Social Talk and Constructing Solutions

Comparing a Teen and Proxy Player in an Educational Alternate Reality Game

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Abstract: An affordance of alternate reality games (ARGs) is that players play as if they were in the game world themselves. Human game-runners (proxy players) interact with participants as characters within the game's fiction, guiding and modeling gameplay. In this paper we employ a method of analyzing gameplay called epistemic network analysis (ENA), which creates relational network graphs between actions within a game space. We found that key players exhibited behavior like proxy players, but also diverged from them in meaningful ways. We present case studies of 1 active player and 1 proxy player that demonstrate the power of ENA to model ARG play. We describe ways in which ENA reinforced the design insights that guided our original creation of proxy players while also allowing us to analyze the implications of those design choices in practice. We conclude by enumerating some research and design benefits of employing ENA in other learning contexts.

Introduction and Theoretical Framework

An alternate reality game (ARG) is a type of pervasive game that takes place across multiple media platforms, where players co-construct a narrative through play. ARGs often create a feeling of "this is not a game," where play is treated as if it were happening as a part of real life (Bonsignore et al., 2012). The complex and multilayered play experience of ARGs also requires collaborative problem solving (Bonsignore, Hansen, Kraus, Visconti, & Fraisat, 2016). These characteristics give ARGs unique power as a platform for meaningful and authentic learning that is directly situated in players' day-to-day lives (Bonsignore et al., 2013).

Drawing on a growing body of design literature, our team created an educational ARG called *DUST*, which ran in spring of 2015. To help ensure that our game remained authentic and meaningful to a target audience of teenagers (13–17 years old) who are traditionally underrepresented in STEM fields, we co-designed many of its elements with them, including the focus for this paper, the game's fictitious characters (Pellicone et al., 2017). In designing our characters, we drew upon the idea of a *proxy character*, referring to the intentional design of in-game characters "who interact with the player community as insiders and often, player role models and guides" (Bonsignore et al., 2016, p. 82).

In an ARG, a proxy player plays an invaluable role: serving as a guide, a model, and a friendly face to players who may be unaccustomed to the challenging gameplay offered by a new game genre (Bonsignore et al., 2016; Pellicone et al., 2017). A key design goal for *DUST* was to create proxy players who were effective at scaffolding scientific inquiry, but who also acted, looked, and talked like our teenage players (Pellicone et al., 2017).

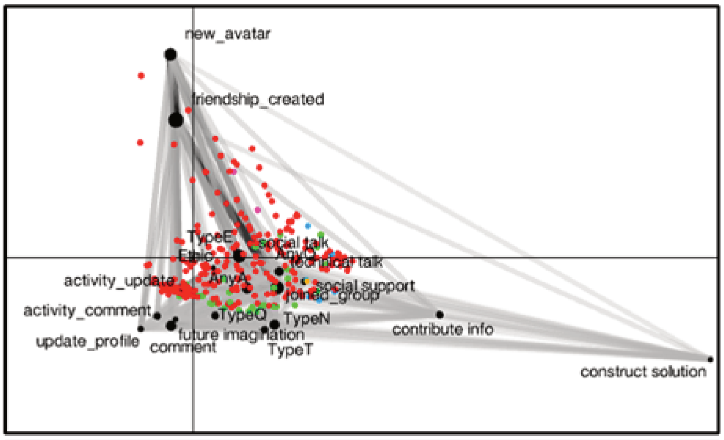
A firm understanding of user roles is a valuable tool in the design of sociotechnical systems (Jahnke, 2010; Welser et al., 2011) and specifically within ARGs (Dena, 2008). A learning modeling methodology called epistemic network analysis (ENA) has been fruitfully employed in previous cases to understand activity within a specific epistemic domain by drawing connections between distinct discursive actions that comprise that domain, which is to say that domain's "epistemic frame," in a way that not only describes action, but also presents that action relationally in a network format. In ENA, actions are coded within an epistemic frame—meaning the set of beliefs, dispositions, and behaviors associated with a social practice. Through calculation of co-occurrences of codes, ENA results in a network model of a particular epistemic frame, where nodes (referred to as *projected points*) represent varying types of behavior within that frame (Shaffer & Ruis, 2017). Therefore, by evaluating DUST's gameplay with ENA we have the opportunity to understand the function of proxy players within a larger context of game activity. In this paper, we explore three related, guiding questions:

- How can ENA be used to identify and represent gameplay signatures of different types of players, and what do those signatures look like in *DUST*?
- How do proxy players designed to engage in specific epistemic practices compare to real players in terms of their gameplay signatures?
- What are the design implications of these similarities and differences?

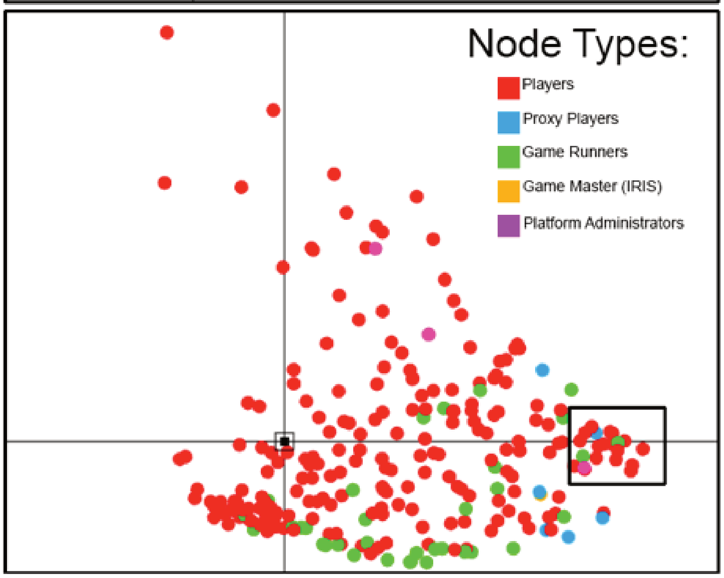
Data Collection and Analysis Methods

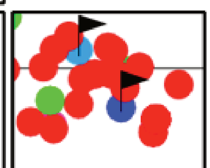
Our ENA was based on gameplay actions that were automatically recorded (e.g., friending a player; updating a profile; commenting), as well as "utterances" (i.e., a discursive gameplay unit showing up when players posted free-text) coded by authors 3, 7, and 8 into semantically meaningful categories (see Figure 1). These codes collectively represent a *scientizing epistemic frame*. *Scientizing* (Clegg & Kolodner, 2014) is the process by which young learners come to recognize that science is not just something that happens in the rarefied space of the research lab but is instead a compelling and vital part of everyday life. It thus subverts common cultural stereotypes about what counts as science, what science looks like, who does it, and where it takes place. We configured our unit of analysis to be the entire game—meaning that data is not chunked into episodes; rather, all gameplay activity is considered over the full course of the game (Siebert-Evenstone et al., 2016). Therefore, our resulting ENA graph (Figure 1) shows a broad, comprehensive view of gameplay. This approach gave us an exploratory snapshot of the overall structure of gameplay, revealing points of interest for deeper qualitative analysis (Rotman, Preece, He, & Druin et al, 2012) and also signaling future work that will include stanza-based ENA for more nuanced, in-depth readings of player interaction at key story beats.

Right: A table of our codes describing the Scientizing epistemic frame for DUST's gameplay. Semantic codes were human coded, and database generated codes were derived from post types and automatically recorded entries regarding social activity.
Below: The equiload graph of our network, showing the relative positions of each coded epistemic action.



Semantic Codes:	Database Generated Codes:
Questioning and Answering (AnyQ, AnyA): We coded posts that players made in the DUST game to signify whether the post posed questions or provided answers to key problems posed in the game.	**Type Q, T, E, N:** Posts on the Co-Lab website are categorized as Questions, Theories, Evidence, or Narrative.
Technical Talk: Posts that discussed technical solutions to problems (e.g., constructing a tool or using a tool to solve a game problem).	**Friendship Created:** A successful friend connection between two players through the social element of the site.
Social Talk: Talking socially about topics not directly related to gameplay.	**Joined Group:** Joining a work group on the site, e.g. Neurology or Astronomy.
Social Support: Providing coaching and encouragement to other players.	**New Avatar**: Changing one's avatar.
Contribute Info: Providing summaries or links to outside informational resources.	**Comment**: Commenting on a QTEN post.
Ethics: Discussing the ethical ramifications of action within the game.	**Activity Update:** Posting a status update to one's profile.
Construct Solution: Providing an answer or solution to a problem or obstacle in the game.	**Activity Comment**: Posting a reply to another player's status update.
Future Imagination: Imagining the future in terms of either the player's reality, or the fictive world of the game.	**Update Profile**: Updating any of the fields of a user's social profile.





Left: A view of each active player node in the game. We used this graph to understand player roles in terms of their relationship to discursive actions within the game, and used this graph as a guide to further qualitative understanding of player roles. The black box is the area shown in the zoomed in view above.
Above: A zoomed in view of the qualitatively described 'constructing solutions' cluster, referring to the proximity of these players to the 'construct solutions' outlier node. Both CoolQuark (the darker dot) and Jay (the ligher dot) have been tagged with flags, indicating their relative positions, and proxminity to one another.

Figure 1. A graphic showing (from top left to bottom right): the equiload graph of DUST's scientizing epistemic frame, a table of codes describing both semantic and automatically coded discursive actions, a graph showing only player-projected points color coded by type, and a zoomed-in view of the qualitatively defined Constructing Solutions cluster (named for its proximity to that particular outlier point).

Using the graph above, we selected a cluster of players who were aligned toward the Constructing Solutions code on the graph (an outlier projected point in the lower right quadrant). This cluster of players had high levels of activity (allowing for rich qualitative data), had all agreed to interviews (allowing us to check our emerging assumptions against their own thoughts and experiences), and were co-located with one of our proxy player characters (fitting the theoretical concerns of our research questions). Because of the correlational method through which ENA graphs are constructed, proximity of points on a graph is indicative of similar aggregate approaches to gameplay (Schaffer & Ruis, 2017).

DUST's Design

DUST's narrative revolves around an apocalyptic event in which nearly all adults on the planet have collapsed after a meteor shower that has spread an unknown substance throughout the atmosphere. Teen players must take charge, understand the circumstances of the collapse, and reverse its effects before they too succumb to the mysterious effects of The Collapse. Our proxy players were all teens present at Kennedy Space Center on a field trip before The Collapse, and who gained access to the data and specialized tools of the center. They were accompanied by IRIS, an artificial intelligence, who served a game-master role, helping tell the story, introduce scientific tools (web or mobile apps), and sets of activities for the week. Teen proxy players and real players shared information (text, images, videos), coordinated activity, and solved problems using a fictional NASA science-collaboration platform called *the Co-Lab*. *DUST*'s initial run lasted for around three months—from January to March of 2015 and enrolled more than 1,000 players, around 300 of whom are accounted for in the analysis described in this paper.

DUST and its design goals and methodologies are described elsewhere in more detail (e.g., Pellicone et al., 2017). Our focus in this paper is on the role of proxy players and how they compare to regular players. The main goal in designing the proxy players was to scaffold learning, help coordinate activity, highlight player contributions, and help players relate to characters with different dispositions toward science. Our diverse cast of proxy players allowed us to differentiate the epistemic actions they engaged in, such as asking questions or contributing solutions, to suit their personalities. *DUST* was also designed to capture the trace activity of players, including their actions and words in the Co-Lab and elements of their participation such as friend connections, post types, and profile changes (Pellicone et al., 2017). The data provided by this design consideration allowed us to collect structural data (see Figure 1) of participation, which is valuable in analyzing user roles (Welser, Gleave, Fisher, & Smith, 2007) and important in constructing ENA graphs (Shaffer, Collier, & Ruis, 2016).

Findings

We selected CoolQuark for analysis in this paper because of the richness of data associated with her case, her theoretical relevance to our larger research program, and both the quantitative and qualitative data that comprised our initial analysis while the game was running, as well as through the preliminary ENA, described above (Rotman et al., 2012; Yin, 2009).

Focal Player: CoolQuark

CoolQuark (her screen-name pseudonym) joined *DUST* one week into the game, shortly after the adults had collapsed in the in-game fiction. She was a key player, providing several major breakthroughs in the game and acting as an information resource for her fellow players. At the time of the game, CoolQuark was a 16-year-old high school junior. She self-identified as being interested in science and as loving mysteries and puzzle solving, which was a major factor in her gameplay in *DUST*. CoolQuark described her fascination with science as an investigative practice as such: "So I really like science. I've always really liked it. But I'd never for sure solidified what things I like in science, I just loved investigating things and being like a detective." Because *DUST*'s gameplay was flexibly structured, allowing individual efforts to gather data and team efforts to construct evidence-based solutions from that data, CoolQuark could act as both a solo investigator and resourceful teammate.

CoolQuark mentioned an initial wariness toward the social elements of gameplay and mentioned in her interview a desire to "get out of her comfort zone" in terms of online socializing. However, she quickly established herself as a strong collaborator, as reflected in what she noted as her first major contribution to the game, a Cryptobiosis theory that she posted on the Co-Lab (see Figure 2). As the game progressed CoolQuark wanted more collaboration from her fellow players, and so made use of the Co-Lab's "Groups" feature. *DUST*'s Co-Lab groups provided a common hub for discussion around specific in-game areas of interest and inquiry, for example, microbiology and ethics. In the Neurology group, CoolQuark constructed two "explainer" posts, collating and presenting copious, relevant scientific information for the game. In her interview, she explained her drive to create these posts.

> I saw a lot of people were confused, and I wanted to make sure that if we're all working together, all collaborating, we gotta make sure that we're on the same page. That was basically running through my head: "In order to get the information that other people can find out on their own, they have to know what's going on. They have to be up on the same level as everyone else."

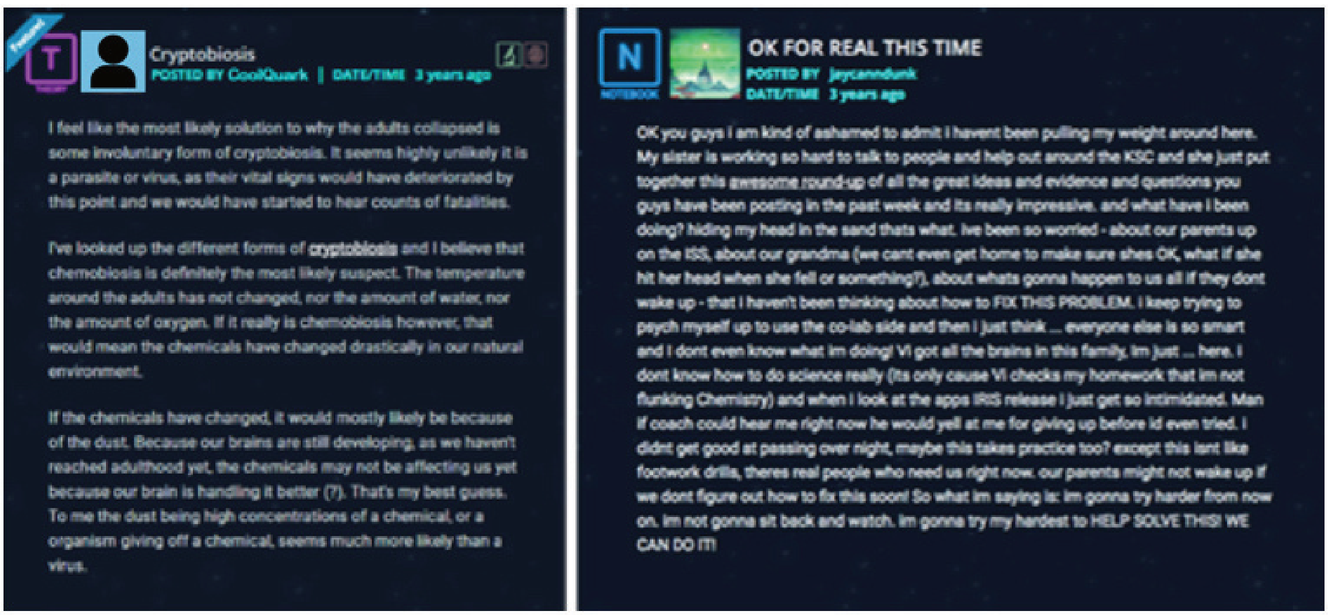


Figure 2. Two screen captures of in-game activity: (left) a post of CoolQuark's initial correct theory of Cryptobiosis, and (right) an example post by Jay, showing his hesitance toward the scientizing frame.

Proxy Player: Jay

Like many of the back stories for characters in *DUST*, fundamental parts of Jay's personality emerged from character ideas generated by our teen co-design partners. For example, one teen collaborator imagined Jay as a member of his school's football team and the child of an astronaut stranded on the International Space Station during The Collapse. While the "jock" is a familiar character trope in teen narratives, Jay's identity as an athlete did not preclude an interest in science; he was also a member of the science club in school and liked to hang out with his dad's colleagues at NASA Mission Control.

Character writer Author 9 distilled ideas such as these to create James ("Jay") Cannon, brother to Violet Cannon ("Vi"). Making Jay the older half of a sibling pair was important to establish his personality and motivations. He feels responsible for caring for Violet while both his astronaut parents are away in space, giving his leadership qualities a new emotional register. At the same time, the erudition of his parents and Violet's natural aptitude for science make him feel inadequate. Drawing from one teen co-designer's description of Jay as "a natural leader" who still fears "failing others" and "sharing leadership," Author 9 crafted Jay as a student who struggles in several academic subjects, and whose biggest fear is: "He's afraid he'll never make anything of himself—that he won't make his parents proud, that he'll let the team down, that he won't be a successful [basketball] player after high school. Essentially, he's afraid of mediocrity." Jay avoids asking for help to hide his failures and masks his fears by teasing Violet; he often uses humor to defuse tense situations. He fails to see that his experience as an athlete—training and caring for his body by eating well and exercising—gives him a basic foundation in biology and human anatomy that will aid the teens as they attempt to discover what has afflicted the adults. Ultimately, Jay demonstrates a strong growth mind-set and a narrative arc showing increased confidence and interest in science, the very traits and learning dispositions we aimed to inspire in *DUST*'s target player base.

In terms of playing style, Author 9 envisioned Jay as a representative of the human biology/neurology track who would be more of a cheerleader than a content expert: "I think James might operate primarily as a facilitator—he doesn't have the specialized knowledge of [other proxy players], so he can't necessarily answer questions, but he can ask good questions, solicit data, make connections, and encourage players." To this end, Jay made very few posts: four notebook posts in total, where he described his own emotional reactions and self-doubt and continually exhorted players to work together, conveying that with collective effort all the problems could be solved. In one early post, Jay essentially gave himself a pep talk to get past his imposter syndrome (see Figure 2). This honest assessment made Jay much more relatable to the players who did not themselves identify as being good at science and provided an example of how to transfer attitudes from other areas of competence (such as sports) into these unfamiliar areas.

Rather than constructing solutions himself, Jay engaged in social activities such as friending, liking, and commenting on player posts that helped other players connect information and solve problems. He started a Co-Lab group called Study Hall and introduced it by asking people to help each other out: "OK i cant be the only one who feels overwhelmed or wants help. join if you have questions about doing science or using the site or are just SUPER NICE and want to help answer other peoples questions." When CoolQuark posted her explanation of the brain, Jay made sure to thank her for her contribution, commenting: "this is awesome! like i really really appreciate this cause i definately find myself getting overwhelmed with all the jargon and medicl terms and stuff. THANK YOU SO MUCH!!! [misspellings were a deliberate narrative move to indicate character emotion, and have been preserved in this quotation]." He followed up this compliment by posting in the Study Hall group, pointing players toward CoolQuark's post, to ensure it received greater attention. Other players also took to commenting on CoolQuark's explanatory posts, thanking her for helping them understand difficult concepts and reinforcing the idea of collective effort. As a proxy player, Jay Cannon served as a model not of the scientific-thinking skills needed to tackle these problems, but of the dispositions needed to progress and persevere. By encouraging everyone to help one another; by establishing personal connections; and by circulating valuable content produced by other players, he demonstrated leadership, fostered a strong sense of community, and facilitated collective problem solving.

Signatures of Play and Role Comparison

In previous work, role signatures have been developed based on quantification of player activity (Jahnke, 2010; Welser et al., 2007). Such quantification is also the basis behind ENA, where player activity is coded and then analyzed in terms of co-occurrence of elements within a larger epistemic frame (Shaffer, Collier, & Ruis, 2016). Therefore, in taking counts of the player activity matrices that define our ENA graph, we can also develop a signature for those players, visualizing their actions within the game and providing insight into how the ENA graph is constructed. Presented in Figure 3 are the signatures for both CoolQuark and Jay, whose projected points share a common region in the ENA projection space, as seen in Figure 1.

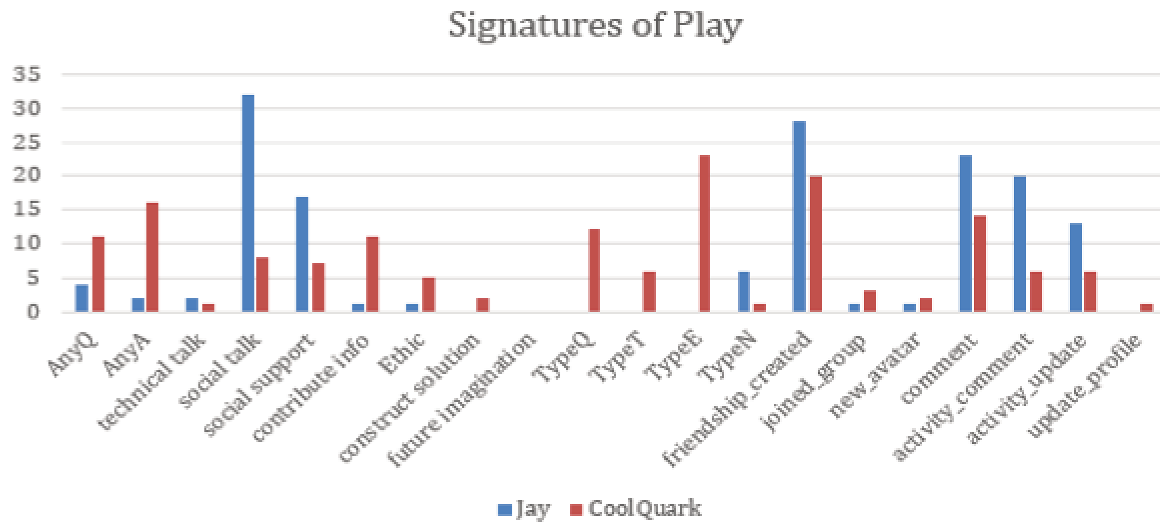


Figure 3. A comparison graph of CoolQuark's and Jay's total coded activity within the game.

Applying our own knowledge of *DUST* as game-runners, and using the insights gleaned from both our design process and player interviews, we can understand Jay and CoolQuark in terms of similarities and differences. In terms of similarities, both players engaged in a relatively large amount of *social talk* and *social support*. That is, they engage in conversation around gameplay that does not necessarily further a specific scientific goal, but rather provided emotional and social support to the efforts of other players. Both players also created a comparatively large number of friendships within the game, which led to information sharing through the "feed" feature of the user profile (which shows friends' posts as they are made). In terms of post types, both players also made heavy use of the "comment" feature of the site. However, CoolQuark *also* started original threads in addition to posting comments, which helps to explain the distance between their projected points on the graph. Similarly, a major difference comes from CoolQuark's role as a problem solver within the game–she posted many questions and answers to main problems, contributed information (e.g., her explainer posts), and led the effort to construct a major solution within the game.

Considering the relative position of both projected points in the ENA graph, we can see that CoolQuark takes on many of the coaching behaviors that were a designed aspect of Jay's character: creating a network of players to share information, chatting and discussing the game in a social manner, and providing support for the efforts of other players. CoolQuark then builds upon these activities, engaging with the challenges of the game in order to use the scientific process to solve problems and find answers. CoolQuark herself recognized the dynamic at work in Jay's character and mentioned him by name in her interview, saying,

> That was really nice, where you had one [proxy player] who was struggling, like every time I was confused I didn't feel left out. Like there was someone else I could connect with. I really liked that, [sarcastically] I mean obviously not that I was struggling at all [laughs]!

Conclusions

Given our exploratory findings above we present two primary conclusions given our guiding questions, and two design considerations for future work.

- **Q1, ENA provides a powerful lens by which to understand player activity and identify and characterize player roles:** Understanding user roles helps us not only to identify and analyze productive player types (Dena, 2008), but also to further design systems that accommodate, promote, and modify those roles (Jahnke, 2010; Welser et al., 2011). The approach of taking large bodies of data, using ENA to map and visualize the relationships within that data, and then doing deeper qualitative analysis of the individuals who comprise that data presents great promise for future work in learning analytics (Rotman et al., 2012; Shaffer & Ruis, 2017). In *DUST* we were able to better understand what the epistemic signature of a major contributor to gameplay looks like. CoolQuark takes on elements of a supportive coach: providing information, making friend connections, sharing information, and providing support to other players. Through those coaching activities she also works with others to construct solutions to problems and bring together a wide variety of evidence and ideas necessary to tackle *DUST*'s complex problems.
- **Q2, We can confirm design intuitions through ENA and qualitative data**: The design of our proxy players was informed by perspectives from young learners that helped us to understand real teenagers' dispositions toward science. Given the strength of ENA in describing Jay's role as a coach, and confirmed through CoolQuark's recognition of his trepidation toward science, we can see that our design methods paid off fruitfully with Jay, who was both behaviorally similar to and emotionally resonant with one of our strongest players. The divergence of Jay's projected point from CoolQuark on the ENA graph is due to our conscious design decision to keep proxy players low on the X-axis for Construct Solutions. While we wanted hesitant teen players to receive the strong support that is characteristic of collaborative, scientific problem-solving teams, we did not want to feed them solutions; rather, we wanted them to do the work of construction on their own. Our hope was that Jay's strong emotional support of others, despite his own diffidence in offering solutions, might spur players to take action. Consequently, a player such as CoolQuark, who may have initially felt like Jay, was primed to make Construct Solutions contributions, which she did, many times over.

From these conclusions we present two primary design considerations as an answer to our third guiding question:

- **Q3, Player Templates:** Given our success in modeling Jay's role as a proxy player, we believe that future work to develop templates of player types would aid educational technology designers in creating authentic characters for a wide variety of experiences, including future ARGs. Furthermore, that typology could be applied to players themselves, allowing game-runners to understand play dynamics more clearly and providing concrete steps to encourage deep and rewarding play experiences. Player templates can essentially function as a methodological affordance, giving researchers an inroad to analyzing data by helping them identify real players who are co-located with proxy players on the ENA graph, indicating a similarity in play style.

- **Q3, Real-Time ENA Modeling:** Recent methodological work with ENA has provided proof-of-concept that automated coding of data sets is indeed possible, and that it can be done in close to real time with high levels of interrater reliability with human coders (e.g., Chesler et al., 2015). We can imagine how, in future game designs, the collaborative platform of the ARG could be configured to look for important discursive moves by players and automatically type them along certain theoretically significant roles within the game.

The work presented above is the first step in a larger research program involving epistemic analysis of *DUST*'s gameplay. Although this analysis was focused on the game as a whole, we plan to use the moving-stanza-window (Siebert-Evenstone et al., 2016) approach in subsequent analysis in order to understand how play changed and evolved over time. Additionally, since we were fortunate to have several hundred active players of *DUST* we have identified other theoretically interesting groups of players. A similar approach to what we have outlined above could instead be turned toward understanding near-peer undergraduate-aged game-runner characters and other models of proxy players (for example, Jay's scientifically inclined sister, Violet), or players who focused on narrative and ethical thinking instead of scientific problem solving. However, even given the early stages of analysis, we forward that ENA, and the models of learning it can be used to uncover, are valuable tools for educational designers seeking to make authentic, inclusive, and responsive learning environments.

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