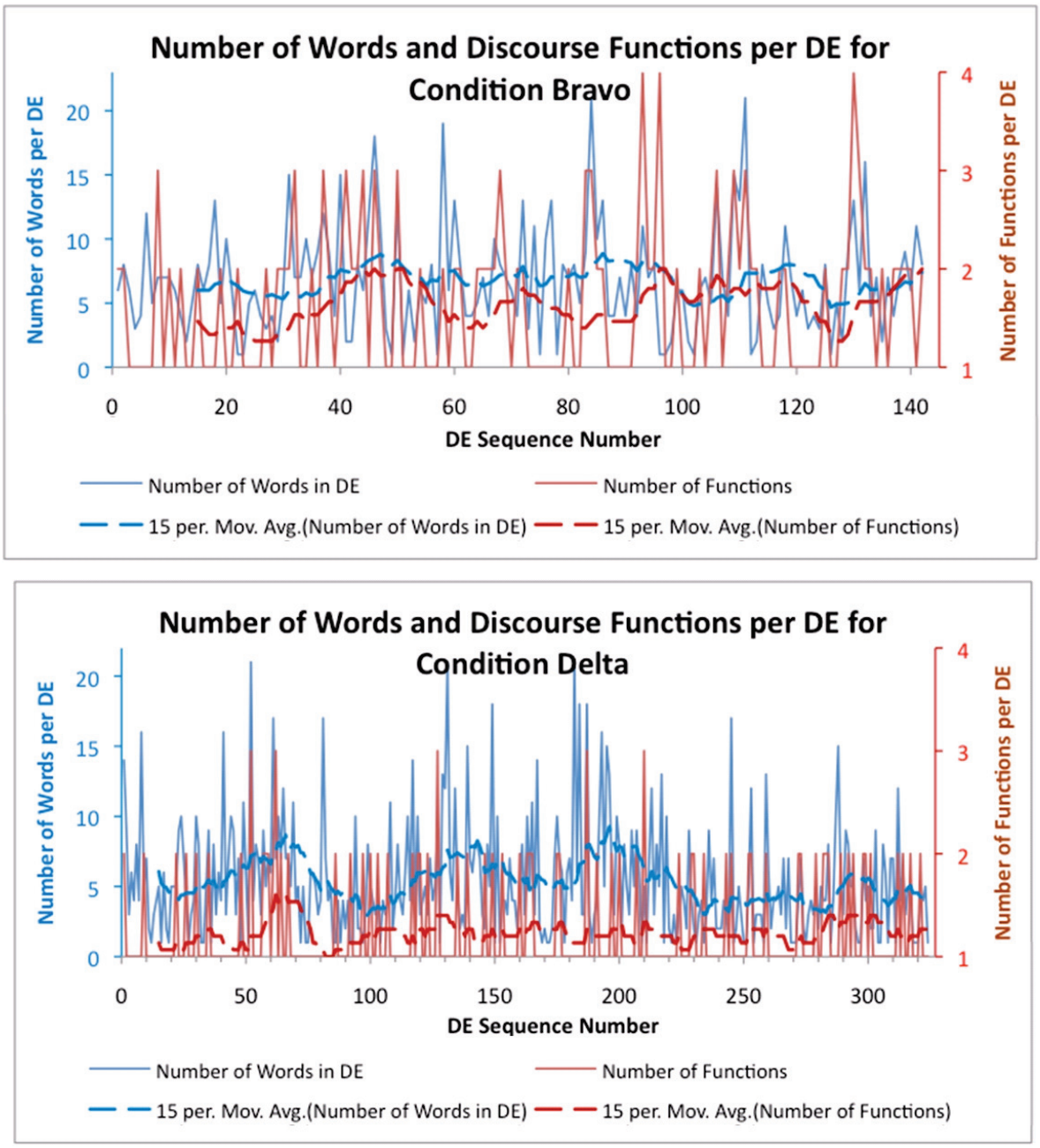

Figure 5. Differing ratios between number of words and number of multi-functional DEs reflect discourse differences between Bravo (0 points) and Delta (250 points).

Discourse analysis indicated that efficiently sharing and coordinating knowledge contributed to winning and that the content and sequences as well as the quantity of DEs promoted success.

Out of 858 DEs, 285 efficiently fit into more than one taxonomy category (Bravo, 71; Charlie, 68; Delta, 68; and Echo, 78). Discussing collaborative strategy fostered success by empowering teamwork. The number of DEs that discussed strategy aligned with teams' rankings: first place Delta (250 points), 60 DEs in strategy categories; second, Echo (250), 46 strategy DEs; third, Charlie (200), 45 strategy DEs; fourth, Bravo (0), 35 strategy DEs. We analyzed DE length and number to discern if there were discourse patterns that evidenced efficiency and effectiveness. Comparing Bravo, the least successful team, and Delta, the most successful, showed that Bravo had the least DEs (142) and Delta (324) the most, but their average DE lengths were approximately equal. Average and peak functions (taxonomy categories) per DE were higher for Bravo than Delta. So, Bravo was the most efficient team in terms of using the least number of words to average the highest number of multi-functional DEs. However, Delta sent more DEs, thus communicating more functions overall throughout gameplay to be more effective.

DEs showed that teamwork characterized gameplay.

Once gameplay started, there was no evidence of personal goals. Even in the Echo leadership dispute, interviews disclosed that each player felt he was right and that his leadership would benefit the team by serving the team goal of earning points.

H2: When a team leadership role is played, text chat discourse proceeding from the team leader will promote and foster the team's goal to win the game.

Teams where discourse analysis showed firm leadership earned more points than Bravo where leadership was less obvious.

Leadership emerged in all conditions. As Sudweeks and Simoff (2005) note, leadership emerged early. Authoritative and goal-oriented DEs with the leader as source were numerous. Team leaders' DEs promoted and fostered winning by asserting authority; providing direction; building community; coordinating team activities; promoting building of collaborative knowledge; and boosting morale. (It is interesting that there was no cheering in Bravo.) DEs to these ends were

both informational and instructional. As expected, teammates' discourse was goal-oriented, reflecting that of team leaders.

The GM Coordinator organized team efforts by focusing discourse on completing and submitting puzzles. DEs disclosed emergent leadership in RV conditions and reflected incidents where RM leaders exerted leadership. Discourse reflected evolving and shared leadership.

In Bravo (RV), where strong leadership did not emerge, discourse did not manifest an organized strategy to win the game. Although a GM Coordinator arose in Bravo (RV), any player could use the GM forum to communicate with the GM. In Echo (RV), where leadership was debated and anyone could use text chat to communicate with the GM, discord arose early and persisted until game's end; a strong community did not develop.

Discourse reflected roles.

Murray (1997) views in-game roleplay as assuming an identity and gameplay discourse as a narrative of players' roleplaying experiences. Immersion in gameplay identity parallels immersion in the game; disrupted narrative can signal that a player has shed an assumed role. PanelPuzzle DEs evidenced this phenomenon. Team leader X-Ray_Echo interrupted gameplay-centered discourse and acted out-of-role to chide Zulu_Echo, using language that contrasted with that of other gameplay DEs.

11:53:31	X-Ray_Echo	zulu, go away and look for more pieces
11:53:45	X-Ray_Echo	dude.. shut up

DEs disclosed that players tended to assume multiple roles even in RM conditions where this was prohibited, e.g., in Charlie (RM), Lima_Charlie, the designated GM Coordinator, filled that role, but also organized puzzles; started forum trends "to keep track;" and discussed locations. Tango_Bravo, while acting as leader, reported his location and discussed puzzle pieces.

H3. Text chat discourse during gameplay will be predominantly serious.

Text chat focused on successful gameplay, rarely expressing fun or emotions.

At least four factors contributed to the serious nature of discourse. Gameplay time limitations left little time for joking and banter. Demand effects could have dampened spirits. Collaboration required serious discourse. Serious discourse served the serious goal of winning points.

H4: The structure and vocabulary of text chat discourse will resemble the structure and vocabulary of the electronic messages that digital natives typically exchange.

Once gameplay started, PanelPuzzle text chat displayed few of the expected properties although, prior to gameplay, as players explored the VE and practiced manipulating their avatars, DEs conformed to the literature. Linguistic evidence of fun diminished in three conditions and disappeared entirely in Echo. Structures and vocabulary common in CMCs were present only to a limited extent that contradicted expectations.

A lack of well-formedness, usually to promote efficiency, was the principal characteristic of most DEs.

On the levels of the word and of DEs, an abandonment of spelling and syntactic conventions, e.g., use of all lower case and omitting punctuation, promoted fast typing. This strategy served players' goals to quickly communicate and coordinate. Despite linguistic distortions and adaptations, Steinkuehler (2006) asserts that gameplay text chat achieves the same full range of purposes as off-line written discourse. Our observations aligned with this. We posit a reason: when parts of a DE were malformed, others were not. Players were able to derive meaning from the context provided by other parts of the DE and the context of shared experience. For example, when Zulu_Echo typed, "i founf 5 pice near train station" teammates understood *founf* and *pice* because (1) other words in the DE, e.g., *near train station*, provided semantic and pragmatic clues that a piece was found; (2) finding pieces and reporting their locations were shared game goals; and (3) the term, *5 pice* reflected vocabulary teammates had invented. Players effectively communicated strategies, tactics and needed information.

Rather than using the expected vocabulary, DEs combined innovative linguistic strategies to accomplish efficient and effective discourse. Brief multi-functional DEs moved discourse efficiently.

Communication succeeded even when one DE contained a variety of aberrations. Zulu-Delta's "dint u say that" elicited an immediate turn-around response that verified the DE's effectiveness. Players invented efficient ways to discuss puzzles. Metonymy, calling something by the name of one of its attributes, occurred in all conditions except Bravo: "we need one more mario" (Charlie); "how need mario?" (Delta); and "but is is mario" (Echo). Bravo players referred to "a super mario picture" and "a mario picture," approximating metonymy by using the attribute name as an adjective.

Because PanelPuzzle discourse focused on winning, it manifested expected characteristics of social digital discourse only to a limited degree even though it reflected digital natives' practice of making others aware of what they are doing and their desire to know what others are doing.

Devices such as abbreviations were rare. There was little evidence of turn-change signals. IM mechanisms such as ellipses and improper punctuation and capitalization were common. Short, rapid, sequential DEs from a single source kept discourse on topic. Even when discourse was disconnected with topic changes, it maintained a collaborative focus to win points. DEs had few of some expected visual aspects such as emoticons, but were rich in others such as untraditional capitalization. Players did adopt vocabulary customized to the game, e.g., role titles and *panel*, a term not usually associated with puzzles. They also invented terms such as *3 piece* and *5 panel*. The most successful team, Delta, were the most efficient communicators, e.g., with the most lexical deletions, lexical truncations, and mimicry of spoken AmerEnglish. Delta was also the most efficient, e.g., with the most self-corrected typos, and the most functions communicated.

Conclusions

This study analyzed 858 discrete DEs recorded during a controlled laboratory experiment. It is framed within two taxonomies that can be generalized for adaptation to general gameplay digital discourse. Discourse analysis disclosed that digital natives adapted lexical and syntactic

conventions, demonstrating and using to their advantage the malleability of natural language. In contorting typed AmerEnglish to build and sustain community and pursue team goals, players did indeed use a distinct register. Its DEs disclosed properties of digital native goal-oriented digital discourse, differing from social digital discourse described in the literature. It sacrificed traditional well-formedness to improve efficiency. Discourse analysis indicates that the more efficient and effective the communication among teammates, the more successful a team was.

Doell (1998) posits that IRC conventions, e.g., unconventional spelling and emoticons, have no precedent in any register, and thus can only have emerged from the communicators' creativity and innovation. We observed that gameplay digital discourse also applied creativity and innovation to create a distinct register. Possibly, these phenomena constitute a step in the evolution of AmerEnglish, perhaps toward a trend where efficiency matters more than form. Digital discourse as expressed by digital natives in text chat differs from traditional written discourse, merging conventions from several digital discourse registers, abandoning others and inventing new conventions. Although it sometimes mimics spoken language, this register has no need for the full panoply of visual references and details required for successful spoken discourse. Its concise, truncated, malformed DEs communicate efficiently and effectively. Players coordinated collaboration, communicating their intentions, facilitating gameplay and sharing outcomes of their efforts.

Murray (1997) foresaw gameplay discourse as narrative, the telling of the story of gameplay. PanelPuzzle DEs did indeed disclose the story of players' experiences in Peninsula City. They also disclosed the power of digital discourse. We have seen that digital discourse, even with frequent topic changes, typos and syntactic and lexical distortions, is an effective communication mechanism. We posit that, in the case of PanelPuzzle gameplay discourse, reasons include shared understanding and shared references built on the shared experience of digital nativehood. As Lakoff and Johnson (1980) demonstrate in their seminal work, such sharing empowers communication. Our study disclosed that text chat relies more on context than syntax. The abbreviation *bf* can mean best friend or boyfriend. Even when chat syntax is the same, context imposes different meanings on *bf*. Without signals such as body language, gestures or tone of voice, when source and sink do not share context, the communication channel is obstructed and misunderstanding can result, e.g., a source may type "ok" to convey disagreement and a desire to end discourse, while a sink interprets "ok" to signify agreement.

PanelPuzzle players conveyed shared context through DEs. When Lima_Charlie abruptly changed topics, requesting "a desc on the forum," teammates knew the lexical truncation *desc* meant a puzzle piece description. As digital natives, they knew a forum was a logical place for this description. As goal-oriented teammates, they knew winning required organizing descriptions of pieces.

The concept of a distinct register has implications for natural language research. What are the impacts of ill-formedness on machine translation? What are the impacts of this register and the communication behaviors it reflects on design of workplace tools and online training for digital natives? Such questions argue for continued research into digital communication among digital natives. We look forward to the community's insights.

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