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# The Fun of Its Parts: Design and Player Reception of Educational Board Games

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Although board, card, and other analog games can serve as useful educational technologies, little research exists to support teachers' efforts in finding analog games that are pedagogically appropriate or likely to be well-received by their students. In this study, the authors retrieved data associated with 208 educational games from the crowdsourced website BoardGameGeek. They used this data to summarize players' description of games into 15 *themes*, *mechanics*, and *genres* that can support teachers' comparison and evaluation of analog educational games. They then analyzed how these design features influenced player reception of these games—as evidenced by game ratings on BoardGameGeek. To do this, they used two models: a hierarchical regression (features were nested within themes, mechanics, and genres categories) and a flat stepwise regression (features were all at the same level). Both analyses indicated that themes were parsimonious and significant predictors of game ratings, suggesting that the theme of an educational game may be an important consideration for teachers. The findings of this paper present helpful initial guidelines for teachers, teacher educators, and others interested in educational analog games; however, holistic evaluation of analog games and thorough consideration of their pedagogical potential are important.

Games may be a hot topic in current educational technology studies, but learning with, through, and around games is nothing new. Educational claims about games predate the advent of modern video games (e.g., Abt, 1970; Raser, 1969). The two-player strategy game *morabaraba*, for example, has been enjoyed by players for hundreds of years in South Africa and is embedded with mathematical concepts that draw from indigenous knowledge systems (Nkopodi & Mosimege, 2009). Similarly, the game of chess — with roots dating back to seventh century India — has been used to teach a variety of topics from managerial skills (Cannice, 2013) to medieval European history (Pagnotti & Russell, 2012).

Indeed, analog games (e.g., board, card, and tabletop games) have the potential to serve alongside video games as useful educational technologies. Not only do analog games share many of the affordances of digital games, but they may also have affordances that digital games do not, such as greater openness and flexibility (Greenhalgh, 2016). Furthermore, hobby board games are increasing in popularity ("Not twilight, but sunrise," 2015; Roeder, 2015), and research has found that players of these games are generally accepting of their educational potential (Staudt Willet, Moudgalya, Boltz, Greenhalgh, & Koehler, 2018).

In recognition of this potential, educators in various contexts have used analog games as educational resources (e.g., Amaro et al., 2006; Fukuchi, Offutt, Sacks, & Mann, 2000); for example, Gray, Topping, and Caracary (1998) examined the effectiveness of a board game intended to help secondary students learn the United Kingdom's Highway Code. In contrast to these games explicitly designed for educational contexts, educators also have the possibility of integrating commercial off-the-shelf games into learning contexts. For example, librarians have used the game Apples to Apples to help second graders build vocabulary (Copeland, Henderson, Mayer, & Nicholson, 2013), and one teacher has modified the rules of the game Battleship to allow students to experience a simulation of the differences between the U.S. Constitution and the Articles of Confederation (Bridge, 2014).

Despite this resurgence of interest in analog games and their continued use and recognized value in educational contexts, noteworthy gaps remain in terms of both practical support for teachers and teacher educators and contributions to the research literature. First, few teacher education programs introduce preservice teachers to game-based learning strategies or provide opportunities to learn the complex process of selecting (or designing), integrating, and facilitating game play (Franklin & Annetta, 2011; Sardone & Devlin-Scherer, 2010). Second, most of the guides available to support teachers as they integrate games into the curriculum tend to offer advice that assumes a game has already been selected (e.g., Charsky & Mims, 2008; Van Eck, 2006) and, therefore, offer little help for teachers looking for criteria to use in choosing a game that will be well-received by students.

Furthermore, the educational technology literature is characterized by an overwhelming focus on *digital* games. For example, several recent major handbooks in the field of educational technology contain chapters on the potential of games for education, but the authors of these chapters have explicitly articulated their focus on digital games (Dawley & Dede, 2014; Kafai & Dede, 2014; Steinkuehler & Squire, 2014; Tobias, Fletcher, & Wind, 2014). As in other academic disciplines (see, for example, Torner, Trammell, & Waldron, 2014), digital games have pushed their predecessors to the margins in the field of educational technology.

This marginalization is not without consequence for those seeking to use analog games in educational settings. Educational scholars studying digital games have asserted that not all games are appropriate for all contexts (Van Eck, 2006) — rather, different game designs "reflect underlying pedagogical strategies that allow for learning in different content areas" (Foster & Mishra, 2009, p. 34). Furthermore, both researchers and game designers have suggested that many — or even most — digital games designed for educational purposes are neither as fun nor as engaging as entertainment games (Bruckman, 1999; Tobias et al., 2014; Van Eck, 2006).

These observations are likely to also hold true for board, card, and other analog games. The ability to make distinctions in analog game design and comment on how these distinctions might influence pedagogical affordances or player reception is, therefore, necessary for effective decision-making when employing these games for educational purposes.

The purpose of this study was to identify some of the design elements that characterize educational analog games and to model how these elements influence player (and potential learner) reception of those games. To carry out this purpose, we use crowd-sourced data from the website BoardGameGeek (BGG; www.boardgamegeek.com). Using player-generated data from this website acknowledges that online communities can both play an important role in the analog gaming hobby (as is also the case for digital games; Gee, 2004; Squire, 2008) and serve as the source of "digital traces" that researchers can then collect and analyze (Lazer et al., 2009; Welser, Smith, Fisher, & Gleave, 2008) to learn more about these phenomena.

Indeed, these features mean that the BGG data lends itself to an analysis of how players distinguish between games and how those distinctions influence their reception of them. Such distinctions are helpful for providing teacher candidates, in-service teachers, and teacher educators with a vocabulary and framework for comparing educational games to each other.

## Background

Those employing, studying, or designing educational board games can benefit from thinking of them as educational technologies. All educational technologies afford and constrain certain behaviors (Koehler & Mishra, 2009). Thinking of digital games in this way has allowed scholars to provide guidelines for ways specific games might most productively be used in educational settings (e.g., Foster, Mishra, & Koehler, 2011).

Contrary to popular perceptions, *educational* technologies are not limited to *digital* technologies (Koehler & Mishra, 2009; Nickerson, 2005), meaning that such an approach is also appropriate for evaluating the educational potential of analog games, whether in broad terms (e.g., Greenhalgh, 2016) or when considering particular games.

When anticipating either the educational potential or player reception of games — whether digital or analog — specific elements of a game's design can be considered to be affordances or constraints. For example, someone considering a game can examine how its design might support or impede particular pedagogical objectives (e.g., Foster et al., 2011) or player reception of that game (Koehler, Arnold, Greenhalgh, & Boltz, 2017; Wang, Shen, & Ritterfeld, 2009).

Although player reception of a game is not a guarantee of its pedagogical effectiveness, it remains a worthy consideration in evaluating games. Much thinking about the educational potential of games is closely tied to the fact that games are generally considered to be fun, engaging, or otherwise popular (Gee, 2007; Kafai & Dede, 2014; McGonigal, 2011; Prensky, 2003; Steinkuehler & Squire, 2014). Indeed, many advocates for educational games worry that students will not receive them well (Bruckman, 1999; Tobias et al., 2014; Van Eck, 2006). Furthermore, teacher candidates have identified questions of fun and motivation as key to their own consideration of games' educational potential (Devlin-Scherer & Sardone, 2010; Sardone & Devlin-Scherer, 2009, 2010; Shah & Foster, 2015).

How might the design of a game be thought of in terms of affordances and constraints for educational purposes or its reception by players? The design of a game can be conceived of in a wide variety of ways. For example, some researchers have made efforts to develop comprehensive lists of the kinds of design features that describe a game (e.g., Bedwell, Pavlas, Heyne, Lazzara, & Salas, 2012; Wilson et al., 2009) or what makes it fun (e.g., Wang et al., 2009). These lists refer to a range of features, including humor, storyline, and

characters (Wang et al., 2009), possibilities for interaction with other players (Bedwell et al., 2012), and the objects represented in a game (Wilson et al., 2009).

In contrast to these detailed lists, we used a simple conceptual framework in this study that recognizes three foundational categories of game features: themes, mechanics, and genres. Game designers and scholars have devoted a great deal of attention to the relationship between themes and mechanics (Bogost, 2007; Brathwaite & Schreiber, 2008; Koster, 2004; Sicart, 2009), suggesting that these two kinds of features account for a significant part of a game's design.

Furthermore, genres are already frequently used to classify educational games (Breuer & Bente, 2010; Foster & Mishra, 2009; Foster et al., 2011), making them a useful concept for further research. Indeed, in previous, exploratory work, we have used the mechanics, themes, and genres framework to great effect. For example, we have found that mechanics, themes, and genres with intuitive connections to education (e.g., genres like Children's Game and Trivia) frequently appeared in educational board and video games but also that games with these features tended to be rated lower by players than games with features more frequently associated with entertainment games (Greenhalgh, Boltz, & Koehler, 2014). However, these findings were limited to descriptive statistics, necessitating future research.

In the following paragraphs, we describe themes, mechanics, and genres; give examples of each category; and summarize existing research that connects these categories with both teachers' use of games and player reception of games (including studies reporting on concepts such as enjoyment, engagement, fun, and motivation). Table 1 supplements these descriptions with a sample of themes, mechanics, and genres from three board games.

## Themes

A game's theme can be thought of as its "dressing" (Koster, 2004, p. 85) or its "fictional world" (Sicart, 2009, p. 33). For example, games may have themes related to history, science fiction, or pirates.

Theme is an important — but not the sole — consideration for evaluating an educational game. Sardone and Devlin-Scherer (2009) found that teacher educators take content (i.e., theme) into consideration when judging the value of an educational game. Sometimes, however, the apparent theme of a game may belie learning outcomes that are quite unexpected.

For example, many educators have recently incorporated the role-playing game Dungeons and Dragons into their classrooms. Perhaps surprisingly for a "sword and sorcery" game based on fantasy and magic, teachers using the game reported that it encouraged students to develop competencies in science, math, computational thinking, and creative problem solving as well as foster social skills (Darvasi, 2018). Similarly, Mayer and Harris (2010) discussed the example of Oregon, a board game about the settling of the American West, which may actually be well suited for a math classroom because of the way it is played (i.e., its *mechanics*).

In terms of player reception, Yee (2006) found that many players mentioned game design elements associated with theme when describing their motivations for playing video games. However, Williams, Yee, and Caplan (2008) later found that higher affinity with theme-related elements predicted spending less time playing a particular game (and, therefore, presumably poorer reception of that game).

**Table 1**
Three Board Games With Examples of Associated Themes, Mechanics, and Genre

| Game | Description | Example Theme | Example Mechanic | Example Genre |
|---|---|---|---|---|
| Axis and Allies | Players take the role of the major powers of World War II and compete for military victory. | *World War II* simulates battles of the Second World War | *Dice Rolling* players move the game forward by rolling dice | *Wargame* uses dice, cards, etc. to simulate battles and conflict |
| Carcassonne | Players add tiles to a growing map and play pieces to claim parts of the map, which earn them points. | *Medieval* the game is set in the 13th century | *Tile Placement* players move the game forward by laying tiles on a surface | *Territory Building* involves players' expanding claims on board |
| Chess | Players try to capture their opponent's king piece with an "army" of 16 pieces of six different types. | *n/a* although there are themed sets, chess itself does not have a strong thematic component | *Grid Movement* players move the game forward by moving pieces around the game grid | *Abstract Strategy* strong themes and chance-based mechanics are absent |

The implications of this finding are not entirely clear for the relationship between themes and player ratings. The authors suggested that it may have resulted from their study's focus on a single game with comparatively few thematic features. Nonetheless, they described the finding as "unexpected and counterintuitive" (Williams et al., 2008, p. 1010). Furthermore, the authors of these studies were more focused on why people choose to play games than on how particular themes affect players' reception of them.

## Mechanics

In a game, a *mechanic* is a "process by which game play proceeds" (Mayer & Harris, 2010, p. 6). For example, game play in the board game Monopoly typically proceeds through mechanics such as rolling dice and drawing cards.

Educators have also reported using a game's mechanics to evaluate its educational potential (e.g., Farber, 2016; Mayer & Harris, 2010). For example, the theme of the popular board game Pandemic is focused on global outbreaks of disease, but Farber's (2016) chief interest in the game was the way that its mechanics supported middle school students in exploring the concept of global interconnectedness. Berland and Lee (2011) divorced the

educational potential of Pandemic even further from its theme by examining how its mechanics acted as algorithms and how its players engaged in computational thinking.

Game mechanics are believed to influence player perceptions of games, but many questions remain about the nature of that influence. For example, Mayer and Harris (2010) have suggested that certain mechanics are more or less engaging than others but provided no empirical evidence for these claims.

On the other hand, Yee's (2006) work on player motivation suggested that some players are driven by an interest in the mechanics in the games they play. He used principal components analysis to identify players' self-reported sources of motivation; the 10 components that emerged from this analysis included one focused on mechanics. Later work determined that player achievement — that is, a mastery of the mechanics — was the motivation that best predicted time spent in a particular game (Williams et al., 2008).

Although this work on motivation likely has implications for the present paper, these studies focused on the existence of an effect rather than what causes that effect. This approach prevented these authors from determining "which game mechanics satisfy which [player] motivations" (Williams et al., 2008, p. 1010), a discovery that would allow designers to "leverage game mechanics into . . . contexts such as educational games" (p. 1010).

## Genres

Strictly speaking, *genres* are not design features of a game so much as categories of games distinguished by common themes, mechanics, or other features. The concept of genre is, naturally, not unique to games; indeed, genre has been used to describe a variety of "artifact types and . . . interpretive habits" (Spinuzzi & Zachry, 2000, p. 172); that is, genres are associated not only with common features of certain media but also the social and cultural contexts surrounding these media (Russell, 1997). Thus, genres describe what games have in common (as perceived and defined by one or more gaming communities) and may, therefore, indicate the educational potential of a game (Breuer & Bente, 2010; Foster & Mishra, 2009; Foster et al., 2011).

Game genres tend to follow conventions regarding length of time required to play the game, the openness of a game's goals, and its affordances for creative expression (Squire, 2011). One example of a genre of board games is the *wargame*: Although wargames represent a variety of different game designs, all have related themes (e.g., conflict and warfare) and use similar — or sometimes identical — mechanics (e.g., dice rolling and vying for control of spaces on a map). For this reason, genres indicate general patterns in a game even though they do not indicate specific details of its design.

Strategy games like Diplomacy and The World Peace Game have been used by educators to complement lessons on history, diplomacy, and international relations (Arnold, 2015; Fink, 2013). From an educational perspective, the affordances of this genre tend to emerge from their reliance on cooperative play, the negotiation of competing interests, awareness of historical/cultural context, and creative problem solving. On the other hand, card and memory games have been used in the classroom to effectively support learning outcomes that involve recall and recognition of features and properties — such as radiological image quality (Ober, 2018), word recognition (Copeland et al., 2013), and mineralogy (Spandler, 2016).

A number of authors have used genres as a means of indicating different affordances related to player reception. For example, Dickey (2005, 2006) suggested that different genres may employ different means of engagement (or use the same means of engagement in different ways) but did not support this claim empirically.

On the other hand, some researchers have determined that players of certain genres of digital games are more likely to exhibit signs of addiction or problem behaviors (Elliott, Golub, Ream, & Dunlap, 2012; Kim et al., 2010), an implicit—if troubling—manifestation of a game being received well by players. However, these studies also note that there are other factors (i.e., gender, disposition) that may contribute to this relationship (Elliott et al., 2012; Kim et al., 2010); that is, genre may not be the most critical variable for determining how long players spend with a game (and, therefore, their implicit reception of it).

## Purpose

The purpose of this study was to identify key design elements that characterize educational analog games on the BGG website and to model how these elements influence reception of the games by the BGG community. Theory and research provide compelling reasons to assume that design elements affect a game's pedagogical affordances and its reception. Identifying the design elements that players use to distinguish games will, therefore, provide teacher candidates, in-service teachers, and teacher educators with a vocabulary and framework for comparing educational games to each other. Furthermore, modeling the relationship between a game's design features and its reception by players will provide basic guidelines for identifying games that are likely to be well received. To support this purpose, we focused our study on the following research questions:

1. What themes, mechanics, and genres emerged from the BGG community's classification of educational analog games?
2. How did these themes, mechanics, and genres influence BGG ratings of educational analog games?

## Method

### Data Sources

This study exclusively used secondary data from BGG — a website that incorporates elements of both social networking websites and online databases to collect and share information about board, card, dice, and other analog games. This study began in 2015, and the data presented here represent the data on BGG at that time.

The BGG database is crowd-sourced (i.e., data is generated by BGG users rather than by a staff) and contains game reviews, game ratings, photos, tags designating various game features, and a great deal of other data. However, while our focus was specifically on educational games, BGG is universal in scope, in the sense that its mission is to catalog any and all analog games. We, therefore, limited our study to games meeting the following criteria:

- The game was educational: The game was tagged as "educational"on BGG and represented what this gaming community believed an "educational game" to be.
- The game had a "Geek Rating": The game had at least 30 user ratings, allowing the BGG database to calculate a Bayes-corrected game rating (a "Geek Rating").

Using these criteria, 208 educational games were identified for this study.

## Procedures

We used the BGG application programming interface to download data related to each of the 208 games we had identified. This data included basic game information, the Geek Rating, and information about 84 category tags and 51 mechanic tags corresponding to game features (see appendix for the full list of 135 game features). We then carried out additional procedures related to each of our research questions.

***First research question.*** To determine what themes, mechanics, and genres emerged from the BGG community's classification of educational games, we reclassified and summarized the tag data available through the website. The BGG database includes category and mechanic tags, which differed from the conceptual framework we employed in this study. A team of two coders familiar with games independently reclassified the 84 category tags as themes, mechanics, or genres (the mechanic tags were all classified as mechanics). The coders agreed 77.4% of the time and achieved a Cohen's kappa value of .51, which Landis and Koch (1977) suggested interpreting as moderate agreement. The coders then discussed and resolved all differences to achieve consensus. This process resulted in the development of the following categories of variables:

- Themes: We defined a theme as any category tag in the BGG database that the coders reclassified as a theme. This approach yielded 53 themes.
- Mechanics:We defined a mechanic as any mechanic tag in the BGG database or any category tag in the BGG database that the coders reclassified as a mechanic. This approach yielded 59 mechanics.
- Genres: We defined a genre as any category tag in the BGG database that the coders reclassified as a genre. This approach yielded 23 genres.

Our next step was to summarize the reclassified game features. Although reclassification helped fit the BGG data into our conceptual framework of themes, mechanics, and genres, it resulted in 135 game features. Not only was this too high a number to describe an educational game's design simply, but many of these features were also closely related to each other, making some features redundant.

We used principal component analysis (PCA) to simplify each set of variables. Before carrying out each PCA, we took two steps to prepare the data. First, we removed all game features that were not present in our data. Second, we followed guidelines from Kaiser (1974) and Field, Miles, and Field (2012) for using the Kaiser-Meyer-Olkin statistic to ensure the adequacy of the data for each PCA.

We then performed three PCAs, one for each category of variables. From each PCA, we extracted the number of components recommended by parallel analysis and then performed an oblimin oblique rotation. We used Velicer's proposal in Stevens (2009) to identify unreliable components, eliminating any component whose four largest loadings averaged less than .6. Then, we interpreted these components based on the loadings that were greater than |.364|.

Although researchers have traditionally interpreted components based off of the loadings that are greater than |.30|, Stevens (2009) argued that it is important to take the size of a dataset into account and suggested |.364| as the critical value for a dataset of about 200 rows, like ours. This process resulted in six mechanics components, six themes

components, and three genres components. The appendix contains all of the factor loadings associated with these PCAs.

***Second research question.*** To determine how these themes, mechanics, and genres influenced BGG ratings of educational analog games, we used two different types of statistical models:

- **Hierarchical regression** (theory driven): This approach assumes that every game feature is nested within an overarching category of mechanics, themes, or genres. The best-fitting model is then sought using this structure.
- **Stepwise regression** (data driven): This approach assumes that features are flat. The best-fitting model is sought using statistical criteria to determine the appropriate combination of predictors (regardless of whether they are themes, mechanics, or genres).

In modeling the analysis in two different ways, we sought to better understand whether considering themes, mechanics, and genres was more useful in terms of entire categories of game features or in terms of individual game features that combine to influence players' opinions in certain ways.

For both models, each of the 208 educational games in our study had 16 measures. First, is the Geek Rating (or Bayes-corrected average rating), which represents players' reception of a game. Geek Ratings are continuous values with an upper bound of 10 and a lower bound of 1. Next, are 15 component scores, one for each theme, mechanic, and genre that emerged from our PCAs. Component scores range between –3.05 and 13.91 and indicated the extent to which an individual game has that game feature. For example, the game Master of Economy has a score of 8.45 on the trading component, indicating that its mechanics require a substantial amount of trade and exchange between players.

## Results

These procedures allowed us to answer our research questions. The following sections include a description of the themes, mechanics, and genres that resulted from our PCAs and the relationship between these game features and player ratings from the BGG community.

### RQ1: Themes, Mechanics, and Genres

Table 2 shows the fifteen themes, mechanics, and genres that emerged from our reclassification and summary of the category and mechanic tags in the BGG database.

### RQ2: Relationship Between Game Features and Player Ratings

We pursued two strategies for modeling the ways these 15 principal components (i.e., game features) influenced player ratings — a theory-driven hierarchical model and a data-driven flat model.

***Theory-driven model.*** In this approach, the conceptual framework of themes, mechanics, and genres guided the analysis approach. Accordingly, hierarchical regression (Table 3) was used with the Bayes-adjusted Geek Rating as the dependent variable and component scores (grouped by themes, mechanics, and genres) as the independent variables.

**Table 2**
Themes, Mechanics, and Genres Derived From Original BGG Categories and Mechanics

| Components | Interpretation |
|---|---|
| **Themes** | |
| Middle Eastern Conflict | Represents themes associated with wars in the Middle East during the 20th and 21st centuries. |
| 17th to 19th Century History | Represents themes associated with the conflicts and other history of the 1600s through the 1800s. |
| 19th to 21st Century History | Represents themes associated with the conflicts and other history of the 1800s through the present. |
| Media-Based | Represents the themes of games based on other media, including books, television, and film. It also represents themes common to those media, including the American West. |
| Progress and Development | Represents themes of games that give the player the role of guiding a nation, company, or other organization from being small to being large or from the past to the future. |
| Travel | Represents themes involving exploration, adventure, and travel. |
| **Mechanic** | |
| Trading | Represents mechanics that involve acquiring, trading, or selling one or more goods. |
| Acting and Betting | Represents two kinds of mechanics: Those that have players act out roles or tell stories and those related to betting and gambling. These two kinds of mechanics appear together because a number of games in this study have mechanics related to both. |
| Map | Represents mechanics closely related to moving between or connecting places on a game map of some kind. |
| Memory | Represents mechanics that require players to memorize and recall information in order to succeed in the game. |
| Number | Represents mechanics that require players to manipulate numbers and make calculations. |
| Strategy | Represents mechanics typically associated with games that put an emphasis on planning, conflict, and management. |
| **Genre** | |

| Components | Interpretation |
|---|---|
| Strategy Games | Represents genres that require thinking or skill, from pursuing correct strategies to correctly balancing pieces. |
| Party Games | Represents genres that focus on interaction with other people. |
| Card Games | Represents genres common to games that use cards frequently or exclusively. |

*Note*. Component loading factors listed in Appendix.

The first step of the hierarchical regression was a model that included all of the theme-related predictors. This model was significant and accounted for 21% of variance. The effect size of this model — as measured by Cohen's $f^2$ — was .27, which Cohen (1992) suggested interpreting as a medium effect. In other words, themes have a significant influence on player ratings.

In the second step, we added all of the predictors related to mechanics. This second model was still statistically significant and now explained 23% of variance. The change in explained variance is practically small but statistically insignificant ($f^2$ = .03). That is, adding mechanics to the model did not significantly change the influence of game features on player ratings.

Adding all of the genre predictors in the third step contributed even less: The model — which is still significant — now explained 24% of variance. The change in explained variance ($f^2$ = .01) was below what Cohen would consider small and was also statistically insignificant. As was the case for mechanics, adding genres to the model did not significantly change the influence of game features on player ratings.

In the final model — indeed, in all three models —only two specific game features were shown to have a significant impact on player ratings. These features were both themes: *17th to 19th century history*, which had a positive effect on ratings, and *media based*, which had a negative effect on ratings.

The comparison of these models suggests that the most parsimonious model is one based solely on predictors related to themes. That is, themes on their own explained as much of the variance in player enjoyment in this model as did themes, mechanics, and genres together. Adding mechanic- and genre-based predictors to the model increased the amount of variance that it explained, but adding additional variables to a model always results in an increased $R^2$ (Field et al., 2012).

Furthermore, these increases are not statistically significant, suggesting that adding these other sets of predictors to the model does not improve the model. In short, the collective influence of all of these game features was not significantly greater than the influence of themes alone.

**Table 3**
Theory-Driven Model of Player Enjoyment and Educational Game Features

| Model | Themes | | Mechanics | | Genres | |
|---|---|---|---|---|---|---|
| Parameters | *B* | SE | *B* | SE | *B* | SE |
| Step 1: Related to Themes | | | | | | |
| Middle Eastern Conflict | .00 | .02 | .00 | .02 | .00 | .02 |
| 17th–19th Century History | .12** | .02 | .12*** | .02 | .12*** | .02 |
| 19th–21st Century History | .04 | .02 | .03 | .02 | .03 | .02 |
| Media-Based | –.07** | .02 | –.07** | .02 | –.07** | .02 |
| Progress and Development | –.01 | .02 | .00 | .02 | .01 | .03 |
| Travel | –.01 | .02 | –.06 | .03 | –.06 | .03 |
| Step 2: Related to Mechanics | | | | | | |
| Trading | | | –.02 | .02 | –.03 | .02 |
| Acting and Betting | | | –.02 | .02 | –.02 | .02 |
| Map | | | .06 | .03 | .06 | .03 |
| Memory | | | .00 | .02 | .00 | .02 |
| Number | | | –.01 | .02 | –.01 | .02 |
| Strategy | | | .01 | .02 | .00 | .02 |
| Step 3: Related to Genres | | | | | | |
| Strategy Games | | | | | –.04 | .03 |
| Party Games | | | | | –.01 | .02 |
| Card Games | | | | | .00 | .02 |
| Total *R*2 | .21 | | .23 | | .24 | |
| *F* for change in *R*2 | 8.70*** (6,201) | | 1.16 (6,195) | | 0.94 (3,192) | |
| * $p < .05$, ** $p < .01$, *** $p < .001$ | | | | | | |

***Data-driven model.*** In this approach, the individual feature components were considered in their own right. That is, although each component drew uniquely from either themes, mechanics, or genres, these three categories were otherwise set aside. In this approach, the data itself were used to derive the structure of the best-fitting model.

Accordingly, we carried out an all-subsets stepwise regression, which uses statistical criteria to determine the appropriate combination of predictors. Kelley and Bolin (2013) warned against stepwise regression for any purpose besides "research [that] is completely exploratory" (p. 93) and urged that researchers rely instead on theory. However, this paper is among the early attempts to use features to predict player reception of educational games, so such an exploratory analysis was appropriate.

Using an all-subsets stepwise regression of the 15 mechanics, themes, and genres components, the 40 best models for each possible number of variables (i.e., from one predictor to 15 variables) were compared. We used Mallows's $C_p$,a measure of fit, to identify the most appropriate model. Table 4 shows that model, which had a Mallows's $C_p$ value of 1.81.

**Table 4**
Statistics-Driven Model of Player Enjoyment and Educational Game Features

| Parameters | *B* | *SE* | *p* |
|---|---|---|---|
| $F(4, 203) = 13.84$; $p < .001$ | | | |
| 17th–19th Century History | .12 | .02 | *** |
| 19th–21st Century History | .04 | .02 | |
| Media-Based | –.07 | .02 | *** |
| Strategy Games | –.03 | .02 | |
| * $p < .05$, ** $p < .01$, *** $p < .001$ | | | |

As is the case for the hierarchical regression, theme-based predictors played a dominant role here. Although the fourth predictor was based on game features coded as genres, the other three predictors were derived from themes. The model was statistically significant ($F[4, 203] = 13.84$; $p < .001$) and had an effect size — as measured by Cohen's $f^2$ — of .27, which can be interpreted as a medium effect (Cohen, 1992). Furthermore, the only two predictors to have a statistically significant impact on player enjoyment were the same the predictors that had such an impact in our hierarchical regression: *17th to 19th century history* and *media-based*.

## Discussion

This section describes noteworthy implications of this study's results.

## Game Features as a Framework for Teachers

The results of this study — particularly the first research question — may serve as basic guidelines for teacher candidates, in-service teachers, and teacher educators. This study used principal components analysis to identify 15 themes, mechanics, and genres that emerged from the BGG community's classification of games. These 15 design features contribute to a vocabulary that teachers can use to quickly and easily communicate or evaluate the design of a game.

Indeed, the summarized game features identified in Table 2 can serve as an initial framework that these populations can use to guide their consideration of (a) the basic categories of game design features they ought to consider when evaluating a game, (b) key features in these categories that are common to educational games, and (c) whether and how those features correspond with the content and pedagogical considerations involved in a particular teaching context.

In the following paragraphs, we demonstrate the utility of these results by describing how this basic framework (i.e., Table 2) could be used by a hypothetical group of teacher candidates from a range of grade levels and subject areas whose professor has organized an activity intended to help them look for and identify analog games that may be helpful in their teaching context.

One teacher candidate in this class is preparing to be a social studies teacher and wonders whether she could find a game that could be used to support a history curriculum. Like many teachers (see Sardone & Devlin-Scherer, 2009; Copeland et al., 2013), she begins searching for educational games that are thematically related to the subject matter that she will be teaching and begins evaluating games based on their themes.

She reviews some of the common themes in educational games and notes two periods of history that educational games are frequently associated with. Based on this insight, she begins identifying potential lesson plans corresponding to these periods and then looking for games that might fit those lesson plans.

Another social studies teacher candidate is more interested in the potential of games to support lessons on globalization. Seeing his classmate's success in finding thematically relevant games, he sets aside the framework and begins with the intuitive step of searching for educational games "about globalization." After a few minutes of fruitless searching, he consults the list of common themes in educational games and realizes that none of these themes have an explicit connection with the concept he is interested in.

Although this discovery does not rule out the possibility that such a game exists, he begrudgingly acknowledges that this theme is not common. Seeing his frustration, another classmate (who has been looking for math-related games) reminds him that theme is only one category of design features he could consider and explains that her success has come from looking for mechanics related to the mathematical concepts she teaches. The two teacher candidates work together to identify mechanics that might be related to globalization. A few minutes later, they are searching for trading games that the social studies-focused candidate could adapt for a globalization lesson.

A third candidate, preparing to be an elementary school teacher, feels overwhelmed by the exercise. He has little personal experience with analog games. In fact, a once-and-never-again attempt at learning a collectible miniatures game popular with his roommates has

left him with the impression that games are too complicated for him — and if too complicated for him, definitely too complicated for his young future students.

He expresses this concern to his professor, who asks him to try his best to complete the activity and reminds him that there are multiple kinds of analog games. The candidate takes this encouragement to heart and begins examining common genres of educational analog games. To his relief, collectible miniatures games are not one of the genres commonly associated with educational games, and although he feels like strategy games would probably still be overwhelming for him and his students, he begins searching for party and card games he might be able to use, recognizing them as genres that may be less complicated and more age-appropriate.

These examples show how a framework of analog game design concepts may be helpful for guiding teacher candidates, in-service teachers, and teacher candidates in evaluating and choosing games for specific educational contexts. Indeed, the experience of these hypothetical teacher candidates shows not only that the separate categories of themes, mechanics, and genres all have implications for educators' evaluation of analog educational games but also that knowing common themes, mechanics, and genres in educational games can help these educators know where to start looking and what to look for when searching for analog games to use in their particular professional contexts.

We also recognize the need for expansion of and further nuance in such a framework. Indeed, the summarizing effect of our principal components analysis necessarily leaves out less common design features present in educational games and less systematic relationships between these design features.

## Anticipating Player Reception

Just as the results to our first research question in this study can be used to guide educators' thinking when considering different analog games, the results to our second research question may provide additional support. That is, the hypothetical teacher educator organizing the activity described in the previous section could also use the results presented in Tables 3 and 4 to guide students in considering the likelihood that a particular game will be received well by students.

Indeed, our findings suggest that themes play a role in predicting players' reception of a game. Both of the models that we tested found themes to be statistically significant predictors for player ratings (with a medium effect size). Furthermore, as evidenced by the two statistically significant predictors in each model, themes have the potential to influence player reception for better (as was the case with the *17th to 19th century history* theme) or for worse (as with the *media-based* theme). Based on these results, educators with a concern for player reception should consider themes carefully when selecting and creating games intended to teach.

Upon further examination, however, the reasons themes such as *17th to 19th century history* and *media-based* had such an impact on player ratings are not yet clear. The respective positive and negative influences of these themes do not necessarily indicate that they are inherently "good" or "bad" for games. Indeed, imagining that a player's reception of a game is based entirely on the time period that it is set in or the media property that it is inspired by is difficult.

Rather, these results are more likely to illustrate the complex interplay between themes, other design features (such as mechanics and genres), and factors such as player

expectations (which were not examined in this study). That is, although we tried to distinguish analog games' themes from their genres, there may be some overlap in how the BGG community conceives of each category.

For example, the *media-based* theme describes games based on established movies, books, and brands, meaning that the theme itself is likely to be well received — at least by those who already appreciate the media franchise. However, the common wisdom in games circles is that players tend to respond negatively to media-based games whose themes appear to be "pasted" onto unsatisfying gameplay (Grayson, 2014).

The low ratings of the *media-based* theme may reflect frustration with the combination of that theme with other elements of the game's design (and not the theme itself). Conversely, players tend to respond positively to a theme that complements other game features and contributes to a "polished game experience" (Squire, 2011, p. 5). That is, the positive reputation of games having a *17th to 19th century history* theme may be associated just as much with other parts of the games' design as with the period of history represented by that theme.

Although the relationship between themes and player reception remains ambiguous, these findings, nonetheless, have some implications for educators. For example, imagine that the hypothetical social studies teacher candidate searching for a history-related game learned that educational games set in the 17th through 19th centuries appear to be particularly well-received by players. Given this discovery — and knowing that she will likely not be able to use games in all of her units — she may look for some of these highly rated games in order to make the most of the games that she does employ.

On the other hand, the teacher candidate preparing to use games in an elementary school classroom, if aware of the negative reputation of media-based games, might hesitate before choosing an educational game based on its association with a media franchise popular among his students. Rather than make the decision based on that association alone, he may take the additional time to evaluate other parts of the game's design and whether it will meet his pedagogical objectives and students' expectations.

## The Importance of Holistic Evaluation

Ultimately, the findings of this paper emphasize the importance of holistic evaluation of analog games and thorough consideration of their intended pedagogical purpose. The design features identified in this study are not comprehensive, and the relationship of themes with player reception of games is somewhat ambiguous. These design features should be seen as a starting point for those educators interested in comparing existing educational games and not as a comprehensive description of what educational games may look like or afford.

In other words, our results suggest that a history teacher has many games to choose from and that games set in the 17th through 19th centuries have been particularly well-received in the BGG community. Our hypothetical history-focused teacher candidate, however, is not guaranteed pedagogical success or student enjoyment simply by following these results.

Indeed, the mechanics of a game have been found to have an important effect on players' enjoyment (Yee, 2006; Williams et al., 2008), and a number of educators have found it to be a useful indication of what is taught in a game (e.g., Berland & Lee, 2011; Farber, 2016; Mayer & Harris, 2008). If this teacher candidate were to select a game simply based on its

being set in the 18th century without considering the rest of its design, she may find that it has only a tenuous connection to the learning objectives she has in mind or that her students find it to be less engaging than other kinds of activities.

Conversely, although the themes and mechanics identified in this study do not appear to lend themselves well to world language education (for example), a preservice French teacher may still be able to find a helpful analog game for that context. The design elements listed in Table 2 suggest that there are few common mechanics, themes, or genres with explicit and obvious connections to the French language, indicating that this teacher candidate may have more difficulty than some of his colleagues finding an obvious educational game for his classroom.

Carefully considering what themes, mechanics, and genres might support a French language or culture lesson, however, would have considerable benefit for him as he looks for analog games. Furthermore, if any of these design features were found to have parallels in the list of common features, the common list of features may be helpful in identifying starting points for adapting games. For example, if the teacher candidate decides he wants mechanics that promote conversation and speaking among his students, he may find that the common *acting and betting* mechanic has more potential for his classroom than he initially thought.

## Limitations and Future Research

Although BGG provides a rich source of data for this kind of research, using this data also imposes limitations on the conclusions that can be drawn from this study's results. Perhaps most obviously, our conclusions are limited to board games (or other kinds of analog games). As previously described, board, card, and other tabletop games are growing in popularity, and more research of the kind seen in this paper is needed. However, the fact remains that digital games remain the emphasis of much research on games and education, and our findings should not be hastily applied to these other areas of research.

There are further limitations to our conclusions even when they are only applied to board games. For example, because the user ratings and information on themes, mechanics, and genres on BGG are all crowdsourced, we do not know much about the identity of the players who are classifying and reviewing these games. Furthermore, what little information can be inferred implies still further limitations: It can be reasonably concluded that the BGG community is composed largely of adults. However, the target audience for educational board games is more likely to be children and young adults, many of whom may not have the same tastes as adults.

Likewise, the BGG community is largely geared towards *hobby gaming*, a niche group of games that is often distinguished by its fans from the mass-market board games familiar to most people. What hobby gamers find appealing in a game may not be what the general population of learners finds appealing in a game.

Furthermore, the number and kinds of games included in this data need to be taken into account when interpreting the results. BGG likely has one of the most comprehensive lists of educational board games in existence, but having more data for this study would still have been useful. Although we took the size of the BGG data into appropriate consideration when performing the PCAs in this study, including more data would further increase confidence in the resulting components.

It is also unclear how the BGG community identified and distinguished educational games: Some games in this study have conceivably never been used in classrooms and other games that have been used to teach may not have been included.

In short, while this study provides useful information, it is largely a study of the BGG community, and further research is needed to produce more generalizable results about game classification and reception. Researchers interested in pursuing these questions should expand this kind of work to larger sets of data and to more transparent settings.

In the first case, BGG data may still prove useful. After all, the distinction between an educational game and an entertainment game is not always easy to make. In the hands of a knowledgeable teacher, any board game that is carefully selected, framed, and scaffolded (see Shah & Foster, 2015) could conceivably become an educational resource. Future research may benefit from analyzing all of the games in the BGG database to determine what game features emerge from a broader study and how those features make board games generally more (or less) enjoyable. These findings could then be applied to educational games.

In the second case, researchers should spend time in classrooms where educational games are being played and ask students and teachers how they make distinctions between games when choosing them (whether in terms of pedagogical value or reception). In addition to providing helpful guidelines for educators, this research could also be valuable in highlighting differences between how students and teachers categorize games and in exploring whether and how certain themes or mechanics appeal differently to different groups of students (e.g., elementary school students vs. high school students).

## Conclusion

In this study, we examined data from the website BGG to investigate the design features that describe and distinguish educational games and determine how they influence players' reception of those games. We used principal components analysis to summarize the themes, mechanics, and genres being used to make distinctions between educational games. We then tested two different models to explore the relationship between these design features and player ratings on BGG: a hierarchical, theory-driven model and a statistical, data-driven model. Both approaches produced statistically significant results, suggesting that themes can play a role in player enjoyment. In contrast, mechanics and genres were not shown to significantly predict enjoyment.

The results of this study provide initial guidelines for teacher candidates, preservice teachers, and teacher educators who are comparing the design of educational analog games and lend empirical support to the argument that themes play an important role in predicting players' reception of a game. In light of the fact that many educational games are perceived to be less enjoyable than their entertainment counterparts, researchers and educators would benefit from a better understanding of the ways specific features of games can contribute to positive or negative player receptions. Themes should be carefully considered in the design, selection, and use of games for learning.

Our interpretation of these findings nonetheless suggests that, above all, a holistic examination of the design of analog games is necessary for their effective use in education. The design features identified in this study suggest which content areas have the most educational games available to them and provide a means of distinguishing between these games but do not comprehensively describe the design or pedagogical affordances of analog games. Furthermore, the themes in this study may be broader than just superficial

"dressing" (Koster, 2004, p. 85), suggesting that educators should consider more than just the apparent subject material of an analog game when evaluating its potential for their classroom.

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## Appendix

## Component Loadings for Principal Components Analysis With Oblimin Rotation of Educational Board Game Themes, Mechanics, and Genres

**Factor loadings greater than |.364| are in boldface**

**Component Loadings (Themes)**

| Original BGG Theme | Middle Eastern Conflict | 17th to 19th Century History | 19th to 21st Century History | Media-Based | Progress and Development | Travel |
|---|---|---|---|---|---|---|
| Adventure | .00 | –.01 | .00 | .05 | –.02 | **.79** |
| Age of Reason | –.01 | **.78** | –.01 | –.02 | .07 | .04 |
| American Civil War | –.01 | –.01 | .35 | –.04 | –.04 | –.03 |
| American Indian Wars | .00 | **.92** | .00 | .01 | –.04 | –.03 |
| Amer. Revolutionary War | .00 | **.85** | .00 | .01 | –.01 | –.01 |
| American West | .01 | –.01 | .04 | **.40** | .05 | –.08 |
| Ancient | .01 | –.01 | .03 | –.01 | **.55** | .01 |
| Animals | –.03 | –.03 | –.06 | **.48** | .26 | –.02 |
| Arabian | **.97** | .00 | –.01 | .01 | .00 | .00 |
| Aviation and Flight | –.01 | –.02 | –.02 | –.06 | –.05 | .16 |
| Book | –.02 | –.03 | –.03 | –.07 | –.07 | –.04 |
| Civilization | .02 | .12 | .04 | –.03 | **.53** | **.37** |
| Civil War | **.97** | .00 | –.01 | .01 | .00 | .00 |
| Comic Book | –.01 | .01 | –.02 | **.41** | –.04 | –.01 |
| Economic | –.06 | .03 | –.02 | –.21 | .06 | –.10 |
| Environmental | –.03 | –.03 | –.08 | .26 | –.06 | .07 |
| Fantasy | –.01 | –.01 | –.01 | –.02 | –.05 | –.03 |
| Farming | –.01 | –.02 | –.02 | .03 | **.59** | –.06 |
| Humor | –.04 | –.05 | –.08 | –.12 | –.15 | –.09 |
| Industry & Manufacturing | –.04 | –.05 | –.07 | –.12 | **.49** | –.09 |
| Mature / Adult | –.01 | –.01 | –.02 | –.03 | –.03 | –.02 |

**Component Loadings (Themes, Cont.)**

| Original BGG Theme | Middle Eastern Conflict | 17th to 19th Century History | 19th to 21st Century History | Media-Based | Progress and Development | Travel |
|---|---|---|---|---|---|---|
| Medical | –.01 | –.02 | –.02 | –.05 | –.04 | –.03 |
| Medieval | .01 | –.01 | .01 | .04 | **.70** | –.02 |
| Modern Warfare | **.84** | .00 | –.03 | –.01 | –.01 | .00 |
| Movies / TV / Radio | .00 | –.01 | .02 | **.65** | –.05 | –.04 |
| Murder / Mystery | –.01 | –.01 | –.02 | –.03 | –.03 | –.02 |
| Music | .01 | –.01 | .03 | .32 | .02 | –.08 |
| Mythology | .00 | .00 | .01 | –.02 | .00 | .00 |
| Napoleonic | .00 | **.45** | .00 | .00 | –.04 | –.04 |
| Nautical | .01 | –.01 | .02 | –.04 | .01 | **.86** |
| Novel-based | .01 | .01 | .03 | **.77** | .00 | –.05 |
| Political | .30 | –.02 | **.39** | –.08 | –.03 | –.04 |
| Prehistoric | –.01 | .01 | –.03 | **.58** | –.05 | .12 |
| Religious | .00 | –.02 | .01 | –.04 | .13 | –.04 |
| Renaissance | –.01 | –.04 | –.02 | –.03 | **.62** | –.08 |
| Science Fiction | –.05 | –.01 | **.77** | –.05 | –.03 | –.04 |
| Space Exploration | –.07 | –.01 | .10 | –.12 | –.05 | –.08 |
| Sports | –.01 | –.01 | –.02 | –.03 | –.03 | –.02 |
| Transportation | –.03 | –.02 | –.06 | –.09 | –.04 | –.05 |
| Travel | –.03 | –.05 | –.05 | –.09 | –.07 | **.60** |
| Video Game Themes | .00 | –.02 | .01 | .13 | –.04 | –.05 |
| World War I | –.02 | .00 | **.85** | .04 | .02 | .02 |
| World War II | –.02 | .00 | **.77** | .04 | .01 | .02 |
| Eigenvalues | 2.70 | 2.42 | 2.25 | 2.23 | 2.22 | 1.99 |
| Proportion of variance | .06 | .06 | .05 | .05 | .05 | .05 |

**Component Loadings (Mechanics)**

| Original BGG Mechanic | Trading | Acting & Betting | Map | Memory | Number | Strategy |
|---|---|---|---|---|---|---|
| Acting | –.01 | **.76** | –.01 | .00 | –.04 | .08 |
| Action Point | .03 | .14 | –.06 | .04 | –.02 | **.77** |
| Auction and Bidding | **.57** | –.18 | –.01 | –.08 | –.13 | .00 |
| Betting and Wagering | .30 | **.44** | –.05 | –.08 | .04 | –.05 |
| Campaign Card | –.02 | –.10 | –.06 | .00 | .01 | **.71** |
| Card Drafting | .00 | .19 | **.37** | –.14 | –.09 | –.11 |
| Commodity Speculation | **.82** | .22 | .01 | .06 | .10 | .05 |
| Deduction | –.07 | .27 | –.01 | .25 | .31 | .02 |
| Dice Rolling | –.11 | **.45** | –.06 | –.06 | –.04 | –.07 |
| Hex and Counter | .02 | –.01 | **.91** | .01 | .01 | –.04 |
| Math | .25 | –.13 | –.03 | –.14 | **.63** | –.03 |
| Maze | .03 | –.13 | .00 | **.46** | –.17 | .01 |
| Memory1 | .01 | –.02 | .00 | **.90** | .00 | –.01 |
| Memory2 | .02 | –.01 | .00 | **.89** | .02 | .03 |
| Negotiation | **.60** | .22 | –.01 | .13 | –.15 | –.06 |
| Number | .10 | .00 | –.02 | –.08 | **.69** | –.02 |
| Paper and Pencil | .19 | .23 | .01 | –.02 | .24 | –.03 |
| Pattern Building | –.04 | .00 | –.03 | –.02 | .03 | –.06 |
| Pattern Recognition | –.06 | –.04 | –.05 | .19 | –.11 | –.11 |
| Pick Up and Deliver | –.04 | .04 | **.71** | .01 | –.05 | .12 |
| Point to Point Movement | –.04 | –.10 | .04 | –.05 | –.07 | **.57** |
| Press Your Luck | .00 | **.57** | –.04 | –.01 | .07 | .00 |

**Component Loadings (Mechanics, Cont.)**

| Original BGG Mechanic | Trading | Acting & Betting | Map | Memory | Number | Strategy |
|---|---|---|---|---|---|---|
| Puzzle | –.03 | –.03 | .10 | .12 | .05 | .13 |
| Real Time | –.02 | –.09 | –.06 | .16 | –.08 | –.13 |
| Role-Playing | .01 | **.72** | .07 | .00 | –.06 | .06 |
| Roll and Move | .14 | .11 | –.05 | .00 | –.05 | –.07 |
| Route Building | .01 | –.02 | **.87** | .00 | .01 | –.05 |
| Set Collection | .01 | .18 | –.03 | **.37** | .14 | –.17 |
| Simulation | **.65** | –.13 | .00 | –.08 | .03 | .12 |
| Stock Holding | **.83** | –.11 | –.01 | –.01 | .09 | –.06 |
| Storytelling | .04 | **.38** | –.04 | .09 | –.06 | .04 |
| Take That | –.10 | .01 | .00 | .16 | **.64** | –.03 |
| Tile Placement | –.01 | –.03 | –.06 | –.03 | –.04 | –.06 |
| Trading | **.52** | .22 | –.05 | .07 | –.16 | –.13 |
| Trick Taking | –.10 | –.01 | .01 | .12 | **.66** | –.01 |
| Variable Phase | **.53** | –.20 | .03 | –.04 | –.01 | .05 |
| Variable Player Powers | .07 | .15 | .06 | .03 | .00 | **.59** |
| Voting | .35 | –.16 | –.05 | –.07 | .00 | .15 |
| Eigenvalues | 3.45 | 2.56 | 2.28 | 2.26 | 2.07 | 1.99 |
| Proportion of variance | .09 | .07 | .06 | .06 | .05 | .05 |

**Component Loadings (Genres)**

| Original BGG Genre | Strategy | Party | Card |
|---|---|---|---|
| Abstract Strategy | **.40** | –.24 | –.02 |
| Action / Dexterity | **.61** | .03 | .03 |
| Bluffing | –.01 | .34 | **.56** |
| Card Game | –.13 | –.04 | **.55** |
| City Building | **.77** | .00 | –.01 |
| Collectible | –.07 | –.25 | .13 |
| Dice | .02 | .01 | .07 |
| Expansion | –.18 | –.27 | –.17 |
| Party Game | .04 | **.68** | .22 |
| Print and Play | .03 | –.05 | **.71** |
| Racing | –.05 | –.06 | –.07 |
| Territory Building | **.72** | .01 | .00 |
| Trivia | –.07 | **.65** | –.06 |
| Wargame | –.11 | –.10 | .02 |
| Word Game | –.03 | **.57** | –.32 |
| Eigenvalues | 1.72 | 1.54 | 1.34 |
| Proportion of variance | .11 | .10 | .09 |