SELF-ASSEMBLED TEAMS: ATTRACTION, COMPOSITION, AND PERFORMANCE

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SELF-ASSEMBLED TEAMS: ATTRACTION, COMPOSITION, AND PERFORMANCE

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SUMMARY

Contemporary teams are self-assembling with increasing frequency, meaning the component members are choosing to join forces with some degree of agency rather than being assigned to work with one another. However, the majority of the teams literature up until this point has focused on randomly assigned or staffed teams. Thus, the purpose of this dissertation was to investigate how people *do* form into teams and how people *should* form into teams. First, I evaluated the bases for and performance implications of team self-assembly using a sample of digital traces from the Chinese version of the massively multiplayer online role-playing game Dragon Nest. The final sample included 1,568 players who played on 1,744 teams. Second, I conducted 51 semi-structured interviews (26 with American participants and 25 with Chinese participants) in order to assess the extent to which teaming behaviors enacted in virtual worlds can be generalized to the real world. The results of the digital trace data analyses and semi-structured interviews both indicated that self-assembled teams form via three mechanisms: homophily, familiarity, and propinquity. However, certain patterns emerged from the trace data analyses that did not surface during the structured interviews—such as self-assembly based on closure—while interviewees highlighted other attraction mechanisms that were not confirmed by the results of trace data analyses—such as preferential attachment, functional diversity, and geographic dispersion. Moreover, results of the digital trace data analyses indicated that unsuccessful teams were more homogenous in terms of certain deep-level characteristics than successful teams were, and successful teams formed based on friendship more often than unsuccessful teams did. Overall, the

findings from this dissertation shed new light on the attraction mechanisms that drive the formation of high- and low-performing self-assembled teams.

CHAPTER 1

INTRODUCTION

With the 21st century well underway, it has become increasingly clear that teams of people—rather than individuals—are at society's forefront, spearheading progress in areas such as business, science, and technology. However, the growing reliance on teams is not the only change to grace the contemporary era; the specific nature of teams is also evolving. Traditionally, work teams have been clearly delineated, stable groups of proximally located members brought together based on the decisions of a supervisor. In contrast, today's teams are frequently ad hoc groups of distributed collaborators, metaphorically described by Amy Edmonson as "a pickup game of basketball rather than plays run by a team that has trained as a unit for years" (2012, p. 4).

Importantly, modern teams are self-assembling with increasing frequency, meaning the component members are choosing to join forces with some degree of agency rather than being assigned to work with one another. In part, the growing prevalence of self-assembled teams can be attributed to the rapid telecommunications advances that have been achieved over approximately the past 50 years (Contractor, 2013). Personal computers, the Internet, and the World Wide Web (WWW) have made it possible for individuals to freely team up at the click of a mouse, regardless of historically daunting constraints such as geographic dispersion of team members. For example, cross-university collaborations between researchers have been sharply rising since the mid 1970s (Jones, Wuchty, & Uzzi, 2008), a phenomenon largely attributed to the proverbial "death of distance" caused by the communications revolution (Cairncross, 2001).

Traditionally, the focal assembly-related issue with regard to manager-led teams has been one of staffing, or developing systematic approaches for configuring teams with optimal compositions for performance (Zaccaro & DiRosa, 2012). By analyzing how composing teams based on individual differences such as knowledge, skills, and abilities explains subsequent variance in team performance, managers can create more effective groups of workers. However—although considering the composition of all types of teams is admittedly important—there is an added dimension of complexity when considering team self-assembly. Namely, unlike staffed teammates, who were brought together based on the decisions of a manager, self-assembled teammates were attracted to one another for interpersonal reasons. Thus, an important open question about self-assembling teams is the matter of how interpersonal attraction mechanisms influence individuals to form into group—how and why do individuals self-assemble into teams?

Previous research on attraction has indicated that individuals are drawn to and repelled from one another based on a wide variety of factors. However, this research has primarily studied interpersonal attraction outside of the context of teamwork. How might attraction function to coalesce teammates differently than friends or romantic partners? There are a number of ways that individuals might make sound decisions when choosing potential teammates. For instance, individuals may choose teammates who possess task-relevant characteristics such as intelligence or motivation to work for the team. However, recent evidence has suggested the existence of the team assembly bias—or, a discrepancy between the criteria people *think* they use to choose their teammates and the criteria they *actually* use (Wax, Dalrymple, DeChurch, Walker, & Contractor, 2014). Thus, it is also possible that individuals commit same "errors" of attraction when deciding on teammates as they do when choosing friends and romantic partners. Theoretically, human patterns of interpersonal attraction are highly adaptive; for example, we use social categorization as a mechanism for creating order in our highly complex social worlds and then tend to exhibit biases toward the social groups with which we identify. By using cognitive heuristics such as these, people naturally tend to affiliate in groups that are more homophilous than they would be by chance, and this is particularly true when considering close intimate relationships. Especially considering the fact that self-assembled teammates were attracted to one another for interpersonal reasons, it seems likely that mental shortcuts—such as those that lead to the phenomenon of similarity-attraction—would also apply to the self-assembled team context. Thus, teammate relationships being exempt from laws of attraction such as the rule of homophily seems unlikely, at best.

Attraction "mistakes" have different implications for self-assembled teams than they do for friends and partners in romance; namely, teammates have shared goals, and a wide variety of performance-relevant outcomes that may be affected by suboptimal self-assembly. Accordingly, another unsolved issue is whether there are different performance implications of team self-assembly mechanisms; how do different mechanisms of interpersonal attraction between teammates translate into different combinations of member capabilities, emergent states, processes, and ultimately performance? The literature on team composition suggests that high-performing teams will tend to form using different attraction mechanisms than low-performing teams. For example, heterogeneous teams have been shown to best homogeneous team on performance outcomes such as decision-making (e.g., Mello & Ruckes, 2006). However, the team composition literature is largely based on samples of teams where the component members did not choose to work with one another (e.g., they were randomly assigned to a group or staffed to a team). Thus, the purpose of this dissertation is twofold: to investigate how people *do* form into teams and how people *should* form into teams.

Self-Assembled Teams

Defined traditionally, a team is "a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/object/mission, who have each been assigned specific roles or functions to perform, and who have a limited life span of membership" (Salas, Dickinson, Converse, & Tannenbaum, 1992, p. 4). Managers can compose teams using a number of different tactics such as random assignment and staffing. Random assignment is the unbiased placement of individuals on teams, while staffing is the process of intentionally forming teams based on the component members' attributes.

Frequently, individuals are staffed into teams (Zaccaro & DiRosa, 2012; Mathieu, Tannenbaum, Donsbach, & Alliger, 2013). Donsbach et al. (2009) taxonomized team staffing decisions into three general groups: existing team decisions, new team decisions, and organizational decisions. Existing team decisions include team member replacement (i.e., assigning an individual to join an existing team), multiple member replacement (i.e., assigning a number of people to fill multiple roles on an existing team), and new talent distribution (i.e., assigning a number of people to fill multiple roles on a number of existing teams). New team decisions include single team formation (i.e., assigning a number of people to form a new team) and multiple team formation (i.e., assigning a number of people to form a number of new teams). Finally, organizational team staffing decisions include reconfiguration, or assigning a number of people within an organization to join multiple existing teams or form multiple new teams; restructuring a business is one example of reconfiguration. Team staffing can be achieved through the use of computer-aided team assignment techniques, including the use of recommender systems (Contractor, 2013) and software such as the web-based *Team-Maker* (Layton, Loughry, Ohland, & Ricco, 2010). However, some teams come into being relatively spontaneously, and this is especially true contemporarily; the Internet is an ever-present portal for connecting with others.

In contrast to manager-appointed teams, self-assembled teams are those that retain some degree of independence over the process of team formation; in this regard, self-assembled teams are similar to Hackman's (1987) self-designing work groups. However, while Hackman's self-designing work groups, by definition, have the ability to structure their own tasks and choose their own performance criteria, the same cannot always be said for self-assembled teams. Thus, self-designing work groups *are* always self-assembled, but self-assembled teams *are not* always self-designing; the self-assembled team is a broader entity than the self-designing work group.

Team self-assembly happens in a wide variety of organizational contexts; computer programmers independently form small groups to tackle a difficult sections of code, humane society volunteers team up to improve fundraising efforts, and Hollywood directors and producers link up for a new project on a "who-knows-who" basis. These types of teams vary on a number of factors including degree of assembly autonomy and size of selection pool. Degree of ***assembly autonomy*** refers to the amount of liberty teams retain over the process of formation. Self-assembled teams vary with regards to this assembly autonomy, ranging in agency from the limited freedom of a staffed work team allowed to hire on a new member to a highly autonomous, virtual team with no formal leaders. Second, self-assembled teams vary in size of ***selection pool***. Different situations can reduce or augment the number of choices of potential teammates that individuals have; options may be very limited, or virtually limitless. Self-assembled teams vary in terms of the range of options that the constituent members have when choosing teammates. A small group of coworkers choosing to work with one another on project is an example of a self-assembled team that had a relatively small number of potential teammates to choose from (i.e., the population of the office). However, a similarly small group of open source software developers choosing to work with one another represents a self-assembled team that had a much larger number of potential teammates to choose from (i.e., the size of the open source software developer community). Theoretically, individuals are best able to exercise agency in decision-making when they are high in assembly autonomy and have a large number of potential teammates at their disposal.

Broadly, self-assembled teams are groups of individuals that, of their own accord, join forces in order to interdependently achieve shared goals. By definition, these groups have some degree of agency during the process of team assembly; contrastingly, other methods of team assembly force a particular group composition, regardless of what the members would have chosen for themselves (e.g., random assignment, staffing). It should be noted that, theoretically, all teams involve self-assembly to some extent. For instance, even randomly assigned teams in laboratory studies are composed of research participants that all independently chose to volunteer for the same experiment at the same time. Thus, participants that are randomly assigned experience a small degree of assembly autonomy, but some autonomy nonetheless. However, the true enigma lies on the other end of the spectrum of team assembly autonomy—the highly autonomous self-assembled group.

Self-assembled teams can be defined, in part, by juxtaposing their characteristics with those of teams where members lacked agency during formation. Preliminary research on the topic has indicated that self-assembled teams experience greater initial cohesiveness (Strong & Anderson, 1990) than teams where members lacked decision-making agency during assembly. Preestablished norms between familiar teammates help to explain this disproportionally high level of cohesion in self-assembled groups (Bacon, Stewart, & Silver, 1999). Self-assembled teams also experience greater satisfaction than randomly assigned teams (Bacon et al., 1999; Chapman, Meuter, Toy, & Wright, 2006), partially because self-assembled teams may experience less logistical concerns than other types of teams (Bacon, Stewart, & Anderson, 2001); individuals with the agency to choose their own teammates can make selections based on schedule compatibility, for instance.

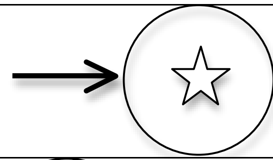
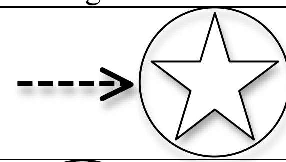
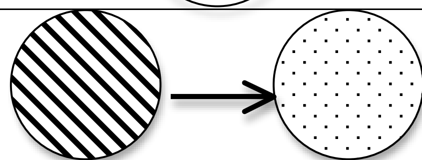
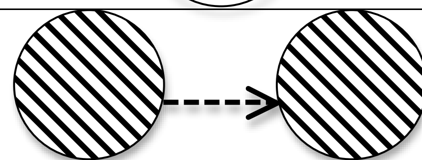
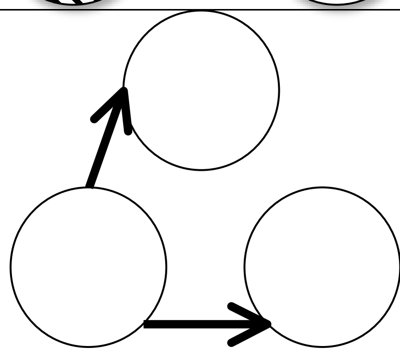
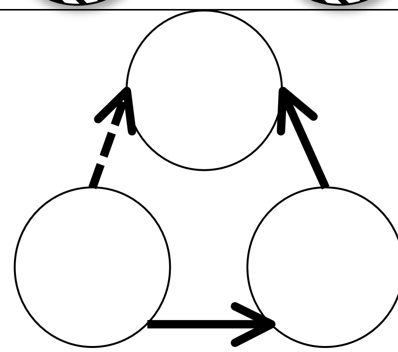
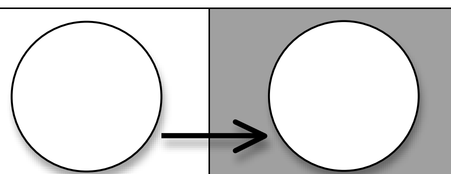
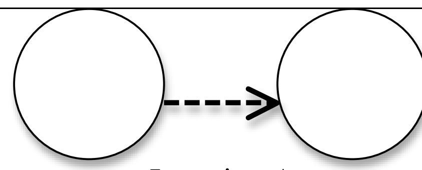
However, these experiential benefits may come at a significant cost, as self-assembled teams tend to be less demographically heterogeneous than deliberately staffed teams (Butterfield & Bailey, 1996), as well as less heterogeneous in terms of skills than other types of teams (Bacon et al., 1999). One study found that self-assembled groups report more conflict than randomly assigned groups (Chapman et al., 2006). Also, due to high levels of cohesion, self-assembled teams are more prone to groupthink than teams formed using different methods (Bacon et al., 1999). Furthermore, preliminary research on self-assembled teams has noted that they perform more poorly than either deliberately staffed teams (Butterfield & Bailey, 1996) or randomly assigned teams (Chapman et al., 2006).

Interpersonal Attraction

Human beings innately desire interpersonal attachments, and are fundamentally motivated by the desire to connect with others (Baumeister & Leary, 1995). Interpersonal attraction is classified as attitudinal positivity toward another person (Huston & Levinger, 1978), and is related to this basic need to belong. The attraction literature has explored a variety of ways that people are drawn to one another, and for the purposes of this research I have taxonomized these various attraction mechanisms into four categories: attraction based on absolute attributes, attraction based on relative attributes, relational attraction, and situational attraction. I will begin by examining how scholars have studied attraction based on individual differences, which can occur in two ways. First, attraction based on *absolute attributes* refers to instances where certain attributes are virtually unanimously considered attractive; the more a person has of that attribute, the more attractive they are. Second, *attraction based on relative attributes* refers to situations where individuals are mutually attracted based on a match between their comparative individual differences. Complementarily, *relative repulsion* can occur when individuals are mutually repelled from one another based on a mismatch between individual differences. Table 1 displays illustrative examples of attraction based on absolute and relative attributes.

Table 1

Interpersonal Attraction Mechanism Taxonomy

Type of Attraction	Illustrative Example: Low Attraction Situation	Illustrative Example: High Attraction Situation	Theoretical Example
Absolute			Preferential Attachment
Relative			Homophily
Relational			Closure
Situational			Proximity

Note. Low and high attraction examples for each type of attraction are pictured. Dotted line indicates the focal team attraction tie that is highly likely based on the corresponding attraction mechanism. Solid lines are friendship ties.

What differentiates absolute and relative attraction from relational and situational attraction is that the former are mechanisms based on individual attributes, while the latter are not. In order to organize the large variety of individual attributes upon which these types of attraction occur, I will employ a preexisting framework. Theoretically, individual differences that drive attraction can be compartmentalized into two broad groups: surface- and deep-level characteristics. Surface-level attributes are readily apparent, can be estimated after only a very short exposure to an individual, and reflect social category memberships; examples include age, race, sexual orientation, and socioeconomic status (Phillips & Lloyd, 2006). Deep-level characteristics, on the other hand, are invisible elements of the self, and are more difficult to determine than surface-level characteristics; personality, attitudes, and beliefs are some examples (Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002). While some characteristics are generally agreed upon as being either surface- or deep-level, others are less easily categorized, and that ambiguity has resulted in some scholarly discord. Surface-level characteristics can be conceptualized as either: visible attributes of a person (e.g., Milliken & Martins, 1996); or as attributes that, if not visible, are easy to discern through brief social interaction (e.g., Bell, 2007). The current study adopts the latter perspective. Table 2 summarizes how attributes were classified for the purposes of this paper, based on the surface- and deep-level diversity literature.

Attraction based on Absolute Attributes

Certain characteristics are inherently attractive; individuals that possess these characteristics are perceived as being more attractive than others. For instance, individuals are considerably more attracted to physically beautiful people than they are to plain or average-looking people (Walster, Aronson, Abrahams, & Rottmann, 1966; Byrne, London, & Reeves, 1968; Stroebe, Insko, Thompson, & Layton, 1971; Downs & Lyons, 1991; Luo & Zhang, 2009; Krendl, Magoon, Hull, & Heatherton, 2011). Furthermore, this effect spans the boundary of reality and virtuality; people feel more

Table 2

Taxonomy of Surface- and Deep-Level Individual Differences

Level	Individual Difference	Classification Examples in Scholarly Literature
Surface	Age	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Van Vianen, De Peter, Kristof-Brown, & Johnson, 2004; Bell, 2007
	Education level	Bell, 2007
	Functional background/occupation	Mohammed & Angell, 2004; Phillips & Lloyd, 2006
	Gender/sex	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Van Vianen, De Peter, Kristof-Brown, & Johnson, 2004; Bell, 2007; Shore et al., 2009
	Location	Phillips & Lloyd, 2006
	Organizational tenure	Mohammed & Angell, 2004; Phillips & Lloyd, 2006; Bell, 2007
	Physical appearance/attractiveness	Bell & McLaughlin, 2006
	Race/ethnicity	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Phillips & Lloyd, 2006; Phillips, Northcraft, & Neale, 2006; Bell, 2007; Shore et al., 2009
	Sexual orientation	Phillips & Lloyd, 2006
	Status	Phillips & Lloyd, 2006
Deep	Abilities/intelligence	Bell, 2007
	Attitudes	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Phillips & Lloyd, 2006; Bell, 2007
	Beliefs	Harrison, Price, Gavin, & Florey, 2002; Van Vianen, De Peter, Kristof-Brown, & Johnson, 2004
	Experiences	Phillips, Northcraft, & Neale, 2006
	Information	Phillips & Lloyd, 2006
	Interests	Harrison, Price, & Bell, 1998
	Opinions	Phillips & Lloyd, 2006
	Personality	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Bell, 2007
	Preferences	Harrison, Price, Gavin, & Florey, 2002; Phillips, Northcraft, & Neale, 2006
	Values	Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Mohammed & Angell, 2004; Van Vianen, De Peter, Kristof-Brown, & Johnson, 2004; Phillips & Lloyd, 2006; Phillips, Northcraft, & Neale, 2006; Bell, 2007

attracted to good-looking online game characters than they do to plain-looking characters (Lo, 2008; Coulson, Barnett, Ferguson, & Gould, 2012).

Status—or, the relative standing of one individual to another—is one surface-level factor upon which individuals vary that has a critical impact on attractiveness. Status is oftentimes defined in economic terms, and research has indicated that individuals of low economic status are disproportionately highly attracted to individuals of high economic status (Byrne, Clore, & Worchel, 1966). Conspicuous consumption, or "attaining and exhibiting costly items to impress upon others that one possesses wealth or status," is tactic employed by men who are motivated to attract a short-term mate (Sundie et al., 2011, p. 664), and it becomes increasingly popular as the human sex ratio in a given area leans toward the side of males (Griskevicius et al., 2012).

People also have a social status relative to others, and—just like socioeconomic status—social status serves to enhance an individual's attractiveness. Even high status children tend to be leaders in their peer groups (Coie, Dodge, & Coppotelli, 1982), and individuals feel more attracted to high social status online game characters than low-status ones (Lo, 2008). Moreover, a variety of characteristics serve as proxies for and hybridize the economic and social elements of status. For example, occupational prestige has both economic and social implications, and research has indicated that attraction is a positive function of level of occupational prestige (Bond, Byrne, & Diamond, 1968). Socioeconomic status is a global measure of status that combines economic and social facets, including education, income, and occupation, and has been implicated as a quality that females value highly in males, perhaps more so than physical attractiveness (Townsend & Levy, 1990).

From a network perspective, high social status individuals can be distinguished from low social status individuals because the former group has more relational ties than the latter, and is thus more popular. In social network theory, the phenomenon whereby individuals tend to associate themselves with the most popular individuals in the social network is termed *preferential attachment* (Johnson & Faraj, 2005; Hai-Bo, Jin-Li, & Jun, 2012). Theoretically, preferentially attachment occurs because popularity is an attractive quality (Papadopoulos, Kitsak, Serrano, Boguñá, & Krioukov, 2012); individuals prefer others with many rather than few social connections. Preferential attachment has been observed in authorship networks (Milojević, 2010), on discussion forums on the Web (Johnson & Faraj, 2005), in trade networks (Maoz, 2012), and on Flickr (Mislove, Koppula, Gummadi, Druschel, & Bhattacharjee, 2008). Hypothetically, this phenomenon should apply to team self-assembly relations—individuals with many teammate relationships will likely be perceived as more attractive teammates than individuals with fewer teammate relationships, and thus will be the preferred choices as teammates. Consequently, it is posited that:

> *Hypothesis 1: Attractiveness as a teammate will be proportional to popularity as a teammate; a small number of individuals will have a disproportionately high number of teaming relationships.*

Attraction based on Relative Attributes

For most individual differences, attraction is not a matter of absolutes. Rather, individuals are attracted to one another based on their relative standing on certain characteristics. Unlike absolute attraction, relative attraction is oftentimes based on surface-level characteristics that reflect different social identities. Individuals categorize themselves and others into groups based on intragroup similarities and intergroup differences (Tajfel, 1982; Turner & Oakes, 1986), a process that has been likened to a lesser form of stereotyping (Allport, 1954). Self-categorization leads to the development of a social identity, or "that *part* of the individuals' self-concept which derives from their knowledge of their membership of a social group (or groups) together with the value and emotional significance attached to that membership" (Tajfel, 1981, p. 255). Members of the same social group—or, demographically similar individuals—tend to favor one another (e.g., Westphal & Zajac, 1995); in general terms, this preference for similar others is known as intergroup bias (Hewstone, Rubin, & Willis, 2002).

Relative Similarity

People prefer others that they perceive as similar to themselves to those that they perceive as different from themselves. This effect has been documented in a broad array of literatures, and occurs in a variety of cultural contexts, including relatively homogeneous and relatively heterogeneous cultures (Schug, Yuki, Horikawa, & Takemura, 2009). Some research has even provided evidence of the direction of causality; strangers with similar demographic profiles come to like one another more than strangers with dissimilar demographic profiles (Newcomb, 1961). In sociology, scholars refer to this tendency of individuals to associate with similar others as the theory of homophily (Lazarsfeld & Merton, 1954). Specifically, "[h]omophily is the principle that a contact between similar people occurs at a higher rate than among dissimilar people" (McPherson, Smith-Lovin, & Cook, 2001, p. 415-416). In the psychological literature, this effect is referred to as the similarity-attraction paradigm (Byrne & Nelson, 1965; Byrne, 1971). Furthermore, some research has provided evidence for a reversed attraction-similarity effect, meaning that people expect similar others to be more attracted to them than dissimilar others (Moss, Byrne, Baskett, & Sachs, 1975).

Surface Level

Physical appearance is the most readily detectable characteristic that individuals mutually ascertain through interaction (Dion, Berscheid, & Walster, 1972), and research has indicated that people prefer others that are similar to them in terms of physical attractiveness, especially in the context of romance (Stroebe et al., 1971; Epstein & Guttman, 1984; Taylor, Fiore, Mendelsohn, & Cheshire, 2011). This phenomenon is termed the matching hypothesis, and research has indicated that it occurs among children as well as adults (Drewry & Clark, 1984), and in same-sex friendships as well as romantic relationships (Feingold, 1988). Scholars have conjectured that matching based on physical attractiveness occurs due to the fact that individuals express what they believe to be socially realistic preferences based on self-perceptions of appearance (Berscheid, Dion, Walster, & Walster, 1971; van Straaten, Engels, Finkenauer, & Holland, 2009). Thus, people see the difference between objectively beautiful and plain individuals, but oftentimes consciously opt for the latter (Lee, Loewenstein, Ariely, Hong, & Young, 2008) out of prudence. In addition, individuals exhibit a preference for similar others based on a wide variety of aspects of physical appearance apart from beauty (Vandenberg, 1972), including height (Pearson & Lee, 1903; Burgess & Wallin, 1944; Berkowitz, 1969; Berkowitz, Nebel, & Reitman, 1971), weight (Burgess & Wallin, 1944; Schafer & Keith, 1990), hair color (Harris, 1912), eye color (Pearson, 1907), and clothing style (Back, Schmukle, & Egloff, 2011).

Race is an individual difference upon which individuals derive group membership, and is fraught with sociopolitical implications (Jones, 1991). Racial groups are distinguished based on "observable physical features, such as skin color, hair type and color, eye color, stature, head shape and size, and facial features (with special attention to noses)" (Zuckerman, 1990, p. 1297-1298). Often thought of as synonymous with race, ethnicity refers to "groups that are characterized in terms of a common nationality, culture, or language" (Betancourt & López, 1993, p. 631). Ethnicity can also refer to "broad grouping of Americans on the basis of both race and culture of origin" (Phinney, 1996, p. 919); clearly, there is significant overlap in how psychologists typically define and operationalize these constructs. In addition, national origin can be confounded with race and ethnicity, and thus is sometimes used as a proxy. Beyond simply being a basis for attraction, race is a force of social division (McPherson et al., 2001); networks tend to be more racially homogeneous than they are homogeneous based on any other demographic difference (Marsden, 1987, 1988; Mayhew, McPherson, Rotolo, & Smith-Lovin, 1995).

People prefer racial ingroup members to racial outgroup members (Louch, 2000; Rustemli, Mertan, & Ciftci, 2000), and this effect is the strongest when considering intimate relationships such as marriages (Vandenberg, 1972; Epstein & Guttman, 1984; Kalmijn, 1998) and friendships (Lincoln & Miller, 1979; Shrum, Cheek, & Hunter, 1988; Mollica, Gray, & Treviño, 2003). One study on race and friendship using a sample of child participants reported that children are more than twice as likely to have a best friend of the same race than a best friend of a different race (Hallinan & Smith, 1985), implying that interracial friendships tend to be less intimate than racially homogeneous friendships.

However, one study qualified the general literature on racial similarity-attraction by identifying a main effect of race. Mehra, Kilduff, and Brass (1988) found that racial minorities are more likely to make homogeneous friendship choices than are White people. This finding can be attributed to the combined influence of preference for same-race friends and exclusion from the dominant racial group that members of minority racial groups experience.

Race-based similarity-attraction has been shown to impact job applicant evaluations and hiring decisions (Young, Place, Rinehart, Jury, & Baits, 1997; Goldberg, 2005), supervisor evaluations of subordinates (Tsui & O'Reilly, 1989), and the demography of educational settings (Schneider, Teske, Roch, & Marschall, 1997). Even performance evaluations made by children are subject to the impact of racial similarity-attraction (Hewstone, Wagner, & Machleit, 1989). Furthermore, the relation between racial similarity and interpersonal attraction is mediated by perceived attitudinal similarity; individuals tend to generalize racial similarity to attitudinal similarity, and therefore perceive racially-similar others as also being similar in terms of deeper-level characteristics, leading to interpersonal attraction (Goldberg, 2005).

Compared to racial homophily, gender/sex similarity is a relatively nuanced attraction mechanism. Gender refers to behavioral, social and psychological aspects of being male or female, while sex refers to the biological aspects of being male or female (Pryzgoda & Chrisler, 2000). However—like race and ethnicity—gender and sex are terms that tend to be used somewhat interchangeably, despite having disparate meanings. Research has indicated that gender similarity drives attraction differently at various points throughout the lifespan. During childhood individuals tend to affiliate in gender-homophilous groups, but this propensity wanes at the onset of adolescence (Shrum et al., 1988). By adulthood most people associate in mixed-gender groups (Marsden, 1987, 1988), and accordingly—by virtue of heterosexual attraction—gender *dissimilarity* has been shown to lead to higher ratings of job applicants (Goldberg, 2005). Relatedly, cross-gender online communications are more frequent and longer in duration than same-gender communications (Leskovec & Horvitz, 2007, 2008). However, networks of adults continue to exhibit gender homophily for certain types of relationships. For instance, individuals tend to form workplace friendships with coworkers of the same gender (Lincoln & Miller, 1979). Although men's friendship networks also tend to exhibit gender homophly, marginalization from male social circles drives females to befriend other women, and thus women's friendships are relatively more gender-homogenous than are men's (Mehra et al., 1998). Furthermore, while both men and women tend to have gender-homophilous workplace friendships, only men are homophilous in terms of their advice and influence ties (Ibarra, 1992, 1997); because men tend to disproportionately occupy positions of power, only they can afford to have gender-homophilous advice networks. Finally, research on naturally occurring groups has noted that same-gender individuals are more likely to congregate than mixed-gender individuals (Mayhew et al., 1995).

Like gender homophily, similarity-attraction based on age involves certain caveats; age similarity is a powerful driver of attraction, but only for certain types of relationships. For instance, age homogamy of marriage partners is so widespread that the literature has all but taken that phenomenon for granted (Lutz, 1905; Epstein & Guttman, 1984; McPherson et al., 2001; Watson et al., 2004). In addition, friendship networks tend to be homophilous in terms of age (Verbrugge, 1977; Feld, 1982); specifically, young and old cohorts tend to be isolated from one another in terms of confiding relationships (Marsden, 1988). Dyads of similar ages also communicate online more frequently than dyads of dissimilar ages (Leskovec & Horvitz, 2007, 2008). However, age-based similarity-attraction may function differently for different age groups; in other words, there may be a main effect of age. In line with this argument, research has shown that the bias for friends of the same age is stronger among young people than among old people (Verbrugge, 1977).

Characteristics that are visually perceptible—such as the aforementioned attractiveness, race, gender, and age—are undeniably surface-level constructs. However, surface-level attributes are demographic in nature (Harrison et al., 1998), and a variety of demographic characteristics do not have clearly defined visual cues associated with them, such as religious identification. Like age, similarity in terms of religious identification drives interpersonal attraction (Louch, 2000), and this is the most prevalent when considering relatively intimate relationships such as marriages (Vandenberg, 1972; Epstein & Guttman, 1984; Kalmijn, 1998; Luo & Klohnen, 2005), friendships (Verbrugge, 1977), and confiding relationships (Marsden, 1988).

Individuals similar in status tend to be attracted to one another, and status—an umbrella term—can be based upon a variety of specific characteristics. For instance, people are drawn to others with the same level of education as themselves (Louch, 2000); this effect has been documented not only in terms of spousal preferences (Warren, 1966; Epstein & Guttman, 1984; Watson et al., 2004), but also in terms of friendships and work relationships (Lincoln & Miller, 1979). Specifically, individuals prefer to confide in others with similar levels of education to themselves (Marsden, 1988), and tend to have important discussions in groups that are homogenous with regards to education level, especially if they are having these discussions with friends rather than relatives (Marsden, 1987). However, when considering the relation between education similarity and attraction, there also appears to be a main effect of education level. For instance, the preference for friends with similar levels of education is most pronounced among the highly educated (Verbrugge, 1977). In the same vein, supervisors report liking subordinates of similar education levels to their own more than subordinates of different education levels from their own; the same holds true for supervisor affect based on subordinate level of job tenure (Tsui & O'Reilly, 1989).

Occupation and occupational prestige are two additional, related indicators of status that drive attraction. Individuals experience interpersonal attraction based on similarity of occupation (Verbrugge, 1977; McPherson et al., 2001)—perhaps because people who work together are physically proximal to one another, or share similar values—and are more likely to be close friends with others that are similar in terms of occupational prestige than others that are different. However, there is a main effect of occupational prestige level on the relation between occupational prestige similarity and attraction; people with high occupational prestige have stronger biases for similar others than people with low occupational prestige (Verbrugge, 1977).

Indicators of status such as education level, occupation, and occupational prestige all have economic implications (e.g., earning potential, salary, etc.). Thus, it is no surprise that results of research have indicated that economic status similarity drives interpersonal attraction (Byrne et al., 1966), and that people are especially prone to marrying within their socioeconomic group (Warren, 1966; Vandenberg, 1972; Epstein & Guttman, 1984; Kalmijn, 1998). Finally, social status is nonmonetary in nature, and usually deals with individuals' relative popularity in the peer group. Similar to how people look for others who "match" them in terms of physical attractiveness, research has shown that individuals are most attracted to others that are similar to them in terms of social prestige (Drewry & Clark, 1984; Whitbeck & Hoyt, 1994; Taylor et al., 2011).

Deep Level

People are also mutually attracted to one another based on similarity of deep-level characteristics such as attitudes, personality, values, and beliefs (Lazarsfeld & Merton, 1954). Meta-analytic research has indicated that both actual similarity and perceived deep-level similarity are strongly related to interpersonal attraction (Montoya, Horton, & Kirchner, 2008), and that the relation between similarity and attraction for deep-level characteristics is moderated by a variety of factors including: the number of attributes that the judgment of similarity is being made on, the ratio of similar to dissimilar information, and information salience (Montoya & Horton, 2012).

The majority of research on deep-level similarity and attraction has focused on attitudes, which are valenced evaluations of objects (Breckler & Wiggins, 1989). For instance, people self-report feeling more attracted to (Byrne, 1961, 1971, 1997; Layton & Insko, 1974; Sachs, 1976; Wyant & Gardner, 1977; Smeaton, Byrne, & Murnen, 1989; Singh, Ho, Tan, & Bell, 2007; Singh, Yeo, Lin, & Tan, 2007) and even position themselves physically closer to (Allgeier & Byrne, 1973; Snyder & Endelman, 1979) attitudinally-similar others than attitudinally-dissimilar others. This effect has been replicated in samples diverse in terms of age (Byrne & Griffitt, 1966; Singh, Ng, Ong, &

Lin, 2008), educational level, socioeconomic status, intelligence, and mental health (Byrne, Griffitt, Hudgins, & Reeves, 1969). Furthermore, attitude similarity impacts attraction for a variety of different kinds of relationships, including friendships, work relationships, casual romantic relationships, and marriages (Stroebe et al., 1971; Black, 1974). One caveat is that attitude similarity is a more powerful driver of attraction for women than it is for men in the context of friendships and work relationships (Stroebe et al., 1971). Married couples also tend to have similar attitudes on religion (Watson et al., 2004), and both friends (Verbrugge, 1977) and married couples (Watson et al., 2004; Luo & Klohnen, 2005) tend be similar with regards to political attitudes. Experimental research has demonstrated that political attitude similarity drives attraction, implying the direction of causality (Davis, 1981).

Attitude similarity trumps other attraction-relevant information such as information on occupational prestige (Bond et al., 1968), and people may use surface-level similarities—such as similarity in terms of race (Goldberg, 2005) or sexual orientation (Pilkington & Lydon, 1997; Chen & Kenrick, 2002)—as indicators of deeper level attitude similarity. Self-monitoring—or the tendency for people to alter their behavior based on situational cues—moderates the relation between attitude similarity and attraction such that said relation is stronger for low self-monitors than it is for high self-monitors (Jamieson, Lydon, & Zanna, 1987). Relatedly, research has indicated that people high in social comparison orientation—an individual difference that combines self-awareness and an awareness of what others are thinking and feeling—prefer attitudinally-similar others, but only if those others are ingroup members (Michinov &

Michinov, 2011). Finally, centrality of attitudes moderates the similarity-attraction relation (Montoya & Horton, 2012).

Personality is another broad deep-level construct upon which people experience similarity-based attraction. Interpersonal attraction is a function of the proportion of personality similarity to personality dissimilarity (Griffitt, 1966; Byrne, Griffitt, & Stefaniak, 1967), and people even tend to physically position themselves most proximally to others with the most similar personalities to them (Snyder & Endelman, 1979). Friends tend to have similar personalities (Izard, 1960a), and this personality similarity has been experimentally demonstrated to be an antecedent of liking (Izard, 1960b). The effect of personality similarity on liking has been reliably produced in samples of college freshman but not in samples of college seniors (Izard, 1963); this can potentially be explained via the finding that similarity of personality is only related to friendship in dyads that are relatively less familiar with one another (Rosenfeld & Jackson, 1965). Furthermore, cohabitating (Barelds & Barelds-Dijkstra, 2007) and married (Burgess & Wallin, 1944; Luo & Klohnen, 2005) couples tend to have similar personalities, and this is true in terms of adaptive (Epstein & Guttman, 1984; Klohnen & Mendelsohn, 1998) and maladaptive characteristics (Vandenberg, 1972; Ahern, Johnson, Wilson, McClearn, & Vandenberg, 1982; Merikangas, 1982; Epstein & Guttman, 1984). There is evidence to suggest that this finding can be explained, at least in part, to initial, pre-marriage assortment based on personality (Mascie-Taylor, 1988; Dijkstra & Barelds, 2008), although it is also possible that couples become more similar over time (Luo & Klohnen, 2005). Moreover, research findings have indicated that both couples in marriage counseling and couples not in marriage therapy are similar on a variety of personality characteristics, but those characteristics differ between the two groups (Lewak, Wakefield, & Briggs, 1985).

Intelligence, or cognitive ability, is yet another deep-level characteristic that people tend to match on. For instance, people feel attracted to similarly intelligent others in a general, social sense (Reagor & Clore, 1970; Singh & Ho, 2000). Furthermore, a plethora of research has found evidence that people inbreed—or engage in assortative mating—based on level of intelligence in both Eastern (Vandenberg, 1972) and Western cultures (Bouchard & McGue, 1981; Epstein & Guttman, 1984; Lewak et al., 1985; Watson et al., 2004), implying that individuals are inherently romantically attracted to others with similar cognitive abilities as them (Mascie-Taylor, 1989).

Finally, other deep-level attributes upon which individuals are attracted to similar others include values (Davis, 1981; Watson et al., 2004; Luo & Klohnen, 2005), interests (Vandenberg, 1972; Davis, 1981), preferences (Jamieson et al., 1987), habits (Epstein & Guttman, 1984), and experiences (Pinel, Long, Landau, Alexander, & Pyszczynski, 2006). Some intriguing findings have been produced with regards to these less well-studied deep-level variables. For instance, interest similarity is a more powerful driver of attraction for men than it is for women (Aron, Steele, Kashdan, & Perez, 2006). Research has shown that Twitter users engage in assortative mixing based on similarity in subjective well-being—or, general happiness (Bollen, Gonçalves, Ruan, & Mao, 2011). Additionally, similarity in subjective experiences is such a powerful attraction mechanism that it overshadows the potential repellant effects of superficially salient, surface-level differences between people (e.g., difference in race, gender, or sexual orientation; Pinel & Long, 2012).

Relative Dissimilarity

Similarity-attraction is a mechanism of relational bonding based on ingroup favoritism; individuals exhibit preferences for similar others, while failing to prefer dissimilar others. This tendency—of individuals to favor ingroups over outgroups—is a form of discrimination, and research has indicated that people readily establish these patterns of discriminatory behavior. For instance, ingroup favoritism even occurs when only minimal, arbitrary information is provided as a means for distinguishing groups (Tajfel, Billig, Bundy, & Flament, 1971; Tajfel, 1982; Blanz, Mummendy, & Otten, 1995; Mummendy, Otten, Berger, & Kessler, 2000). When exaggerated, ingroup favoritism can lead to outgroup derogation, or the aggressive denigration of dissimilar individuals (Brewer, 1979; Hewstone et al., 2002). Some scholars have even suggested that similarity-attraction effects are nothing more than misinterpreted signs of outgroup derogation (Rosenbaum & Holtz, 1985; Rosenbaum, 1986). Although the dissimilarity-repulsion phenomenon is less well studied than similarity-attraction, the scholarly literature has indicated that based on certain, specific characteristics, dissimilarity does indeed reduce interpersonal attraction between people.

Surface Level

Paralleling the conclusion that people favor their racial ingroups, research findings have indicated that individuals also disparage racial outgroups (Levin & Sidanius, 1999). For instance, privileged ingroup members are more likely to associate negative characteristics such as “ignorant,” “unmannerly,” “not modern,” and “not polite” with oppressed outgroup members than with ingroup members (Rustemli et al., 2000). Similarly, individuals tend to deride others with national origins different from their own, and when an outgroup's nationality is perceived as threatening, research has indicated that engaging in acts of ridicule serves to bolster the collective self-esteem of the ingroup (Branscome & Wann, 1994).

Deep Level

Analogous to the finding that attitude similarity leads to attraction, research has also indicated that attitude dissimilarity leads to interpersonal repulsion (Rosenbaum, 1986). In fact, dissimilarity-repulsion may even be a more powerful interpersonal force than similarity-attraction; research has indicated a positive-negative asymmetry effect occurs with attitude similarity and dissimilarity, meaning that the former has a positive effect weaker in magnitude than the latter's negative effect (Singh, Lin, Tan, & Ho, 2008). For example, attitude dissimilarity has a disproportionately strong negative impact on interpersonal liking and enjoyment of company, when contrasted with positive effect of attitude similarity (Singh & Ho, 2000). Furthermore, not only do people tend to be repulsed by those that champion alternative attitudes, they also experience the most extreme repulsion when these comparison others are ingroup members. For instance, when individuals share a political affiliation or sexual orientation, research has shown that they assume they are similar in other ways, and consequently are more repulsed when their dissimilar attitudes are elucidated than they would have been if they had initially assumed dissimilarity (Chen & Kenrick, 2002). However, other research has indicated that this patterning of results occurs only in highly prejudiced samples (Pilkington & Lydon, 1997).

In Teams

Relative attributes as a basis for attraction have also been studied in the context of teams, but this area of the literature is still in its infancy. In terms of surface-level similarity, work teams tend to form based on the homophily principle for surface-level attributes such as occupation (Ruef, Aldrich, & Carter, 2003) and race/ethnicity (Hinds, Carley, Krackhardt, & Wholey, 2000; Ruef et al., 2003). Analogous to the main effect of race on similarity-attraction reported in the general attraction literature, research has indicated that attraction to the group is higher for ethnically homogeneous teams than it is for ethnically heterogeneous teams, but only marginally so (McLeod, Lobel, & Cox, 1996). Mixed results have been reported for gender; some research has reported significant gender homophily in work teams (Ruef et al., 2003). For instance, research has indicated higher levels of self-reported liking in same-sex work teams than in mixed-sex work teams (Alagna, Reddy, & Collins, 1982). However, two studies employing samples of massively multiplayer online role-playing game (MMORPG) self-assembled teams both concluded that gender homophily is not a mechanism by which individual form into teams (Putzke, Fischbach, Schoder, & Gloor, 2010; Huang, Shen, & Contractor, 2013a). Furthermore, research on team self-assembly has suggested that individuals specifically seek out teammates that are similar to them in terms of age (Huang, Shen, Williams, & Contractor, 2009a; Huang et al., 2013a; Zhu, Huang, & Contractor, 2013) and organizational affiliation (Zhu et al., 2013). Therefore, based on these preliminary findings predominately supporting the homophily effect in teams, I posit that:

Hypothesis 2a: Self-assembled teams will be more homophilous on surface-level characteristics than would be expected by chance.

Teammates are also attracted to one another based on deep-level similarities. For instance, individuals report being interpersonally attracted to (e.g., liking and desiring to supervise) their work groups when they and their teammates have similar attitudes (Good & Nelson, 1973; Royal & Golden, 1981; Davis, 1984). Furthermore, individuals specifically seek out teammates that are similar to them in terms of expertise, or skill level (Huang et al., 2009a; Huang et al., 2013a; Zhu et al., 2013), as well as teammates similarly interested in completing tasks of a certain level of difficulty (Huang et al., 2009b). From these findings, it is posited that:

Hypothesis 2b: Self-assembled teams will be more homophilous on deep-level characteristics than would be expected by chance.

Relational Attraction

Beyond experiencing interpersonal attraction based on absolute or relative individual differences, people also are drawn to one another for relational reasons. As exemplified in Table 1, certain social configurations breed interpersonal attraction, while others maximize disdain. At a fundamental level, people's attitudes toward a stimulus tend to become more positive simply by repeatedly experiencing said stimulus; scholars have dubbed this phenomenon the mere exposure effect (Zajonc, 1968, 2001). Research has indicated that the mere exposure effect holds true for social relations, as familiarity has been shown to promote interpersonal attraction. Specifically, frequency of interaction promotes liking for virtual (Reis, Maniaci, Caprariello, Eastwick, & Finkel, 2011) as well as face-to-face interaction (Ebbesen, Kyos, & Konečni, 1976; Moreland &

Beach, 1992). Furthermore, balance theory (Heider, 1958) posits that people are attracted to others whose relationships mirror their own. Specifically, because individuals are also motivated to achieve cognitive consistency in triadic relationships (Holland & Leinhardt, 1976), liking is transitive in nature; in other words, two friends of an individual are also highly likely to be friends with one another (Krackhardt & Kilduff, 1999).

In Teams

Although relational attraction in teams is a burgeoning research area, there is still much work to be done on the topic. Previous research on team self-assembly has indicated that individuals prefer to work with teammates with which they are familiar (Hinds et al., 2000; Guimerá, Uzzi, Spiro, & Amaral, 2005). Specifically, individuals tend to exhibit a preference for friends when choosing teammates (Owens, Mannix, & Neale, 1998). Furthermore, one study found that the primary attraction mechanism driving the formation of teams of open source software developers was previous collaboration ties (Hahn, Moon, & Zhang, 2008). Consequently, it is hypothesized that:

Hypothesis 3a: Self-assembled teams will have higher levels of familiarity than would be expected by chance.

Some scholars have implicated this restriction on group formation as negative, arguing that the tendency for social networks to be constrained by strong ties serves to isolate social groups from one another (Ruef et al., 2003; Ferriani, Cattani, & Baden-Fuller, 2009).

An individual who is connected to two people who are also connected to one another is known as a closed triplet; at the network level, the overall prevalence of this structure is commonly referred to as closure, and is typically measured via the clustering coefficient (Wasserman & Faust, 1994). Psychologically, individuals tend to form closed triplets because closure—or, the tight interconnectedness of a network—allows individuals to capitalize on their relationships with others (Coleman, 1988, 1990; Burt, 2001). Triads are inherently distinct from dyads—namely, they are more stable. Simmel (1950) posited that is due to three causal factors. First, dyads preserve the individuality of the component members, because there is never a situation where the "majority rules." In triads, however, individual component members can easily be outvoted and thus everyone must work for the collective good. Second, component members of dyads retain more bargaining power because they each can threaten to dissolve the relationship. In triads, if one member threatens to leave the group there will still be a relationship left over between the remaining two members; thus, this threat loses its potency with the addition of a third member to the group. Finally, conflict in the context of a dyad can escalate quickly, but is ameliorated by the presence of a third party in a triad. Krackhardt defined *Simmelian tie* as a situation where two individuals "are reciprocally and strongly tied to each other and…reciprocally and strongly tied to at least one third party in common" (1999, p.186). He noted that when compared with dyads, the component members of these types of triangular relationships experience stronger interpersonal bonds and more powerful social sanctions on behavior.

Balance—or, the tendency of people to strive for relational equilibrium—has also been proposed as a mechanism that shapes team self-assembly (Contractor, 2013). Theoretically, balance occurs in team assembly when two individuals team up because they have a mutual connection. Research has indicated that two individuals who interact with a mutual third teammate are highly likely to become teammates themselves (Huang et al., 2013a), providing some evidence that balance does influence team assembly patterns. In particular, one study on MMORG self-assembled teams indicated that the likelihood of transitive triplet (i.e., a specific measure of closure that only applies to directed networks) is greater than the likelihood of random tie formations (Putzke et al., 2010). In other words, people form relationships in patterns of closure more often than would be expected by chance.

I expect that for the same reasons that balance emerges in friendship networks (e.g., cohesiveness, social sanctioning, and stability), balance will also occur in team assembly networks. Component individuals in team formation networks stand to gain from patterns of closure; balanced team assembly relations mean consolidating workloads, reducing role conflict, and minimizing role overload. In other words, individuals should be driven to employ balance mechanisms in their assembly networks because developing network features such as social sanctions and Simmelian ties will facilitate teamwork in the long run. Thus, based on previous research and theory, I propose that:

Hypothesis 3b: Self-assembled teams will have higher levels of team membership closure than would be expected by chance.

Situational Attraction

In addition to the various ways that people can be attracted to one another because of individual differences and relational characteristics, certain contexts—or situations—serve to promote interpersonal attraction. The situation that has the most powerful impact on interpersonal attraction is proximity, a situation of physical closeness; “other things equal, people are most likely to be attracted toward those in closest contact with them" (Newcomb, 1956, p. 575). Proximity is the natural antecedent of other attraction mechanisms such as familiarity; apart from virtual contexts, dyads must be physically proximal in order to become familiar. In fact, proximity is the single best predictor of whether two people will form a connection or not, even surpassing the predictive ability of absolute, relative, and relational characteristics. With few exceptions, people are more likely to form platonic and romantic connections with those who live nearby (Festinger, Back, & Schachter, 1950; Vandenberg, 1972; Ebbesen et al., 1976; Hays, 1985). For instance, students assigned seats near one another are more likely to become friends than students in the same class sitting further apart (Back, Schmukle, & Egloff, 2008). The finding that proximity positively influences attraction is so robust, in fact, that it has even been entitled the "Law of Propinquity." As Krackhardt writes, "[t]his law states that the probability of two people communicating is inversely proportional to the distance between them" (1994, p. 213). Furthermore, proximity has been shown to amplify the effect of other attraction mechanisms; one study showed that individuals similar in age had stronger network connections than individuals of disparate ages, but people similar in age and proximally located to one another had the strongest network connections of all (Reagans, 2011).

Although much of the attraction literature to date has emphasized mechanisms that function in face-to-face situations, a new line of research has begun delving into attraction in the virtual realm. First, the effect of physical proximity is so powerful that it has even been demonstrated on the Web; people that are geographically proximal to one another communicate more frequently online than do people that are geographically disparate (Leskovec & Horvitz, 2007, 2008). Furthermore, due to the advent of the

Internet and rich communication technologies that increase feelings of closeness between individuals in geographically disparate locations, researchers have expanded upon the definition of proximity to include *perceived* proximity (Wilson, O'Leary, Metiu, & Jett, 2008). Preliminary research has indicated that computer-mediated-communication leads to increased levels of self-disclosure and direct questioning, thereby leading to increased levels of interpersonal attraction between dyads (Mantovani, 2001; Antheunis, Valkenburg, & Peter, 2007).

<u>In Teams</u>

To date, very little research has been done on the impact that proximity has on attraction in teams. One study's results indicated that individuals are more likely to choose teammates that are physically proximal than select physically distal teammates (Cummings & Kiesler, 2007). This effect has been shown to hold true even when solely considering virtual teams (Huang et al., 2009a; Huang et al., 2013a). Based on these preliminary findings, it is conjectured that:

> *Hypothesis 4: Self-assembled teams will exhibit a propinquity effect, choosing teammates who are nearby more often than would be expected by chance.*

A second goal of this dissertation is to understand the relative impact of assembly mechanisms. Whereas the previous sections have explored the mechanisms that likely govern team formation ties, in this section I consider the relative strength of each mechanism as a force of attraction in drawing people to work together. Although little research has compared and contrasted absolute, relative, relational, and situational attraction mechanisms, one clear finding from research on attraction is the profound effect of proximity on interpersonal relationships (Festinger et al., 1950; Priest & Sawyer, 1967; Back et al., 2008).

The proximity effect can even overpower other influential forces of attraction, such as homophily; proximity has been shown to account for friendships that disobey the law of similarity-attraction. Specifically, Nahemow and Lawton (1975) compared the effects of homophily and propinquity by assessing friendships in a sample of 270 residents of a city housing project. They found that the law of homophily was violated under one condition: when individuals lived close to one another. This finding implies that people's tendency to associate with nearby individuals is stronger than their tendency to form homophilous friendships.

Other research has shown that, in addition to the definite impact of proximity, relational attraction mechanisms also have a profound effect on interpersonal relationships. For example, Škerlavaj, Dimovski, and Desouza (2010) studied learning networks using a sample of individuals employed at a company specializing in software development, information technology, and business consulting. Based on the results of ERGM analyses predicting the extent to which learning ties form between individuals (i.e., the extent to which person A learns something from person B, or vice versa), the researchers concluded that the effect of transitivity (i.e., a specific measure of closure that only applies to directed networks) was greater in magnitude than the effect of educational, gender, hierarchy, or tenure homophily, but that the propinquity effect overpowered both transitivity and homophily.

The aforementioned research results portray homophily as a relatively weak social force. How can that be the case, when homophily is so well documented? One potential explanation is that the similarity-attraction effect appears robust only when absolute, relational, and situational social forces are not accounted for; in other words, the homophily effect is epiphenomenal (Feld, 1982; Rivera, Soderstrom, & Uzzi, 2010). For instance, if propinquity is excluded from analyses evaluating how racial similarity influences attraction, than the impact of living in a racially homogenous area on tie formation is discounted. This line of reasoning is the basis for differentiating between *choice* and *induced homophily.* The former term refers to homophily when it occurs based on the preferences of individuals, while the latter refers to homophily that occurs due to structural constraints on individuals' social relationships (McPherson & Smith-Lovin, 1987; Kossinets & Watts, 2009).

The results of a number of studies have (at least in part) supported the notion of induced homophily. For instance, Wimmer and Lewis (2010) used the Facebook data for a cohort of college students consisting of 1,640 individuals to study racial homophily in friendship networks. Based on the results of ERGM analyses predicting the formation of friendship ties, the researchers concluded that propinquity (i.e., residence in a shared room) had a stronger effect than transitivity (i.e., the tendency to form friendships with friends of friends), which in turn had a stronger effect than any sort of surface- or deep-level homophily. Overall, Wimmer and Lewis determined that social balancing mechanisms (e.g., transitive relationships), propinquity, and homophily based on deep-level characteristics all influence the formation of social ties more so than racial homophily. In a similar study, Kossinets and Watts (2009) used email exchanges from 30,000 members of a university community to study patterns of homophily and transitivity. The researchers found that, while homophily did powerfully impact tie formation, triadic closure had a very strong influence as well; 60% of all new ties formations occurred as a result of triadic closure. They concluded that triadic closure exacerbates induced homophily by constraining individuals' social relations.

Very few studies have assessed the aforementioned issues in the context of team assembly patterns. However, one such study is Huang et al.'s (2009a), which used a sample of Everquest II MMORPG teams. The researchers used ERGM analyses on a network of team membership relationships to evaluate how absolute, relative, relational, and situational attraction mechanisms impact team assembly patterns. They determined that popularity, transitivity, and propinquity all impact team assembly patterns to a degree greater than homophily on gender, age, or experience. This finding is especially surprising, considering the fact that players have no discernable means of detecting one another's actual geographic locations in the virtual world of Everquest II. Huang et al. suggest that perhaps player familiarity is confounded with proximity; nearly 70% of their respondents reported playing the game with friends that they knew offline[1]. Consequently, I hypothesize that:

> *Hypothesis 5: The propinquity effect will be stronger than the absolute, relative, and/or relational effects on team self-assembly.*

Team Composition and Outcomes

Whereas the previous hypotheses concern the mechanisms that characterize how individuals are likely to form teams, I now consider the consequences of those decisions—namely, team composition. The team composition literature centers on how

[1] This particular study did not control for the effect of familiarity.

team performance, cohesion, and other important outcomes can be predicted using team members' personal characteristics. Traditionally, researchers have grouped team characteristics into two general categories: compositional and configurational. Compositional—or, global (Molleman, 2005)—properties of teams are fundamentally equivalent across levels (Kozlowski & Klein, 2000). Because they manifest at the team level just as they do at the individual level, these attributes can be adequately operationalized as averages. In certain situations and/or with certain variables, however, it is not appropriate to take team-level averages (Barrick, Stewart, Neubert, & Mount, 1998). Thus, the configurational approach evaluates team composition from a different angle, using team-level variance, minimums, and maximums (Hollenbeck, DeRue, & Guzzo, 2004) to emphasize the dispersion of attributes. For the purposes of this research, I built on this established classification system to create an even broader taxonomy that is more amenable to the incorporation of both personal characteristics and relationships as building blocks of team assembly. I have grouped team characteristics into four broad categories: absolute attributes, relative attributes, relational structures, and situational attributes. Absolute attributes are certain attributes that additively impact team outcomes; in other words, the higher level of a given attribute on a team, the better the outcome. This category closely resembles the traditional compositional approach. Conversely, variance levels of relative attributes predict team outcomes; likewise, this category closely resembles the traditional compilational approach. Adding to the preexisting framework, relational structures are specific ways that teammates' relationships can be characterized—or patterned—that predict team outcomes. Finally, situational attributes are characteristics of team contexts that can be used to predict team outcomes.

Absolute Attributes and Team Outcomes

The team literature's additivity model (Hill, 1982; Tziner, 1985) suggests that certain team member characteristics combine in an additive manner with regard to their impact on group-level outcomes. Research has indicated that popularity may be one such additive attribute. In the network science literature the term "degree" refers to the number of connections a node (i.e., a person) has to other nodes; essentially, degree represents social connectedness, or popularity. The "so-called 'rich-club' phenomenon…refers to the tendency of high-degree nodes, the hubs of the network, to be very well-connected to each other. Essentially, nodes with a large number of links, usually referred to as rich nodes, are much more likely to form tight and well-interconnected subgraphs…than low degree nodes" (Colizza, Flammini, Serrano, & Vespignani, 2008, p. 110). Furthermore, findings from empirical and meta-analytic research have suggested that teams with dense social ties outperform teams with sparse social ties (Reagans & Zuckerman, 2001; Balkundi & Harrison, 2006). It follows, then, that teams of high degree, high social status hubs will outperform teams of less popular individuals. Psychologically, assembling based on popularity and status will give teams an upper hand because they will be able to leverage the social capital afforded to them by their many relational ties (Burt, 2001) in order to outperform teams with fewer social connections. Thus, I hypothesize that:

> *Hypothesis 6: Self-assembled teams composed of many popular members will outperform self-assembled teams composed of relatively few popular members.*

Relative Attributes and Team Outcomes

The team composition literature has also delved into the relation between the variance of surface- and deep-level attributes on a team and team performance (as well as other important team outcomes). Research on team diversity often operationalizes heterogeneous (i.e., diverse) teams as those that have a high level of variance on one or more demographic attributes, while teams that have a low level of variance on one or more demographic attributes are considered homogenous. In general, research has shown that teams that are heterogeneous—in terms of surface- and/or deep-level attributes—have a broader array of information to draw from than homogeneous teams, and heterogeneous teams perform better than homogeneous teams when situational uncertainty and decision importance are high (Mello & Ruckes, 2006). However, this disparity in performance has not surfaced consistently across studies (West & Schwenk, 1996).

Surface Level

The literature on surface-level team diversity predicting team performance has resulted in a number of contradictory findings. For instance, meta-analytic research has indicated no relation between surface-level diversity and team performance (Webber & Donahue, 2001; Stewart, 2006; Horwitz & Horwitz, 2007) or team cohesion (Webber & Donahue, 2001; Horwitz & Horwitz, 2007). Still, other scholars have argued that surface-level diversity has a positive impact on team processes and outcomes, such as team cohesion (Jackson, 1991). Furthermore, some research has indicated that teams that are diverse at the surface level outperform teams that are heterogeneous at the surface level on creativity and judgmental decision-making tasks (Jackson, 1991; Watson, Kumar, & Michaelsen, 1993). From a network analytic perspective, increasing the diversity of a network reduces internal density and heightens external range, two factors that tend to enhance team performance (Reagans, Zuckerman, & McEvily, 2004). Overall, the effects of surface-level diversity characteristics on teams have been shown to weaken over time, as group members become better acquainted (Harrison et al., 1998; Harrison et al., 2002).

Specific dimensions of diversity, such as race/ethnicity, have also been studied in the context of team performance. In general, racial diversity is negatively related to team performance (Jehn & Bezrukova, 2004; Bell, Villado, Lukasik, Belau, & Briggs, 2011; Leslie, 2014). However, this finding appears to be contextually specific. For instance, archival research on sports teams has shown that racial diversity negatively predicts performance for basketball but not baseball teams (Timmerman, 2000). In addition, a number of studies have found evidence supporting the notion that racially/ethnically diverse teams outperform more homogeneous groups on creative/innovative performance. For instance, research has shown that racially diverse teams devise more creative and implementable solutions to problems than do racially homogeneous groups (O'Reilly, Williams, & Barsade, 1996). Moreover, studies delving into the relation between ethnic diversity and team creative performance found that, when faced with a brainstorming task, ethnically heterogeneous groups produce more effective and feasible responses than homogeneous teams (McLeod & Lobel, 1992; McLeod et al., 1996). In further support of this claim, research has indicated that long-term culturally heterogeneous groups—culture essentially being operationalized as racial identification—outperform their homogeneous counterparts on problem-solving tasks (Watson et al., 1993).

Racial heterogeneity has also been linked to a variety of team-level outcomes apart from performance. For instance, racially diverse groups experience more emotional conflict (Pelled, Eisenhardt, & Xin, 1999) and less cohesion (Leslie, 2014) than racially homophilous groups. Other research has shown that group racial heterogeneity is associated with decreased psychological attachment to the group, and that this effect is more profound for White people than it is for people of color (Tsui, Egan, & O'Reilly, 1992). Furthermore, culturally heterogeneous teams—culture being operationalized as ethnic identification—develop lower levels of affect-based trust than culturally homogeneous teams (Rockstuhl & Ng, 2008). However, network analytic research has reported that racial heterogeneity in teams does not have a significant impact on team processes such as task-relevant or task-irrelevant communication (Yuan & Gay, 2006).

Gender is another surface-level characteristic that is studied in the context of team diversity and performance. Meta-analytic research has reported mixed results with regards to the relation of gender diversity and team performance. Some research has indicated a negative relation (Jehn & Bezrukova, 2004; Bell et al., 2011); specifically, research has indicated that all-male and all-female teams perform similarly, and both types of gender-homogeneous groups outperform mixed-gender teams (Clement & Schiereck, 1973). Additionally, some research has indicated that gender-homogeneous groups produce more original solutions to problems than gender-heterogeneous groups do (Kent & McGrath, 1969). Contrastingly, more recent meta-analytic research has indicated no relation between gender diversity and team performance (Bowers, Pharmer,

& Salas, 2000). Some work has even concluded—contrary to the antiquated notion that some work is best carried out by homogeneous, male teams—that all-male teams actually perform worse than mixed-gender or all-female teams on traditionally male tasks (LePine, Hollenbeck, Ilgen, & Colquitt, 2002).

Gender heterogeneity also impacts other group outcomes apart from performance. For instance, research has shown that component members of mixed-sex teams feel less satisfied, perceive communication to have been of lower quality, perceive lower levels of work efficiency and cooperation, and perceive enhanced levels of intragroup competition and tension relative to members of same-sex teams (Alagna et al., 1982). Furthermore, gender heterogeneity is associated with decreased psychological attachment to the group, and that this effect is more profound for men than it is for women (Tsui et al., 1992). However, team gender diversity does not significantly impact task-relevant or task-irrelevant communication (Yuan & Gay, 2006).

By some scholars' accounts, age diversity in teams is unrelated to team performance (Simons, Pelled, & Smith, 1999; Bell et al., 2011). However, other work has suggested that age diversity is negatively related to group performance (Jehn & Bezrukova, 2004). Field research on work teams has indicated a negative relation between age diversity and both with-group technical communication (Zenger & Lawrence, 1989) and firm performance (Goll, Sambharya, & Tucci, 2001), and a positive relation between age diversity and turnover (O'Reilly, Caldwell, & Barnett, 1989; Jackson et al., 1991; Wiersema & Bird, 1993). Moreover, like the finding for racial diversity, archival research on sports teams has shown that age diversity negatively predicts performance for basketball but not baseball teams (Timmerman, 2000).

However, research has also suggested that age heterogeneity is positively related to certain beneficial team-level outcomes. For instance, there is a positive relation between age diversity and both progressive decision-making (Goll et al., 2001) and innovation (Zajac, Golden, & Shortell, 1991). Furthermore, age-diverse groups also experience less emotional conflict than age-homophilous groups (Pelled et al., 1999).

A variety of status-relevant surface-level diversity characteristics are also related to team outcomes. Research looking at general informational diversity (i.e., a combined measure of education, functional area, and position in firm) has concluded that the construct positively impacts group performance (Jehn, Northcraft, & Neale, 1999). Specific work on heterogeneity in terms of education level, however, has implicated the variable as a negative predictor of a variety of performance-relevant dependent variables. For instance, education level diversity negatively predicts productivity (Stvilia et al., 2010, 2011), progressive decision-making (Goll et al., 2001), strategic consensus (Knight et al., 1999), and performance ratings (Jehn & Bezrukova, 2004). Research specifically on top management teams has also indicated a positive relation between education level heterogeneity and firm performance (Goll et al., 2001), sales growth, and return on investments (Smith et al., 1994). To further complicate matters, meta-analytic research has suggested that the relation between education level diversity and performance is null (Bell et al., 2011).

Functional background diversity positively predicts a variety of performance-relevant team outcomes (Ancona & Caldwell, 2009), such as interteam communication (Ancona & Caldwell, 1992), informal within-team communication (Smith et al., 1994), innovation/creativity (Bantel & Jackson, 1989; Ancona & Caldwell, 1992; Bell et al., 2011), productivity (Stvilia et al., 2010, 2011), adaptability (Keck & Tushman, 1993), progressive decision-making (Goll et al., 2001), and performance in general (Jehn & Bezrukova, 2004; Bell et al., 2011). Functional background heterogeneity has been shown to be an especially powerful predictor of performance for certain types of teams. For instance, the relation between functional background diversity and performance is strongest when considering design and product development teams (Bell et al., 2011). Furthermore, functional background heterogeneity of top management teams positively predicts change in firm market share and profits (Hambrick, Cho, & Chen, 1996). Meta-analytic research has also shown that educational background diversity—a variable akin to functional background diversity, reflecting functional focus during postsecondary school—is unrelated to general team performance, expect when considering top management teams, and positively related to creative/innovative team performance (Bell et al., 2011). Experimental work on top management teams has indicated that educational background heterogeneity positively predicts change in firm market share, profits (Hambrick et al., 1996), and corporate strategic change (Wiersema & Bantel, 1992), but also positively predicts turnover (Jackson et al., 1991).

There are a number of caveats to the finding that functional background diversity positively impacts team performance. For example, the positive relation holds when teams are completing highly complex tasks, but the valence of the relation is reversed when teams are completing simple tasks (Higgs, Plewnia, & Ploch, 2005). In addition, functional background diversity can be conceptualized as dominant or intrapersonal. Dominant functional diversity is the extent to which team members differ in terms of their primary areas of expertise, while intrapersonal functional diversity is the extent to which team members vary in terms of being narrow specialists or broad generalists. Research has indicated that dominant functional diversity has a negative relation with both information sharing and team performance, while intrapersonal functional diversity has a positive relation with both information sharing and team performance (Bunderson & Sutcliffe, 2002). Research has also suggested that functional background diversity is a primary driver of task conflict in teams (Pelled et al., 1999), and negatively predicts strategic consensus (Knight et al., 1999), team satisfaction (Yeh & Chou, 2005), and social integration (Smith et al., 1994). In addition, a number of studies explicitly investigating self-assembled teams indicated that functionally heterogeneous self-assembled teams perform similarly to their more homogeneous counterparts (Porac et al., 2004; Cummings & Kiesler, 2005).

Mixed findings have been reported with regard to the relation between tenure diversity and team performance. Meta-analytic research has indicated no relation between the variables (Bell et al., 2011). Nevertheless, other scholars have posited that organizational tenure diversity is detrimental to team outcomes, following findings that tenure heterogeneity positively predicts emotional conflict (Pelled et al., 1999) and turnover (O'Reilly, Snyder, & Boothe, 1993; Wiersema & Bird, 1993) and is negatively related to progressive decision-making (Goll et al., 2001), with-group technical communication (Zenger & Lawrence, 1989), team dynamics (e.g., cooperation), and adaptive change (O'Reilly et al., 1993). Furthermore, tenure diversity negatively predicts social integration, which, in turn, positively predicts turnover (O'Reilly et al., 1989).

However, the effect of tenure diversity on team outcomes does not seem to be solely detrimental; the variable is also positively related to team task work (e.g., setting goals, clarifying priorities; Ancona & Caldwell, 1992), strategic change (Boeker, 1997), team performance ratings (Jehn & Bezrukova, 2004), and firm growth (Eisenhardt & Schoonhoven, 1990). Research on top management teams has indicated that tenure heterogeneity positively predicts change in firm market share and profit (Hambrick et al., 1996). When the effects of functional and tenure diversity are compared, functional diversity has a greater impact on the social network structure of a team than does tenure diversity (Reagans et al., 2004). In addition, similar constructs to tenure diversity have been linked to important team outcomes. For instance, heterogeneity in terms of years of experience negatively predicts social integration, sales growth, and return on investment, and positively predicts informal team communication (Smith et al., 1994). Finally, research has indicated a positive relation between organizational prestige diversity and turnover (Wiersema & Bird, 1993), and positional diversity—a construct essentially analogous to occupational prestige diversity—is positively related to team satisfaction (Yeh & Chou, 2005). Overall, the general patterning of findings is such that surface-level diversity is good for team outcomes. Thus, I posit the following hypothesis:

> *Hypothesis 7a: Teams that assemble based on surface-level heterophily will outperform teams that do not assemble based on surface-level heterophily.*

<u>Deep Level</u>

The diversity of deep-level attributes has also been studied in relation to team performance and other performance-relevant outcomes. In general, meta-analytic research has indicated mixed findings when reporting on the relation between deep-level diversity and team performance; some research has indicated no relation between either deep-level diversity and performance or cohesion (Webber & Donahue, 2001), while other research has suggested a positive relation between deep-level diversity and performance (Horwitz & Horwitz, 2007). Overall, the effects of deep-level diversity characteristics on team outcomes have been shown to strengthen over time, as group members become better acquainted with one another (Harrison et al., 1998; Harrison et al., 2002). Attitudinal diversity is one type of deep-level variance that has been used to predict team performance; attitudinally-diverse teams produce more creative output than attitudinally-homogeneous teams (Triandis, Hall, & Ewen, 1965). Attitudinal diversity is also related to other team-level performance-relevant outcomes. For instance, team attitude heterogeneity negatively predicts team cohesiveness (Good & Nelson, 1973). Specifically, job satisfaction diversity negatively predicts group cohesion, and that relation strengthens over time (Harrison et al., 1998). In addition, team diversity in terms of outcome importance—or, the value of doing the team's work well—negatively predicts team social integration, and both diversity in terms of outcome importance and task meaningfulness—or, personal salience of the team's work—negatively predict collaboration (Harrison et al., 2002).

Overall, teams heterogeneous with regard to personality are similar to their homogeneous counterparts in terms of performance (Bowers et al., 2000). Some research has even suggested that personality-diverse groups come up with problem solutions of a higher quality than personality-homogeneous groups (Hoffman, 1959; Hoffman & Maier, 1961). However, rather than investigating actual personality heterogeneity, one study manipulated team members' perceptions of personality similarity by providing participants with false personality inventory feedback. The scholars found that teams that believed they were personality-homogeneous outperformed teams that believed they were personality-heterogeneous (Civettini, 2007).

In terms of research findings related to specific personality facets, conscientiousness variance negatively predicts performance in teams (Peeters, Van Tuijl, Rutte, & Reymen, 2006). Contrastingly, extraversion variance positively predicts team performance (Neuman, Wagner, & Christiansen, 1999; Mohammed & Angell, 2003). Some scholars have even concluded that, when formally staffing a team, attempts should be made to minimize conscientiousness variance and maximize extraversion variance in order to enhance team outcomes (Humphrey, Hollenbeck, Meyer, & Ilgen, 2007). However, other research has indicated that higher variations in levels of extraversion lead to less constructive, more passive-aggressive interaction styles in teams (Balthazard, Potter, & Warren, 2004). Furthermore, agreeableness variance (Mohammed & Angell, 2003; Halfhill, Nielsen, Sundstrom, & Weilbaecher, 2005; Peeters et al., 2006) and neuroticism variance are both negatively predictive of team performance (Neuman et al., 1999; Mohammed & Angell, 2003). Apart from the Big Five personality traits, team proactive personality diversity indirectly impacts team proactive performance via its impact on favorable interpersonal norms (Williams, Parker, & Turner, 2010).

Ability is another deep-level characteristic upon which team members may vary. However, research has suggested that ability diversity within teams is not predictive of team performance, and that this is true for cognitive ability (Devine & Philips, 2001) as well as for more general, task-relevant ability (Bowers et al., 2000). Furthermore, teams that are homogeneous in terms of creative ability actually outperform more heterogeneous teams on creative tasks (Triandis et al., 1965). Additionally, one study found that variance in team values is negatively related to team social integration (Harrison et al., 2002). Overall, the general patterning of findings is such that deep-level diversity is good for team outcomes. Thus, I posit the following hypothesis:

Hypothesis 7b: Teams that assemble based on deep-level heterophily will outperform teams that do not assemble based on deep-level heterophily.

Relational Structures and Team Outcomes

"Better the devil you know than the devil you don't know."

Relational structures refer to the patterns of relationships that characterize the group; teams can be described not only based on the attributes of the component individuals, but also based on the relationships between teammates. At a very general level, individuals on a team can be either previously familiar with one another, or total strangers. Research comparing teams composed of familiar individuals with teams composed of unfamiliar individuals has indicated that initially familiar teams outperform unfamiliar teams. However, over time, as unfamiliar teams grow familiar, this disparity in performance disappears (Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003). Specifically, prior relationships increase team transactive memory, and make it easier for teammates to express disagreement with one another (Katz, Lazer, Arrow, & Contractor, 2005). In particular, the firm growth of top management teams composed of members that have previously worked with one another trumps that of top management teams composed of unfamiliar members (Eisenhardt & Schoonhoven, 1990). Additional research on familiarity and team performance has found that, when teams are solving a problem based on information that is fully shared amongst teammates, groups composed of all strangers outperform both fully and partially familiar teams. However, when solving a problem based on partially shared information, fully and partially familiar teams outperform unfamiliar teams (Gruenfeld, Mannix, Williams, & Neale, 1996). Furthermore, familiarity has the most beneficial effects on team performance when coordination between team members is challenging (e.g., in large teams or dispersed teams; Espinosa, Slaughter, Kraut, & Herbsleb, 2007).

Specifically, teams can be composed of individuals with certain types of preexisting relationships. Meta-analytic research relating relational attributes of teams with team outcomes has concluded that the instrumental tie density (e.g., work-related advice) and expressive tie density (e.g., friendship) are both positively predictive of team viability and team performance (Balkundi & Harrison, 2006). Specifically, teams of friends tend to outperform teams of acquaintances on both decision-making tasks and motor tasks, due to higher relative levels of cooperation and commitment (Jehn & Shah, 1997). Interestingly, friendship expansiveness—a situation where team members have a high number of friendship ties with non-teammates—is negatively related to team performance (Baldwin, Bedell, & Johnson, 1997). Contrastingly, the density of a team's hindrance network—or, reported relationships that inhibit rather than facilitate work—negatively predicts team performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). Based on the extant literature, I propose that:

> *Hypothesis 8a: Teams that assemble based on familiarity will outperform teams that do not assemble based on familiarity.*

The framework of balance theory (Heider, 1958), which suggests that individuals strive for consistency in their relationships with others, can be used as a basis for predicting critical team outcomes using relational structures. Triadic closure is one type of relational structure that exemplifies balance theory. Generally, triadic closure promotes the development and enforcement of norms between individuals, which in turn positively benefits performance (Reagans et al., 2004). Specifically, transitivity is the "tendency that two actors who are connected to a third party form mutual relationships over time" (Batjargal, 2007, p. 998). At the group level, teams that have more transitive trust ties outperform teams with less transitive trust ties (Lusher, Kremer, & Robins, 2014). Other research has noted that teams with high levels of transitive communication ties experience stronger feelings of team cohesion, while teams devoid of such transitive communication subjectively experience a lack of cohesion (Quintane, Pattison, Robins, & Mol, 2013). Finally, one study suggested that transitivity mediates the negative relation between age diversity and knowledge transfer as well as the positive relation between educational diversity and knowledge transfer (Miao-miao & Jun, 2013). Following findings from the extant literature, I posit that:

Hypothesis 8b: Teams that assemble based on closure will outperform teams that do not assemble based on closure.

Situational Attributes and Team Outcomes

Teams can further be distinguished by defining characteristics of their situations, or contexts. Akin to the dyadic attraction literature on the subject, proximity is an extremely powerful driver of team-level processes and outcomes. For example, research has suggested that individuals on globally distributed teams tend to identify with the subgroup in their proximal environment rather than identifying with the larger distributed team (Joshi, Labianca, & Caligiuri, 2002). This findings serves, in part, to explain why globally distributed teams' performance suffers in comparison with other types of teams.

In general, distributed work groups have increased levels of conflict and experience communication breakdowns (Armstrong & Cole, 2002). Specifically, research has indicated that geographic heterogeneity negatively predicts task-relevant and task-irrelevant communication within teams (Yuan & Gay, 2006). Furthermore, geographic distance between teammates is often accompanied by differences in time zone, culture, and organizational style, all of which can make communication and coordination more challenging for distributed teams (Armstrong & Cole, 2002). Research juxtaposing proximity and virtuality concluded that globally distributed teams face greater behavioral challenges, project management challenges, and performance detriments when compared with proximally located virtual and face-to-face teams (McDonough, Kahn, & Barczak, 2001). Preliminary research on proximity and self-assembled team outcomes indicated that colocated self-assembled teams coordinate and perform better than geographically distributed self-assembled teams (Cummings & Kiesler, 2005). Specifically, proximity positively impacts the communication, coordination, mutual support, and effort facets of teamwork quality (Hoegl & Proserpio, 2004).

Nevertheless, distance also impacts team processes and performance in some positive ways. For instance, geographic heterogeneity weakens the detrimental impact of racial and gender homophily on team communication (Yuan & Gay, 2006). Distributed teams may even outperform colocated teams, but only if they exhibit high-quality teamwork (Hoegl, Ernst, & Proserpio, 2007). Stvilia et al. (2011) concluded that better outcomes result from research carried out by (distributed) scholars at multiple institutions rather than by (colocated) scholars at a single institution. In general, however, the literature suggests that proximity has a positive impact on team outcomes. Thus, it is conjectured that:

Hypothesis 9: Teams that assemble based on propinquity will outperform teams that do not assemble based on propinquity.

Rarely have absolute, relative, relational, and situational facets of team composition been empirically compared and contrasted with one another. However, one clear finding from research on team composition and performance is the beneficial effect of heterophily on team performance; research has shown that teams that are heterogeneous—in terms of surface- and/or deep-level attributes—have a broader array of information to draw from than homogeneous teams, and consequently heterogeneous teams outperform homogeneous teams in important and/or uncertain situations (Mello & Ruckes, 2006). It follows that the team composition factor that contributes most expressly to the performance of self-assembled teams will be demographic heterogeneity. Thus, it is posited that:

Hypothesis 10: Teams that assemble primarily based on heterophily will outperform teams that assemble primarily based on absolute, relational, or situational attraction mechanisms.

Figure 1 displays a visualization of my full theoretical model, including Hypotheses 1 through 10.

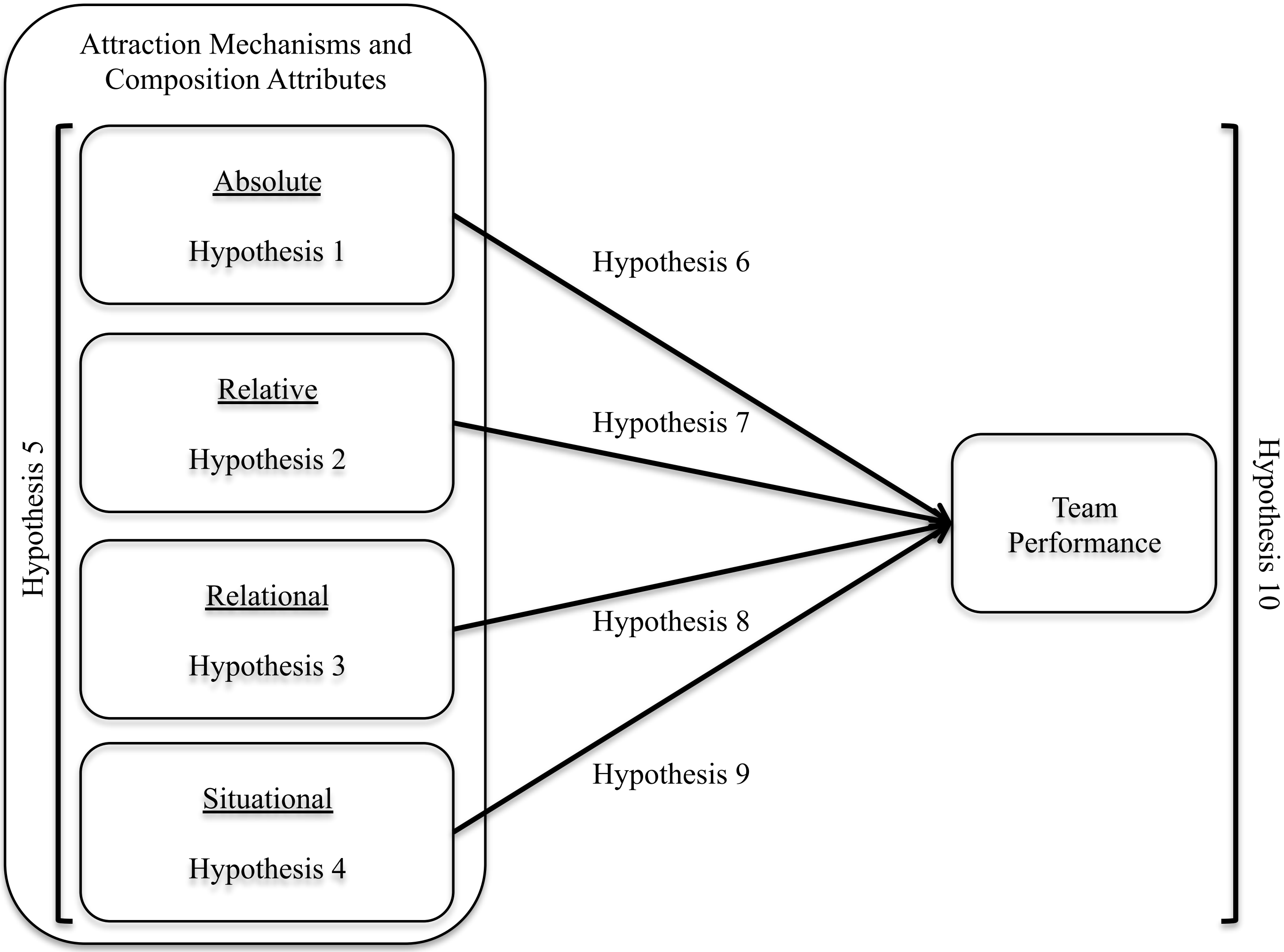


Figure 1. Theoretical model.

CHAPTER 2

METHOD

This study was reviewed by the Georgia Tech Institutional Review Board (IRB) and qualified for exemption status due to the minimal risk retrospective nature of the data collection, meaning that the Dragon Nest players did not need to consent for their data to be used for the purposes of this research. These ideas were tested using de-identified server-side data on a large sample of individuals who joined teams to play the online game Dragon Nest. Dragon Nest is a free-to-play web-based massively multiplayer online role-playing game—or MMORPG—developed by Eyedentity Games, Inc. MMORPGs are games that envelop players in a virtual reality. Similar to the real world, these fantasy worlds can be mapped out, are large and complex, and are constantly in flux. Importantly, the world of an MMORPG does not cease to exist when a player turns off her computer; rather, large numbers of players simultaneously interact in one persistent reality, and can come and go as they see fit (Yee, 2006). In the virtual, fantasy world of Dragon Nest, gameplay centers on the completion of task-based missions called quests. Importantly, players are encouraged to complete quests in teams, which range in size from 2 to 4 people[2]. Thus, making progress in Dragon Nest is contingent upon the successful self-assembly of teams. Upon the completion of a quest, teammates are rewarded with experience points that, upon accumulation, result in level advancement for each individual. Upon reaching certain milestone levels, players begin assume more

[2] Three Dragon Nest quests for very high-level players that have maximum team sizes of 8 are exceptions to this rule.

advanced roles, graduating to secondary classes of characters at level 15, and tertiary classes of characters at level 45. Although online gameplay may appear superficially dissimilar from organizational behavior, scholars have argued otherwise (Williams, Contractor, Poole, Srivastava, & Cai, 2011). For instance, Contractor argued that "online environments are in fact the ideal 'online laboratories' to understand and enable how we will use the Web to assembly into teams in the foreseeable future" (2013, p. 9), while Castronova dubbed online games "Petri dishes for social science" (2006, p. 163).

Participants and Materials

The Dragon Nest data set is largely comprised of digital trace data, which is a type of big data that stems from the automatic recording of information based on users' activity within the context of a virtual system. Digital trace data are defined by 3 characteristics: they are found data, event-based, and longitudinal in nature. First, digital trace data are found data, meaning they are the virtual by-products of human interaction rather than the result of an intentional data collection process using instruments designed for research purposes. Second, digital trace data are event-based rather than summary-based. Traditional social network analysis can be classified as the latter; individuals are often asked to summarize their extant relationships for network analytic purposes. However, computational social science—or, social science that employs digital trace data (Lazer et al., 2009)—has to draw conclusions about relationships based on digital records of virtual events rather than individual summarization. Finally, digital trace data is longitudinal in nature, as the component virtual events of any given digital trace data set occurred over time (Howison, Wiggins, & Crowston, 2011). One primary benefit of the use of digital trace data is the unobtrusive nature of its acquisition; the current data was all collected within the context of the Dragon Nest game, allowing for inconspicuous tracking of team self-assembly patterns.

The raw Dragon Nest trace data set includes roughly 6,116,200 data points (i.e., instances of individual players questing, either by themselves or on teams) for each weeklong period. Contemporarily, computing power poses a serious limitation to the analysis of such a large data set. Thus, due to the unusually large size of the raw data, the proposed research tested the aforementioned hypotheses on a sample of Dragon Nest in-game data. Specifically, gameplay from Monday, February 6, 2012 was analyzed, because this date coincides with China's Lantern Festival. The Lantern Festival is a holiday that marks the end of the lunar (i.e., Chinese) New Year, when Chinese people release colorful paper lanterns and fireworks into the night sky to express their hopeful wishes for the coming year. The Lantern Festival is widely celebrated in China—so much so, in fact, that this annual burning of fireworks has a significant, negative impact on the air quality in major Chinese metropolitan areas (Wang, Zhuang, Xu, & An, 2007). For the purposes of this study, data from February 6, 2012 were selected to analyze because many Chinese schools and businesses are closed on the day of the Lantern Festival; thus, because of the holiday, more Dragon Nest players would be interacting in the virtual world throughout the course of the day. Indeed, Dragon Nest traffic was much higher on February 6 than on comparable dates in early 2012. For instance, the prior Monday had 608 less players and 265 less teams than February 6, while the subsequent Monday had 4,527 less players and 3,204 less teams.

Data Cleaning

A number of steps were taken to clean the data, identifying the portion of data that contained instances of team assembly on which the 10 hypotheses could be tested. First, 1,082,290 observations of 82,794 players were excluded because these records characterized independent play, where players did not form teams. Next, 159,949 observations of 28,735 players on 14,093 teams were removed from the data set because of variance between team members on one or more critical team-level variables, including quest success, quest performance, quest start/stop time, team size, task type, and task difficulty. Subsequently, 26 instances of single-member “teams” were removed from the data set; 343 observations of 293 players on 82 teams were excluded from analyses because the team size variable did not accurately reflect the number of team members; and 2,080 instances of 1,435 players on 200 teams were removed from the data set because these teams included more than 8 members (i.e., the maximum possible amount of players on a team). Next, 5,759 observations of 923 teams were excluded because these teams’ team identification codes were not unique.

Finally, teams that engaged in very high-level tasks were excluded from the sample because they systematically differed from the general population of Dragon Nest players in a number of ways, including level and team size. Specifically, Dragon Nest includes 4 quests that are only available to players that have successfully completed all of the other quests that the game has to offer; thusly, these tasks are very challenging, and allow players to form teams as large as 8 (as opposed to the usual limit of 4). This subset of 941 players, who formed 297 teams, was excluded from analyses.

Furthermore, in order to distinguish between players that selected their teammates in psychologically meaningful ways and players that joined forces using a random team generator, a given teammate relationship was only included in the sample if it occurred at least twice during the course of the 24-hour period in question. The final, "clean" sample included 1,568 players of the Chinese version of Dragon Nest who played on 1,744 teams, forming 929 dyadic teammate relationships. While the vast majority of individuals were only part of 1 teammate dyad (n = 1,372), others were part of 2 (n = 171), 3 (n = 22), and even 4 dyads (n = 3) during the course of the day.

Individual Level

The Dragon Nest data set includes a variety of individual-level variables, including surface-level and deep-level attributes.

Surface-Level Attributes

The in-game data set contains a variety of surface-level characteristics at the individual-level, including class, gender, level, guild, and guild role.

Class and Gender

Class is a variable that indicates the type of character that a player is embodying in the virtual world of Dragon Nest. Initially, each player chooses to assume the role of one of 5 classes: warrior, archer, sorceress, cleric, or assassin. Although all players initially start out at the same skill level, each class of characters has a unique skill set. The warrior is a strong and agile male character who fights using weapons such as axes and hammers. The archer is a female character who fights using a bow and arrow, and consequently can attack enemies from a distance but is lacking at self-defense. The sorceress is a female character who fights with a staff, using magic spells to attack opponents. The cleric, a male character noted for his healing powers, fights using weapons such as maces (i.e., clubs) and wands. The assassin is a male character who is most notable for inflicting damage onto opponents, and fights with a scimitar (i.e., a sabre) or a dagger.

Of the entire sample, 27.87% of players assumed the role of a warrior, 10.52% acted as an archer, 18.11% role-played as a sorceress, 23.47% were clerics, and 20.03% chose to be assassins. The five initial classes subdivide into 10 secondary and 20 tertiary subclasses as players advance in level; Figure 2 illustrates how different classes develop at different levels in Dragon Nest (Classes, 2013), and Figures 3 through 5 provide frequency distributions for character classes and subclasses. Character class was determined by evaluating a data snapshot—or, a static measurement from a particular point in time—from the beginning of January 2012.

Players' in-game gender was determined based on character class; as aforementioned, each class is associated with a particular gender. Of the entire sample, 71.37% assumed the role of a male character while 28.63% role-played as female characters. Although variable, admittedly, does not necessarily reflect the actual gender of the player, it is interesting to note that the observed 70:30 gender ratio is in line with past findings on the demography of certain MMORPGs (Cole & Griffiths, 2007; Williams, Consalvo, Caplan, & Yee, 2009). However, it is also important to note that research has indicated that the majority of players of MMORPGs indicate that they have role-played as a character of a gender different from the one that they personally identify

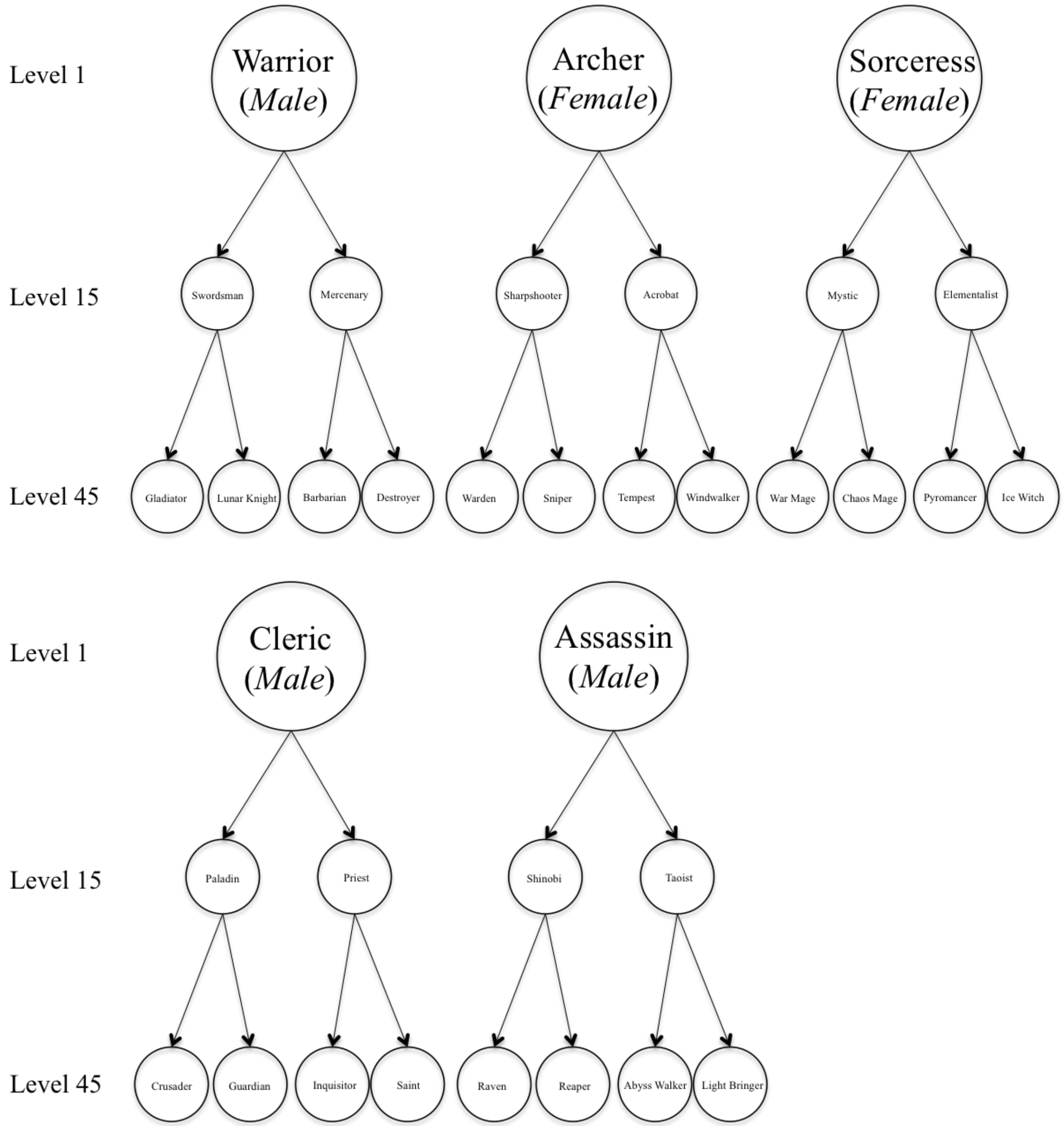


Figure 2. Classes in Dragon Nest.

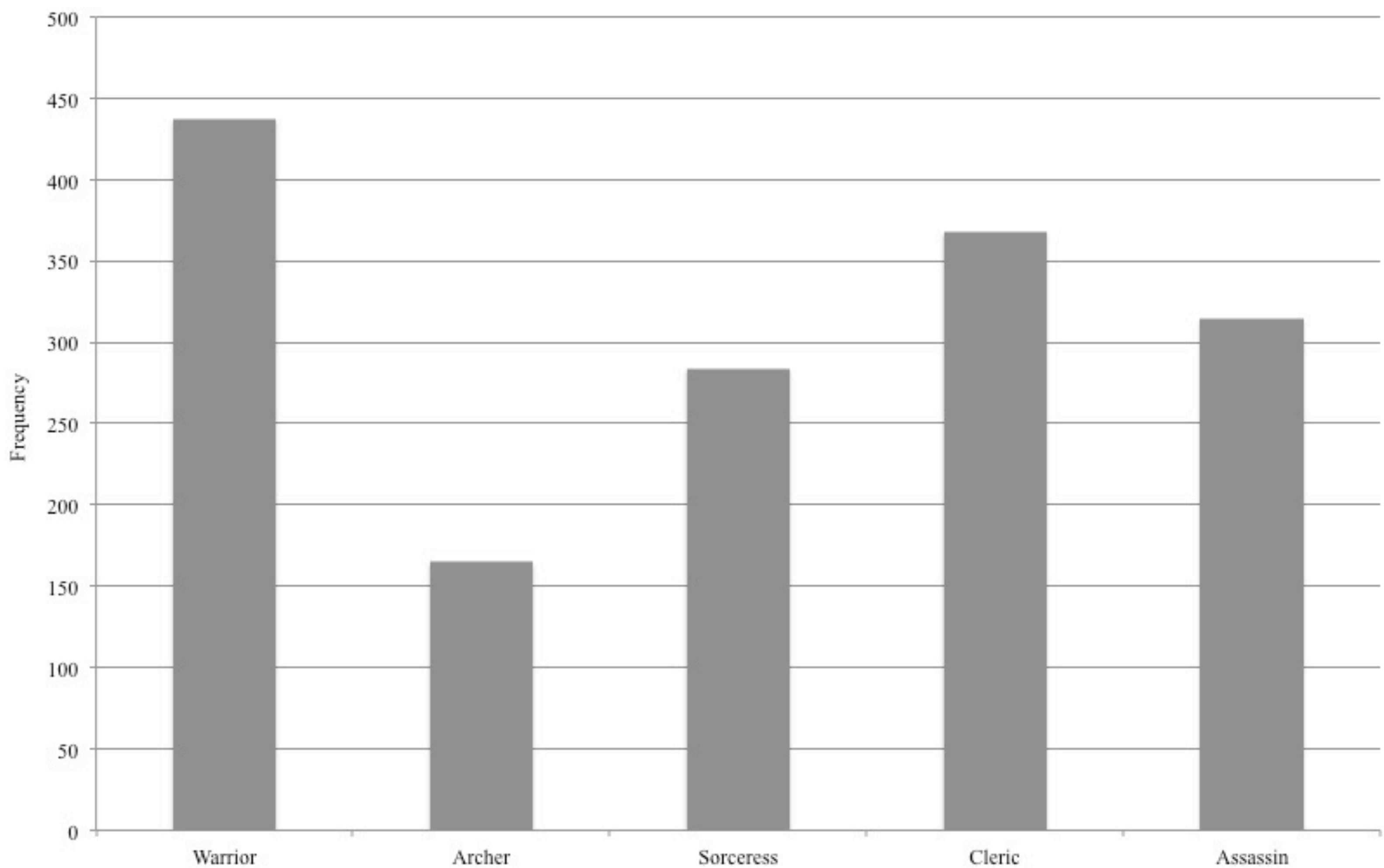


Figure 3. Frequency distribution of classes. (*n* = number of individuals = 1,568)

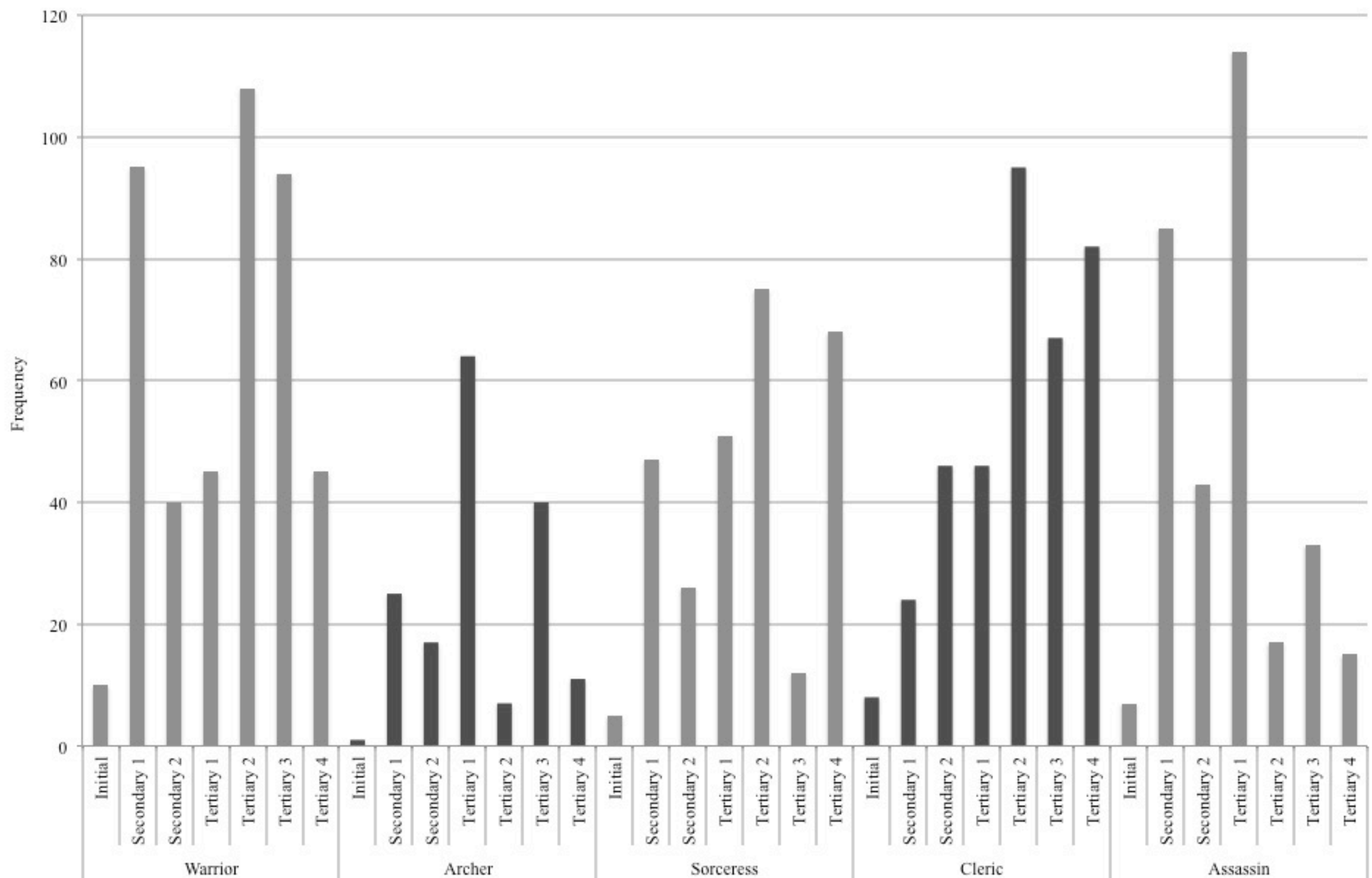


Figure 4. Frequency distribution of subclasses, organized by class. (*n* = number of individuals = 1,568)

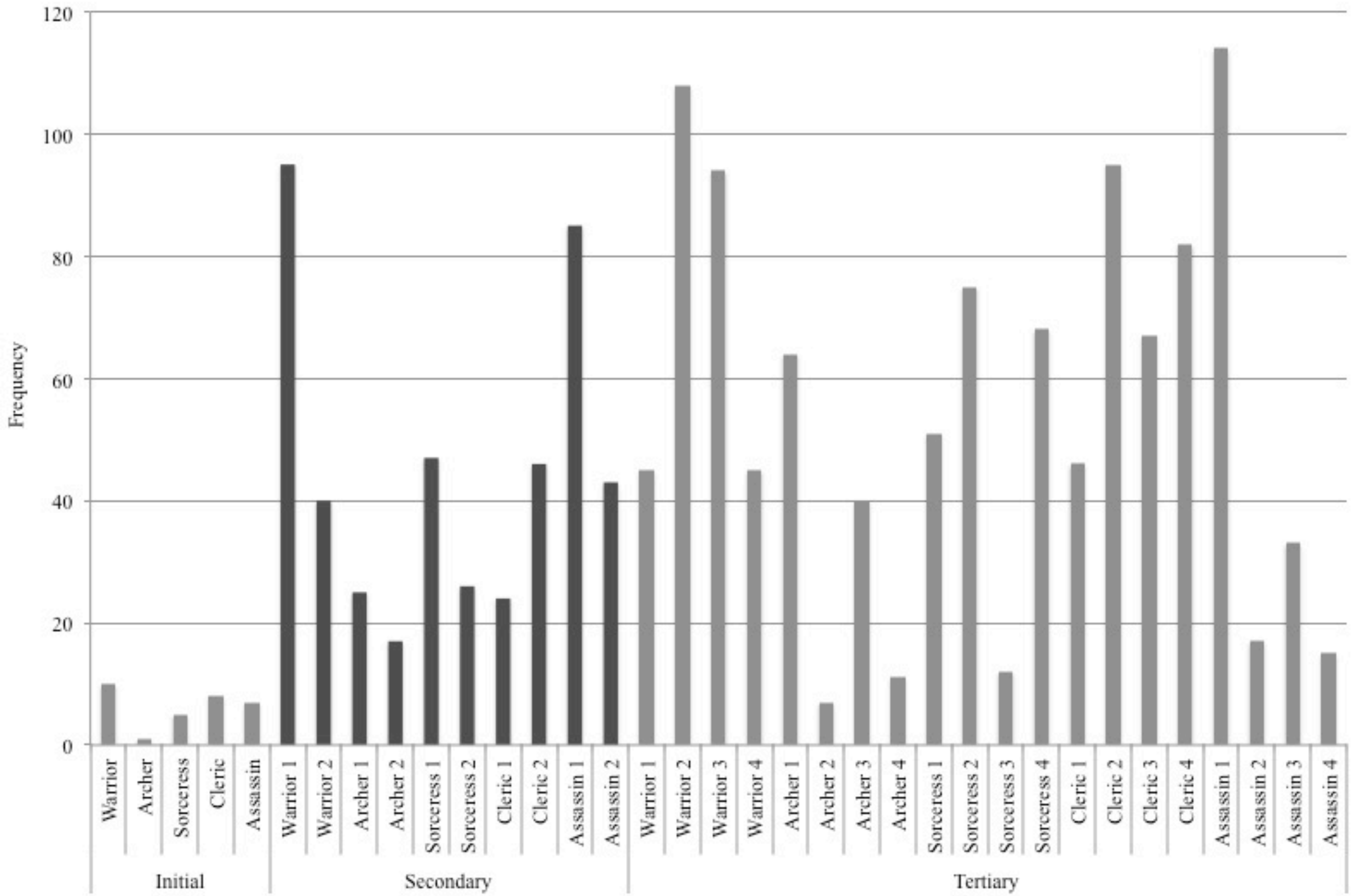


Figure 5. Frequency distribution of subclasses, organized by level. (*n* = number of individuals = 1,568)

with (Hussain & Griffiths, 2008). Figure 6 provides a frequency distribution of character gender.

Level

Level—a variable ranging from 1 to 50—is an overall measure of a player's progress in the world of Dragon Nest. Level was recorded for each component team member upon the completion of a quest. In order to deduce each player's overall level, median level across all instances of team quests that occurred on February 6, 2012 was calculated for each player. Furthermore, Huang, Ye, Bennett, and Contractor (2013b) found that Dragon Nest players at level 32 or below are generally relatively inexperienced, while players at level 33 or above are categorically more advanced; consequently, they suggest dichotomizing player level. Accordingly, level was binarized; 29.66% of the sample was classified as low level, while the remaining 70.34% was considered to be high level. Figures 7 and 8 provide frequency distributions of the raw and transformed versions of player level, respectively, and descriptive statistics for both versions of the variable can be seen in Table 3.

Guild and Guild Role

Guilds are official alliances between players. Guild membership is a matter of public record in the Dragon Nest world, as the guild plaque appears next to the name of each member of a guild, and is associated with a number of benefits, included shared storage space (Guild, 2013). Guilds range vastly in size, so players that share a common guild membership may be familiar with one another, or may be relative strangers. Guild data from January 1 to 24, 2012 was used to determine players' guild affiliations. In instances when individuals participated in multiple guilds, modal guild affiliation was

Table 3

Descriptive Statistics

	Mean	*SD*	Min.	Max.
Individual Level				
Player level (raw)	39.09	12.86	4.50	50.00
Player level (transformed)	.70	.46	.00	1.00
Skill points (raw)	25.78	82.05	.00	510.00
Skill points (transformed)	1.39	1.74	.00	6.23
Completed quests (raw)	162.84	136.64	1.00	873.00
Completed quests (transformed)	4.62	1.16	.00	6.77
Money (raw)	10,116,040.00	38,315,756.00	.00	584,742,359.00
Money (transformed)	13.57	2.87	.00	20.19
Logins (raw)	62.66	61.68	1.00	744.00
Logins (transformed)	3.64	1.12	.00	6.61
Average teaming frequency	2.15	.58	2.00	14.00
Average team size	2.82	.58	1.25	3.81
Average task difficulty†	3.37	.58	1.25	5.00
Dyadic Level				
Proximity (raw)	918,750.20	1,208,061.00	.00	17,339,483.00
Proximity (transformed)	.09	.28	.00	1.00
Teaming frequency	2.18	.71	2.00	16.00
Team Level				
Team size	3.38	.85	2.00	4.00
Task difficulty†	4.73	.82	1.00	5.00
Quest success+	.87	.34	.00	1.00

Note. *t* = number of teams = 1,744. *n* = number of individuals = 1,568. *l* = number of teammate relationships = 929. *SD* = standard deviation. †Lower numbers indicate easier tasks; higher numbers indicate harder tasks. +"0" indicates failure and "1" indicates success.

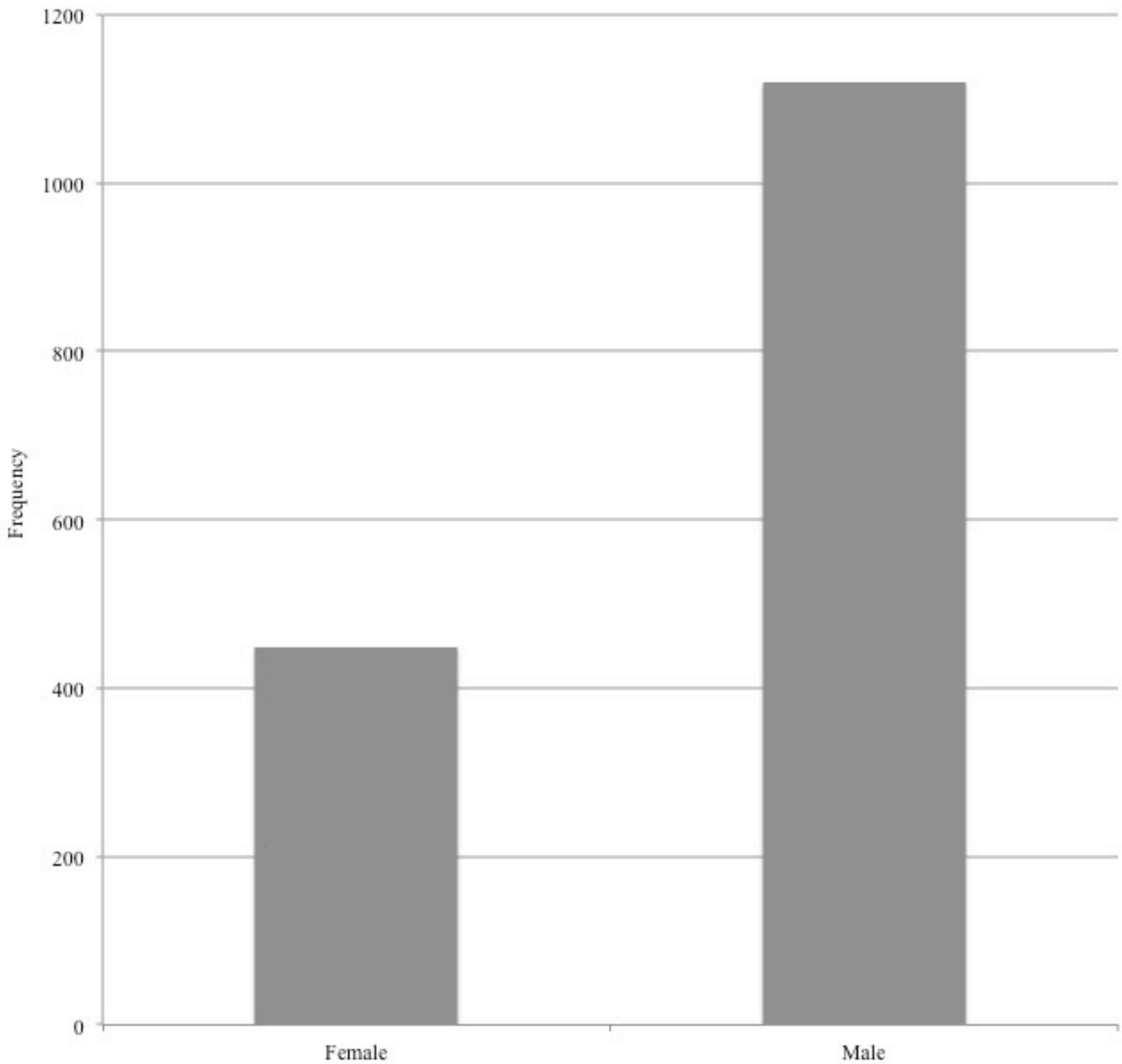


Figure 6. Frequency distribution of character gender. (*n* = number of individuals = 1,568)

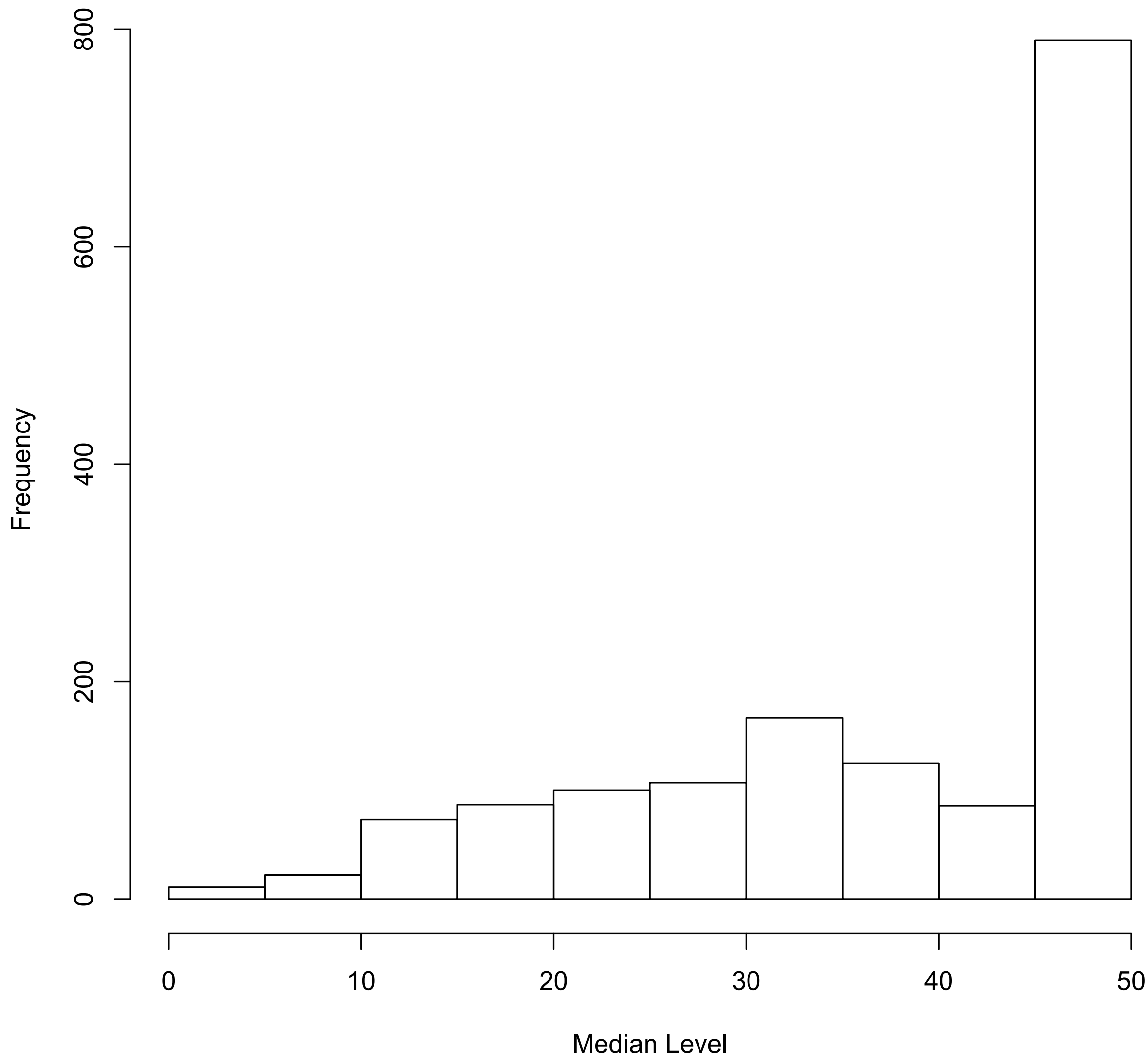


Figure 7. Frequency distribution of raw player level. (*n* = number of individuals = 1,568)

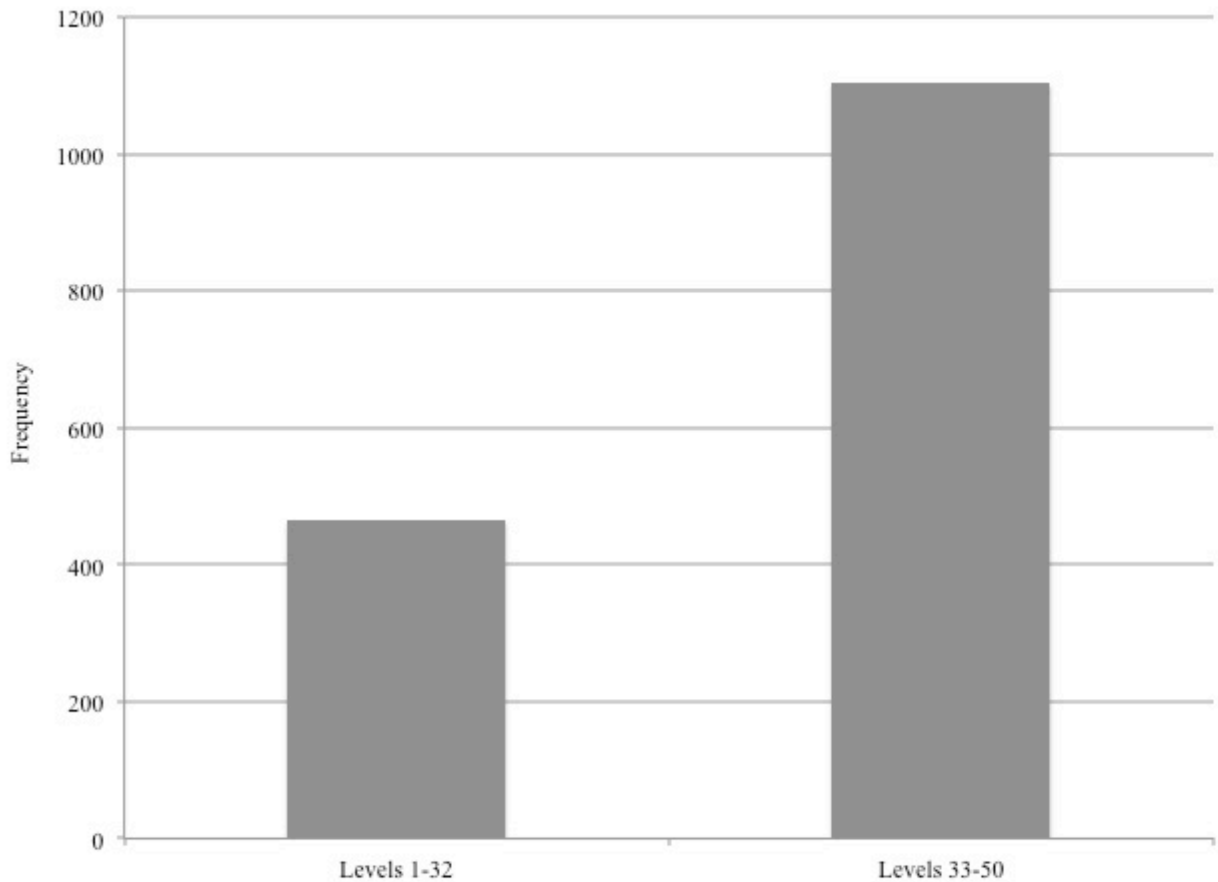


Figure 8. Frequency distribution of transformed player level. (n = number of individuals = 1,568)

used. The 990 players in the current sample that were guild members belonged to 660 unique guilds. In order to assess guild membership homophily, information on guild membership was used to create a binary relational matrix; in other words, common modal guild affiliations were translated into relational ties. Of the full sample, 35.27% shared a guild affiliation with another player in the sample, 27.87% were isolates in terms of guild affiliation, and 36.86% had no guild affiliation. Figure 9 is a sociogram of the guild membership network.

Individuals can occupy one of five potential roles within a guild: leader, manager, senior member, ordinary member, or newcomer. Guild data from January 1 to 24, 2012 was also used to determine players' guild roles. In instances when individuals occupied multiple roles during this time span, modal guild role were used. Of the 990 guild members in the sample, 7.07% were leaders, 11.41% were managers/deputies, 39.90% were senior members, 19.19% were ordinary members, and 22.42% were newcomers. Figure 13 provides a frequency distribution of guild role. For analytic purposes (i.e., because ERGMs have difficulty running/converging when factors with many levels are included), leaders and managers were combined into a single group, and newcomers and individuals with no guild affiliation were also joined to form a single category.

Deep-Level Attributes

Deep-level individual characteristics in the Dragon Nest data set were evaluated via a number of variables related to player skill and experience, including skill points, total number of completed quests, Money, and total number of logins.

Skill Points

Skill points—a variable ranging from 0 to 510— are acquired upon achieving a new level, and can be used to learn new and update previously learned skills (Skills, 2014). Skill point levels were determined by evaluating a data snapshot from the beginning of January 2012. As visible in Figure 14, the raw distribution of skill points conformed to a typical power law distribution. Therefore, the raw variable was adjusted using a natural logarithm transformation; in order to achieve this, all instances of "0" skill points were changed to "1". The resulting, transformed distribution can be seen in Figure 15. Descriptive statistics for both the raw and transformed versions of skill points can be seen in Table 3.

Completed Quests

Total number of completed quests is a player's overall quantity of successfully accomplished quests, or missions (e.g., slaying a monster). Higher numbers of completed quests leads to progress in the world of Dragon Nest. Total number of completed quests reflects the number of missions successfully accomplished per person between January 1 and February 6, 2012. Data on completed quests was missing for 39 players in the final sample. Simple random imputation was used to account for these missing data points[3]; the R code, borrowed from Gelman and Hill (2006), can be seen in Appendix A. Subsequently, the raw completed quests variable was transformed using a natural logarithm transformation. The raw and transformed distributions are displayed in Figures

[3] ERGMs cannot handle missing data, so it is critical to substitute absent values.

16 and 17, respectively, and additional descriptive statistics for both versions of completed quests can be seen in Table 3.

Money

In the Dragon Nest virtual world, money is purchased in the Dragon Vault. In order to purchase money, players must either use actual money or Dragon Scales, which are awarded to them from completing certain in-game events. Money can be used to purchase: tools to facilitate gameplay; pets, which assist players during battles; and cosmetic items such as hair dye (Dragon Vault, 2013). Each player's total money equals the amount that s/he has in the bank plus the amount on her/his character. Amounts of money were determined by evaluating a data snapshot from the beginning of January 2012. In addition, a natural logarithm transformation was applied to the raw variable. In order to carry this adjustment out successfully, all null instances of money were changed to "1". Descriptive statistics for the raw and transformed versions of money can be seen in Table 3, and Figures 18 and 19 provide frequency distributions for both versions of the variable.

Logins

Total number of logins reflects the amount of time players have spent in the virtual world of Dragon Nest, and thus is an indicator of player experience. This variable reflects the aggregate number of logins that occurred per person between January 1 and February 6, 2012. Due to its power law distribution, logins was adjusted using a natural logarithm transformation. Descriptive statistics for both versions of logins can be seen in Table 3, and frequency distributions for the raw and transformed variables can be seen in Figures 20 and 21.

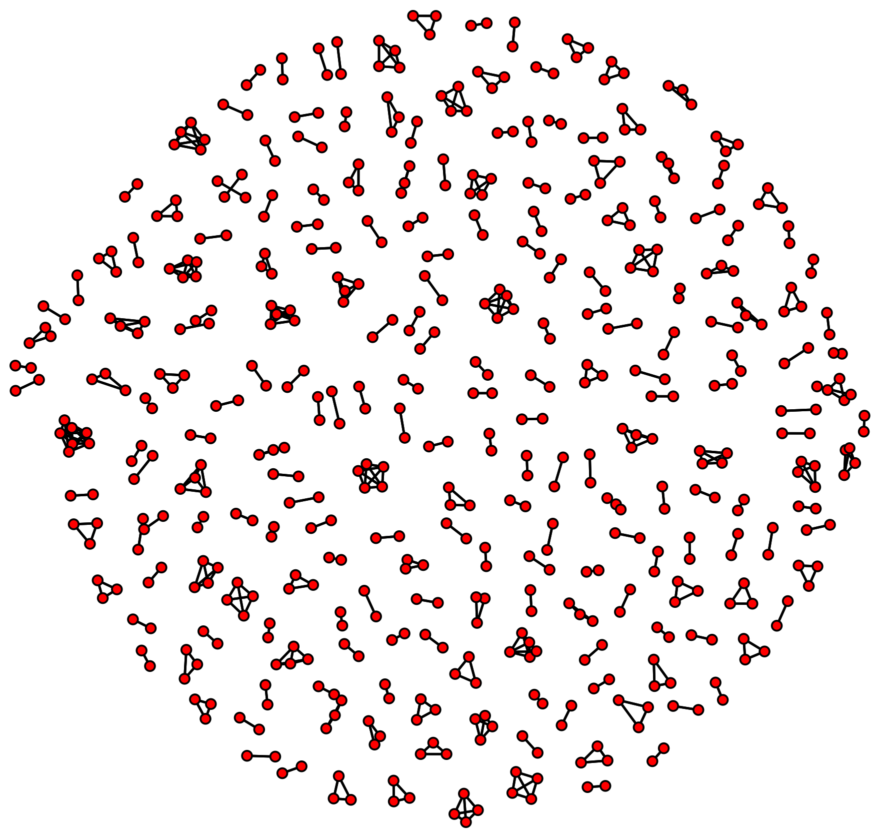


Figure 9. Undirected guild membership network. (n = number of individuals = 553; l = number of guild member relationships = 482)

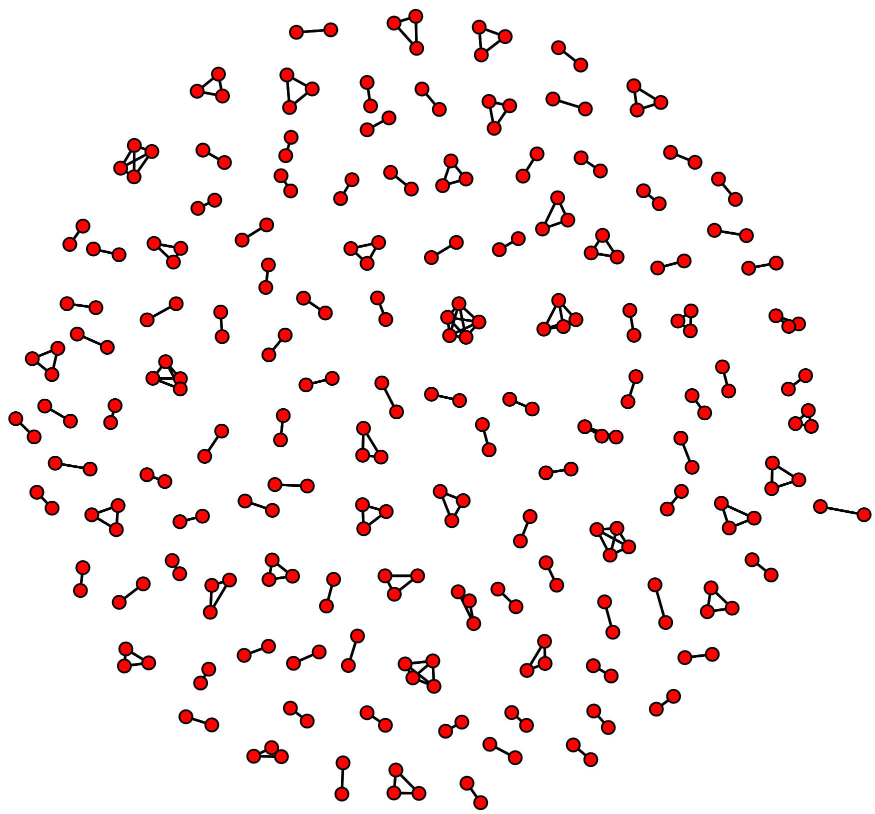


Figure 10. Undirected guild membership network; successful dyads only. (n = number of individuals = 288; l = number of guild member relationships = 218)

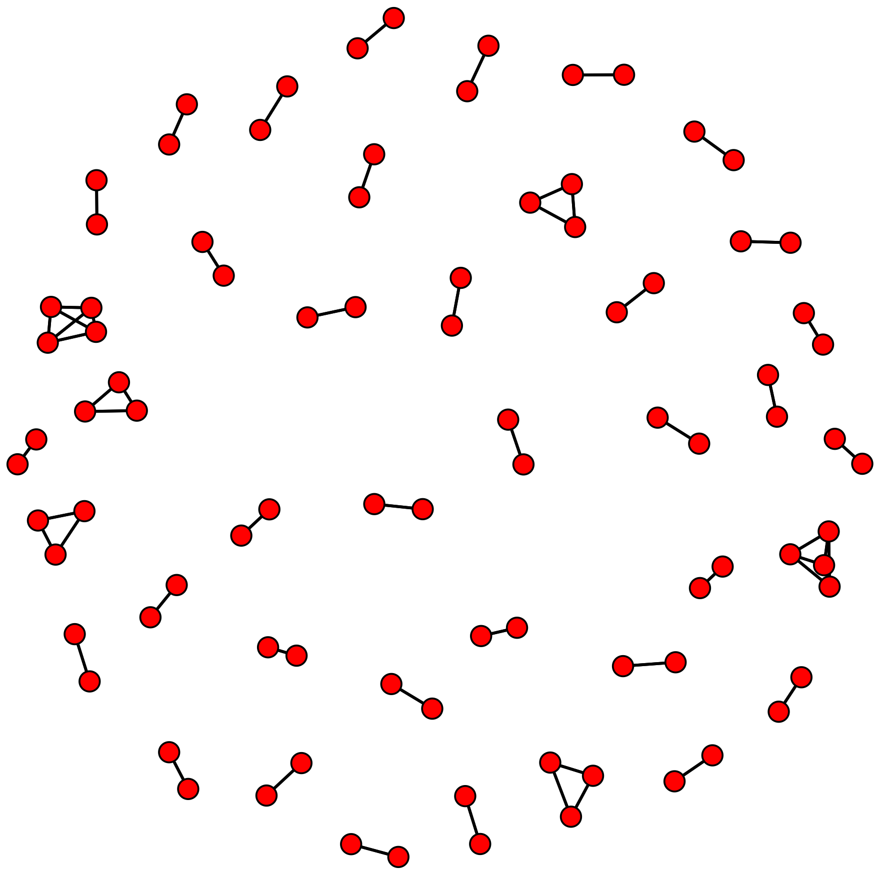


Figure 11. Undirected guild membership network; mixed dyads only. (n = number of individuals = 88; l = number of guild member relationships = 58)

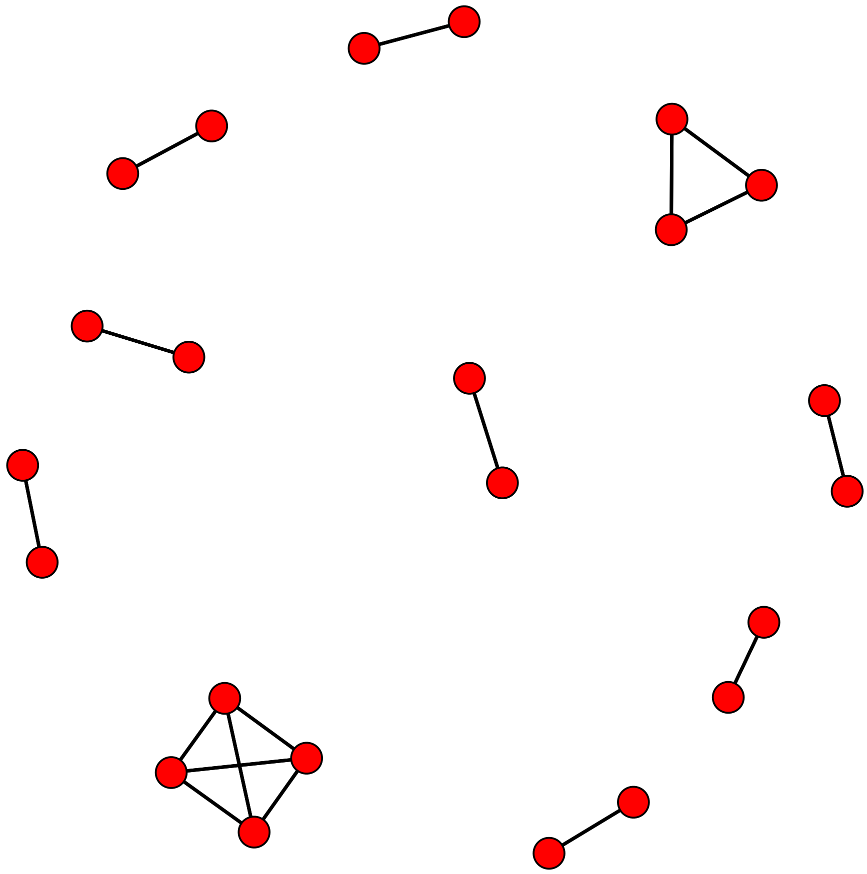


Figure 12. Undirected guild membership network; unsuccessful dyads only. (*n* = number of individuals = 23; *l* = number of guild member relationships = 17)

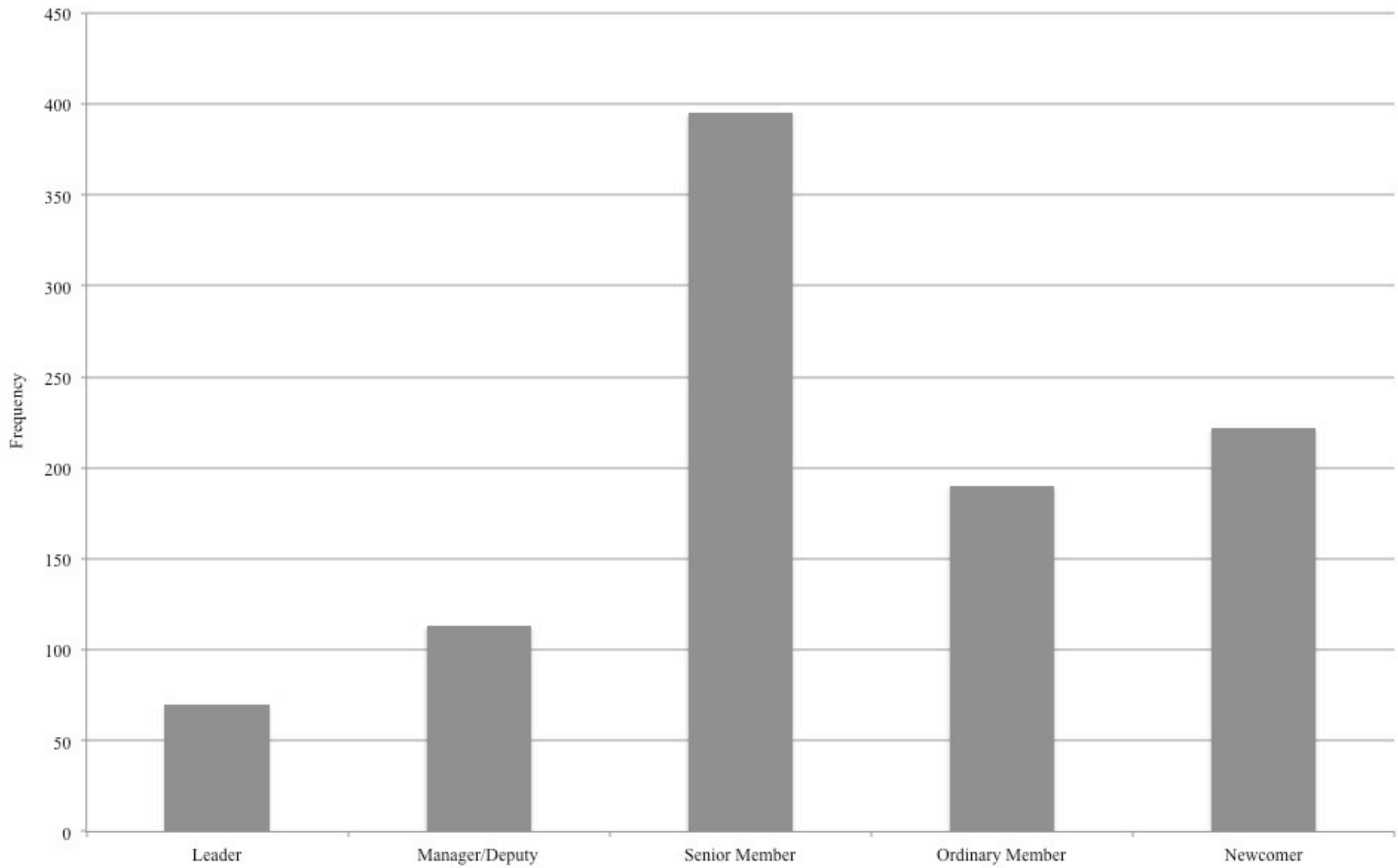


Figure 13. Frequency distribution of guild role. (*n* = number of individuals = 990)

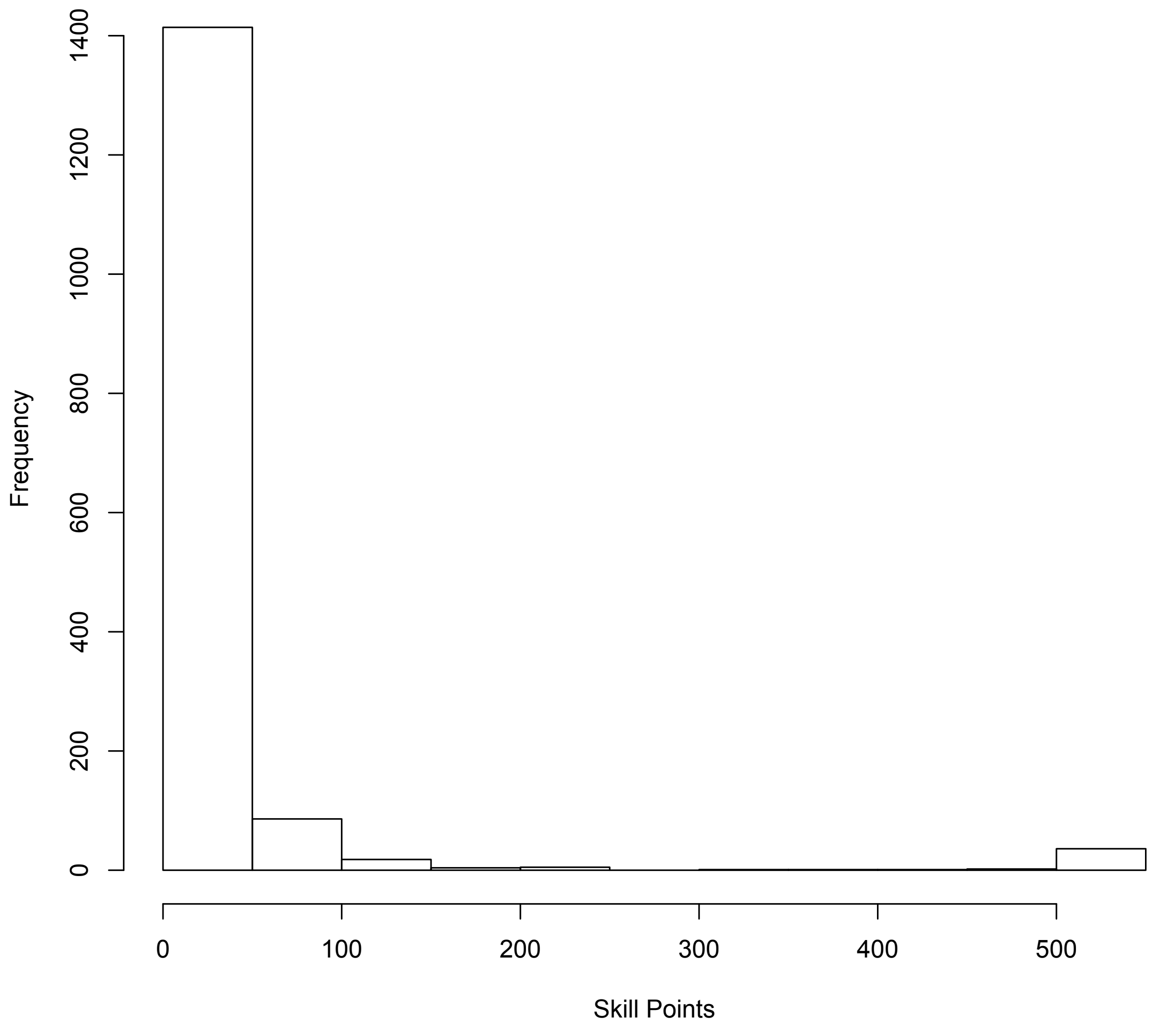


Figure 14. Frequency distribution of raw skill points. (*n* = number of individuals = 1,568)

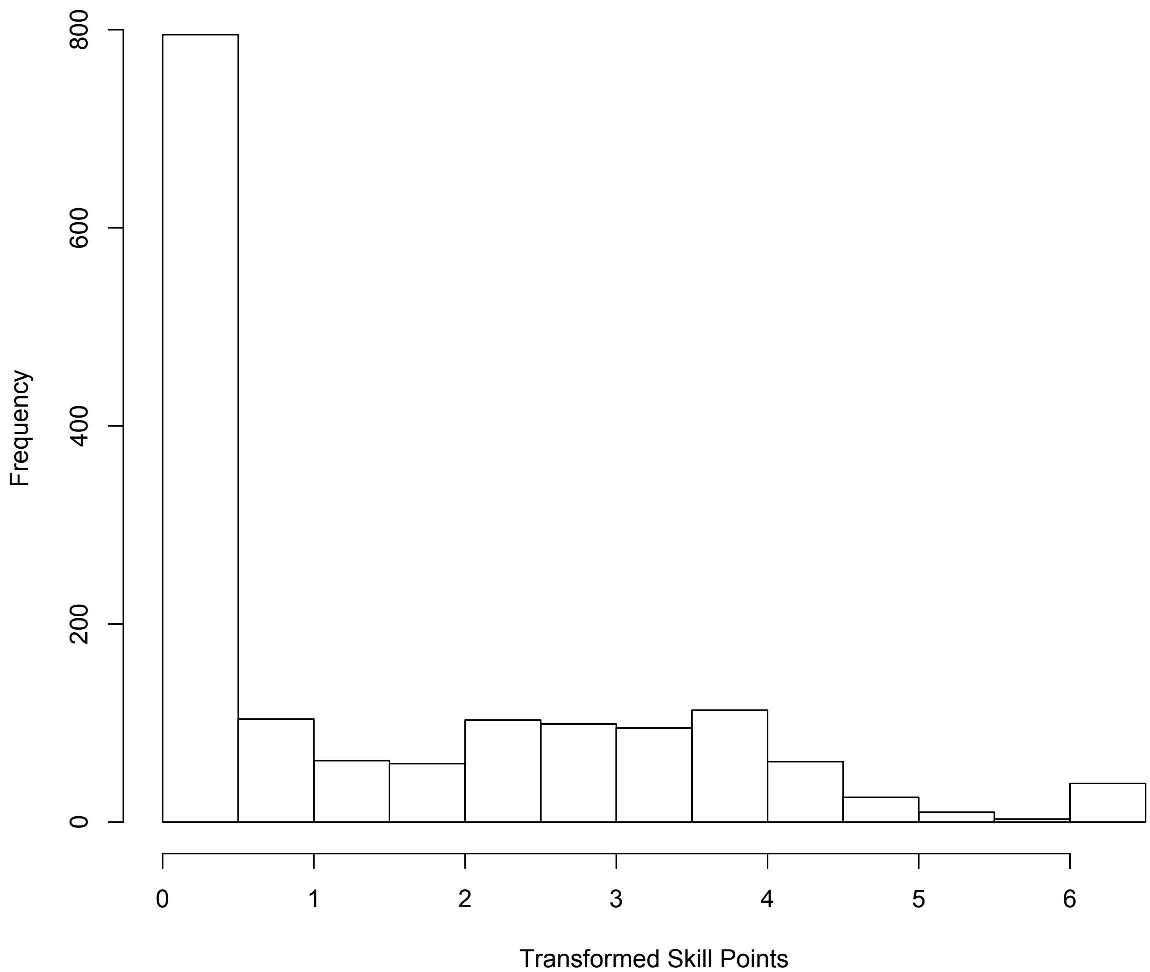


Figure 15. Frequency distribution of transformed skill points. (n = number of individuals = 1,568)

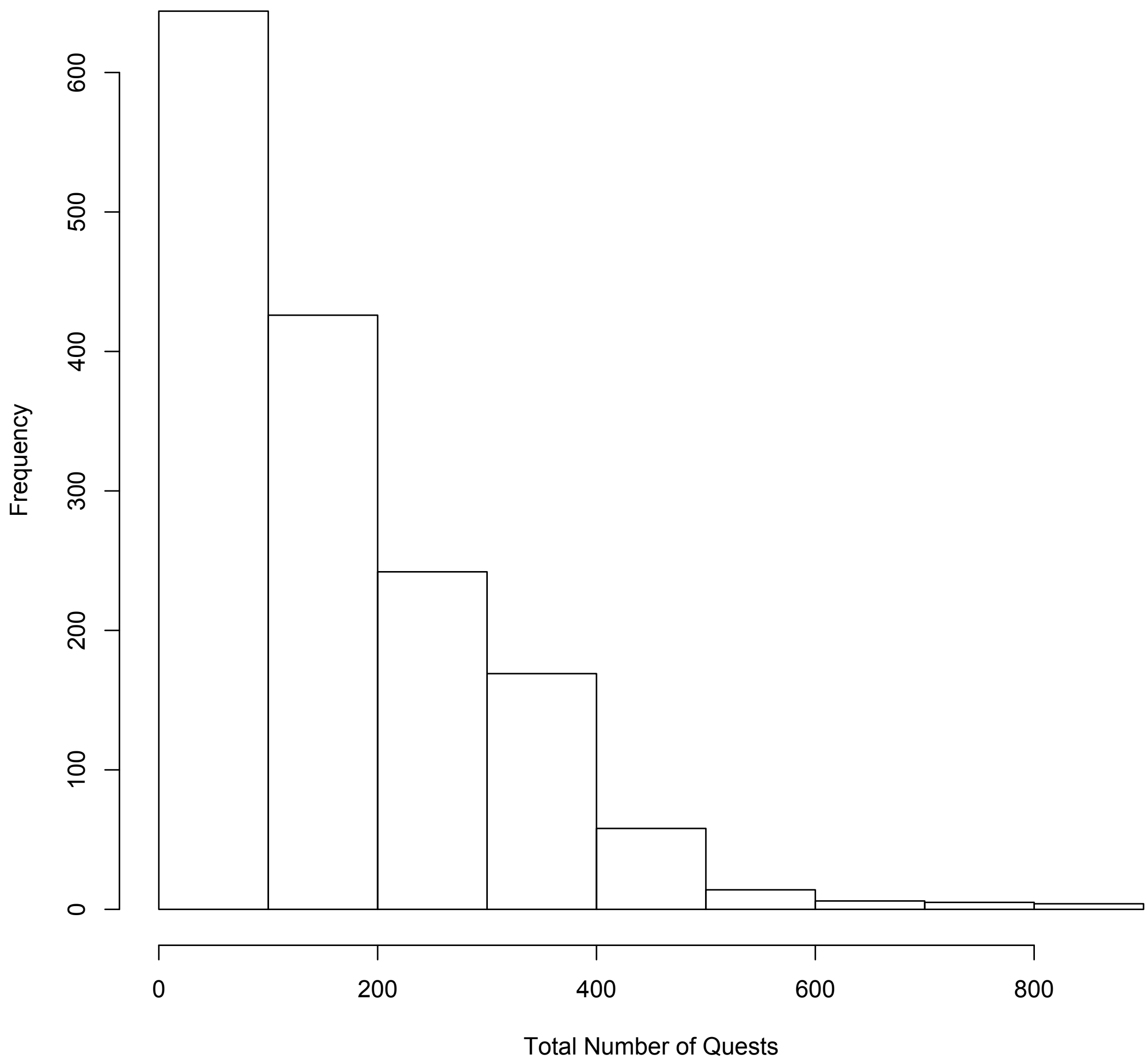


Figure 16. Frequency distribution of raw completed quests. (*n* = number of individuals = 1,568)

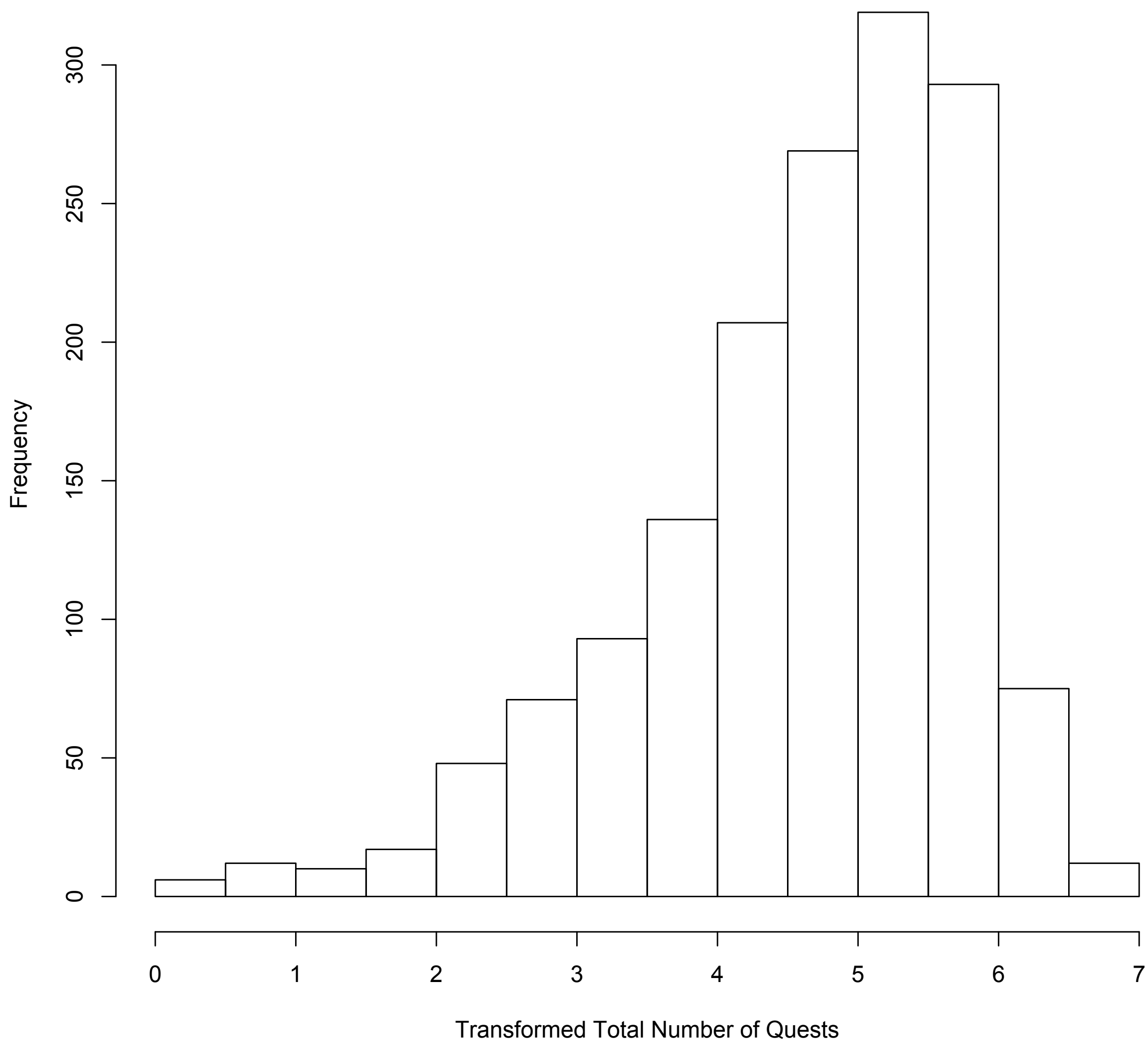


Figure 17. Frequency distribution of transformed completed quests. (n = number of individuals = 1,568)

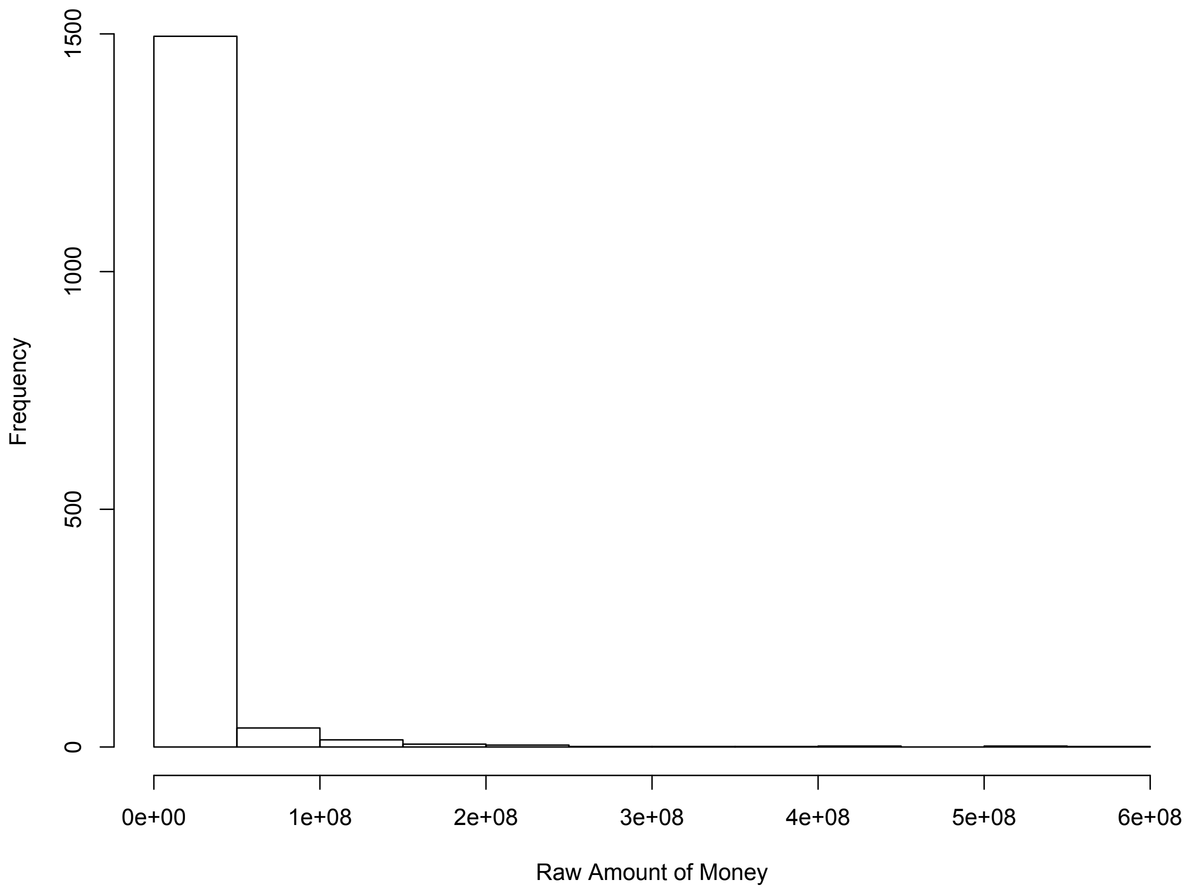


Figure 18. Frequency distribution of raw money. (*n* = number of individuals = 1,568)

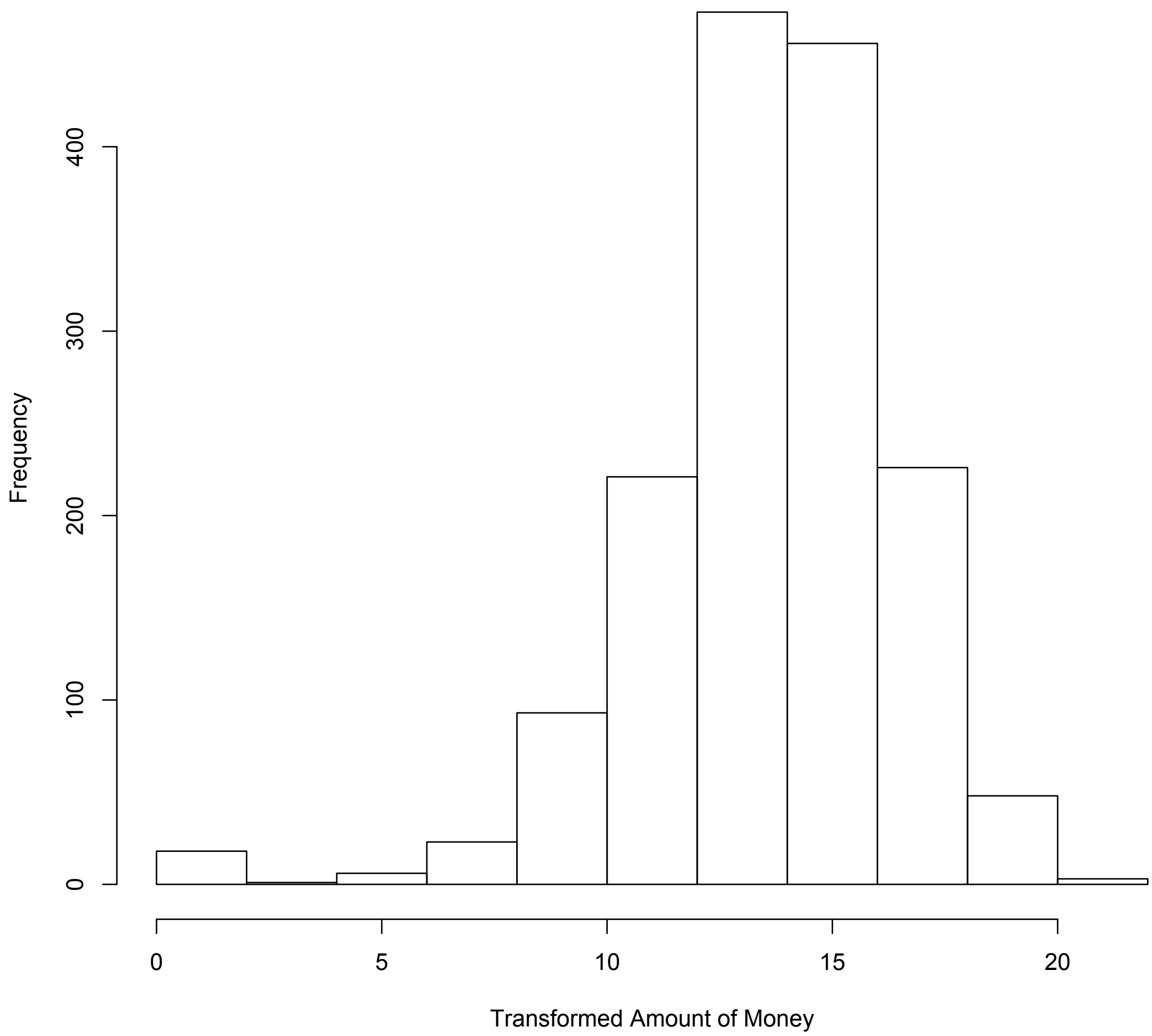


Figure 19. Frequency distribution of transformed money. (*n* = number of individuals = 1,568)

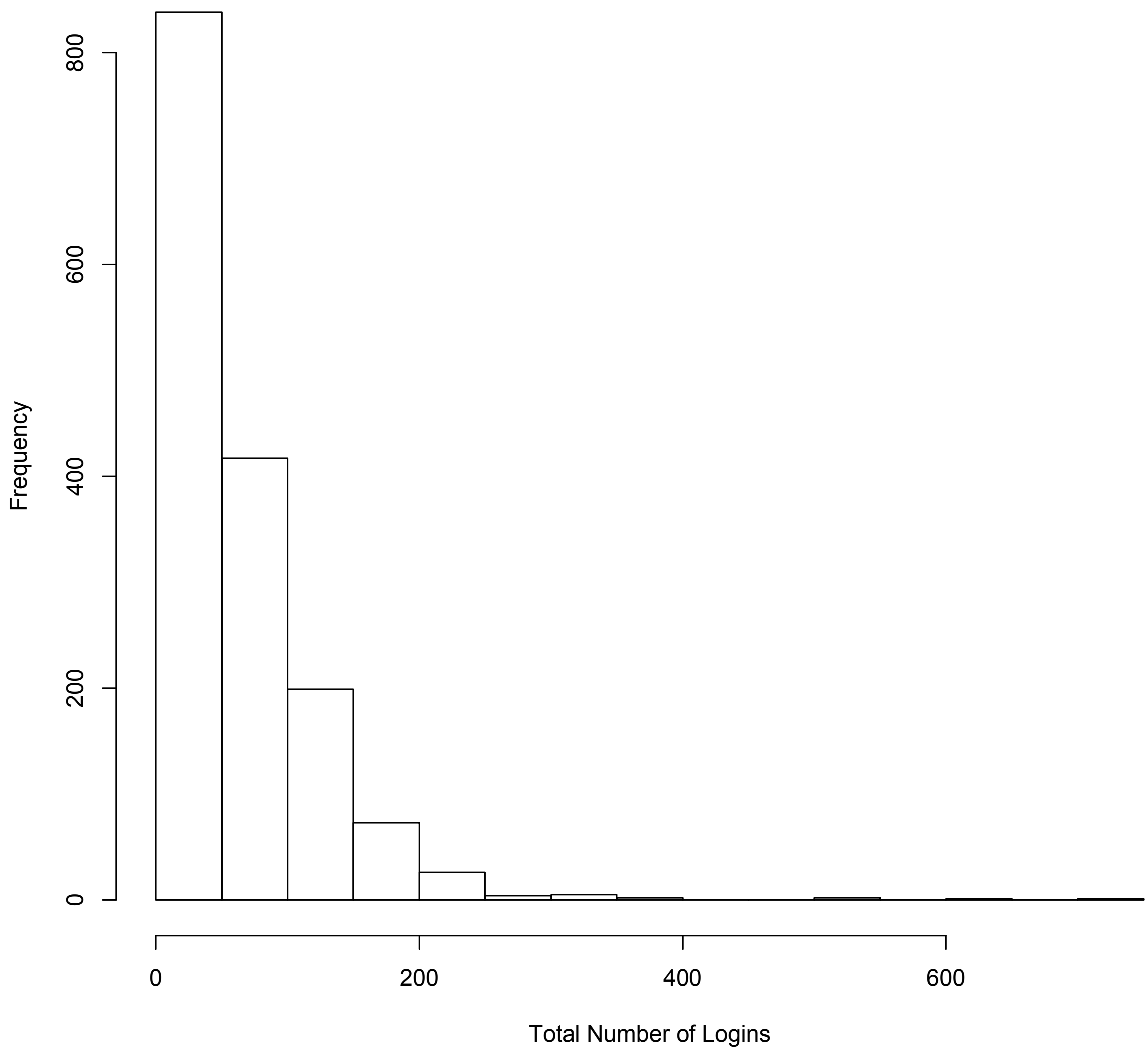


Figure 20. Frequency distribution of raw number of logins. (*n* = number of individuals = 1,568)

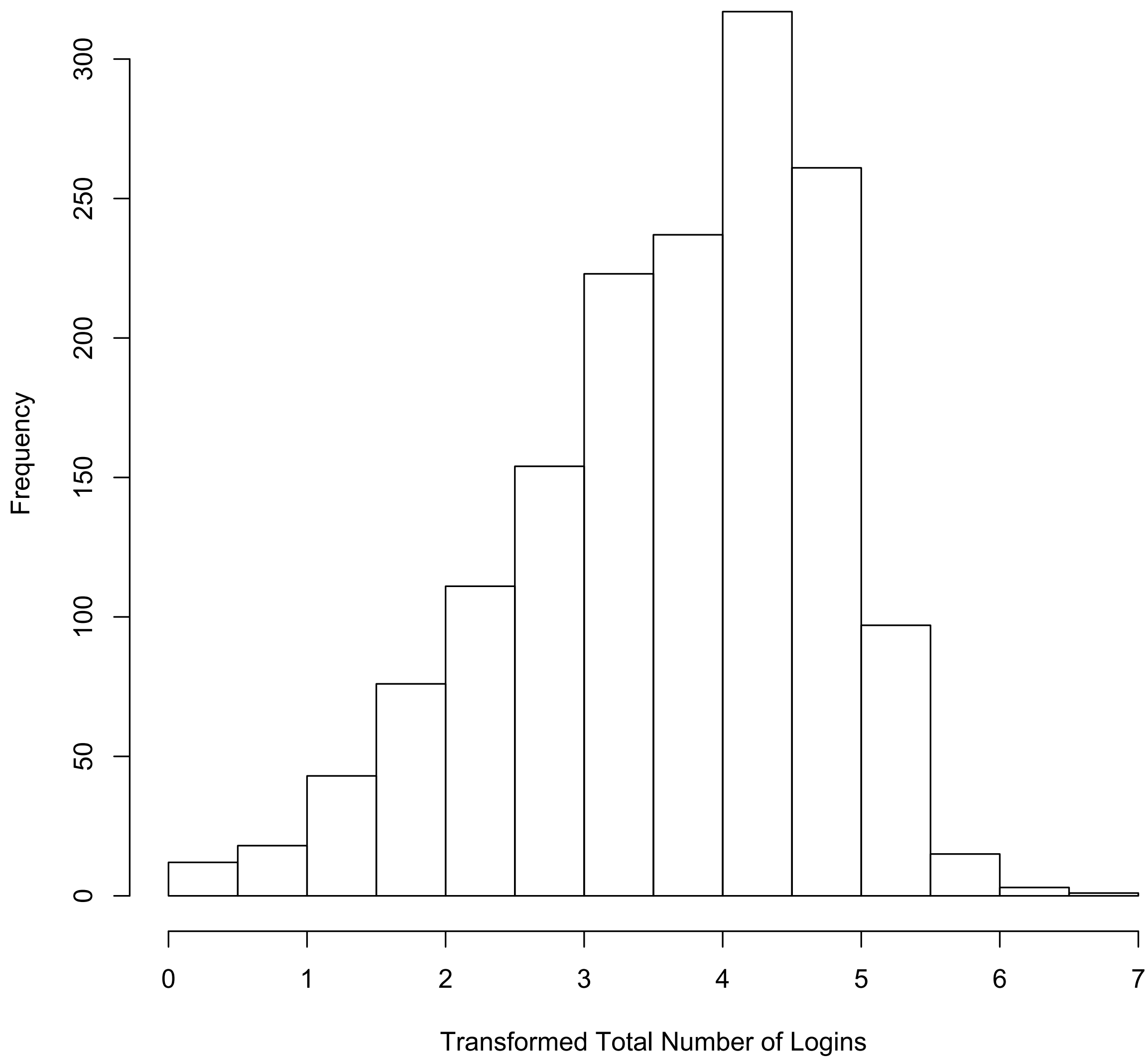


Figure 21. Frequency distribution of transformed number of logins. (*n* = number of individuals = 1,568)

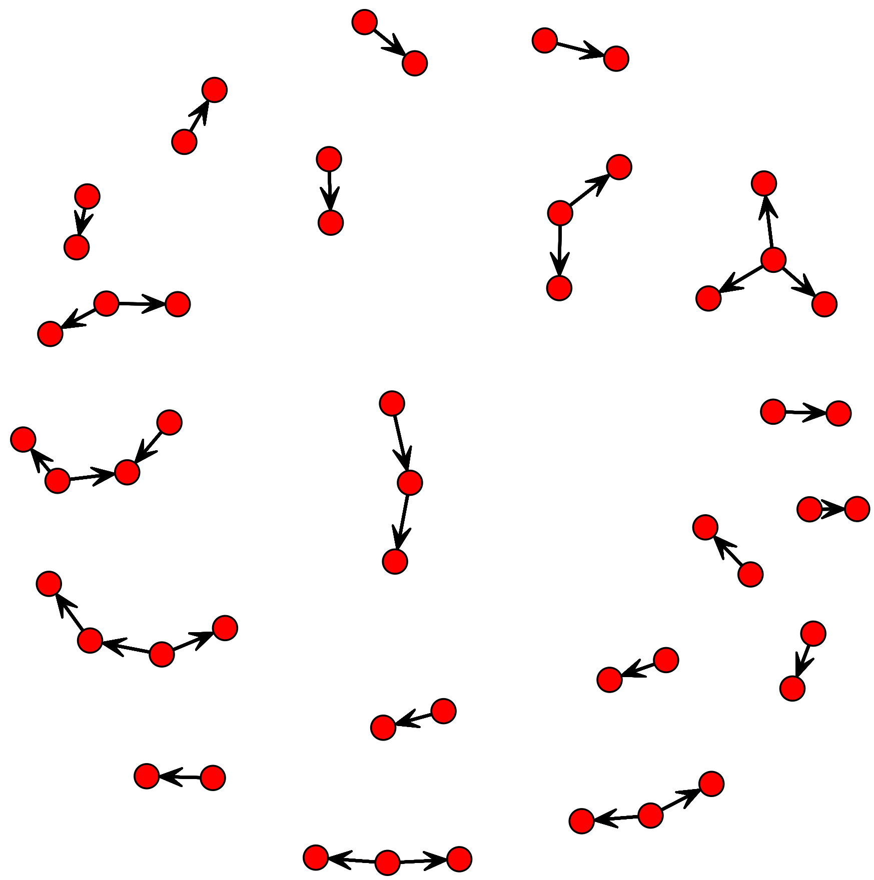


Figure 22. Directed friendship network. (1,517 isolates removed). (n = number of individuals = 51; l = number of friendships = 31)

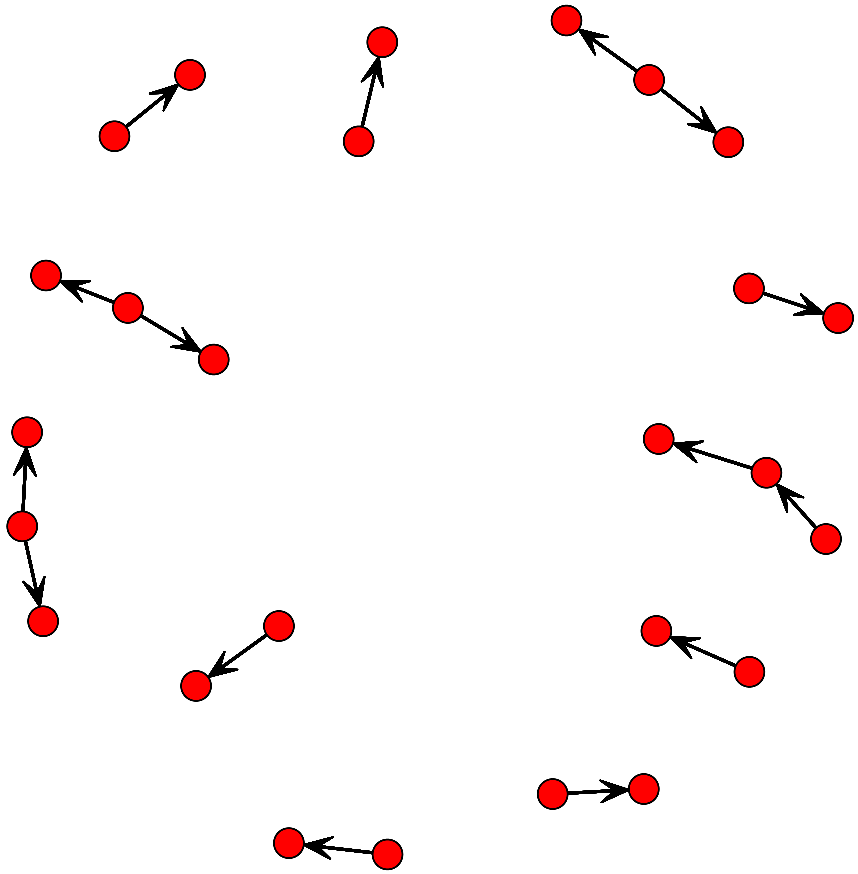


Figure 23. Directed friendship network (1,001 isolates removed); successful dyads only. (*n* = number of individuals = 26; *l* = number of friendships = 15)

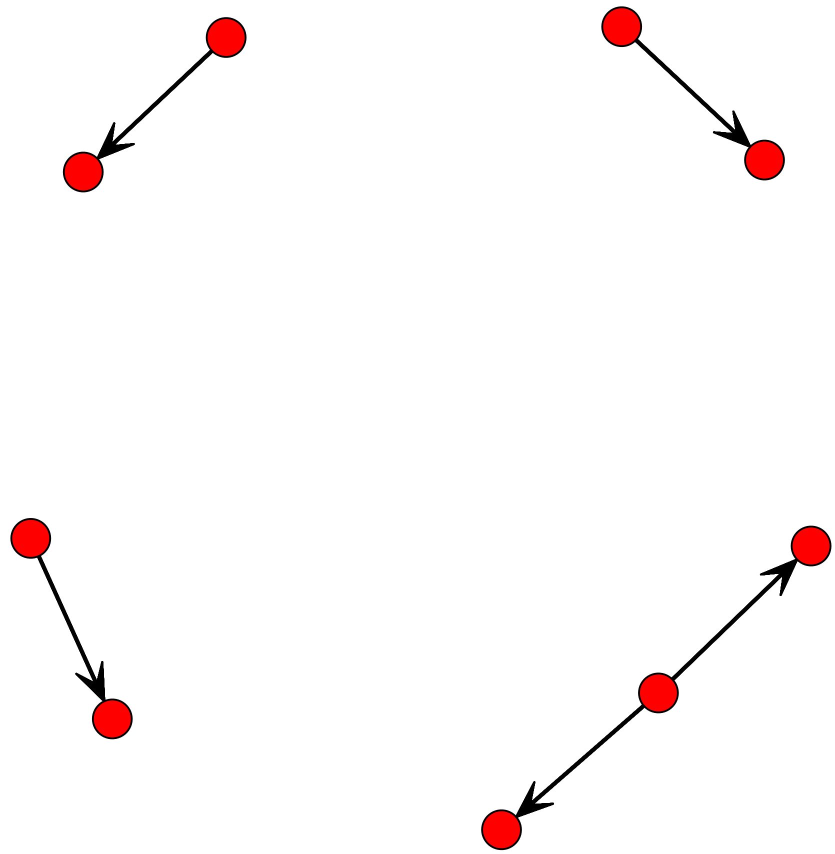


Figure 24. Directed friendship network (328 isolates removed); mixed dyads only. (*n* = number of individuals = 9; *l* = number of friendships = 5)

Figure 25. Worldwide geographic dispersion of Dragon Nest players. (*n* = number of individuals = 1,568)

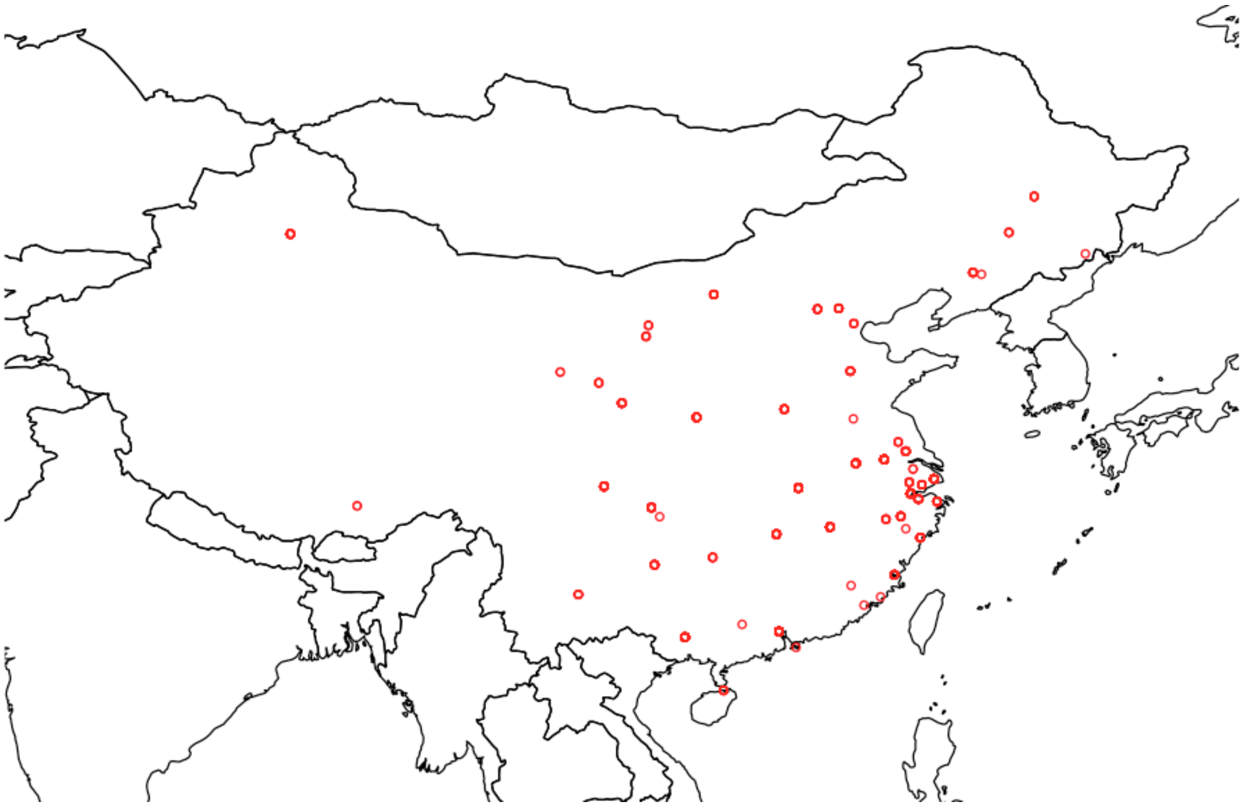


Figure 26. Chinese locations of Dragon Nest players. (n = number of individuals = 1,558)

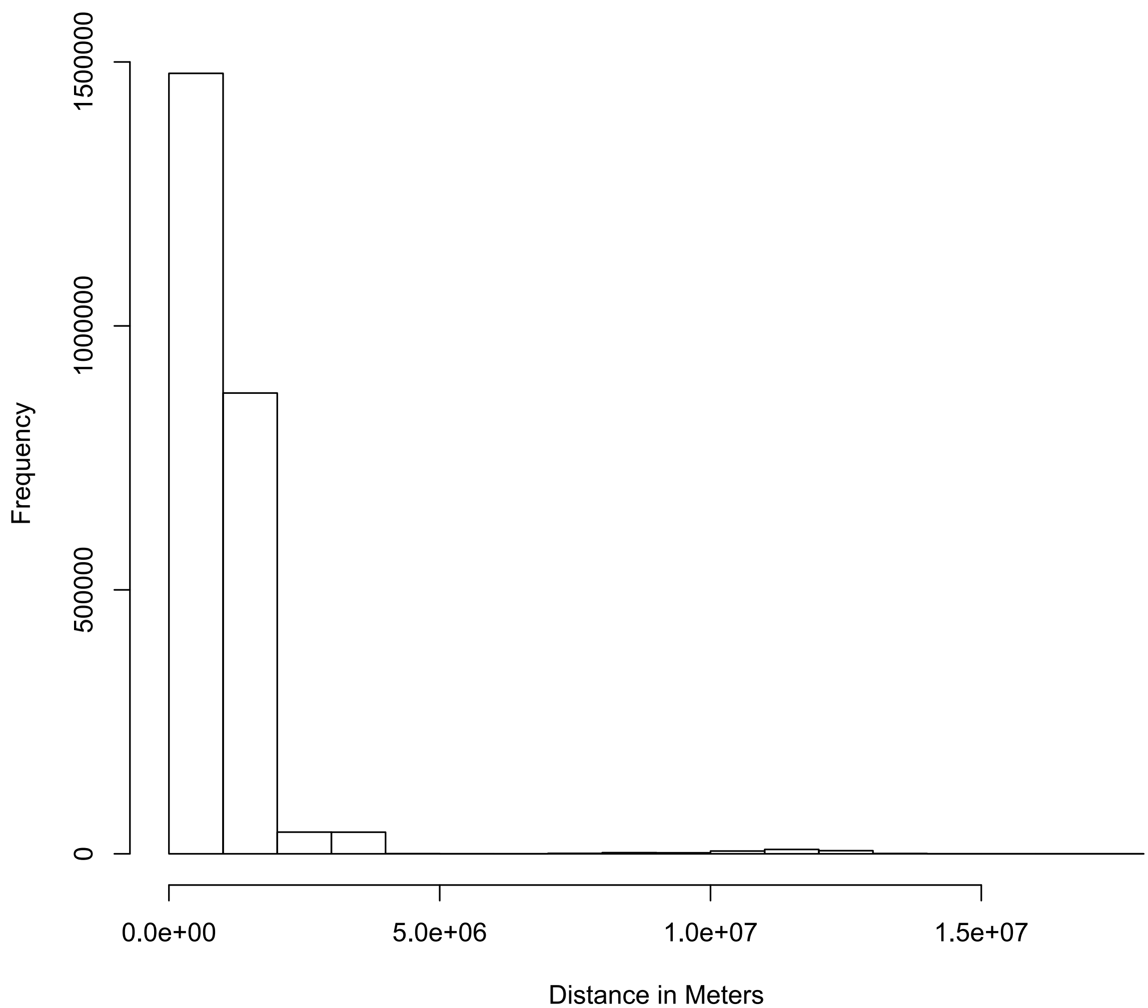


Figure 27. Frequency distribution of raw geographic distances. (*l* = number of dyadic relations = 1,228,528)

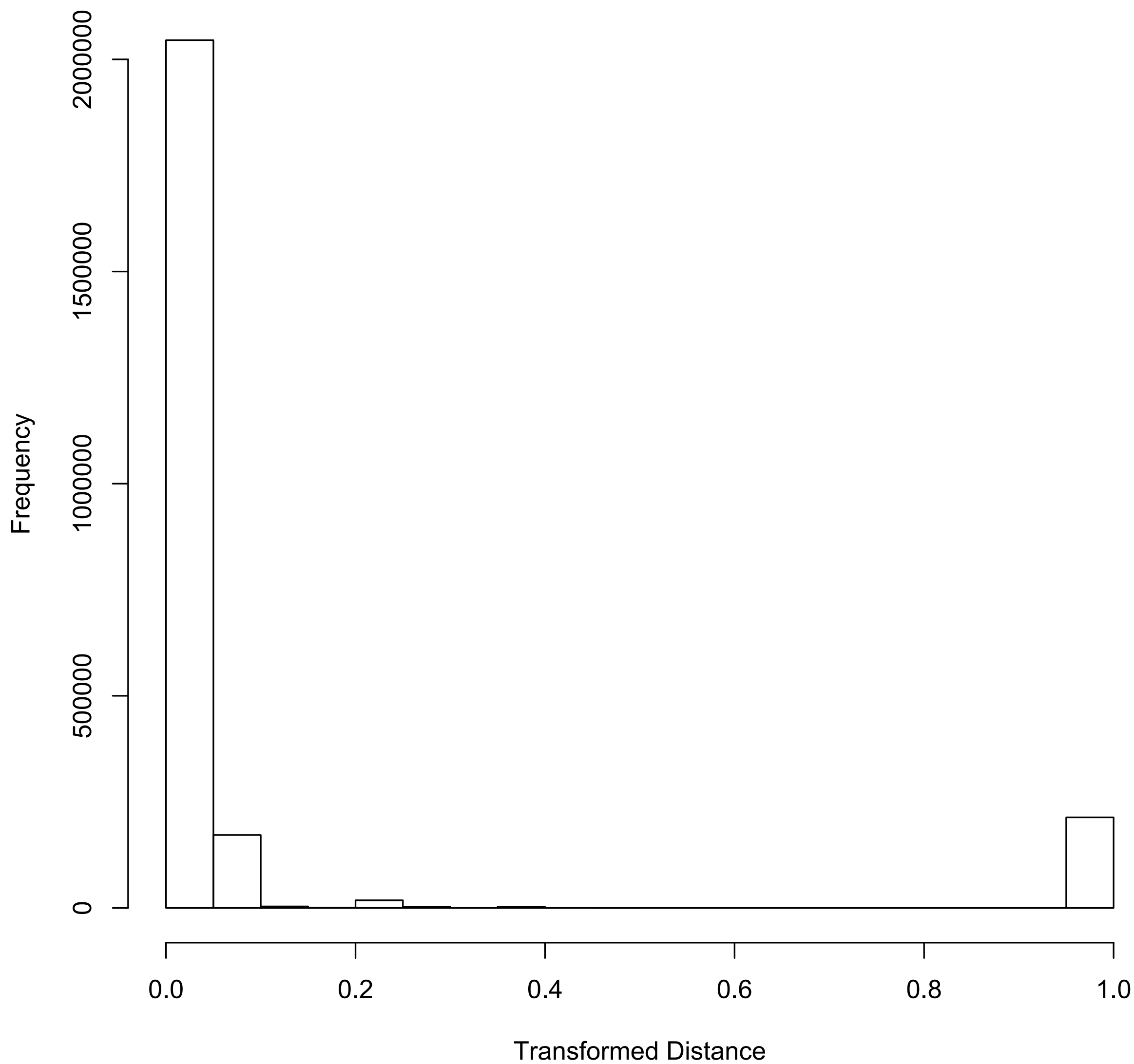


Figure 28. Frequency distribution of transformed geographic distances. (l = number of dyadic relations = 1,228,528)

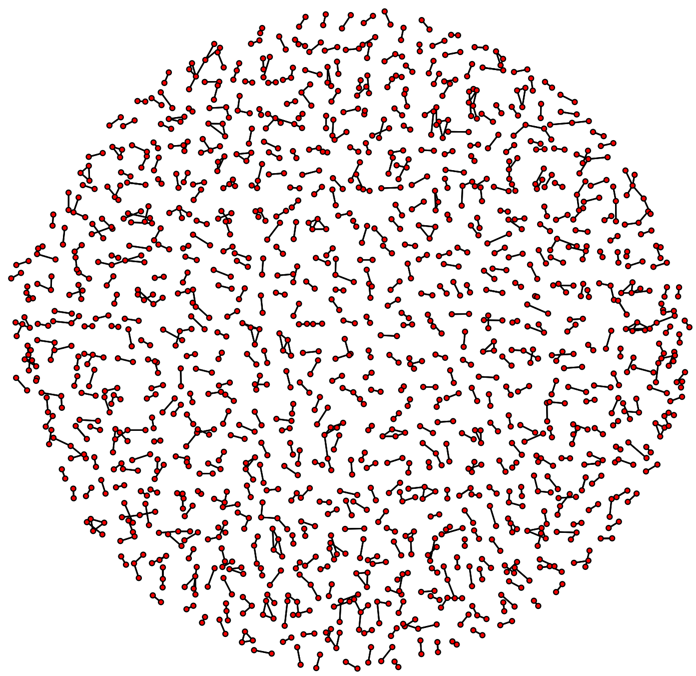


Figure 29. Undirected team membership network. (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

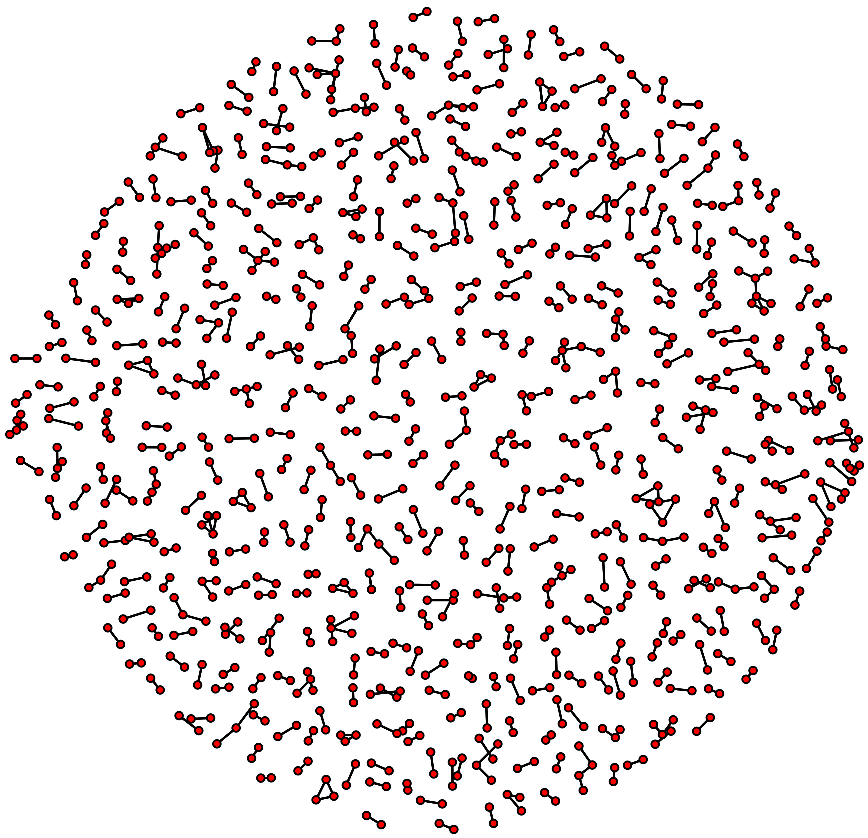


Figure 30. Undirected team membership network; successful dyads only. (n = number of individuals = 1,027; l = number of teammate relationships = 580)

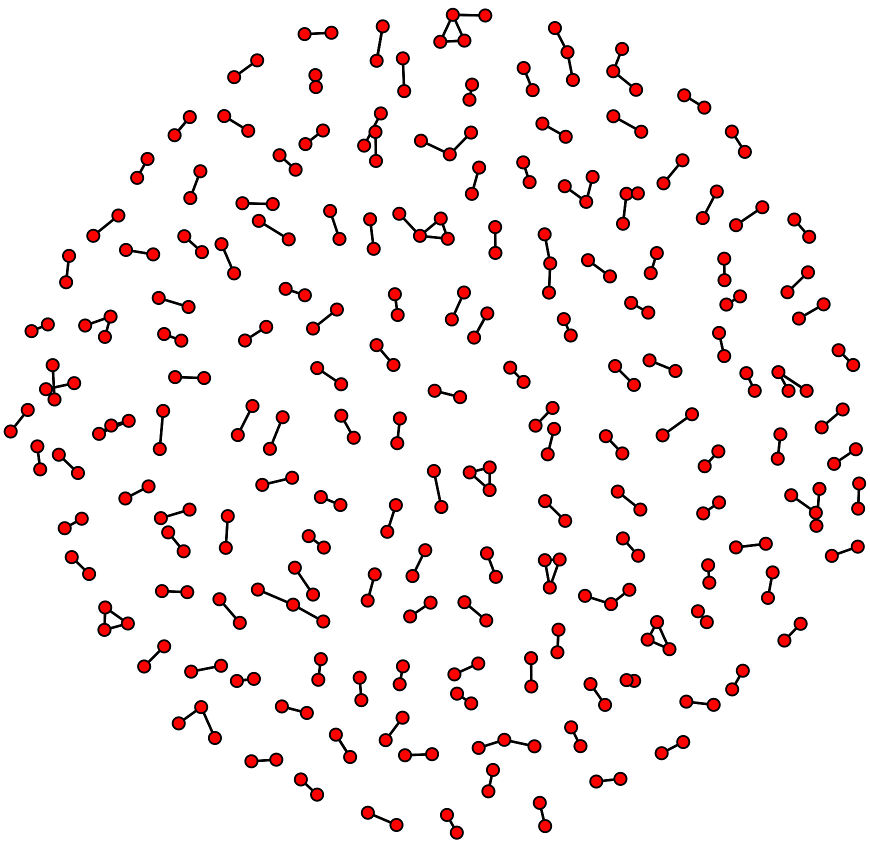


Figure 31. Undirected team membership network; mixed dyads only. (n = number of individuals = 337; l = number of teammate relationships = 191)

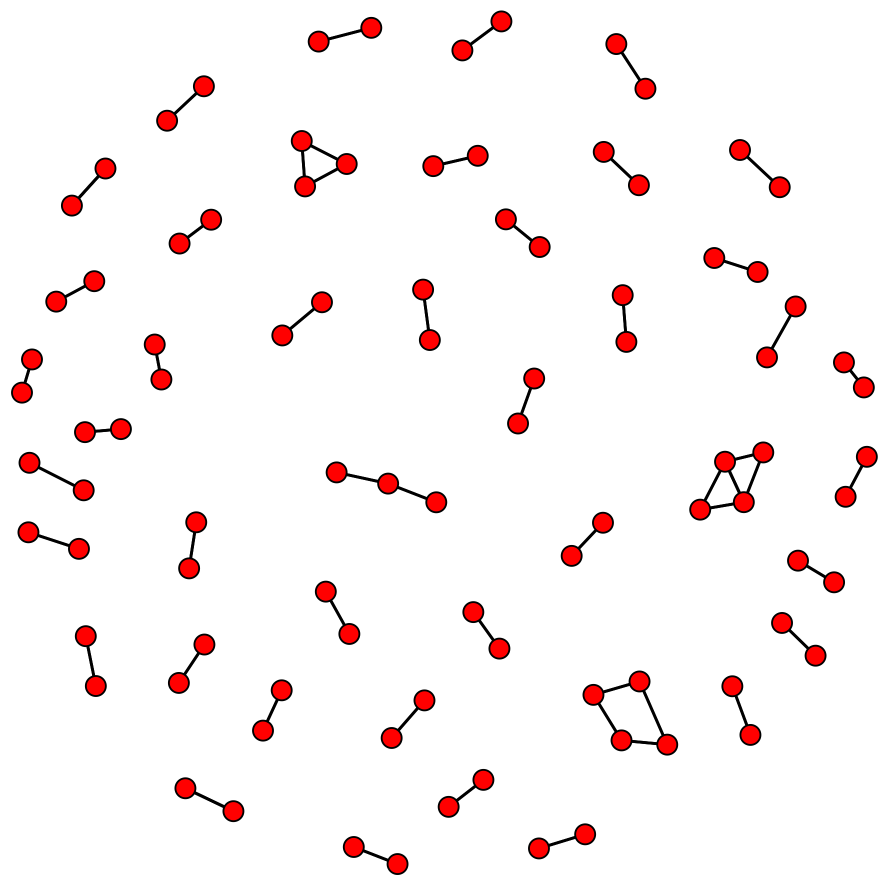


Figure 32. Undirected team membership network; unsuccessful dyads only. (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

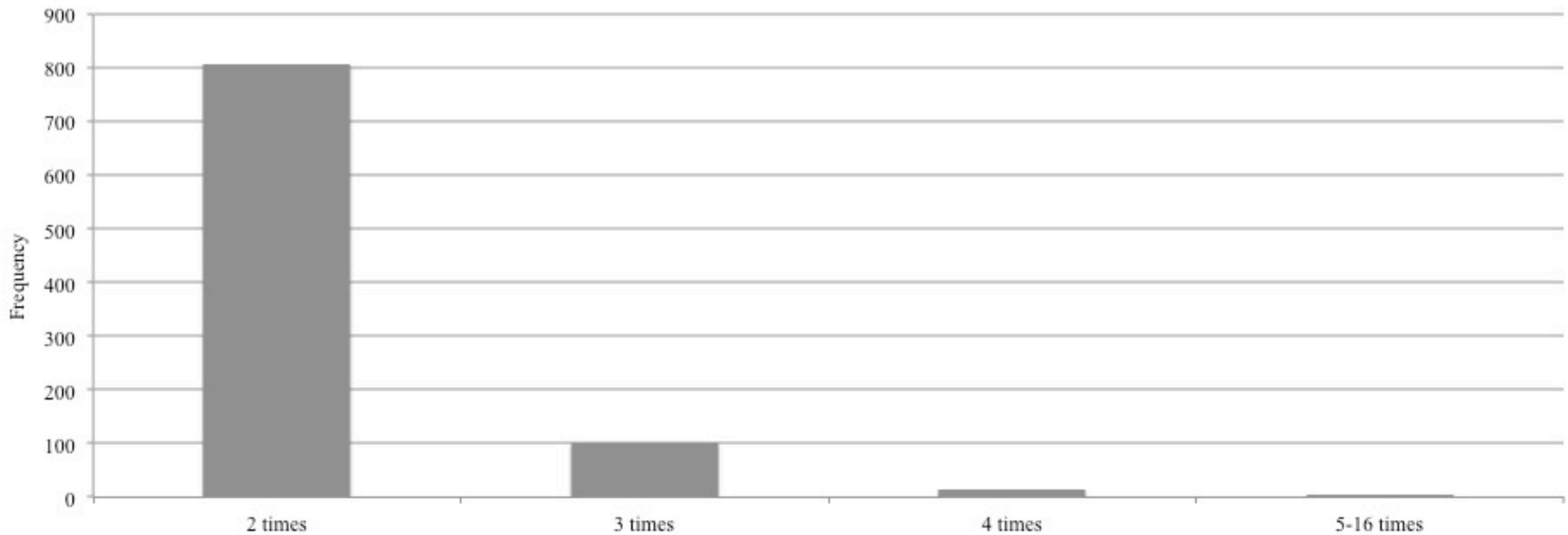


Figure 33. Frequency distribution of teaming frequency. (*l* = number of teammate relationships = 929)

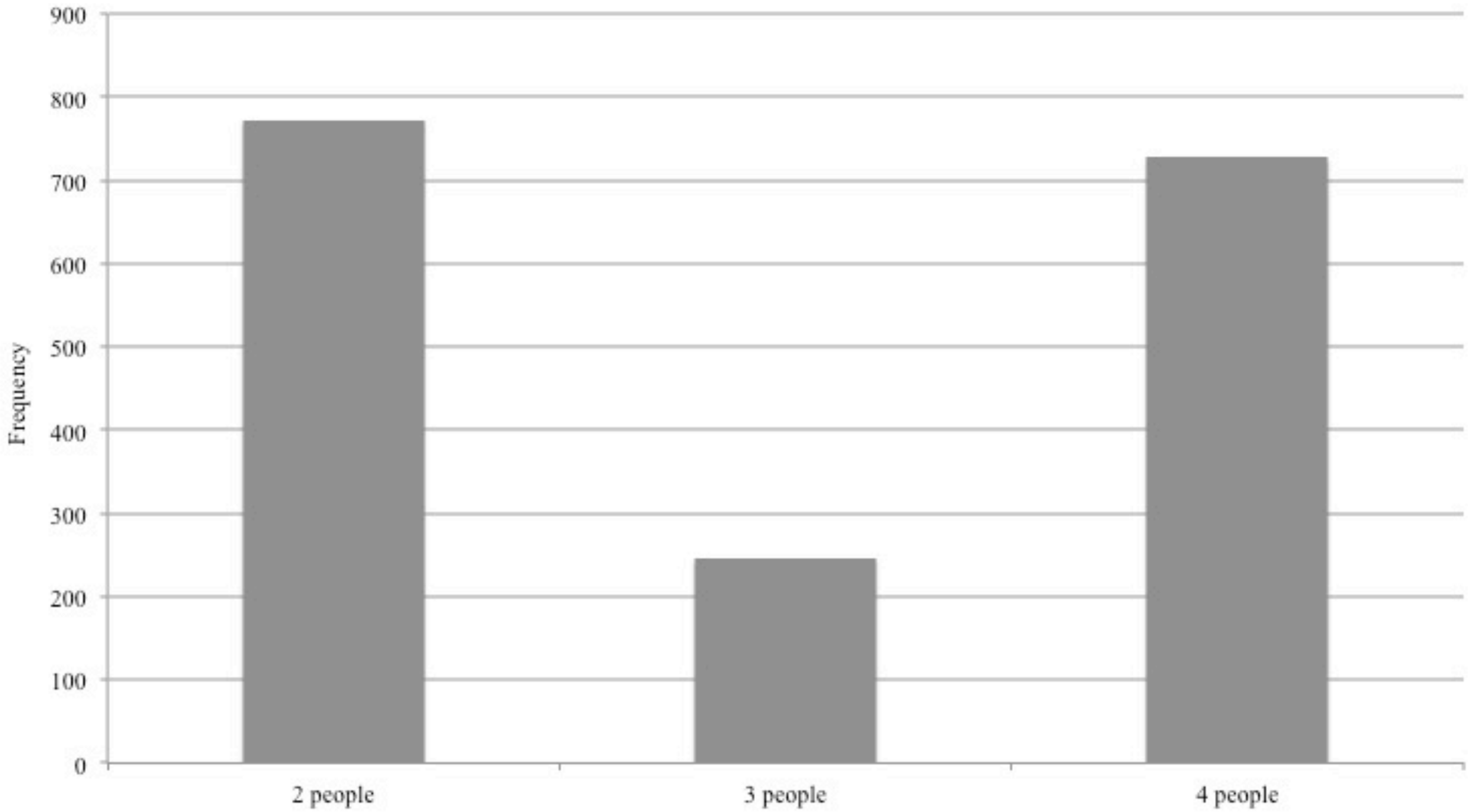


Figure 34. Frequency distribution of team size. (*t* = number of teams = 1,744)

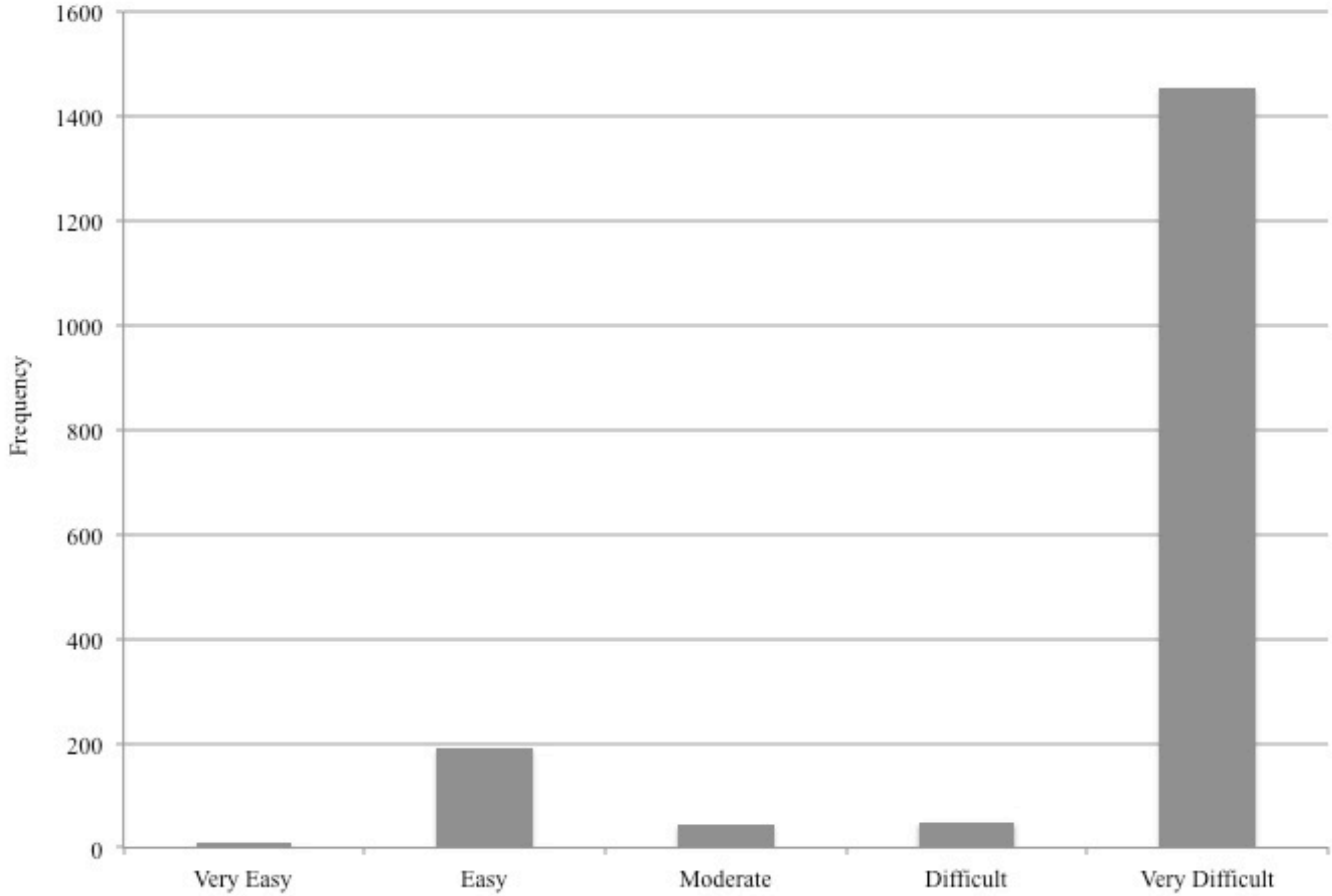


Figure 35. Frequency distribution of task difficulty. (*t* = number of teams = 1,744)

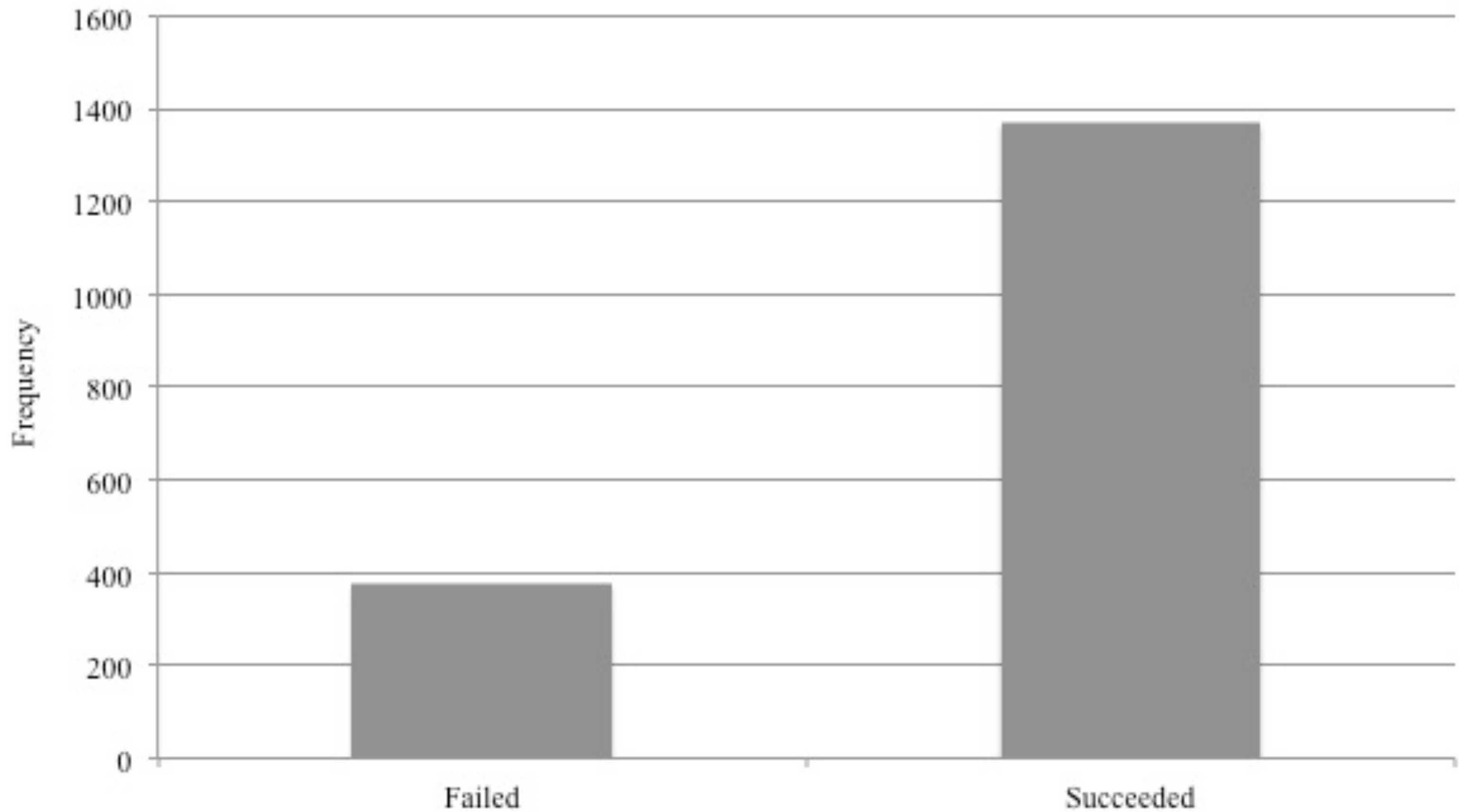


Figure 36. Frequency distribution of quest success. (*t* = number of teams = 1,744)

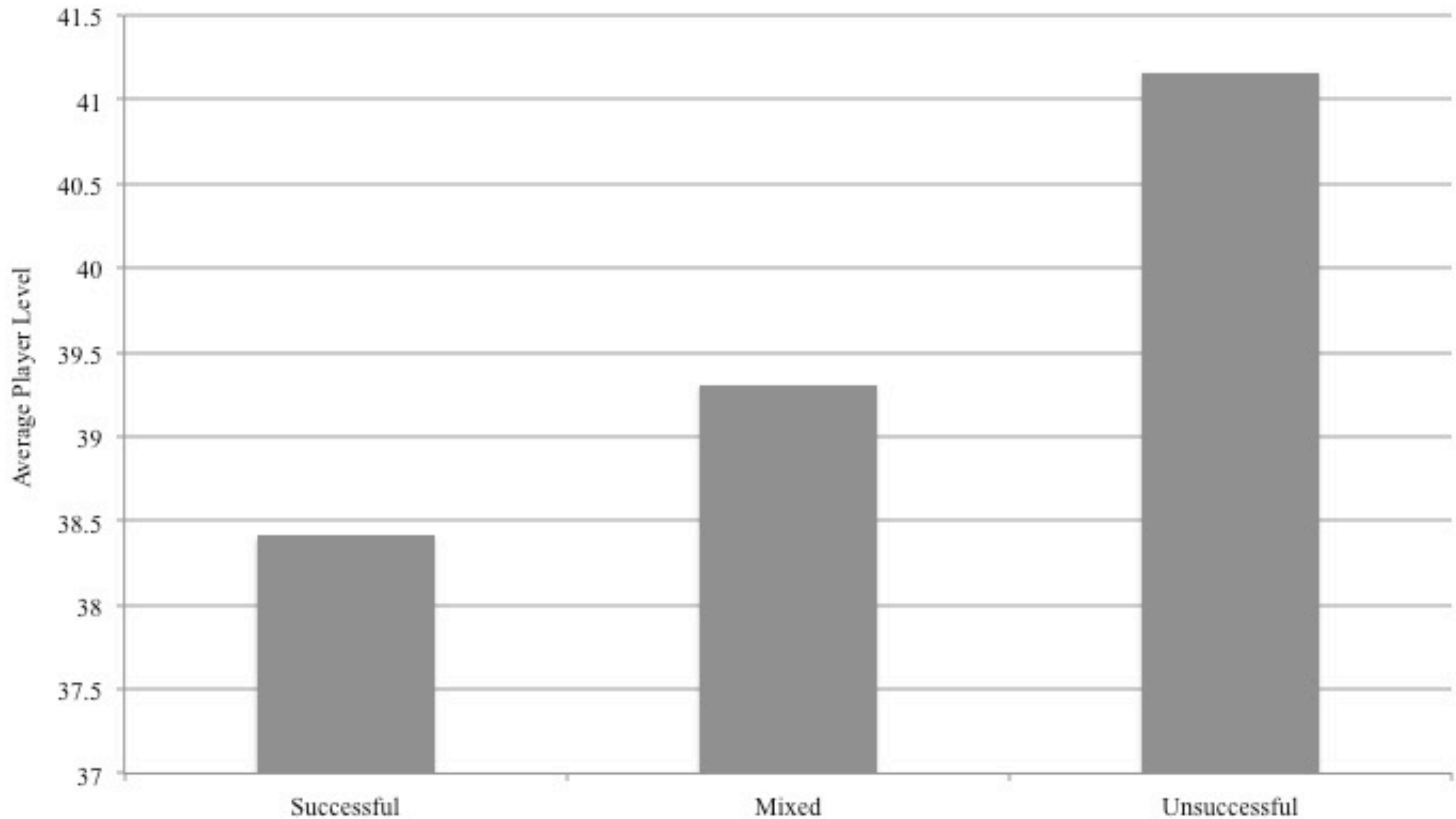


Figure 37. Average raw player level, grouped by performance. (*n* = number of individuals = 1,027 (successful) / 337 (mixed) / 92 (unsuccessful))

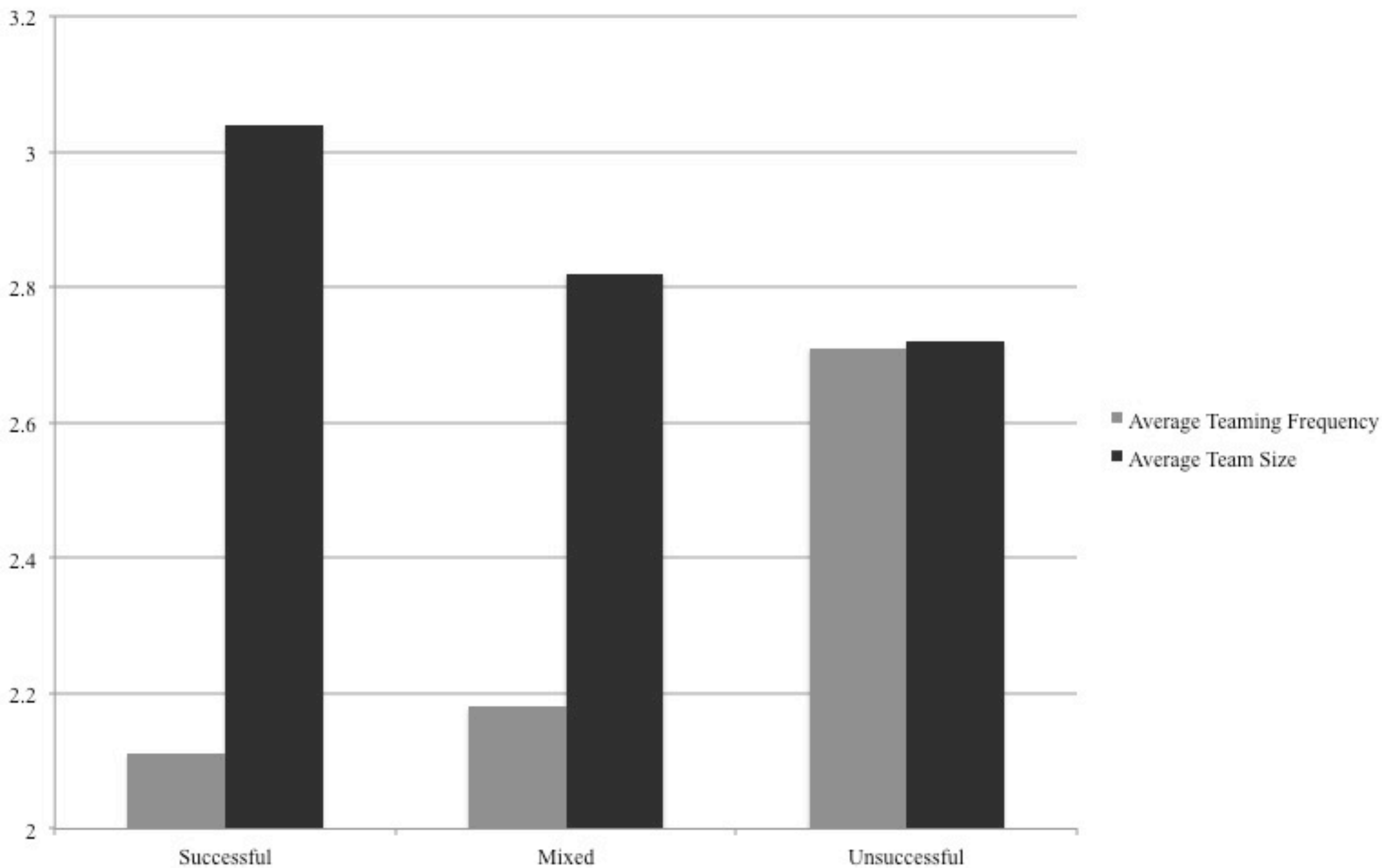


Figure 38. Average teaming frequency and team size, grouped by performance. (t = number of teams = 1,100 (successful) / 362 (mixed) / 130 (unsuccessful); l = number of teammate relationships = 580 (successful) / 191 (mixed) / 56 (unsuccessful))

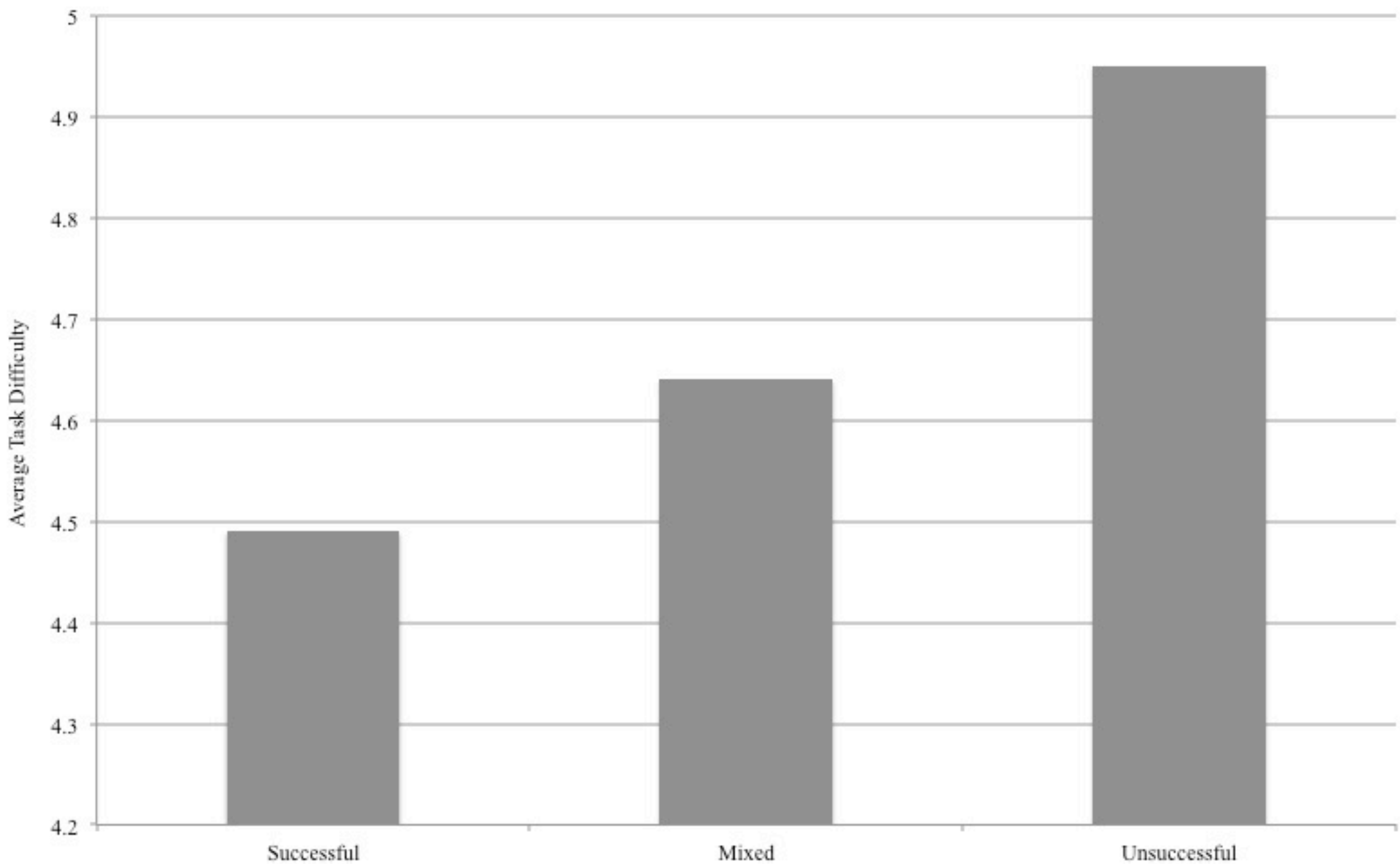


Figure 39. Average task difficulty, grouped by performance. (*t* = number of teams = 1,100 (successful) / 362 (mixed) / 130 (unsuccessful); *l* = number of teammate relationships = 580 (successful) / 191 (mixed) / 56 (unsuccessful))

Dyadic Level

At the dyadic level, the Dragon Nest data set includes information on players' friendships and digital trace records of player proximity.

Familiarity

Dragon Nest players can add one another to friend groups (similar to the functionality of circles in Google+), thus providing documentation of familiarity at the dyadic level. Logistically, this feature in Dragon Nest allows players to easily communicate with one another via instant message. Furthermore, friendships in Dragon Nest are directed, meaning that—for example—person A may indicate a friendship with person B, but this doesn't necessarily mean that person B indicated a friendship with person A. Familiarity was determined by evaluating a data snapshot from January 2, 2012, which included 31 unique, directed relationships between 51 players (23 senders and 30 receivers). An example friendship network can be seen in Figure 22.

Proximity

Proximity of dyads was determined based on individual-level locations, which were determined using Internet Protocol addresses (IP addresses). IP addresses are 32-bit binary numbers that are assigned to computers, tablets, and other devices that access the Internet; they are analogous to postal addresses, expect they are used for sending and receiving information across the World Wide Web. A sample of individual-level IP address data from January to early/mid-February was evaluated. For individuals that logged in from more than 1 IP address during this time frame, modal IP addresses were used. Players' geographic location was operationalized as their coordinates (i.e., longitude and latitude). In order to identify players' coordinates based on their IP addresses, I used the rjson package in R (Couture-Beil, 2014) and freegeoip.net to create a database of IP addresses and associated coordinates. The R code that I used to accomplish this can be seen in Appendix B (Geolocate IP addresses in R, 2013). The vast majority of the final sample of 1,568 players (i.e., 99.36%) hailed from Mainland China. Graphical depictions of the worldwide geographic distribution of players can be found in Figures 25 and 26; these maps were created using the rworldmap package in R (South, 2011).

I used the package geosphere in R (Hijmans, 2014) to calculate the shortest distance between each pair of player coordinates according to the spherical law of cosines. The formula used by the package is as follows:

$$\Delta\sigma = \arccos(sin\phi_1 sin\phi_2 + cos\phi_1 cos\phi_2 cos\Delta\lambda) \times 6378137$$

In the above formula, ϕ_1, λ_1, and ϕ_2, λ_2 stand for coordinates, $\Delta\phi$ and $\Delta\lambda$ are the absolute differences of said coordinates, and $\Delta\sigma$ is the central angle between the 2 given points. The trigonometric function, arccos, is the inverse of cosine. The number 6,378,137 is the radius of the Earth in meters. A frequency distribution of raw geographic distances can been seen in Figure 27.

Furthermore, I transformed the raw proximity variable for computational purposes. Specifically, I applied the following transformation:

$$transformed\ proximity = \exp\left(\frac{-\ raw\ proximity}{50{,}000}\right)$$

This equation is based on two pieces of information. First, a number of researchers have proposed that the probability of a tie forming between two nodes is a negative exponential function of geographic distance (Kleinberg, 2000). Second, the raw proximity distances were divided by 50,000 because it has been suggested that 50,000 meters (or, 50 kilometers) is a reasonable base distance to measure close geographic proximity (Huang et al., 2013a). A frequency distribution of transformed geographic distances can been seen in Figure 28.

Teaming

In Dragon Nest, team membership is recorded for every instance that a group of players assembles to complete a quest. In addition, teams can be identified and differentiated by their unique team identification codes. For the purposes of this study, teaming was operationalized at the dyadic level. In other words, if two players joined forces at least twice on February 6, 2012, it was inferred that they had a teaming relationship. Figure 29 depicts the full, undirected team membership network.

Frequency

Although dyads had to work together at least twice in a 24-hour period to be included in the sample, some pairs joined forces far more frequently—as many as 16 times throughout the course of the day. Descriptive statistics for teaming frequency can be found in Table 3, and Figure 33 presents a frequency distribution for teaming frequency.

Team Level

At the team level, the Dragon Nest data set includes information on team size, task difficulty, and performance. Descriptive statistics for all team-level variables are located in Table 3.

Size

Team size was recorded for each instance of team-based questing. Figure 34 provides a frequency distribution of team sizes, which ranged from 2 to 4 people.

Task Difficulty

Difficulty level was also recorded for each instance of team-based questing. A frequency distribution of task difficulty levels can be seen in Figure 35.

Performance

Team questing performance was measured via quest success. Quest success is a binary variable indicating whether a team successfully completed their mission or not. Figure 36 provides a frequency distribution for quest success.

For analytic purposes, dyads were categorized into three performance groups: one group consisting of dyads that only succeeded when questing, one group consisting of dyads that only failed, and a third group consisting of dyads that both succeeded and failed (i.e., the "mixed" group). Furthermore, steps were taken in order to ensure that all of the performance groups were truly independent. First, 55 individuals were excluded from the performance analyses because they appeared in more than one performance group. Second, 57 individuals were excluded from the performance analyses because they shared at least 1 common team membership with a player in a different performance group. Therefore, 1,456 players constituted the sample that was analyzed to assess performance-related hypotheses; 1,027 individuals were in the successful group, 337 were in the mixed group, and 92 were in the unsuccessful group. Figures 10 through 12 present guild membership sociograms for each performance group. Figures 23 and 24 provide friendship sociograms for the successful and mixed group; there is no friendship sociogram for the unsuccessful dyads because this group did not report any friendships. Figures 30 through 32 present team membership sociograms for each performance group. Figure 37 through 39 present average player level, teaming frequency, team size, and task difficulty for each performance group. Furthermore, Table 12 displays detailed descriptive statistics for all variables of interest for each performance group.

Analytic Approach

Dr. Yunjie Xu of Fudan University in Shanghai, China partnered with the Chinese publisher of Dragon Nest, Shanda Interactive Entertainment Ltd., in order to have access to the in-game data for research purposes. However, due to the immense size of the data set, it could only be accessed in Dr. Xu's laboratory in Shanghai; there was no possibility of accessing the data via the Internet. Accordingly, I was awarded a National Science Foundation (NSF) East Asia and Pacific Summer Institutes (EAPSI) Award[4], which allowed me to spend June and July of 2014 collecting data for the proposed research at Fudan University.

ERGM

To test my hypotheses, I used exponential random graph models (ERGMs), also known as *p** models. In an ERGM, the observed network is the relational dependent variable that the user is interested in modeling. The pattern of ties present in the observed network is conceptualized as just one potential configuration out of many, many potential configurations of ties. ERGMs allow users to estimate model parameters based

[4] NSF award #: 1414978.

on this observed network; in other words, users can determine whether structural characteristics of interest in the observed network likely occurred by chance or not (Robins, Pattison, Kalish, & Lusher, 2007a). Parameter estimates can be based on node attributes (i.e., individual differences) and relational configurations present in the observed network (Anderson, Wasserman, & Crouch, 1999). Furthermore, ERGMs allow users to predict relational dependent variables using relational independent variables (Robins et al., 2007a). The analyses produce effect estimates and associated significant levels, and thus are suitable for testing hypotheses. Furthermore, ERGMs can be applied to very large networks; the maximum number of nodes that can be run in a single estimation is approximately 1,000 to 2,000 (Lusher, Koskinen, & Robins, 2013). The statnet package in R (Handcock et al., 2014) was used to test the proposed hypotheses using ERGMs.

Power

Statistical conclusion validity is concerned with accuracy of two statistical inferences: the inference regarding the covariation of the independent and dependent variables, and the inference regarding the strength of said covariation (Shadish, Cook, & Campbell, 2002). Two broad types of errors are related to statistical conclusion validity: type I and type II. Type I errors—or, false positives—occur when researchers incorrectly reject true null hypotheses. Type II errors—or, false negatives—occur when researchers incorrectly fail to reject false null hypotheses. Statistical conclusion validity may be hindered by power, or the ability of a study to detect effects that are significant at the level of the population; studies low in statistical power are prone to committing type II errors. Power can easily be calculated, as long as the study’s sample size, type I and II error rates, and effect sizes are known. As a rule of thumb, psychologists set type I error rates to .05 and type II error rates (i.e., β) to .20.

Power poses a potential threat to the statistical conclusion validity of the current research. However, while issues of low statistical power typically plague scholars, big data researchers have a different power-related dilemma—extremely large sample sizes lead to the ability to conduct highly sensitive statistical analyses. These tests can be so sensitive, in fact, that type I errors become increasingly common as sample sizes grow (Marcus & Davis, 2014). Therefore, statistically significant findings must be approached and interpreted with caution when dealing with big data. In order to minimize type I errors, I took a number of precautionary steps when conducting ERGM analyses. First, I used a more conservative alpha level. According to Lin, Lucas, and Shmueli (2013), an alpha level of .01 is appropriate for a study with N=500 or more. Second, I report the goodness of fit of all models. Goodness of fit testing compares "features of the observed network…with the same features of a set of networks simulated according to the MLE model" (Hunter, Handcock, Butts, Goodreau, & Morris, 2008, p. 22).

An analogy can be drawn between ERGM and logistic regression; although the latter assumes independence of observations and the former does not, there are many similarities between the two methods. Logistic regression involves predicting a binary outcome from multiple independent variables, with model parameters (i.e., regression coefficients) indicating the relative importance of predictors. Similarly, ERGM involves predicting the presence/absence of a network tie (i.e., a binary outcome) from multiple independent variables (i.e., network configurations), with model parameters indicating the relative importance of each configuration to the presence of a tie (Lusher, Koskinen,

& Robins, 2013). Therefore, because of this correspondence, I calculated power levels for my proposed analyses using the statistical test usually reserved for calculating power for logistic regressions. First, I used criterion power analysis to compute the required alpha level (α) given power level ($1\text{-}\beta$=.80), effect size (p_1=p[Y=1 | X=1]), and sample size (N=1000). When p_1=.10, α=.05; when p_1=.30, α=.002; and when p_1=.50, α<.001. This result signifies that most effects in the Dragon Nest data set (apart from very small ones) are detectable when α=.01. Next, I computed the power level ($1\text{-}\beta$) given alpha level (α), effect size (p_1=p[Y=1 | X=1]), and sample size (N=1000). When alpha is set to .05: p_1=.10 produces a power level of .80; p_1=.30 produces a power level of .98; and p_1=.50 produces a power level of .99. However, when alpha is set to .01: p_1=.10 produces a power level of .57; p_1=.30 produces a power level of .92; and p_1=.50 produces a power level of .96. Again, this result implies that most effects the Dragon Nest data set are detectable when α=.01.

Selection Bias

Potential selection bias poses a threat to the internal validity of the current study. Because all of the hypotheses focus on the context of teams, any players that chose to complete quests individually were excluded from the sample. Thus, it's entirely possible that these individuals, who self-selected into this group, may differ somehow from those who preferred to work in teams. In order to address this threat to internal validity, I compared three groups of players: the aforementioned sample of team players, team players from the same day that were excluded from analyses, and players that chose to work independently (i.e., solo players).

Participants

Participants were players of the Chinese version of Dragon Nest who had engaged in gameplay on February 6, 2012. However, in addition to the primary sample of 1,568 individuals that quested together at least twice on that date, two additional groups were utilized for this analysis. The first comparison group was the 19,220 individuals that quested in teams on February 6, 2012, but never more than once with any given partner. The second comparison group was the players that engaged in gameplay on February 6, 2012, but never quested with teammates. The full sample of solo players for the day in question included 82,794 individuals. However, 849 of those players were excluded because they appeared in the primary team player sample, and 8,767 were excluded because they appeared in the excluded team player sample. Thus, the final sample of solo players included 73,178 individuals.

Materials

The same digital trace data set described previously was used for the selection bias analyses, and all variables for all groups were adjusted according to the previously delineated specifications, with two slight caveats. First, akin to the primary sample, both comparison groups were missing completed quests data. Specifically, the excluded team players lacked 728 data points and the solo players lacked 4,466. Second, both comparison groups were also missing some login data; the excluded team player group lacked 22 data points, while the solo player group lacked 510. In order to account for these missing values, simple random imputation—the same method that was previously used to account for missing data—was employed.

Procedure

First, Levene's tests were conducted in order to evaluate the appropriateness of ANOVA (the parametric option) versus a Kruskal-Wallis one-way analysis of variance (the nonparametric option). Next, Kruskal-Wallis one-way analyses of variance were used to compare the three independent samples. Subsequently, post hoc Nemenyi tests were conducted to achieve pairwise comparisons. The car (Fox & Weisberg, 2011), stats (R Core Team, 2014), and PMCMR (Pohlert, 2014) packages in R were used to carry out these three sets of analyses, respectively. Results indicated some evidence of selection bias for certain variables. For instance, the primary sample of team players and the sample of excluded team players both had significantly higher player levels, more completed quests, more money, more logins, and higher average task difficulties than did the solo players. However, the solo players had significantly more skill points than either group of team players. Furthermore, the primary sample of team players and the excluded team players differed in terms of three variables: player level, completed quests, and average task difficulty. The excluded team players had significantly higher levels and average task difficulties than the current sample of team players, while the current sample of team players had significant more completed quests than the excluded team players.

Semi-Structured Interviews

As aforementioned, research employing MMORPG samples has steadily been on the rise. However, it is yet unclear whether actions in the online realm are representative of real-world behaviors. In order to investigate the comparability of online and offline teammate attraction rules, I conducted a series of semi-structured interviews with two sets of subject matter experts: an American group of team-based online gamers, and a Chinese group of Dragon Nest players. These interviews were conducted to investigate the mapping of online and offline teammate attraction; mapping describes "the extent to which human behaviors occur in virtual spaces in the same way they occur in real spaces" (Williams, 2010, p. 452). The mapping principle has previously been investigated and demonstrated for certain types of behaviors; for instance, economic behaviors in MMORPGs have been shown to map on to real-world economic behaviors (Castronova et al., 2009). Specifically, in the context of the current research, it is critical to understand the potential generalizability of online teaming behaviors (or lack thereof).

Participants

American[5] participants were 26 undergraduate subject-matter experts of team-based online games, recruited through the psychology research participation website of a southeastern university. Upon completion of the study, two credits were awarded to each participant through said research participation website. The gender ratio was highly skewed; 88.46% of participants were male, while 11.54% were female. Although this gender distribution underrepresents female gamers, it accurately reflects gender disparity of the university that participants were recruited from.

Chinese participants were 25 undergraduate subject-matter experts of Dragon Nest, recruited from three universities in eastern China. Upon completion of the study, participants were compensated 100 renminbi (roughly 16 United States dollars) on phone

[5] Several participants were technically international students living in the United States, but will be referred to as American from here on.

cards, which are a common method of paying research participants in China. The gender ratio of the Chinese sample was also highly skewed; 92% of participants were male, while only 8% were female.

Materials

The full semi-structured interview script, in English[6], can be seen in Appendix C. In order to be used in China, the institutional review board had the script professionally translated. Audio recording smartphone applications (such as the iPhone Voice Memos application) were used to record all 51 interviews. English and Chinese audio recordings were professionally transcribed, and Chinese transcriptions were professionally translated to English for coding.

Procedure

Upon arriving to the laboratory, participants were greeted, and it was confirmed that they were indeed over the age of 18 and current players of a team-based online game/Dragon Nest. Subsequently, each participant was given a consent form to read and sign, and was left alone for several minutes. Once it was established that participants had read and understood the consent form, the interviewer doubled-checked that they were aware that the session would be audio recorded, and then turned on the recording device. The interviewer went through the semi-structured interview script from start to finish, and then, upon completion of the interviews, turned off the recording device, thanked the participants, briefly discussed how they would be receiving compensation, and dismissed

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[6] The Chinese interview script was translated exactly from the English script, except the general term "MMORPG(s)" was replaced with the specific referent "Dragon Nest."

them. The average American interview length was 30.47 minutes (*SD*=14.26, minimum=13.56, maximum=68.43). The average Chinese interview length was 36.92 minutes (*SD*=9.03, minimum=15.00, maximum=54.00). In total, approximately 29 hours of recorded interviews were transcribed and coded.

Analytic Approach

Interviews were coded for five pre-set categories based on guidelines laid forth by qualitative researchers such as Gorden (1992) and Saldaña (2012). First, absolute assembly mechanisms were coded for in the interview data; for example, instances of participants saying that they preferred "highly skilled" teammates were classified as absolute. Second, relative assembly mechanisms were coded for in the data; for example, instances of participants saying that they preferred "teammates with similar personalities" served as relative indicators. Third, relational assembly mechanisms were coded for in the data; for example, instances of participants saying that they preferred to team up with their "real-world friends" were classified as relational. Fourth, situational assembly mechanisms were coded for; for example, instances of participants saying that they preferred to team up with other local gamers served as situational indicators. The four aforementioned categories were coded for in two separate places—participants' explanations of their in-game teaming practices and participants' explanations of their real-world teaming practices. Finally, the fifth category that was coded for was the mapping principle category. This category included any direct comparisons that participants made between their in-game and real-world teaming practices.

CHAPTER 3

RESULTS

The results will be presented in three sections. First, quantitative analyses testing the hypotheses about the assembly mechanisms and performance of teams in Dragon Nest will be reported. Second, qualitative analysis of semi-structured interviews of American and Chinese gamers will be detailed. Third, the quantitative and qualitative results will be compared and contrasted.

Quantitative Analysis: Hypothesis Testing

In order to analyze the Dragon Nest digital trace data set, first I correlated all of the focal variables of the study. Next, I tested the aforementioned hypotheses using ERGMs. Finally, I conducted goodness-of-fit tests and selection bias analyses.

Correlations among Focal Variables

Tables 4 and 5 present individual- and team-level correlation coefficients[7] for variables of interest in the current study. At the individual level, one interesting pattern was that player level, completed quests, money, and logins were all positively correlated with one another; *r*'s ranged from .16 to .65, $p<.001$. The robust relation between these variables is unsurprising, as they are all strongly related to experience playing Dragon Nest. Over time, players that login more will likely have higher cumulative numbers of completed quests than those who login less. This progress results in level promotions,

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[7] The Hmisc package in R (Harrell, 2014) was used to calculate these Pearson's correlation coefficients.

and higher-level players tend to earn more money than lower-level players because they are able to successfully complete difficult tasks for bountiful rewards. However, these four variables also negatively correlated with skill points; *r*'s ranged from -.09 to -.34, $p<.001$. Because the administration of skill points ceases once players reach a high enough level, it is reasonable that less experienced players have more skill points than higher-level players.

In addition, individual-level average team size was weakly to moderately correlated with both player level and logins, *r*'s=.08, $p<.01$. The pattern of correlations between average task difficulty and these two variables was strikingly similar; average task difficulty correlated weakly with player level, $r=.05$, $p<.05$, as well as logins, $r=.06$, $p<.05$. Unsurprisingly, average team size and average task difficulty were strongly associated, $r=.73$, $p<.001$. This relation was anticipated, given that difficult quests in Dragon Nest call for larger groups of players than easier tasks do. In Table 5, the team level correlations told a similar story, as team size and task difficulty were strongly positively correlated, $r=.16$, $p<.001$. Furthermore, task difficulty and quest success were negatively related, $r=-.11$, $p<.001$. Again, this result was foreseeable; as quests become more challenging, successfully completing them becomes less likely.

The Quadratic Assignment Procedure (QAP) is a technique that is commonly used to correlate social network data (Whitbred, 2011). The sna package in R (Butts, 2014) was used to calculate QAP coefficients for the current study's three social networks. All networks were treated as undirected in order to accurately reflect subsequent analyses. As visible in Table 6, friendship, guild membership, and team membership all correlated positively with one another; QAP coefficients ranged from .06 to .22, $p<.001$.

Hypothesis Testing

Although most hypotheses were tested in separate ERGMs, there were elements common to all models. Hypotheses 1 through 5 were tested using five separate ERGMs, which can be seen in Tables 7 through 11. All of these models had two common variables—edges and average teaming frequency. First, edges is a crucial control variable that accounts for the number of relationships in the network expected to occur by chance, and must be included in every ERGM. Second, average teaming frequency was included in all models as a node attribute covariate to control for differences among players in how many teams they joined. Although dyads had to work together a minimum of 2 times to be included in the sample, some pairs quested together as many as 16 times throughout the course of the day. In order to control for this discrepancy, average teaming frequency was calculated at the individual level; in other words, each player's teaming frequencies across all of her teammate relationships were averaged. Teaming frequency could not be included as a dyadic covariate because it correlated perfectly with the teammate relationship outcome network. In other words, modeling the undirected, binary network of teaming relationships by including an identical but valued network of relationships as a dyadic covariate was not a feasible method of controlling for teaming frequency because the input and outcome networks were identical, save for the fact that one was binary and the other was valued. In addition, the default ERGM settings—which can be viewed in Appendix D—were always employed, unless otherwise stated.

Table 4

Individual-Level Pearson's Correlation Coefficients

	1.	2.	3.	4.	5.	6.	7.	8.
1. Player level (transformed)	—							
2. Skill points (transformed)	-.29***	—						
3. Completed quests (transformed)	.16***	-.09***	—					
4. Money (transformed)	.26***	-.22***	.18***	—				
5. Logins (transformed)	.65***	-.34***	.47***	.27***	—			
6. Average teaming frequency	.02	.04	.05	-.02	.04	—		
7. Average team size	.08**	-.05	.00	.00	.08**		—	
8. Average task difficulty†	.05*	-.03	-.01	-.01	.06*	-.01	.73***	—

Note. $^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$. n = number of individuals = 1,568. †Lower numbers indicate easier tasks; higher numbers indicate harder tasks.

Table 5

Team-Level Pearson's Correlation Coefficients

	Team size	Task difficulty†	Quest success^{+}
Team size	—		
Task difficulty†	.16***	—	
Quest success^{+}	.06*	-.11***	—

Note. $^{*}p<.05$. $^{***}p<.001$. t = number of teams = 1,744. †Lower numbers indicate easier tasks; higher numbers indicate harder tasks. $^{+}$"0" indicates failure and "1" indicates success.

Table 6

Quadratic Assignment Procedure (QAP) Coefficients

	Friendship	Guild Membership	Team Membership
Friendship	—		
Guild Membership	.11***	—	
Team Membership	.06***	.22***	—

Note. ***$p<.001$. n = number of individuals = 1,568. Average p-values were used.

Table 7

ERGM Revealing the Absolute and Relational Attraction Mechanisms that Predict Team Tie Formation (Hypotheses 1 and 3b)

	Effect Estimate	*SE*	Odds Ratio
edges	-14.76***	.70	—
Node Covariate (nodecov)			
Average Teaming Frequency	-.06	.14	.94
Preferential Avoidance (gwdegree)	9.39***	.55	11,968.10
Closure (gwesp)	3.68***	.11	39.65

Note. ***$p<.001$. t = number of teams = 1,744. n = number of individuals = 1,568. l = number of teammate relationships = 929. *SE* = standard error. gwdegree decay fixed at .25. gwesp alpha fixed at .10. MCMC sample size = 100,000. Maximum iterations = 40. Outcome network = team membership. AIC = 12,081. BIC = 12,130.

Table 8

ERGM Revealing the Surface- and Deep-Level Relative Attraction Mechanisms that Predict Team Tie Formation (Hypothesis 2)

	Effect Estimate	*SE*	Odds Ratio
edges	-7.39^{***}	.41	—
Node Covariate (nodecov)			
Average Teaming Frequency	-.04	.04	.96
Main Effects (nodefactor)			
Archer	-.02	.09	.98
Sorceress	-.01	.07	.99
Cleric	-.02	.07	.98
Assassin	-.02	.07	.98
Player Level^{+}	-.15	.08	.86
Ordinary Member	.04	.09	1.04
Senior Member	-.01	.07	.99
Manager/Leader	.00	.09	1.00
Main Effect (nodecov)			
Skill Points^{+}	.01	.02	1.01
Money^{+}	.01	.01	1.01
Completed Quests^{+}	-.02	.03	.98
Logins^{+}	.02	.04	1.02
Homophily (nodematch)			
Character Class	.11	.08	1.12
Player Level^{+}	$.26^{**}$	.09	1.30
Guild Role	$.23^{**}$	.08	1.26
Homophily (absdiff)			
Skill Points^{+}	.00	.03	1.00
Money^{+}	.01	.01	1.01
Completed Quests^{+}	-.08	.04	.92
Logins^{+}	.02	.04	1.02
Edge Covariate (edgecov)			
Guild Membership	6.58^{***}	.11	720.54

Note. $^{**}p<.01$. $^{***}p<.001$. t = number of teams = 1,744. n = number of individuals = 1,568. l = number of teammate relationships = 929. *SE* = standard error. $^{+}$The transformed version of the variable was used. control=control.ergm(1,228,528). Outcome network = team membership. AIC = 13,213. BIC = 13,478.

Attraction based on Absolute Attributes

Hypothesis 1 predicted that attractiveness as a teammate would be proportional to one's popularity—in other words, there would be a popularity effect in the team membership network. In order to test this premise, the team membership network was modeled using gwdegree, a preferential *avoidance* (i.e., anti-preferential attachment) structural parameter. I also included gwesp in the model to control for the effect of transitivity, or the tendency of individuals to meet through mutual connections (Lusher, Koskinen, & Robins, 2013). In order to draw conclusions about the preferential attachment with a good degree of confidence, it important to first control for structural characteristics of the outcome network such as transitivity.

A positive, significant gwdegree coefficient signifies that the network exhibit preferential avoidance; essentially, this means that low-degree, or unpopular nodes (i.e., individuals with relatively few social connections) are more likely to gain new edges than high-degree nodes (i.e., individuals with relatively many social connections; Hunter, 2007). The results testing H1 are presented in Table 7. In the full sample, gwdegree was estimated as 9.39, $p<.001$, meaning that individuals were nearly 12,000 times more likely to team up with a low-degree player than a high-degree player. This is opposite the preferential attachment mechanism that proposed in H1; in effect, unpopular individuals were far more attractive as teammates. Players' degree was much more evenly distributed in the observed network than it was in the comparable random network. Thus, Hypothesis 1 was not supported.

Attraction based on Relative Attributes

Hypothesis 2 posited that self-assembled teams would be homophilous in terms of surface-level (2a) and deep-level (2b) characteristics. Table 8 presents the test of this hypothesis using surface- and deep-level homophily terms. Specifically, the nodematch ERGM term—which counts of the number of edges (*i*, *j*) for which attribute(*i*)=attribute(*j*)—was used to test for homophily for categorical variables, while the absdiff ERGM term—which equals the sum of the absolute difference of an attribute for all edges in the network—was used to test for homophily for continuous variables. Importantly, I also controlled for main effects for all variables of interest. I used the nodefactor ERGM term—which indicates the number of times that a node with a given attribute appears in an edge in the network—to control for the main effects of categorical variables, and I used the nodecov ERGM term—which equals the sum of the levels of an attribute for all edges in the network —to control for the main effects of continuous variables (Handcock et al., 2014). At the surface-level, homophily was estimated for the following variables: character class, player level, guild affiliation, and guild role. The homophily effect for character class was not significant (.11, *ns*). The homophily effect for player level was significant (.26, $p<.01$); for every 1 unit decrease in two player's level, the players were 1.26 times more likely to team up with one another. Thus, H2a was supported with player level but not character class.

Hypothesis 2a was also tested with guild affiliation. A vast number of different guild affiliations were present in the sample, and ERGMs tend to become unstable when factors with too many levels are modeled. Accordingly, guild membership was translated into an adjacency matrix, and was included in the Table 8 ERGM as an edge covariate.

The homophily effect for guild affiliation was significant (6.58, $p<.001$); players were 720 times more likely to team up with a fellow guild member than a player outside of their guild. Furthermore, the homophily effect for guild role was significant (.23, $p<.01$); players were 1.26 times more likely to team up with a player of the same guild role as themselves than a player of a different guild role. Character subclass and gender were excluded from the model because of their similarity to character class (which was not significant). However, models were tested in which character subclass or gender was used in lieu of character class, and the results were comparable. Overall, Hypothesis 2a was partially supported; results supported homophily effects for player level, guild affiliation, and guild role, but not for the character class.

Homophily on deep-level variables was estimated for the following variables: skill points, completed quests, money, and logins. As seen in Table 8, the parameter estimates for these four variables ranged from -.08 to .02, *ns*, indicating that there were no statistically significant homophily effects for any of the deep-level characteristics included in the model. Therefore, Hypothesis 2b was not supported.

<u>Attraction based on Relational Attributes</u>

In order to test Hypothesis 3a—that self-assembled teams would form based on familiarity more often than would be expected by chance—the observed network of team membership ties between individuals was modeled by estimating a friendship edge covariate parameter, using the edgecov term in statnet. The friendship network was modeled as undirected rather than directed; the team membership outcome network was undirected, thereby necessitating that relational predictors be undirected. As seen in Table 9, the effect of prior friendship on teaming relationships was significant (6.49, *p*<.001); players were over 658 times more likely to team up with a friend than they were to join forces with a stranger. Thus, Hypothesis 3a was supported.

Hypothesis 3b postulated that self-assembled teams would form based on closure more often than would be expected by chance. In order to test this proposition, the observed team membership network was modeled using gwesp, a structural parameter that captures alternating *k*-triangles. Alternating *k*-triangles are referred to as a "higher order" measure of transitivity because they capture configurations that involve more than three nodes (Robins, Snijders, Wang, Handcock, & Pattison, 2007b). In other words, gwesp accounts for the fact that as 2 individuals gain an increasing number of shared connections, the positive impact of these connections on the probability of the dyad will form a tie decreases in magnitude (Goodreau, Kitts, & Morris, 2009). As seen in Table 7, gwdegree was also included in the model, because it is essential to control for preferential avoidance when estimating closure, just as it is important to control for closure when estimating preferential avoidance.

A positive, significant gwesp coefficient signifies evidence of triadic closure. In the current sample, the effect of triadic closure was significant (3.68, *p*<.001). Practically, what this means in the current sample is that if person A teamed up with person B, and person B teamed up with person C, then person C was 40 times more likely to team up with person A. Accordingly, Hypothesis 3b was supported.

<u>Attraction based on Situational Attributes</u>

Hypothesis 4 predicted that self-assembled teams would exhibit a propinquity effect, choosing teammates who were nearby more often than would be expected by chance. In order to test this hypothesis, the observed network of team membership ties between individuals was modeled by estimating a proximity edge covariate parameter. This was accomplished first by calculating (and transforming) the distance between every pair of players in the sample, and then translating those calculations into a weighted adjacency matrix.[8] As seen in Table 10, the proximity edge covariate was estimated as 2.03, $p<.001$. This model reflects decrease in distance rather than the typical increase in distance because the raw proximity scores were transformed using a negative exponential function, thus reversing the interpretation of the proximity parameter estimate. In other words, individuals were more likely to team up with spatially proximal individuals than with distal individuals. Consequently, Hypothesis 4 was supported. However, the 7.61 odds ratio is not easily interpretable because I transformed the raw distances; in other words, one unit of distance in the current model does not have much meaning. In order to make sense of the 7.61 odds ratio, I plugged two arbitrary distances into the equation that used to transform distance. I chose 55.80 kilometers and 146.40 kilometers, because these are the distances from Beijing to two nearby suburbs, Langfang and Tianjin. I then multiplied the resulting difference by the 7.61 odds ratio. The result, 2.09, is how much more likely a gamer from Beijing would be to team up with someone from Langfang than to team up with someone from Tianjin.

Overall Attraction

Hypothesis 5 posited that the propinquity effect would be stronger than the absolute, relative, and/or relational effects on team self-assembly. To test this hypothesis,

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[8] I also tried dichotomizing this adjacency matrix (at the mean) and then running the ERGM, but the results were nearly identical to those reported.

the observed network of team membership ties was modeled by estimating preferential avoidance, homophily, familiarity, closure, and proximity parameters. In fact, all of the parameters used to test Hypotheses 1 through 4 were included in the model, with the exception of nonsignificant parameters from the model testing Hypothesis 2. These parameters were excluded because they were consistently estimated as being nonsignificant, and their inclusion led to model instability. As seen in Table 11, the effect of preferential avoidance on team membership ties was estimated as 9.52, $p<.001$; player level homophily was estimated as .26, $p<.01$; guild membership homophily was estimated as 5.74, $p<.001$; guild role homophily was estimated as .26, $p<.01$; familiarity was estimated as 1.59, *ns*; closure was estimated as 3.15, $p<.001$; and proximity was estimated as 2.31, $p<.001$. Therefore, because preferential avoidance, guild membership, and closure (i.e., the most powerful observed influencers of team self-assembly) are absolute, relative, and relational in nature, Hypothesis 5 was not supported.

<u>Absolute Composition and Performance</u>

In order to test the remaining hypotheses, which posit that certain assembly mechanisms are associated with better/worse team performance, I first needed to determine if systematic differences between performance groups on primary variables of interest existed; if disparities emerged, these variables would need to be controlled for in all subsequent models, in order to ensure that these disparities did not influence the outcome of the tests of Hypotheses 6 through 10. Accordingly—as visible in Table 13—Levene's tests were conducted in order to evaluate the appropriateness of Kruskal-Wallis one-way analyses of variance versus ANOVAs; Kruskal-Wallis one-way analyses of variance are nonparametric, and can be used when the assumptions of ANOVA are not met. Out of the 8 variables tested, only average teaming frequency had a statistically significant Levene's test result, F=24.62, p<.001, indicating inequality of variances across groups. Subsequently, as seen in Tables 14 and 15, a Kruskal-Wallis one-way analysis of variance was conducted for average teaming frequency, while ANOVAs were conducted for the other seven variables. Out of all the tested variables, only two surfaced as being significantly different between groups: average teaming frequency, χ^2=44.25, p<.001, and total number of logins, F=3.45, p<.05. In other words, unsuccessful teams tended to have the highest average teaming frequencies and the most logins, while successful teams tended to have the lowest average teaming frequencies and the least logins. Consequently, average teaming frequency (which was previously included as a node covariate in the models testing Hypotheses 1 through 5) and logins were included as control variables in the models testing Hypotheses 6 through 10.

Hypothesis 6 postulated that self-assembled teams composed of many popular members would outperform self-assembled teams composed of relatively few popular members. As presented in Table 16, the team membership networks for successful, mixed, and unsuccessful dyads were modeled using gwdegree in order to test this premise. In the successful sample, gwdegree was estimated as 10.63, p<.001; in the mixed sample, gwdegree was estimated as 11.70, p<.001; and in the unsuccessful sample, gwdegree was estimated as 9.51, p<.001. Therefore, although all three groups exhibited preferential avoidance effects, the group with the effect of the lowest magnitude was the unsuccessful individuals, opposite the direction proposed by H6. Thus, Hypothesis 6 was not supported.

Table 9

ERGM Revealing a Relational Attraction Mechanism that Predicts Team Tie Formation (Hypothesis 3a)

	Effect Estimate	*SE*	Odds Ratio
edges	-7.21***	.18	—
Node Covariate (nodecov)			
Average Teaming Frequency	-.01	.04	.99
Edge Covariate (edgecov)			
Friendship	6.49***	.39	658.52

Note. ***p<.001. t = number of teams = 1,744. n = number of individuals = 1,568. l = number of teammate relationships = 929. *SE* = standard error. Outcome network = team membership. AIC = 14,636. BIC = 14,672.

Table 10

ERGM Revealing a Situational Attraction Mechanism that Predicts Team Tie Formation (Hypothesis 4)

	Effect Estimate	*SE*	Odds Ratio
edges	-7.56***	.18	—
Node Covariate (nodecov)			
Average Teaming Frequency	-.03	.04	.97
Edge Covariate (edgecov)			
Proximity+	2.03***	.07	7.61

Note. ***p<.001. t = number of teams = 1,744. n = number of individuals = 1,568. l = number of teammate relationships = 929. *SE* = standard error. +The transformed version of the variable was used. Outcome network = team membership. AIC = 14,045. BIC = 14,081.

Table 11

ERGM Revealing the Absolute, Relative, Relational, and Situational Attraction Mechanisms that Predicts Team Tie Formation (Hypothesis 5)

	Effect Estimate	*SE*	Odds Ratio
edges	-15.46***	.84	—
Node Covariate (nodecov)			
Average Teaming Frequency	-.12	.16	.89
Preferential Avoidance (gwdegree)	9.52***	.57	13,629.61
Closure (gwesp)	3.15***	.13	23.34
Main Effects (nodefactor)			
Player Level+	-.07	.23	.93
Ordinary Member	.34	.27	1.40
Senior Member	.14	.24	1.15
Manager/Leader	-.38	.35	.68
Homsophily (nodematch)			
Player Level+	.26**	.10	1.30
Guild Role	.26**	.09	1.30
Edge Covariate (edgecov)			
Guild Membership	5.74***	.18	311.06
Friendship	1.59	1.04	4.90
Proximity+	2.31***	.09	10.07

Note. ** p<.01. *** p<.001. t = number of teams = 1,744. n = number of individuals = 1,568. l = number of teammate relationships = 929. *SE* = standard error. +The transformed version of the variable was used. gwdegree decay fixed at .25. gwesp alpha fixed at .10. MCMC sample size = 100,000. Maximum iterations = 150. control=control.ergm(1,228,528). Outcome network = team membership. AIC = 9,894. BIC = 10,051.

Table 12

Descriptive Statistics, Grouped by Performance

	Successful (*t*=1,100, *n*=1,027, *l*=580)				Mixed (*t*=362, *n*=337, *l*=191)				Unsuccessful (*t*=130, *n*=92, *l*=56)			
	Mean	*SD*	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*	Min.	Max.
Individual Level												
Player level (raw)	38.41	13.09	4.50	50.00	39.31	12.95	9.00	50.00	41.16	12.41	12.00	50.00
Player level (trans.)	.70	.46	.00	1.00	.67	.47	.00	1.00	.66	.48	.00	1.00
Skill points (raw)	24.38	76.38	.00	510.00	22.48	67.16	.00	510.00	39.53	120.09	.00	510.00
Skill points (trans.)	1.43	1.72	.00	6.23	1.41	1.72	.00	6.23	1.33	1.85	.00	6.23
Quests (raw)	168.80	143.32	1.00	873.00	145.14	120.94	1.00	736.00	141.57	126.18	2.00	848.00
Quests (trans.)	4.65	1.16	.00	6.77	4.52	1.14	.00	6.60	4.47	1.18	.69	6.74
Money (raw)	9.69e+6	3.55e+7	.00	5.20e+8	1.07e+7	4.36e+7	.00	5.85e+8	1.62e+7	5.91e+7	67.00	4.04e+8
Money (trans.)	13.63	2.73	.00	20.07	13.53	3.01	.00	20.19	13.74	2.61	4.20	19.82
Logins (raw)	59.55	59.81	1.00	744.00	64.57	63.08	1.00	622.00	73.30	66.34	1.00	385.00
Logins (trans.)	3.57	1.15	.00	6.61	3.69	1.08	.00	6.43	3.85	1.06	.00	5.95
Avg. teaming freq.	2.10	.36	2.00	7.00	2.18	.39	2.00	4.00	2.53	1.81	2.00	14.00
Avg. team size	2.82	.57	1.25	3.75	2.84	.60	1.33	3.71	2.83	.58	1.38	3.81
Avg. task difficulty	3.37	.57	1.25	5.00	3.37	.59	1.33	4.29	3.28	.65	1.38	4.29
Dyadic Level												
Proximity (raw)	9.01e+5	1.09e+6	.00	1.56e+7	1.09e+6	1.69e+6	.00	1.52e+7	6.84e+5	5.02e+5	.00	2.05e+6
Proximity (trans.)	.10	.29	.00	1.00	.09	.28	.00	1.00	.09	.27	.00	1.00
Teaming frequency	2.11	.40	2.00	7.00	2.18	.40	2.00	4.00	2.71	2.29	2.00	16.00
Team Level												
Team size	3.04	.93	2.00	4.00	2.82	.91	2.00	4.00	2.72	.90	2.00	4.00
Task difficulty*	4.49	1.07	1.00	5.00	4.64	.93	2.00	5.00	4.95	.38	1.00	5.00
Quest success+	1.00	.00	1.00	1.00	.53	.50	.00	1.00	.00	.00	.00	.00

Note. *t* = number of teams. *n* = number of individuals. *l* = number of teammate relationships. *SD* = standard deviation. *Lower numbers indicate easier tasks; higher numbers indicate harder tasks. +"0" indicates failure and "1" indicates success.

Table 13

Levene's Test Assessing the Equality of Variances Across Performance Groups

Variable	*df*	*F*
Player level+	2	.78
Skill points+	2	.23
Completed quests+	2	.50
Money+	2	.36
Logins+	2	.54
Average teaming frequency	2	24.62***
Average team size	2	2.02
Average task difficulty	2	1.45

Note. ***$p<.001$. *df* = degrees of freedom. +The transformed version of the variable was used.

Table 14

Kruskal-Wallis One-Way Analyses of Variance by Performance

Dependent Variable	Group	*N*	Mean	*SD*	*df*	χ^2	Nemenyi Test
Average teaming frequency	Successful	1,027	2.10	.36	2	44.25***	Unsuccessful > Successful*
	Mixed	337	2.18	.39			Unsuccessful > Mixed*
	Unsuccessful	92	2.53	1.81			

Note. *$p<.05$. ***$p<.001$. *SD* = standard deviation. *df* = degrees of freedom.

Table 15

One-Way Analyses of Variance by Performance with Post-Hoc Tests

Dependent Variable	Source	*df*	*SS*	*MS*	*F*	Tukey's HSD
	Between groups	2	.33	.17	.78	
Player level[+]	Within groups	1,453	308.66	.21		—
	Total	1,455	341.66			
	Between groups	2	1.00	.47	.16	
Skill points[+]	Within groups	1,453	4,337.00	2.98		—
	Total	1,455	4,338.00			
	Between groups	2	5.70	2.85	2.13	
Completed quests[+]	Within groups	1,453	1,946.40	1.34		—
	Total	1,455	1,952.10			
	Between groups	2	4.00	1.95	.25	
Money[+]	Within groups	1,453	11,331.00	7.80		—
	Total	1,455	11,335.00			
	Between groups	2	8.80	4.40	3.45*	
Logins[+]	Within groups	1,453	1,853.80	1.28		*ns*
	Total	1,455	1,862.60			
	Between groups	2	.10	.03	.09	
Average team size	Within groups	1,453	480.70	.33		—
	Total	1,455	480.80			
	Between groups	2	.80	.40	1.17	
Average task difficulty	Within groups	1,453	490.30	.34		—
	Total	1,455	491.10			

Note. *$p<.05$. *df* = degrees of freedom. *SS* = sum of squares. *MS* = mean sum of squares. [+]The transformed version of the variable was used.

Table 16

ERGMs Revealing the Absolute and Relational Attraction Mechanisms that Predict Team Tie Formation, Grouped by Performance (Hypotheses 6 and 8b)

	Successful (t=1,100, n=1,027, l=580) AIC=7,141 BIC=7,197			Mixed (t=362, n=337, l=191) AIC=1,902 BIC=1,947			Unsuccessful (t=130, n=92, l=56) AIC=426.50 BIC=458.20		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
edges	-15.74***	1.55	—	-16.37***	2.60	—	-15.07***	2.94	—
Node Covariate (nodecov)									
Number of Logins+	.09	.08	1.09	-.04	.16	.96	.38	.30	1.46
Average Teaming Frequency	-.15	.31	.86	.21	.42	1.23	-.08	.19	0.92
Preferential Avoidance (gwdegree)	10.63***	.95	41,357.13	11.70***	2.12	120,571.71	9.51***	2.15	13,493.99
Closure (gwesp)	3.69***	.14	40.04	3.71***	.29	40.85	2.92***	.43	18.54

Note. ***p<.001. t = number of teams. n = number of individuals. l = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. gwdegree decay fixed at .25. gwesp alpha fixed at .10. MCMC sample size = 100,000. Maximum iterations = 60. Outcome network = team membership.

Table 17

ERGMs Revealing the Surface- and Deep-Level Relative Attraction Mechanisms that Predicts Team Tie Formation, Grouped by Performance (Hypothesis 7)

	Successful (*t*=1,100, *n*=1,027, *l*=580) AIC=8,179 BIC=8,424			Mixed (*t*=362, *n*=337, *l*=191) AIC=2,152 BIC=2,349			Unsuccessful (*t*=130, *n*=92, *l*=56) AIC=496.20 BIC=635.60		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
edges	-7.52***	.61	—	-5.00***	1.06	—	-2.32	1.80	—
Node Covariate (nodecov)									
Average Teaming Frequency	-.02	.09	.98	-.05	.15	.95	-.06	.08	.94
Main Effects (nodefactor)									
Archer	.04	.11	1.04	-.21	.22	.81	-.12	.47	.89
Sorceress	.02	.09	1.02	-.16	.17	.85	.06	.37	1.06
Cleric	-.02	.08	.98	-.20	.17	.82	.41	.35	1.51
Assassin	.06	.09	1.06	-.05	.17	.95	-.21	.34	.81
Player Level+	-.20	.10	.82	-.29	.19	.75	-.43	.44	.65
Ordinary Member	.02	.11	1.02	.29	.21	1.34	.27	.44	1.31
Senior Member	-.01	.09	.99	.20	.19	1.22	.14	.34	1.15
Manager/Leader	-.07	.12	.93	.43	.23	1.54	-.06	.44	.94
Main Effect (nodecov)									
Skill Points+	.02	.02	1.02	.03	.04	1.03	.05	.08	1.05
Money+	.01	.01	1.01	-.02	.02	.98	.04	.05	1.04
Completed Quests+	.02	.04	1.02	.02	.07	1.02	-.11	.12	.90
Logins+	.02	.04	1.02	.00	.09	1.00	-.07	.17	.93

Note. *p<.05. **p<.01. ***p<.001. t = number of teams. n = number of individuals. l = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. control=control.ergm(1,228,528). Outcome network = team membership.

Table 17 (continued)

ERGMs Revealing the Surface- and Deep-Level Relative Attraction Mechanisms that Predicts Team Tie Formation, Grouped by Performance (Hypothesis 7)

	Successful (t=1,100, n=1,027, l=580) AIC=8,179 BIC=8,424			Mixed (t=362, n=337, l=191) AIC=2,152 BIC=2,349			Unsuccessful (t=130, n=92, l=56) AIC=496.20 BIC=635.60		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
Homophily (nodematch)									
Character Class	.14	.10	1.15	-.18	.20	.84	.04	.38	1.04
Player Level+	.26*	.11	1.30	.19	.20	1.21	-.09	.38	.91
Guild Role	.04	.11	1.04	.35	.20	1.42	.13	.38	1.14
Homophily (absdiff)									
Skill Points+	-.03	.03	.97	-.08	.06	.92	-.16	.12	.85
Money+	.02	.02	1.02	-.02	.03	.98	-.09	.08	.91
Completed Quests+	.03	.05	1.03	-.15	.10	.86	-.42*	.20	.66
Logins+	-.05	.05	.95	.03	.10	1.03	-.30	.21	.74
Edge Covariate (edgecov)									
Guild Membership	6.35***	.15	572.49	6.86***	.31	953.37	6.55***	.70	699.24

Note. *p<.05. **p<.01. ***p<.001. t = number of teams. n = number of individuals. l = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. control=control.ergm(1,228,528). Outcome network = team membership.

Table 18

ERGMs Revealing a Relational Attraction Mechanism that Predicts Team Tie Formation, Grouped by Performance (Hypothesis 8a)

	Successful (t=1,100, n=1,027, l=580) AIC=8,816 BIC=8,861			Mixed (t=362, n=337, l=191) AIC=2,490 BIC=2,526			Unsuccessful (t=130, n=92, l=56) AIC=576.20 BIC=601.60		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
edges	-6.89***	.40	—	-5.76***	.71	—	-4.65***	.76	—
Node Covariate (nodecov)									
Number of Logins+	.02	.03	1.02	.00	.05	1.00	.04	.10	1.04
Average Teaming Frequency	-.02	.08	.98	.02	.13	1.02	-.01	.06	.99
Edge Covariate (edgecov)									
Friendship	7.01***	.52	1,107.65	5.32***	.92	204.38	—	—	—

Note. ***p<.001. t = number of teams. n = number of individuals. l = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. Outcome network = team membership.

Table 19

ERGMs Revealing a Situational Attraction Mechanism that Predicts Team Tie Formation, Grouped by Performance (Hypothesis 9)

	Successful (t=1,100, n=1,027, l=580) AIC=8,519 BIC=8,564			Mixed (t=362, n=337, l=191) AIC=2,325 BIC=2,360			Unsuccessful (t=130, n=92, l=56) AIC=555.80 BIC=581.20		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
edges	-7.36***	.41	—	-6.73***	.71	—	-5.05***	.77	—
Node Covariate (nodecov)									
Number of Logins+	.01	.03	1.01	.01	.05	1.01	.06	.10	1.06
Average Teaming Frequency	.01	.09	1.01	.08	.13	1.08	-.01	.06	.99
Edge Covariate (edgecov)									
Proximity+	1.85***	.09	6.36	2.19***	.15	8.94	1.51***	.30	4.53

Note. ***p<.001. t = number of teams. n = number of individuals. l = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. Outcome network = team membership.

Table 20

ERGMs Revealing the Absolute, Relative, Relational, and Situational Attraction Mechanisms that Predicts Team Tie Formation, Grouped by Performance (Hypothesis 10)

	Successful (*t*=1,100, *n*=1,027, *l*=580) AIC=6,037 BIC=6,171			Mixed (*t*=362, *n*=337, *l*=191) AIC=1,356 BIC=1,463			Unsuccessful (*t*=130, *n*=92, *l*=56) AIC=298.90 BIC=368.70		
	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio	Effect Estimate	*SE*	Odds Ratio
edges	-17.19^{***}	1.99	—	-16.62^{***}	3.01	—	-11.85^{***}	3.25	—
Node Covariate (nodecov)									
Number of Logins+	.13	.16	1.14	-.06	.31	.94	.26	.48	1.30
Average Teaming Frequency	-.31	.40	.73	-.06	.49	.94	$-.55^{*}$	.23	.58
Preferential Avoidance (gwdegree)	10.85^{***}	.97	51,534.15	11.92^{***}	2.10	150,241.61	13.12^{***}	3.96	498,819.71
Closure (gwesp)	3.24^{***}	.19	25.53	3.10^{***}	.30	22.20	2.69^{***}	.48	14.73
Main Effects (nodefactor)									
Player Level+	-.41	.36	.66	-.54	.63	.58	.18	1.08	1.20
Main Effect (nodecov)									
Completed Quests+	.15	.13	1.16	.14	.22	1.15	-.28	.28	.76
Homophily (nodematch)									
Player Level+	$.35^{**}$	.11	1.42	$.36^{*}$	.17	1.43	.26	.34	1.30
Homophily (absdiff)									
Completed Quests+	.02	.07	1.02	-.22	.13	.80	$-.58^{**}$	.21	.56
Edge Covariate (edgecov)									
Guild Membership	5.54^{***}	.20	254.68	6.66^{***}	.33	780.55	7.46^{***}	1.10	1,737.15
Friendship	4.81^{***}	1.04	122.73	-1.31	1.38	.27	—	—	—
Proximity+	2.08^{***}	.12	8.00	2.83^{***}	.20	16.95	2.12^{***}	.36	8.33

Note. $^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$. *t* = number of teams. *n* = number of individuals. *l* = number of teammate relationships. *SE* = standard error. +The transformed version of the variable was used. gwdegree decay fixed at .25. gwesp alpha fixed at .10. control=control.ergm(1,228,528). Outcome network = team membership. MCMC sample size = 100,000. Maximum iterations = 40.

Table 21

Descriptive Statistics for Selection Bias Analyses

	Primary Sample of Team Players (*n*=1,568)				Excluded Team Players (*n*=19,220)				Solo Players (*n*=73,178)			
	Mean	*SD*	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*	Min.	Max.
Player level (raw)	39.09	12.86	4.50	50.00	41.04	12.88	1.00	50.00	19.47	9.99	1.00	50.00
Player level (trans.)	.70	.46	.00	1.00	.75	.43	.00	1.00	.08	.28	.00	1.00
Skill points (raw)	25.78	82.05	.00	510.00	24.42	81.64	.00	510.00	74.20	56.28	.00	510.00
Skill points (trans.)	1.39	1.74	.00	6.23	1.29	1.71	.00	6.23	3.84	1.30	.00	6.23
Quests (raw)	162.84	136.64	1.00	873.00	133.94	126.63	1.00	1,006.00	36.30	59.93	1.00	933.00
Quests (trans.)	4.62	1.16	.00	6.77	4.31	1.30	.00	6.91	2.83	1.28	.00	6.84
Money (raw)	1.01e+7	3,83e+7	.00	5.85e+8	1.29e+7	6.38e+7	.00	3.03e+9	1.35e+6	2.02e+7	.00	2.84e+9
Money (trans.)	13.57	2.87	.00	20.19	13.61	2.95	.00	21.82	8.07	5.56	.00	21.77
Logins (raw)	62.66	61.68	1.00	744.00	64.07	62.29	1.00	1,018.00	17.16	28.49	1.00	1,386.00
Logins (trans.)	3.64	1.12	.00	6.61	3.65	1.17	.00	6.93	2.10	1.21	.00	7.23
Avg. task difficulty	3.37	.58	1.25	5.00	4.76	.68	1.00	5.00	2.86	.99	1.00	5.00

Note. *n* = number of individuals. *SD* = standard deviation.

Table 22

Levene's Test Assessing the Equality of Variances for Selection Bias Analyses

Variable	*df*	*F*
Player level+	2	2,323.40***
Skill points+	2	1,265.90***
Completed quests+	2	16.09***
Money+	2	4,533.90***
Logins+	2	80.67***
Average task difficulty	2	9,262.70***

Note. ***$p<.001$. *df* = degrees of freedom. +The transformed version of the variable was used.

Relative Composition and Performance

Hypothesis 7a predicted that teams that assembled based on surface-level heterophily would outperform teams that did not assemble based on surface-level heterophily. As presented in Table 17, surface-level homophily was estimated for character class, player level, guild affiliation, and guild role. Character class homophily was estimated as .14, *ns*, in the successful sample; as -.18, *ns* in the mixed sample; and as .04, *ns*, in the unsuccessful sample. Player level homophily was estimated as .26, $p<.05$, in the successful sample; as .19, *ns*, in the mixed sample; and as -.09, *ns*, in the unsuccessful sample. Guild affiliation homophily was estimated as 6.35, $p<.001$, in the successful sample; as 6.86, $p<.001$, in the mixed sample; and as 6.55, $p<.001$, in the unsuccessful sample. Finally, guild role homophily was estimated as .04, *ns*, in the successful sample; as .35, *ns*, in the mixed sample; and as .13, *ns*, in the unsuccessful sample. Overall, results for all surface-level variables were roughly equivalent for all three performance groups, with 1 exception; only the successful performance group exhibited a significant effect of player level homophily on team self-assembly. Accordingly, Hypothesis 7a was not supported. With the exception of player level homophily, homophily on most variables was not related to team performance.

Table 23

Kruskal-Wallis One-Way Analyses of Variance for Selection Bias Analyses

Dependent Variable	Group	*N*	Mean	*SD*	*df*	χ^2	Nemenyi Test
Player level+	1. Primary sample of team players	1,568	.70	.46	2	40,204.72***	2 > 1**
	2. Excluded team players	19,220	.75	.43			1 > 3***
	3. Solo players	73,178	.08	.28			2 > 3***
Skill points+	1. Primary sample of team players	1,568	1.39	1.74	2	26,536.32***	3 > 1***
	2. Excluded team players	19,220	1.29	1.71			3 > 2***
	3. Solo players	73,178	3.84	1.30			
Completed quests+	1. Primary sample of team players	1,568	4.62	1.16	2	18,493.06***	1 > 2***
	2. Excluded team players	19,220	4.31	1.30			1 > 3***
	3. Solo players	73,178	2.83	1.28			2 > 3***
Money+	1. Primary sample of team players	1,568	13.57	2.87	2	19,436.21***	1 > 3***
	2. Excluded team players	19,220	13.61	2.95			2 > 3***
	3. Solo players	73,178	8.07	5.56			
Logins+	1. Primary sample of team players	1,568	3.64	1.12	2	20,326.36***	1 > 3***
	2. Excluded team players	19,220	3.65	1.17			2 > 3***
	3. Solo players	73,178	2.10	1.21			
Avg. task difficulty	1. Primary sample of team players	1,568	3.37	.58	2	34,550.97***	2 > 1***
	2. Excluded team players	19,220	4.76	.68			1 > 3***
	3. Solo players	73,178	2.86	.99			2 > 3***

Note. ** $p<.01$. *** $p<.001$. *SD* = standard deviation. *df* = degrees of freedom. +The transformed version of the variable was used.

Hypothesis 7b posited that teams that assembled based on deep-level heterophily would outperform teams that did not assemble based on deep-level heterophily. As presented in Table 17, deep-level homophily was estimated for skill points, completed quests, money, and logins. Skill point homophily was estimated as -.03, *ns*, in the successful sample; as -.08, *ns*, in the mixed sample; and as -.16, *ns*, in the unsuccessful sample. Completed quest homophily was estimated as .03, *ns*, in the successful sample; as -.15, *ns*, in the mixed sample; and as -.42, $p<.05$, in the unsuccessful sample. Money homophily was estimated as .02, *ns*, in the successful sample; as -.02, *ns*, in the mixed sample; and as -.09, *ns*, in the unsuccessful sample. Finally, login homophily was estimated as -.05, *ns*, in the successful sample; as .03, *ns*, in the mixed sample; and as -.30, *ns*, in the unsuccessful sample. Again, results for all variables were comparable for all performance groups, with a single exception. Unsuccessful teams were more likely to form based on quest homophily (i.e., similarity in number of completed quests) than were the successful teams. Therefore, Hypothesis 7b was partly supported, with quest homophily.

Relational Composition and Performance

In order to test Hypothesis 8a—that teams that assembled based on familiarity would outperform teams that did not assemble based on familiarity—the observed networks of team membership ties between individuals for two of the three performance groups were modeled by estimating a friendship edge covariate parameter. An effect estimate was not produced to test this hypothesis for the unsuccessful performance group because there were no friendship ties available to model in that network. As seen in Table 18, the effect of friendship on team self-assembly was estimated as 7.01, $p<.001$, in the successful sample and as 5.32, $p<.001$, in the mixed group. Overall, Hypothesis 8a was supported; the large magnitude of the friendship effect estimate for the successful performance group combined with the sheer lack of friendship ties in the unsuccessful group jointly support this hypothesis.

Hypothesis 8b predicted that teams that assembled based on closure would outperform teams that did not assemble based on closure. As presented in Table 16, the team membership networks for successful, mixed, and unsuccessful dyads were modeled using gwesp in order to test this proposition. [G]wesp was estimated as 3.69, $p<.001$, in the successful sample; as 3.71, $p<.001$, in the mixed sample; and as 2.92, $p<.001$, in the unsuccessful sample. Therefore, because all three performance groups exhibited statistically significant effects of transitivity of similar magnitudes, and the mixed performance group demonstrated the effect of the greatest magnitude overall, Hypothesis 8b was not supported.

Situational Composition and Performance

Hypothesis 9 posited that teams that assembled based on propinquity would outperform teams that did not assemble based on propinquity. In order to test this hypothesis, the observed network of team membership ties between individuals was modeled for all three performance groups by estimating proximity as an edge covariate, just as was accomplished in the analysis testing Hypothesis 4. As seen in Table 19, the effect of proximity on team self-assembly was estimated as 1.85, $p<.001$, in the successful sample; as 2.19, $p<.001$, in the mixed group; and as 1.51, $p<.001$, in the unsuccessful group. This pattern indicates that players from all three performance groups tended to team up with geographically proximal players, and that this effect was most extreme for the mixed performance group. Thus, the results failed to support Hypothesis 9.

Overall Composition and Performance

Hypothesis 10 postulated that teams that assembled primarily based on heterophily would outperform teams that assembled primarily based on absolute, relational, or situational attraction mechanisms. To test this hypothesis, the observed network of team membership ties was modeled for each performance group by estimating preferential avoidance, homophily, familiarity, closure, and proximity parameters. In fact, all of the parameters used to test Hypotheses 6 through 9 were included in the model, with the exception of nonsignificant parameters from the model testing Hypothesis 7. These parameters were excluded because they were consistently estimated as being nonsignificant, and their inclusion led to model instability.

As seen in Table 20, the effect of preferential avoidance on team membership ties was estimated as 10.85, p<.001, in the successful sample; as 11.92, p<.001, in the mixed group; and as 13.12, p<.001, in the unsuccessful group. Player level homophily was estimated as .35, p<.05, in the successful sample; as .36, p<.05, in the mixed group; and as .26, *ns*, in the unsuccessful group. Guild membership homophily was estimated as 5.54, p<.001, in the successful sample; as 6.66, p<.001, in the mixed group; and as 7.46, p<.001, in the unsuccessful group. Completed quest homophily was estimated as .02, *ns*, in the successful sample; as -.22, *ns*, in the mixed group; and as -.58, p<.01, in the unsuccessful group. Familiarity was estimated as 4.81, p<.001, in the successful sample and as -1.31, *ns*, in the mixed group. This parameter was not estimated in the unsuccessful group because of the complete absence of friendship ties. Closure was estimated as 3.24, *p*<.001, in the successful sample; as 3.10, *p*<.001, in the mixed group; and as 2.69, *p*<.001, in the unsuccessful group. Proximity was estimated as 2.08, *p*<.001, in the successful sample; as 2.83, *p*<.001, in the mixed group; and as 2.12, *p*<.001, in the unsuccessful group. Overall, the successful performance group did not evidence any tendency of self-assembling based on heterophily, but did appear to use homophily (in terms of player level and guild membership) as a mechanism of self-assembly. Based on this evidence, Hypothesis 10 was not supported.

Goodness of Fit

There are three primary ways to assess goodness of fit for ERGMs: 1) Akaike information criterion (AIC) and Bayesian information criterion (BIC) values; 2) Markov Chain Monte Carlo (MCMC) model diagnostics; and 3) goodness-of-fit plots. In general, it is optimal to take a holistic approach to assessing goodness of fit; by considering different pieces of evidence, the most accurate possible understanding of model fit can achieved. First, AIC and BIC values reflect how well a model fits a particular data set; higher values indicate worse fit, while lower values indicate better fit. However, AIC and BIC values only approximate the fit of an ERGM, and are relatively imprecise (Hunter, Goodreau, & Handcock, 2008). As visible in Tables 7 through 11, for the full sample AICs ranged from 9,894 to 14,636, while BICs ranged from 10,051 to 14,672. As visible in Tables 16 through 20, AICs ranged from 6,037 to 8,816 for the successful performance group; from 1,356 to 2,490 for the mixed performance group; and from 298.90 to 576.20 for the unsuccessful performance group. Similarly, BICs ranged from 6,171 to 8,861 for the successful performance group; from 1,463 to 2,526 for the mixed performance group; and from 368.70 to 635.60 for the unsuccessful performance group.

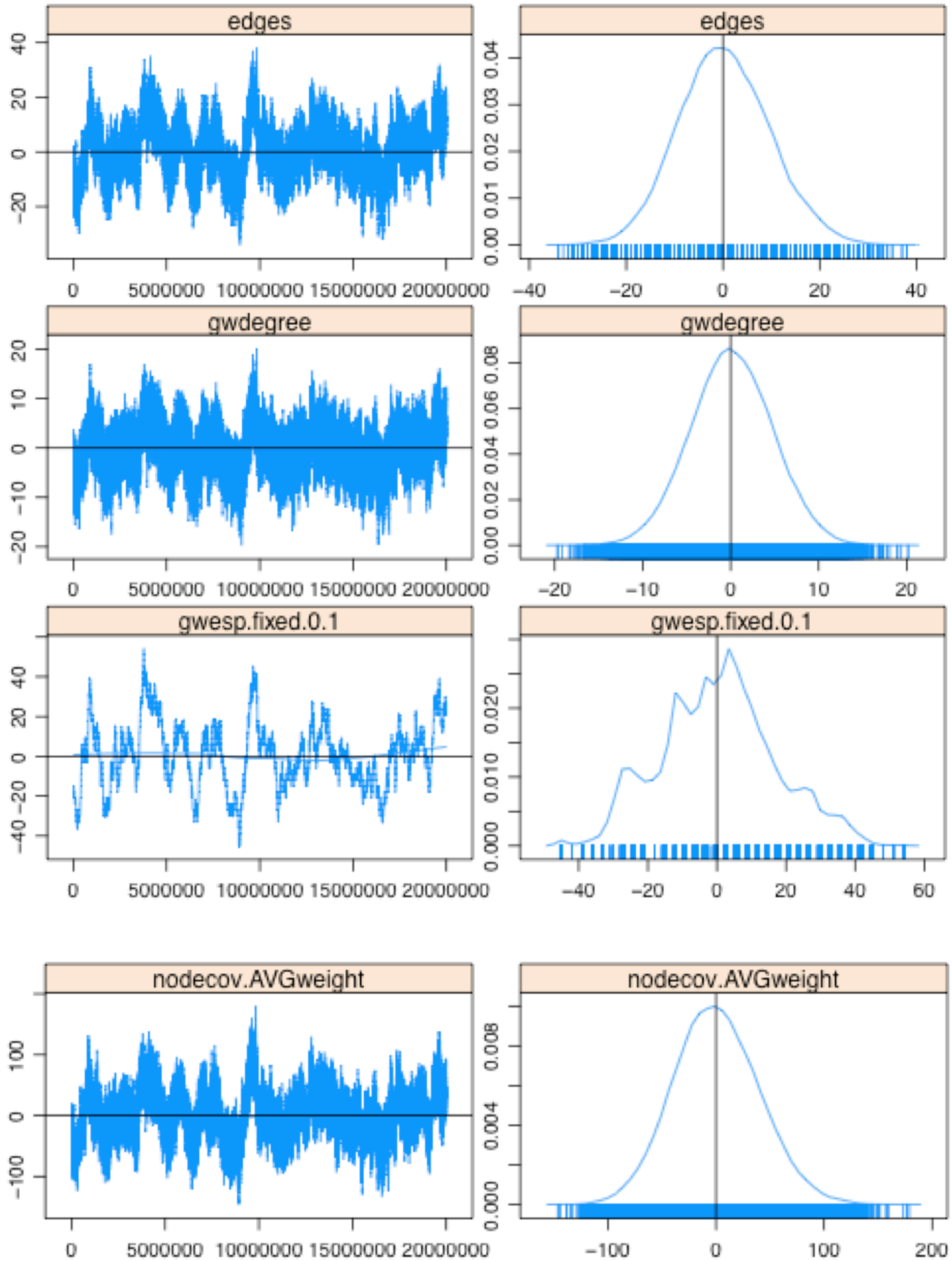

Figure 40. Markov Chain Monte Carlo diagnostics for the Hypotheses 1 and 3b ERGM analysis (as seen in Table 7). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

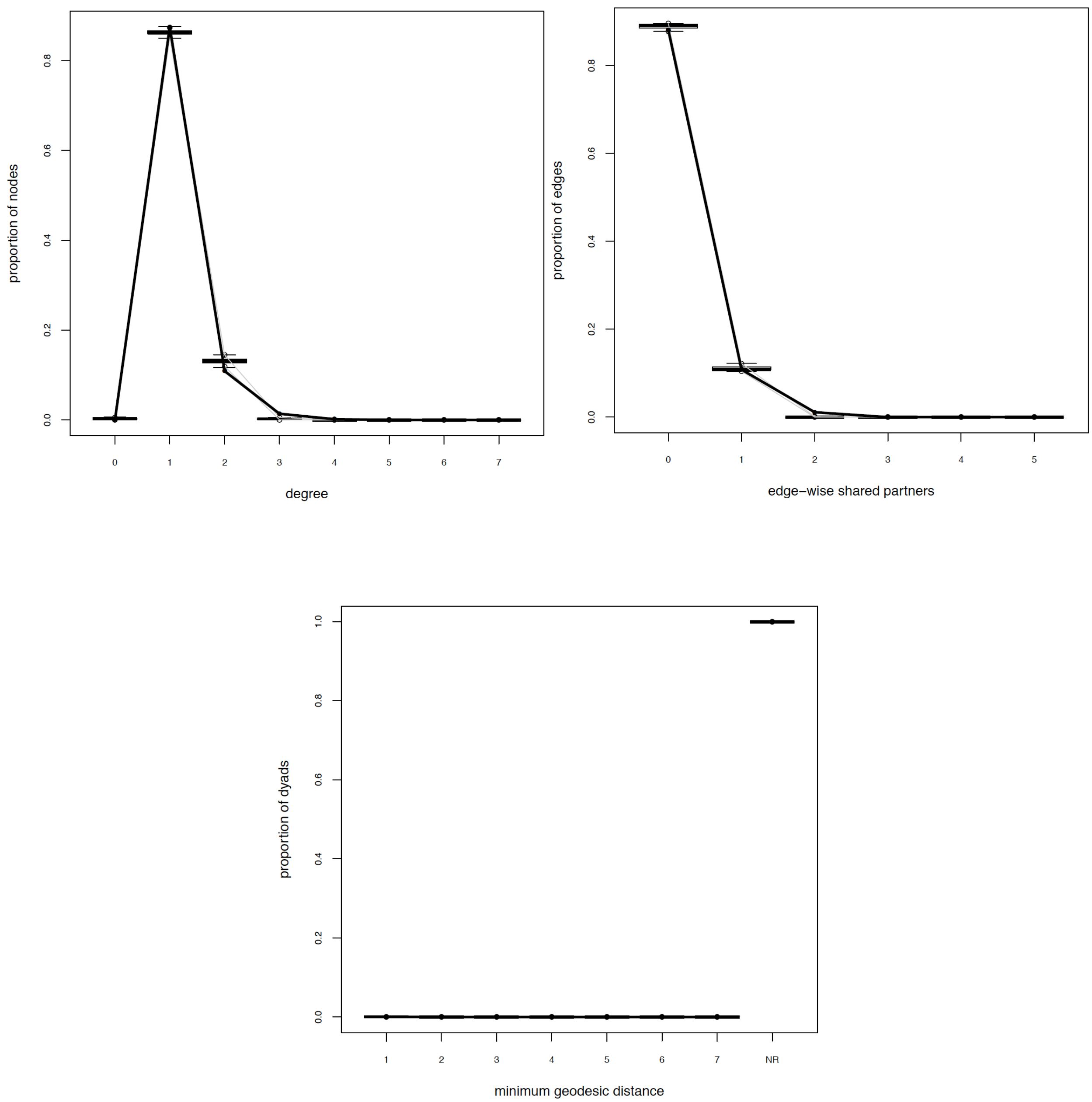

Figure 41. Goodness-of-fit diagnostics for the Hypotheses 1 and 3b ERGM analysis (as seen in Table 7). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

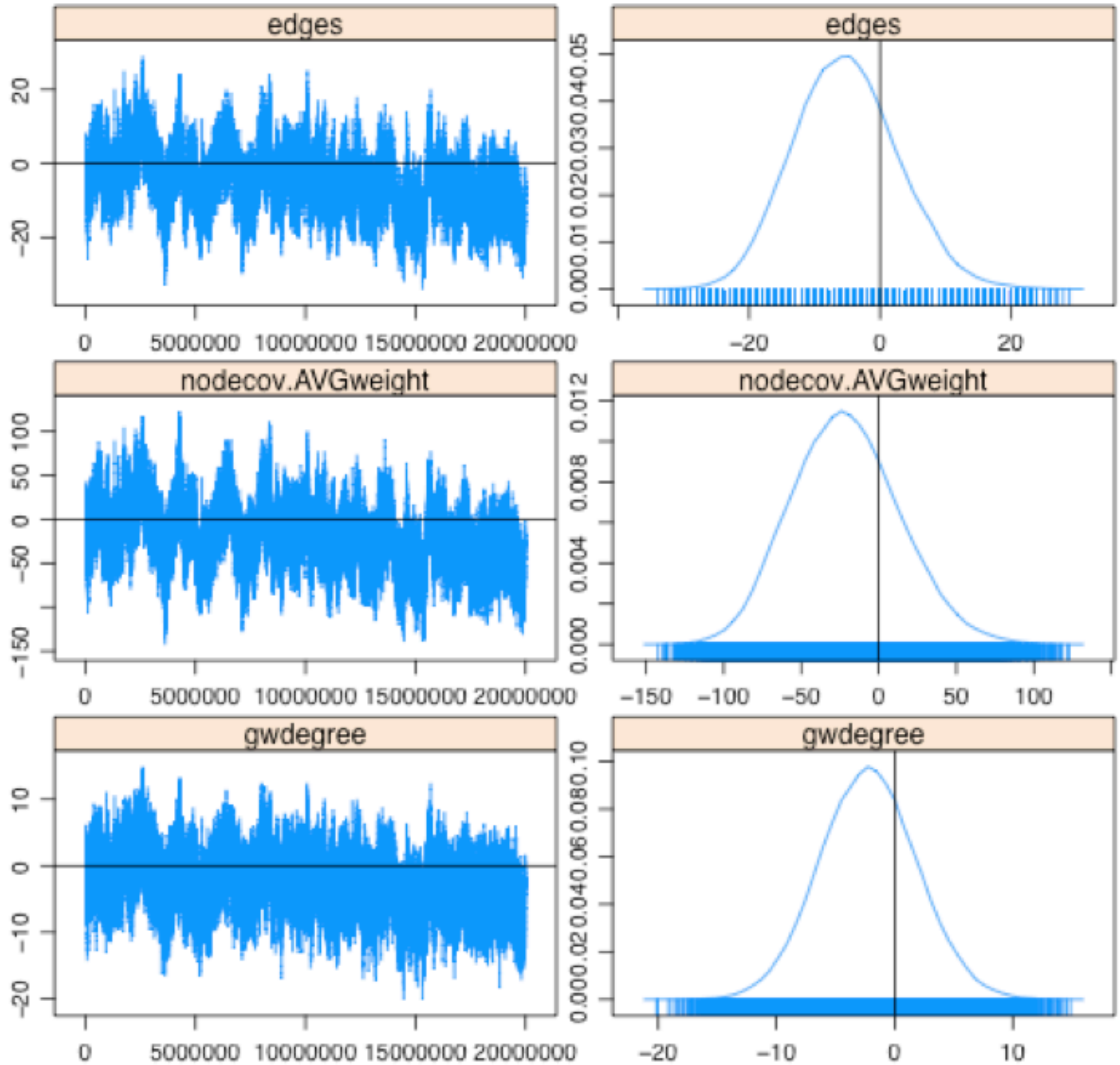

Figure 42. Markov Chain Monte Carlo diagnostics for the Hypothesis 5 ERGM analysis (as seen in Table 11). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

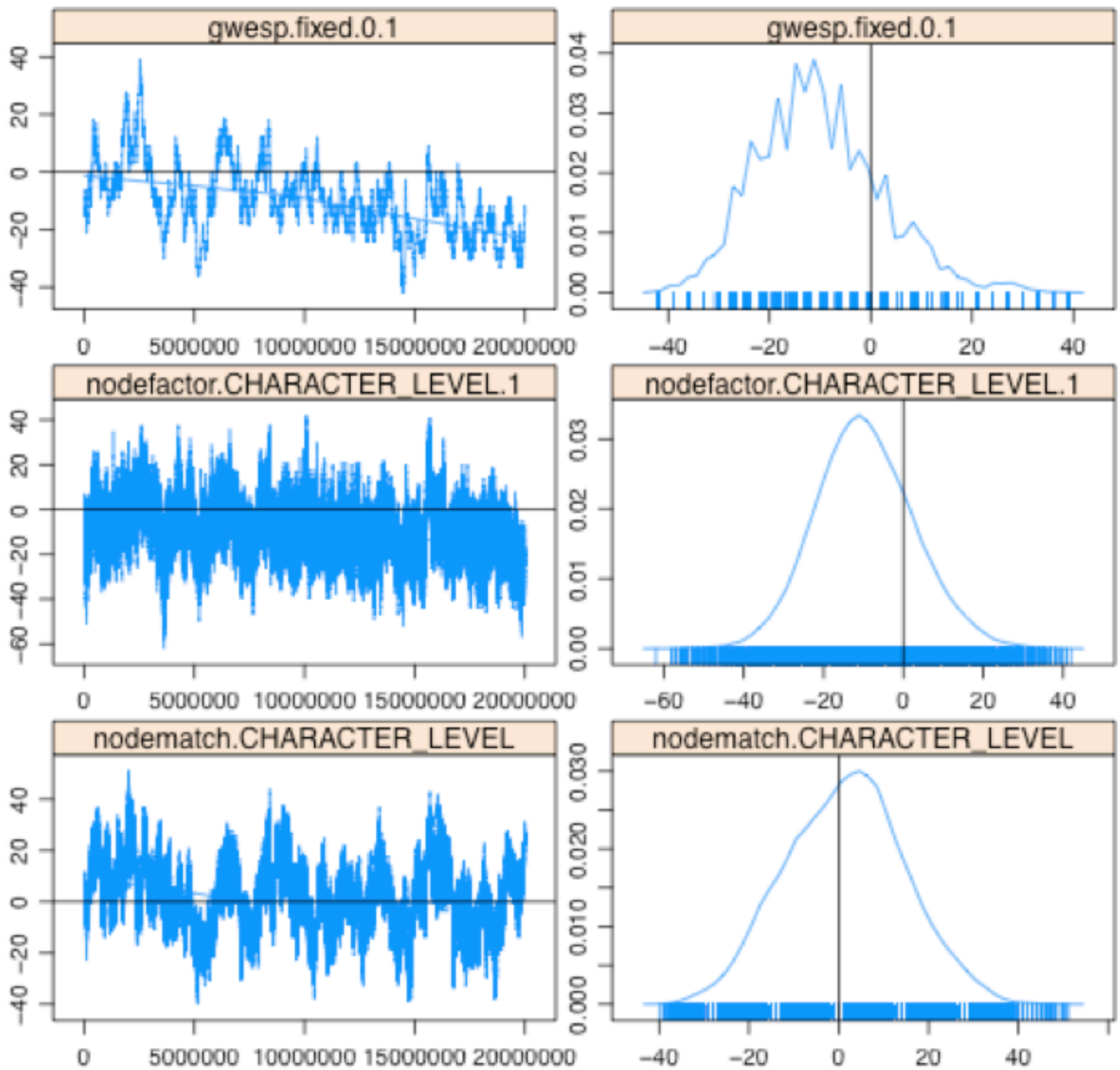

Figure 42 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 5 ERGM analysis (as seen in Table 11). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

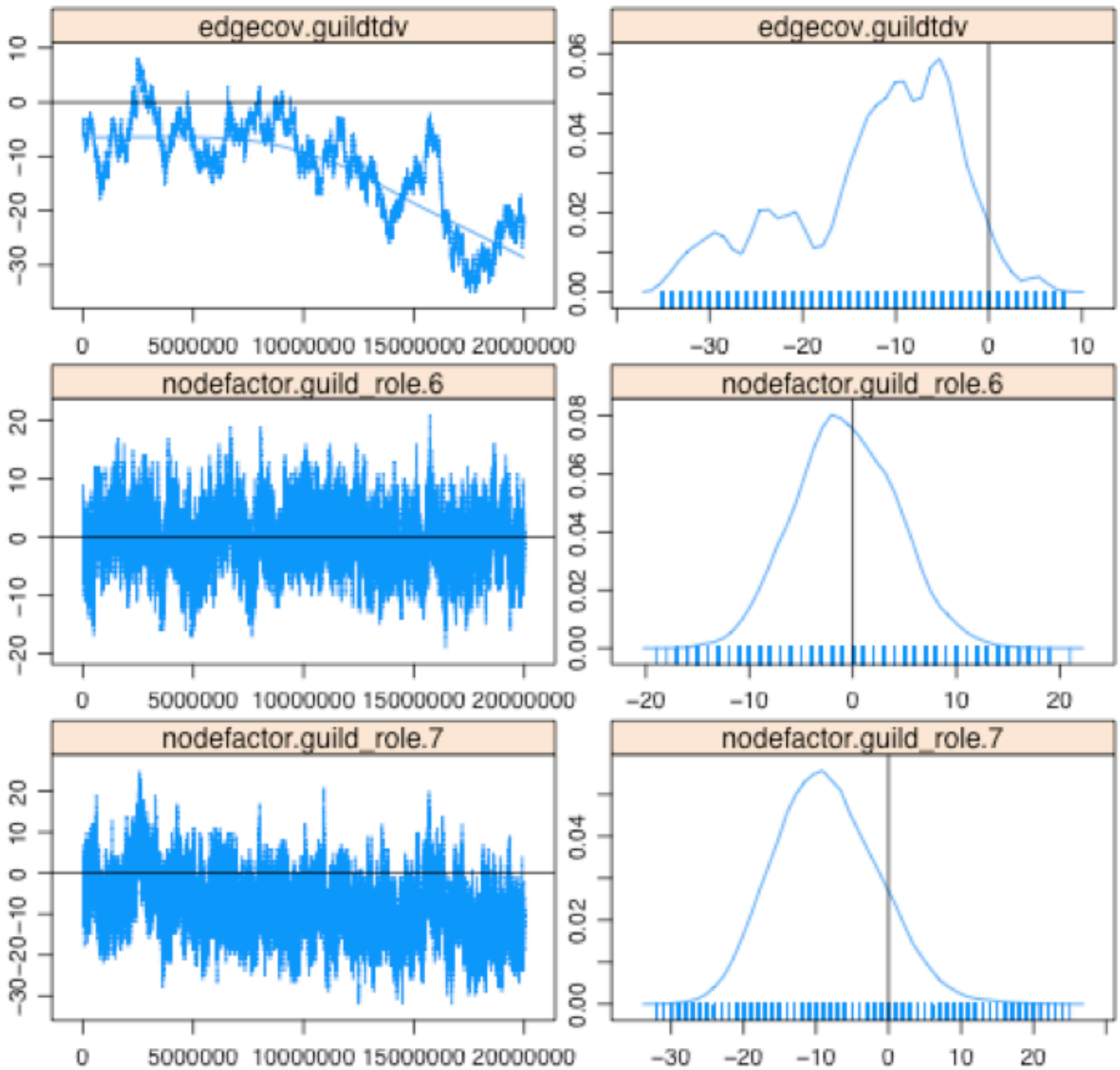

Figure 42 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 5 ERGM analysis (as seen in Table 11). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

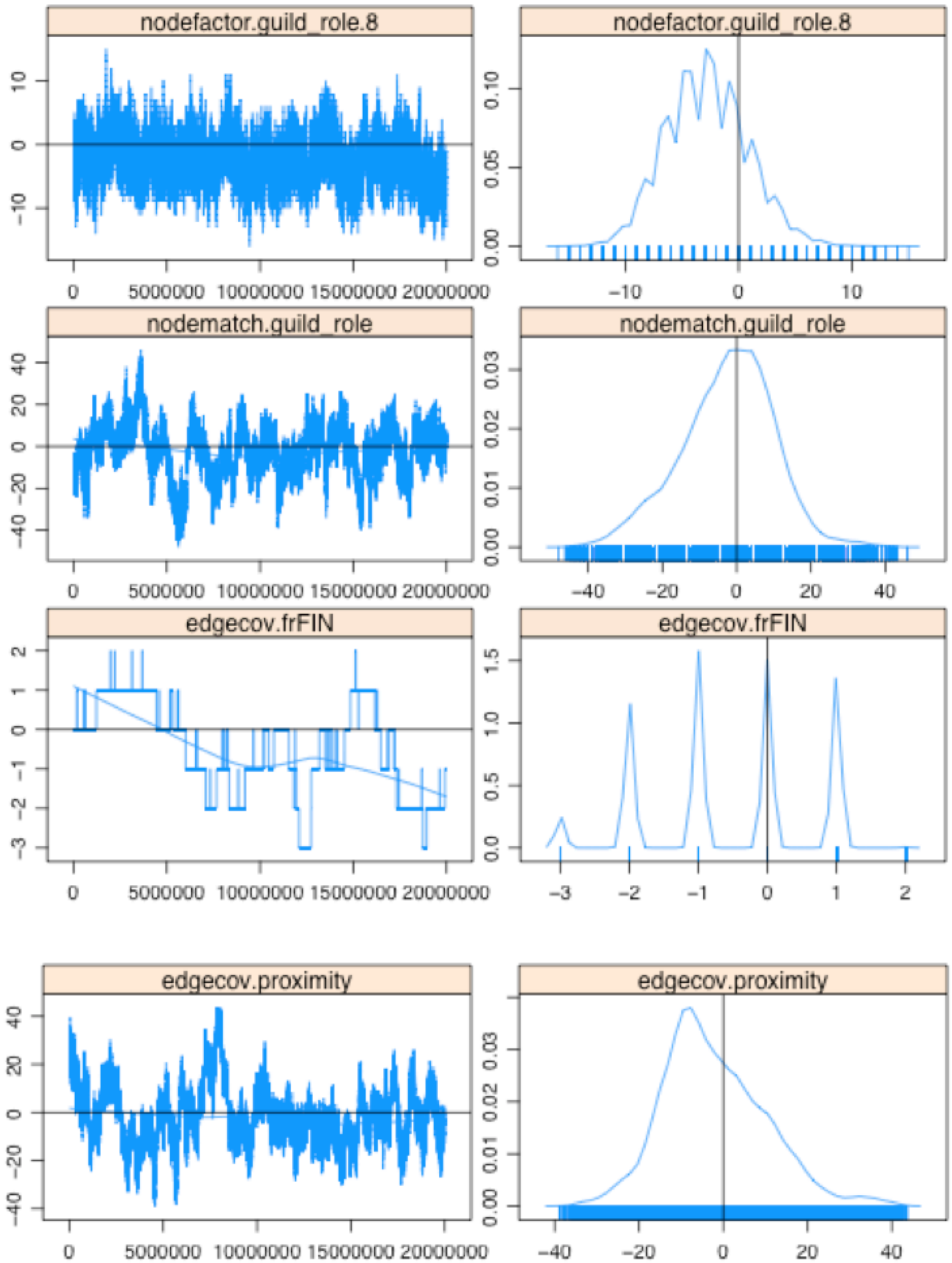

Figure 42 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 5 ERGM analysis (as seen in Table 11). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

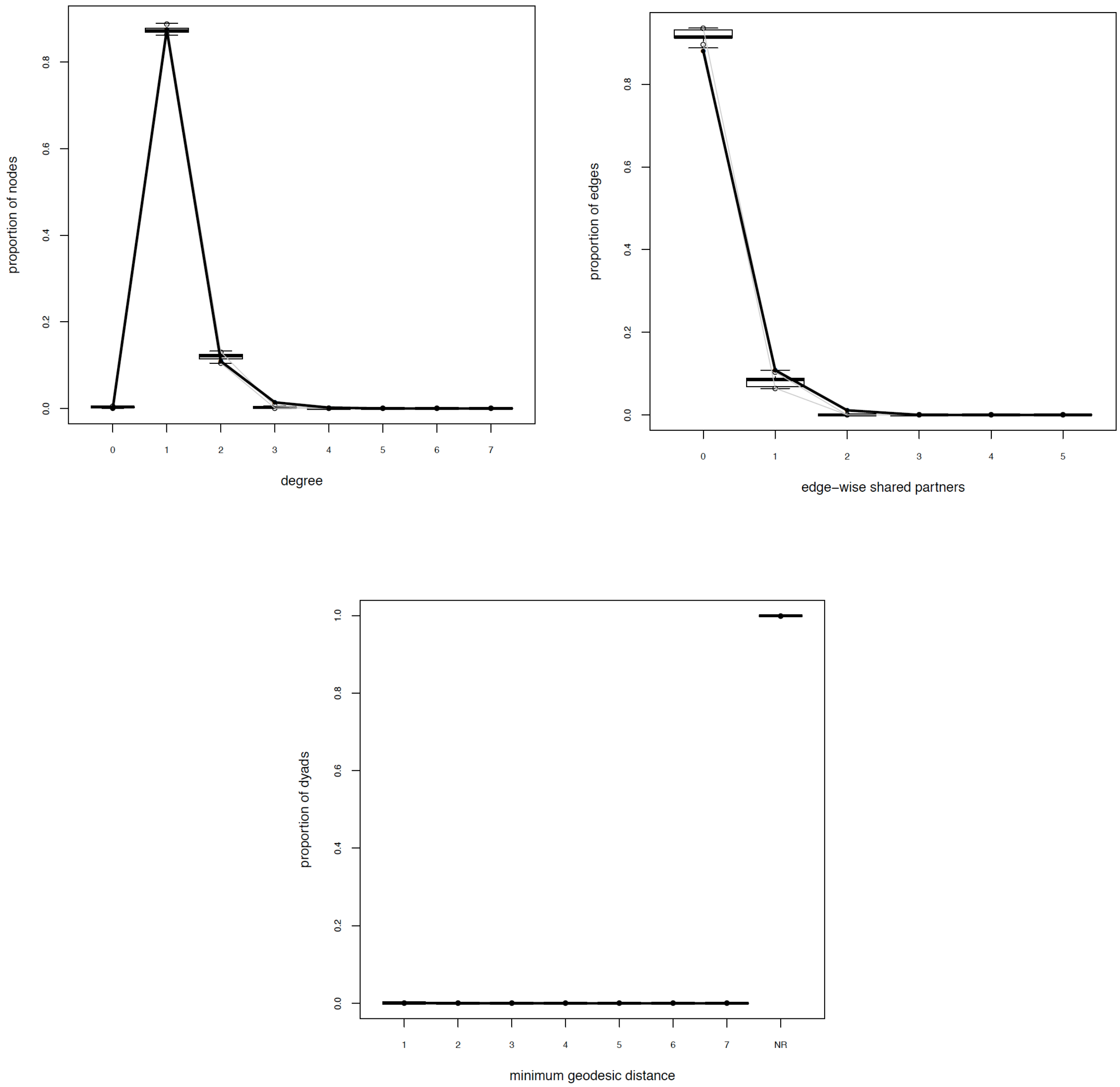

Figure 43. Goodness-of-fit diagnostics for the Hypothesis 5 ERGM analysis (as seen in Table 11). (*n* = number of individuals = 1,568; *l* = number of teammate relationships = 929)

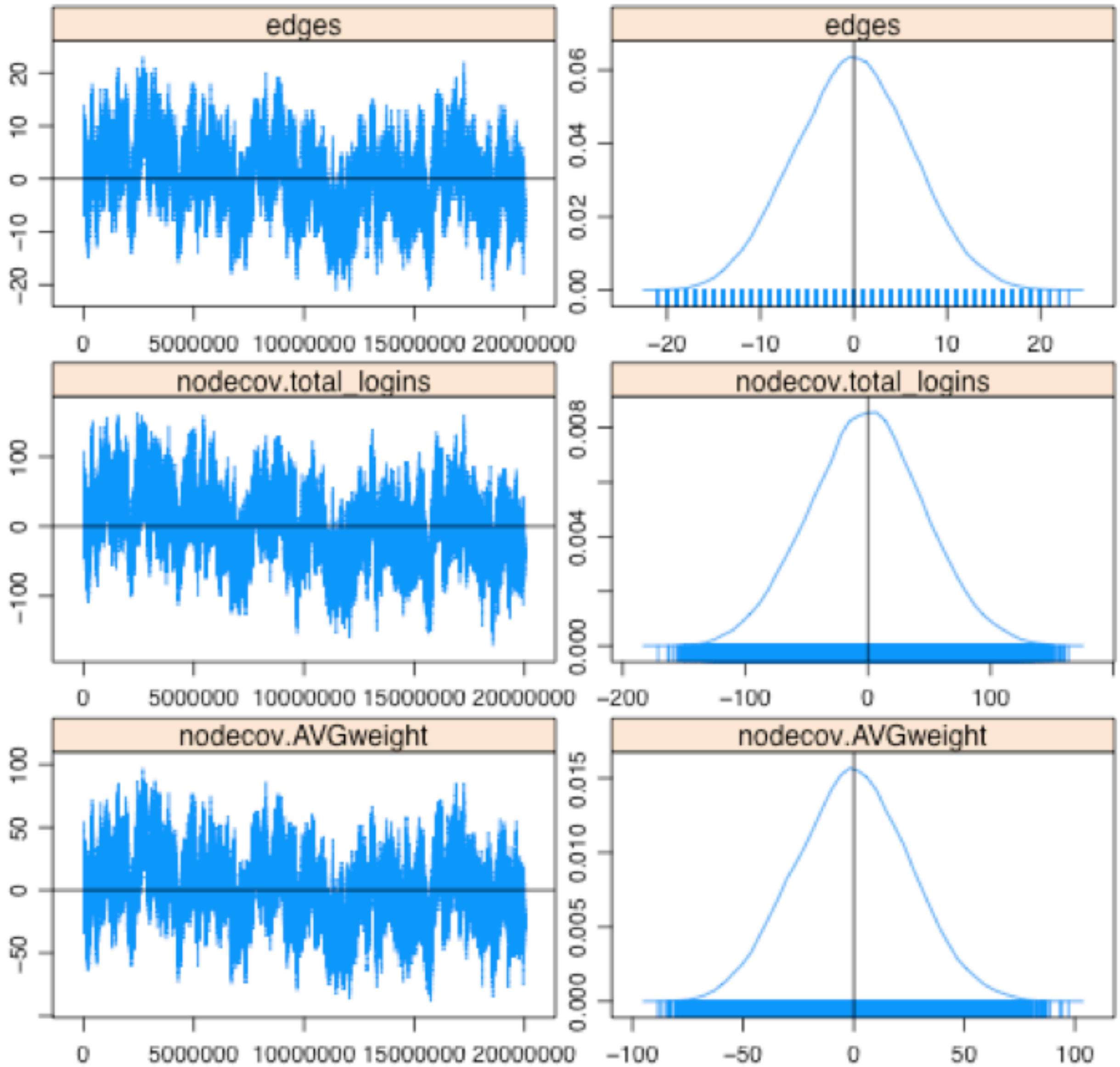

Figure 44. Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; successful dyads only (as seen in Table 16). (n = number of individuals = 1,027; l = number of teammate relationships = 580)

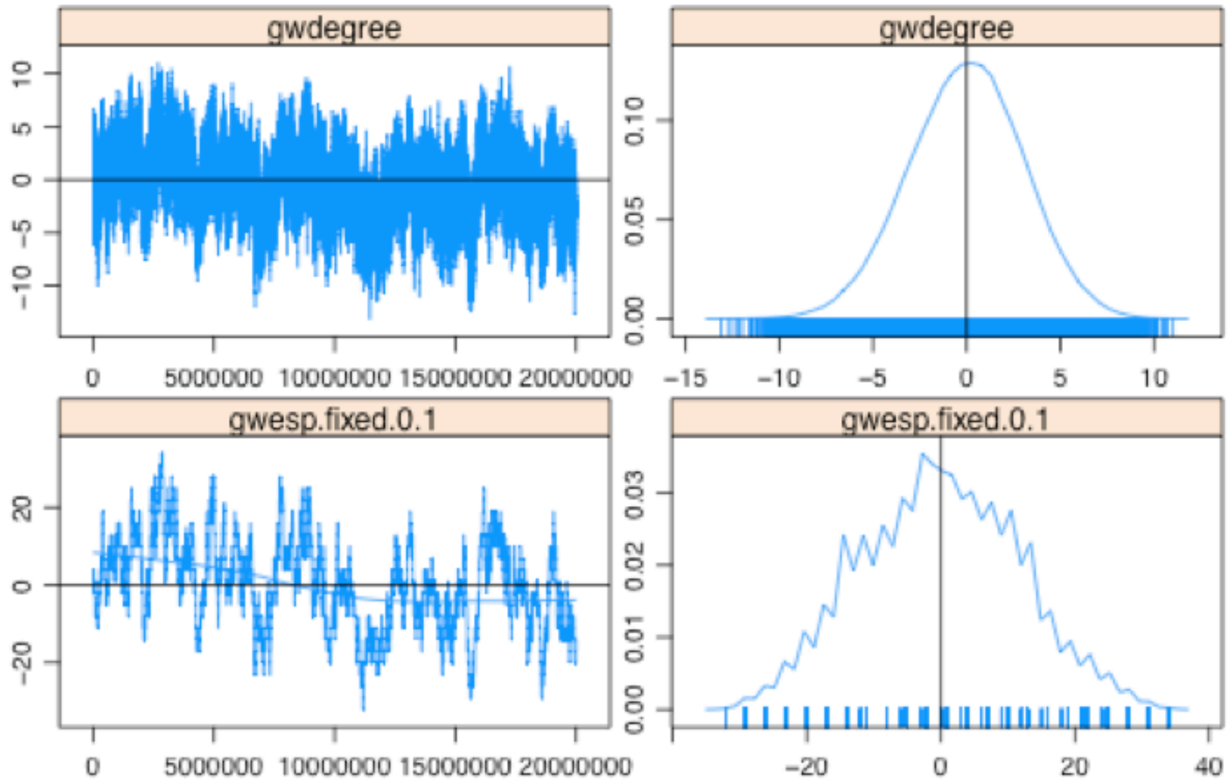

Figure 44 (continued). Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; successful dyads only (as seen in Table 16). (*n* = number of individuals = 1,027; *l* = number of teammate relationships = 580)

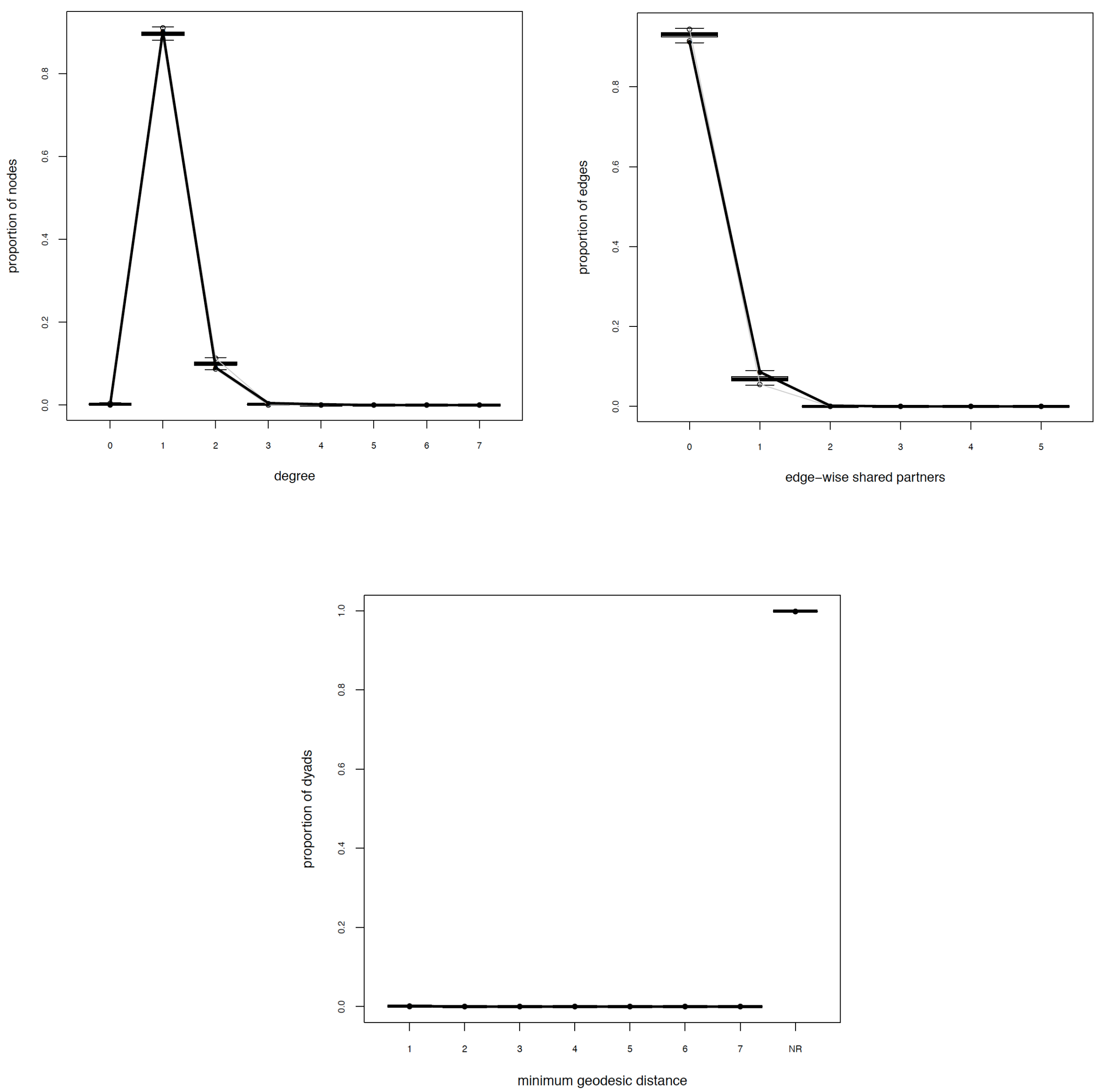

Figure 45. Goodness-of-fit diagnostics for the Hypotheses 6 and 8b ERGM analysis; successful dyads only (as seen in Table 16). (*n* = number of individuals = 1,027; *l* = number of teammate relationships = 580)

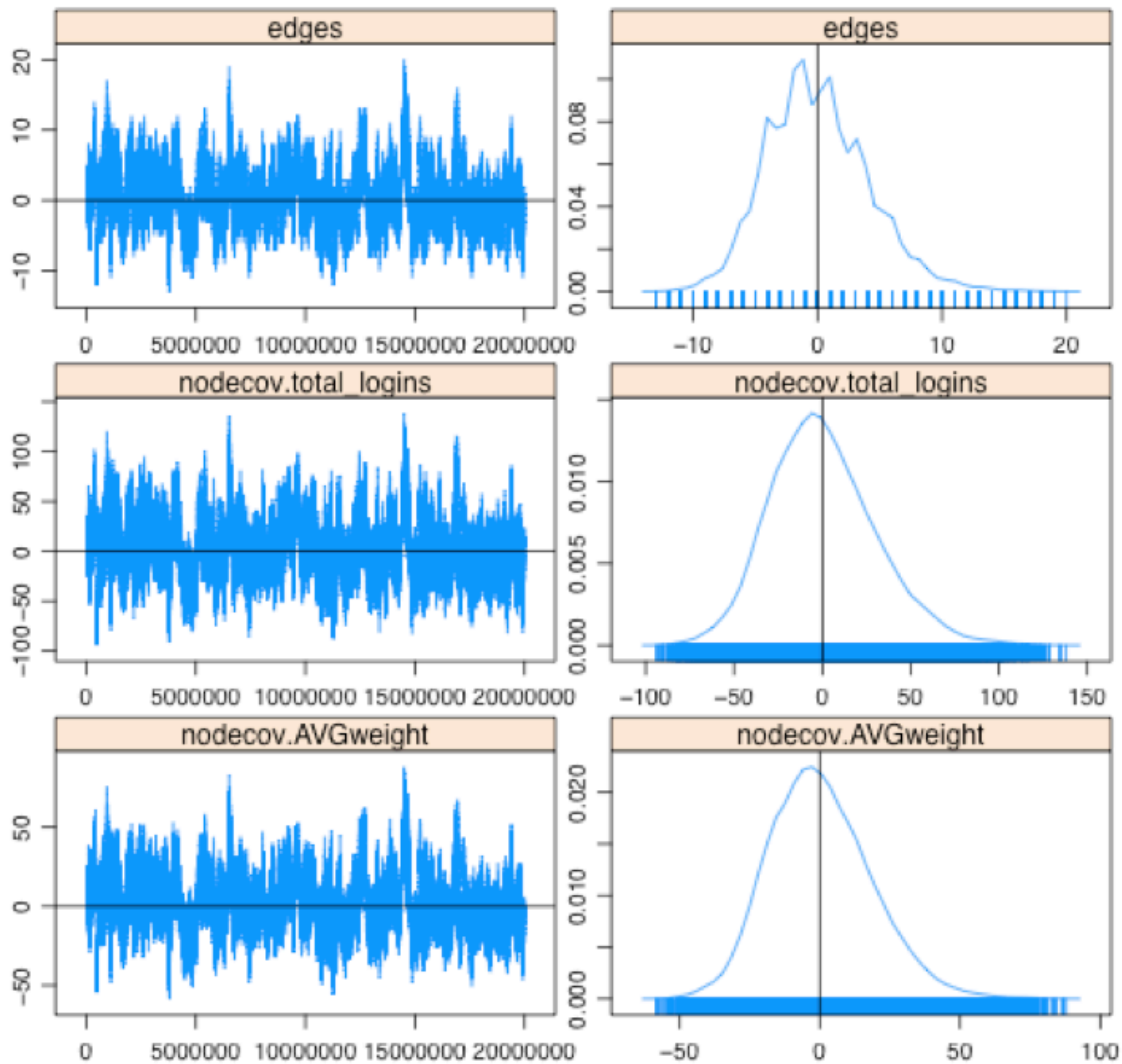

Figure 46. Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; mixed dyads only (as seen in Table 16). (n = number of individuals = 337; l = number of teammate relationships = 191)

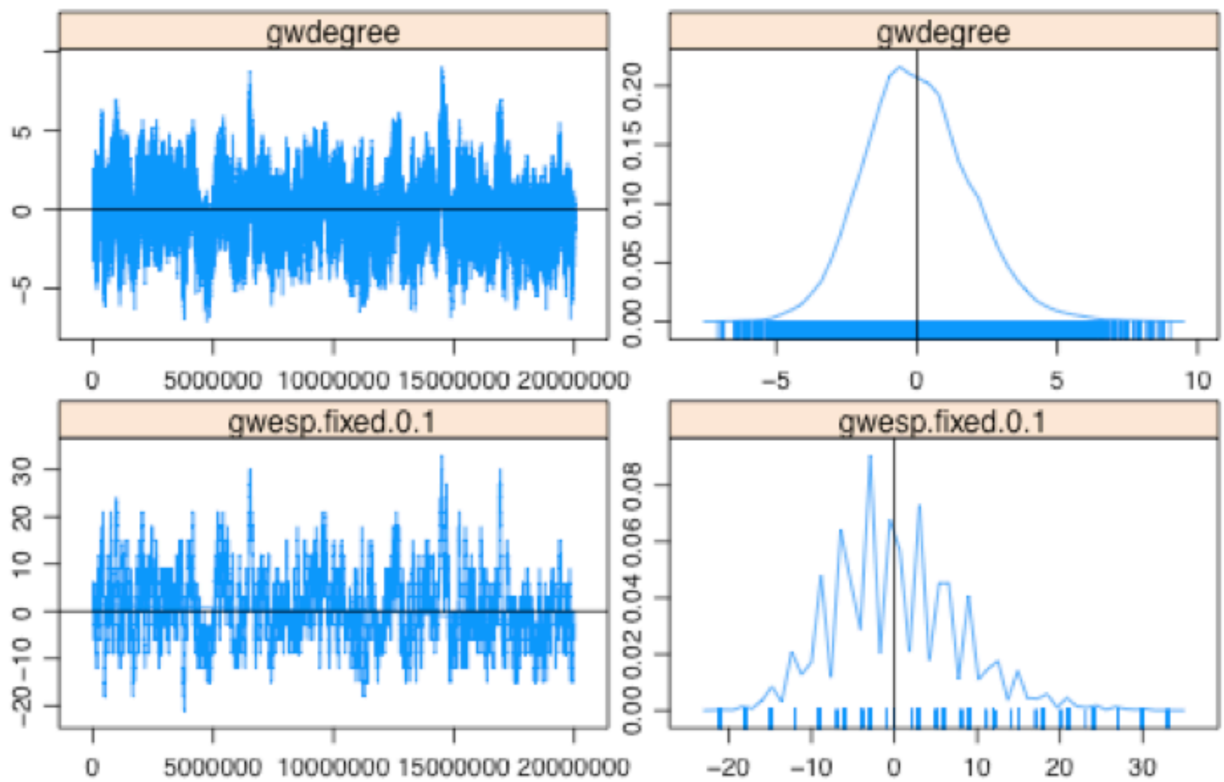

Figure 46 (continued). Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; mixed dyads only (as seen in Table 16). (*n* = number of individuals = 337; *l* = number of teammate relationships = 191)

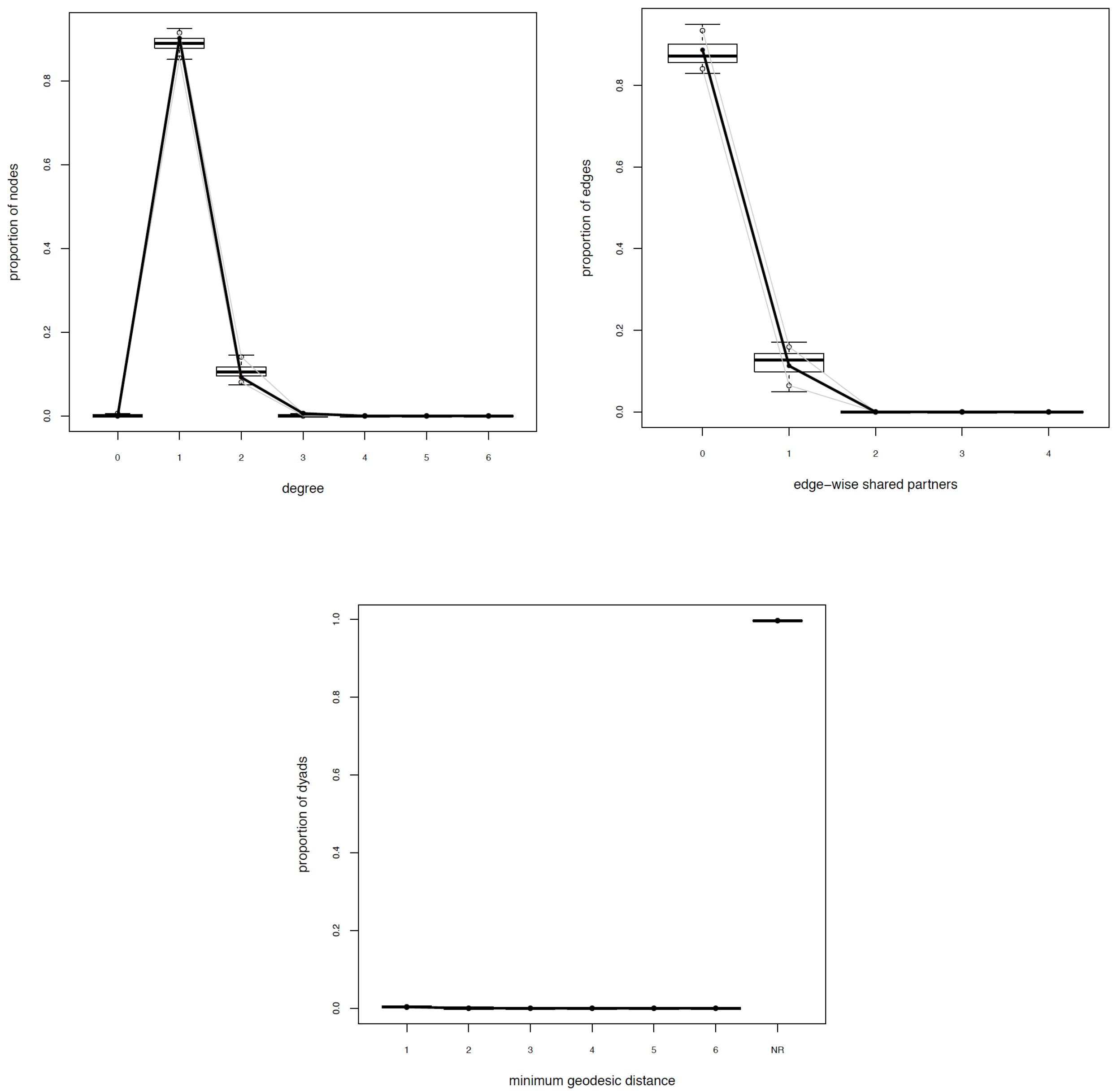

Figure 47. Goodness-of-fit diagnostics for the Hypotheses 6 and 8b ERGM analysis; mixed dyads only (as seen in Table 16). (n = number of individuals = 337; l = number of teammate relationships = 191)

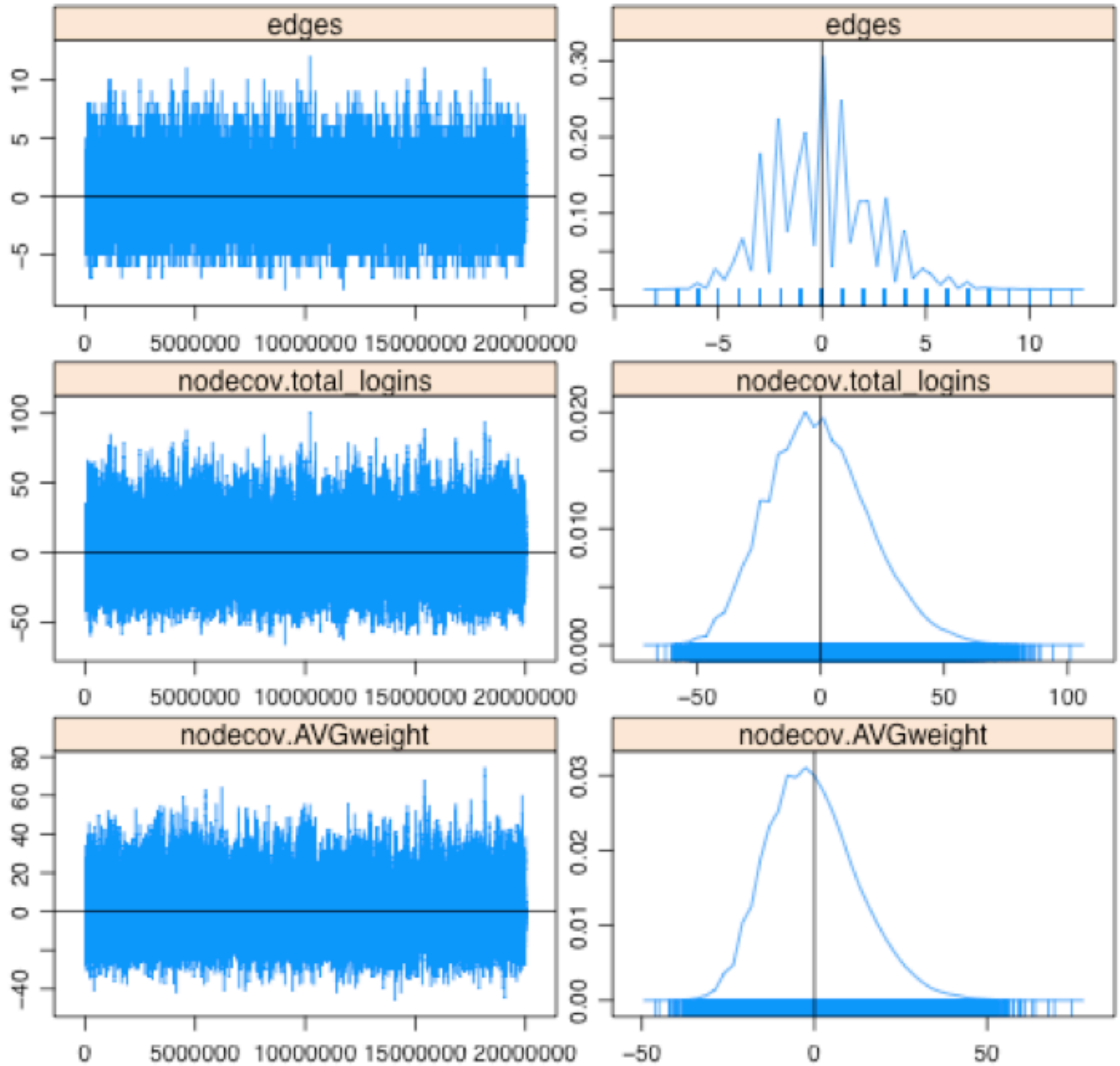

Figure 48. Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; unsuccessful dyads only (as seen in Table 16). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

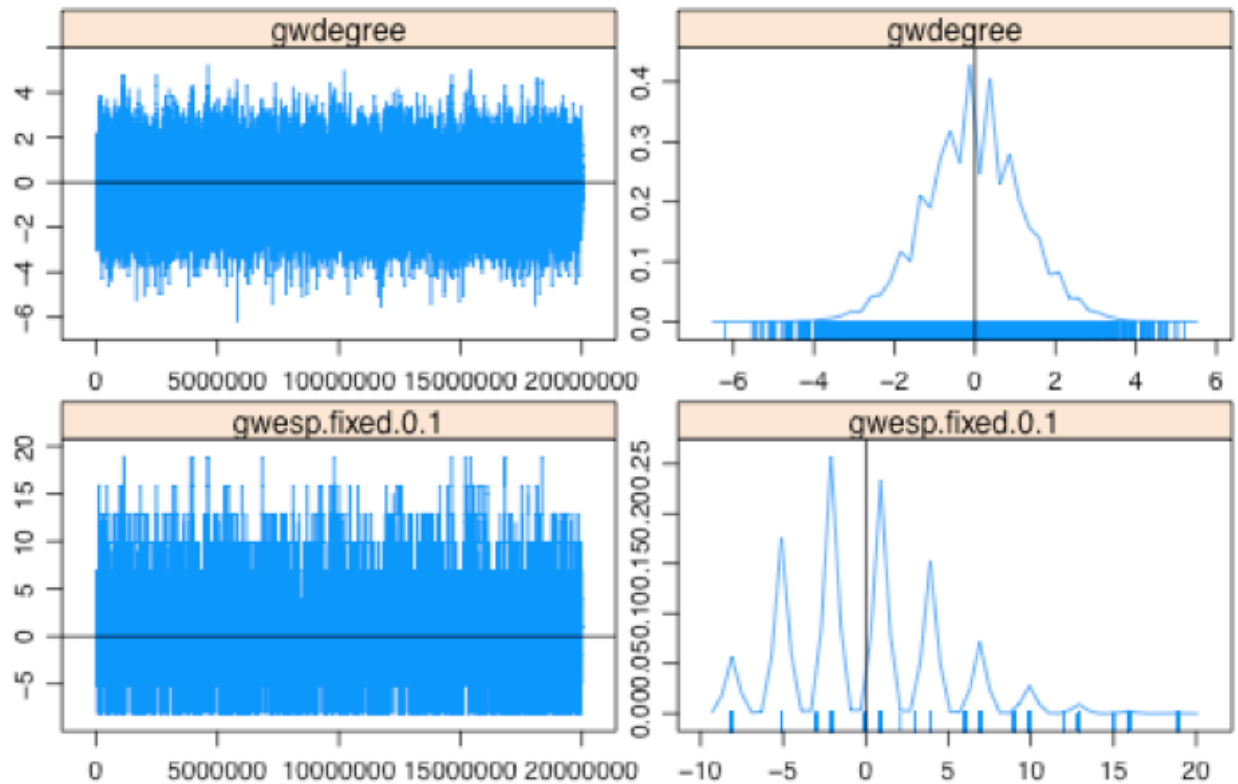

Figure 48 (continued). Markov Chain Monte Carlo diagnostics for the Hypotheses 6 and 8b ERGM analysis; unsuccessful dyads only (as seen in Table 16). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

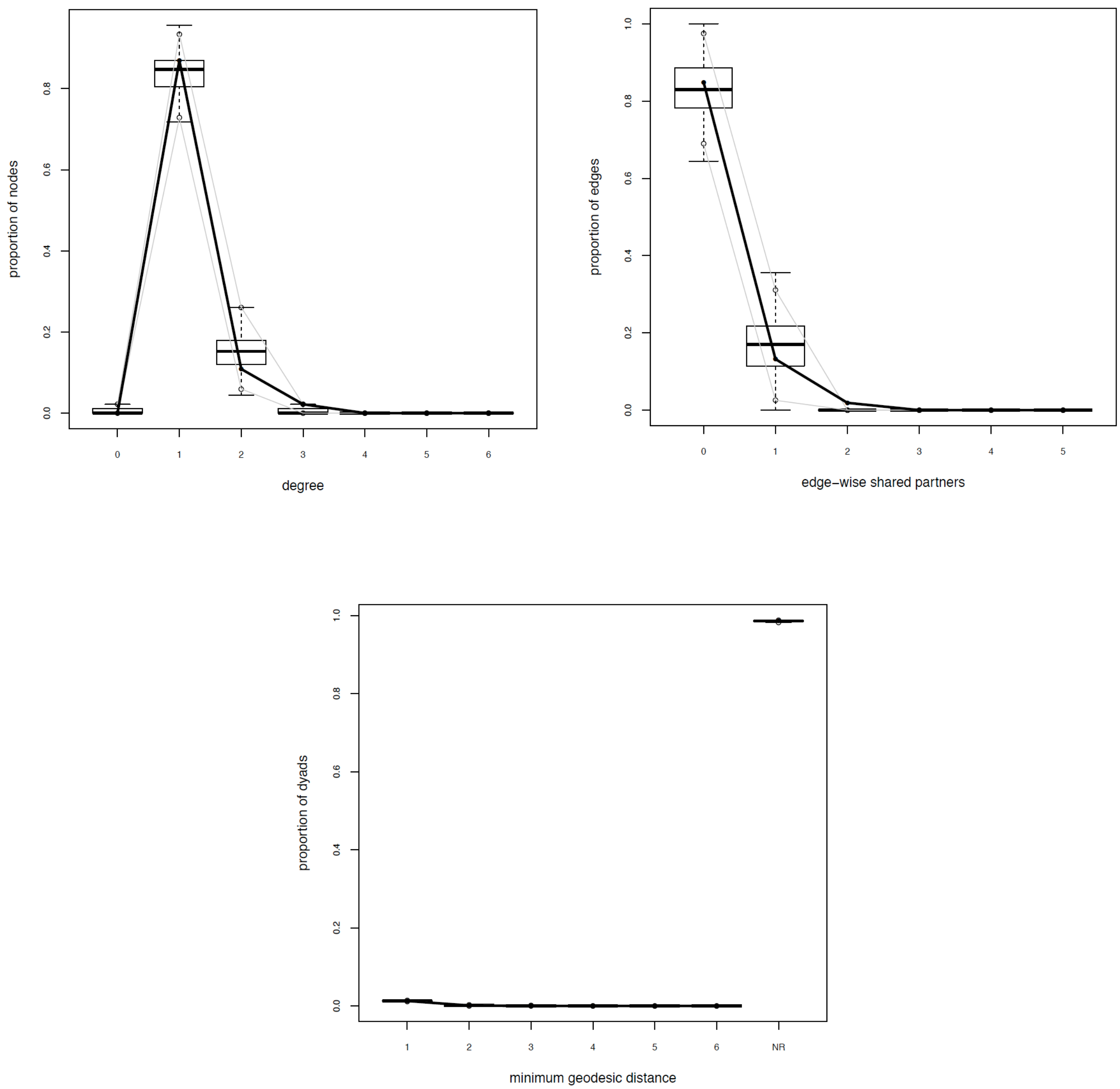

Figure 49. Goodness-of-fit diagnostics for the Hypotheses 6 and 8b ERGM analysis; unsuccessful dyads only (as seen in Table 16). (n = number of individuals = 92; l = number of teammate relationships = 56)

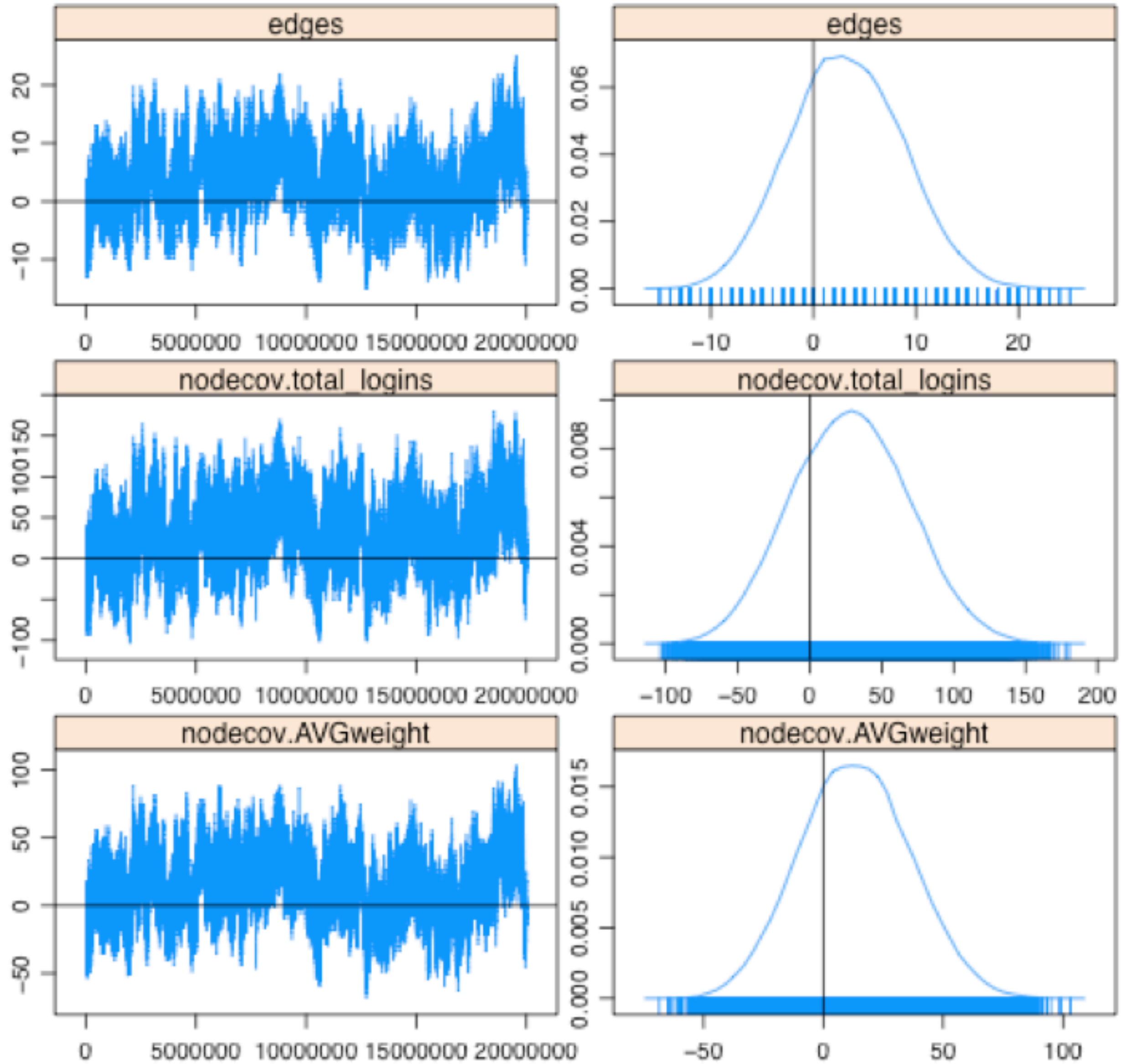

Figure 50. Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; successful dyads only (as seen in Table 20). (n = number of individuals = 1,027; l = number of teammate relationships = 580)

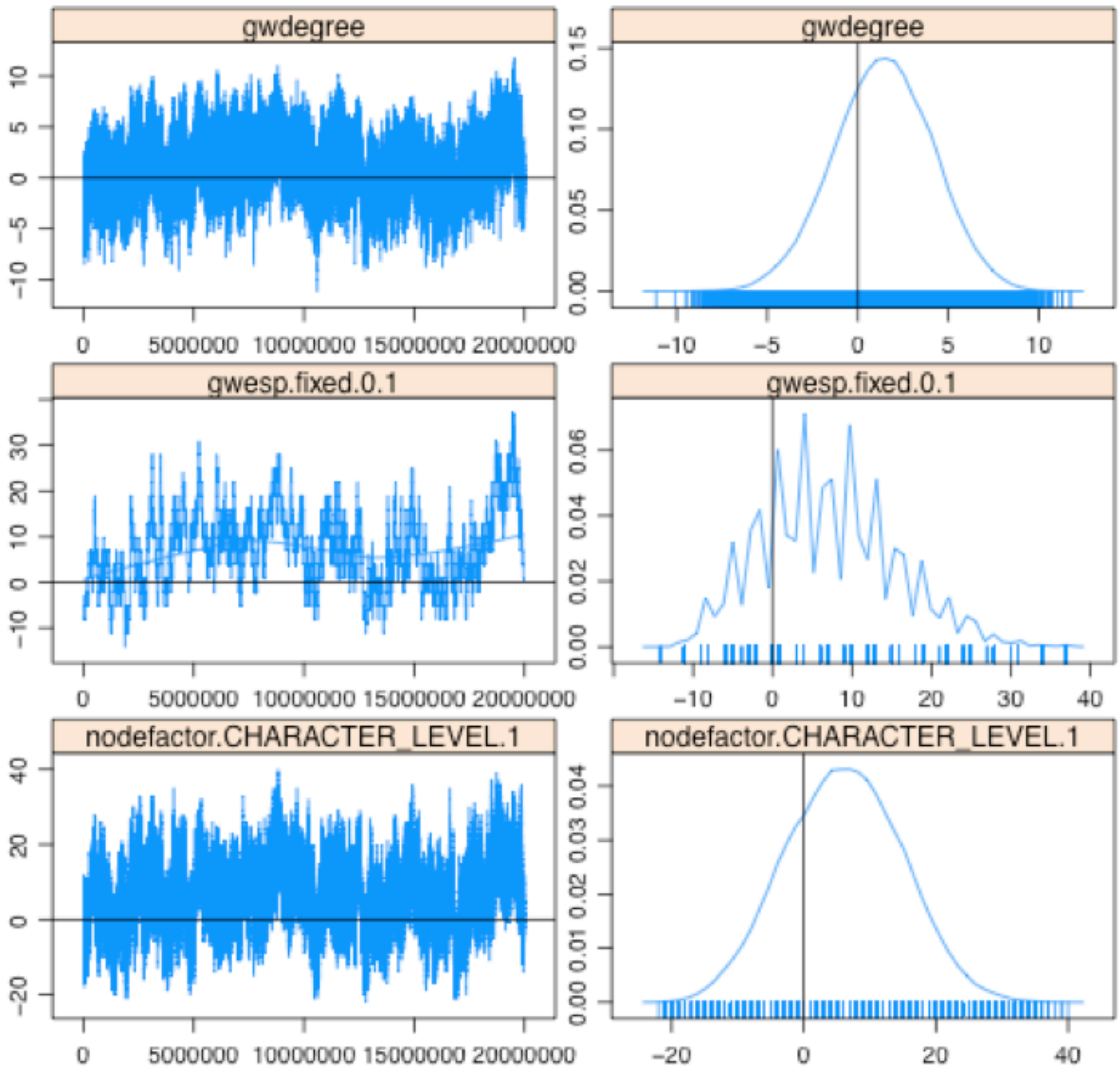

Figure 50 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; successful dyads only (as seen in Table 20). (n = number of individuals = 1,027; l = number of teammate relationships = 580)

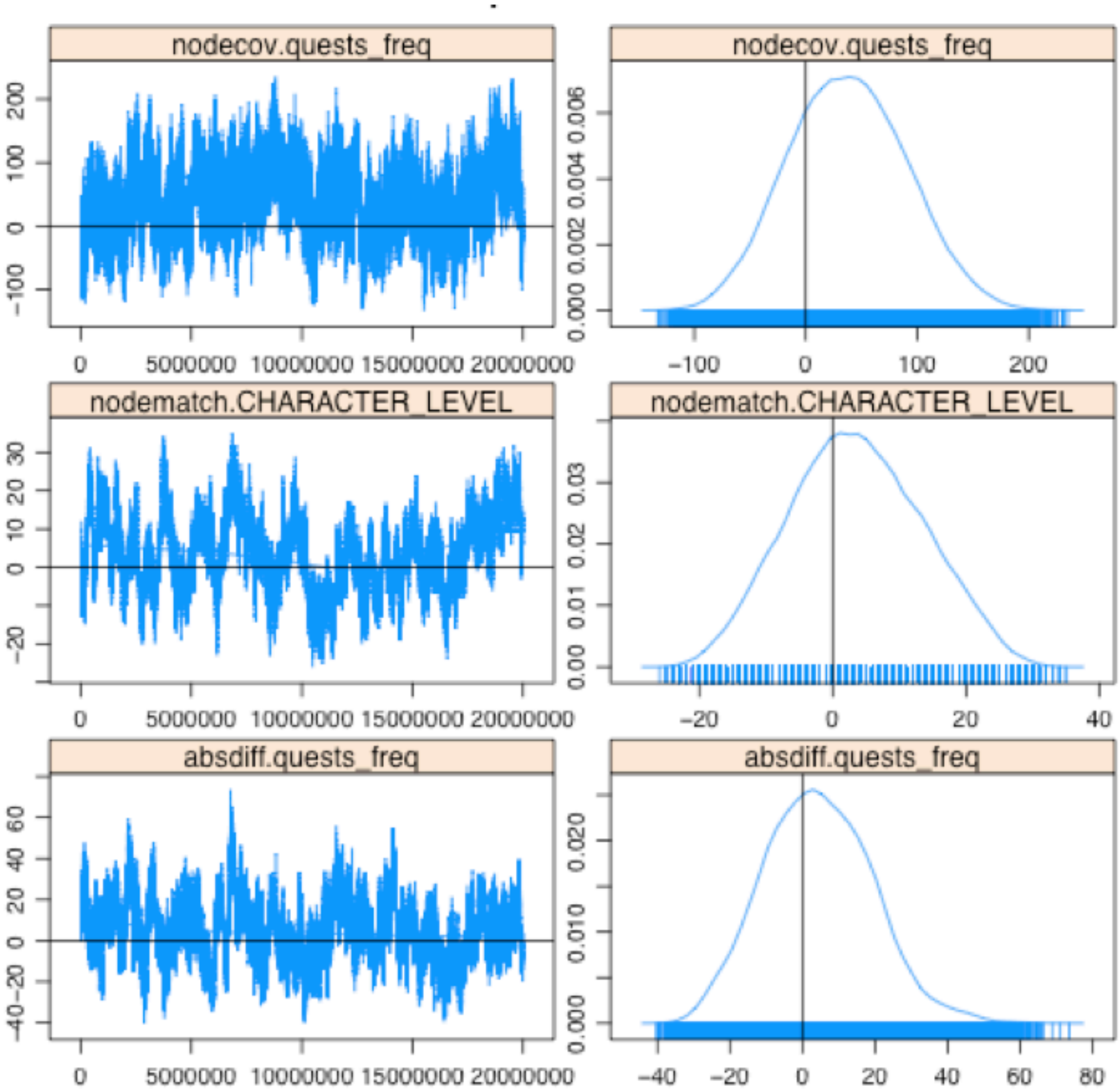

Figure 50 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; successful dyads only (as seen in Table 20). (n = number of individuals = 1,027; l = number of teammate relationships = 580)

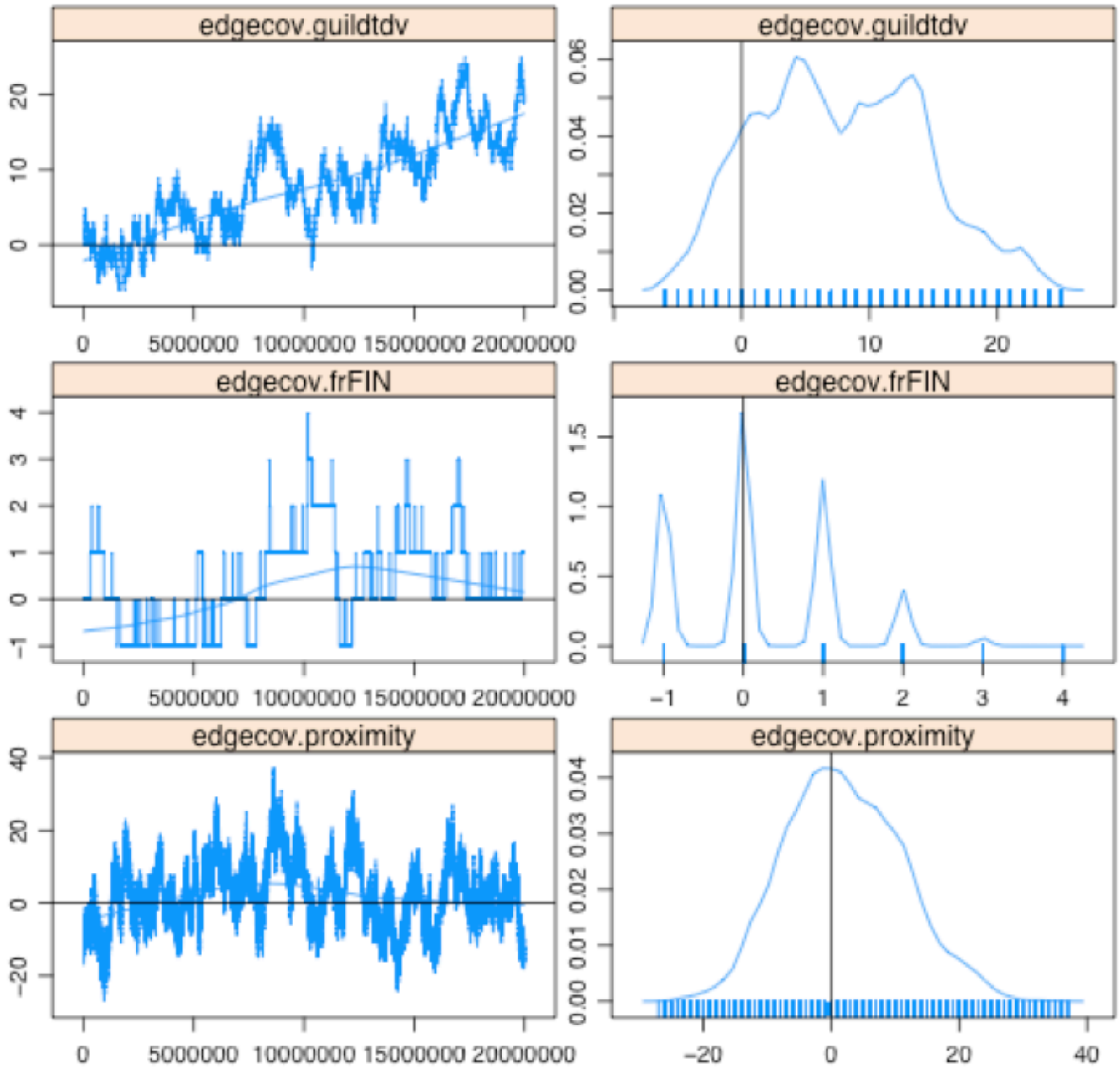

Figure 50 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; successful dyads only (as seen in Table 20). (*n* = number of individuals = 1,027; *l* = number of teammate relationships = 580)

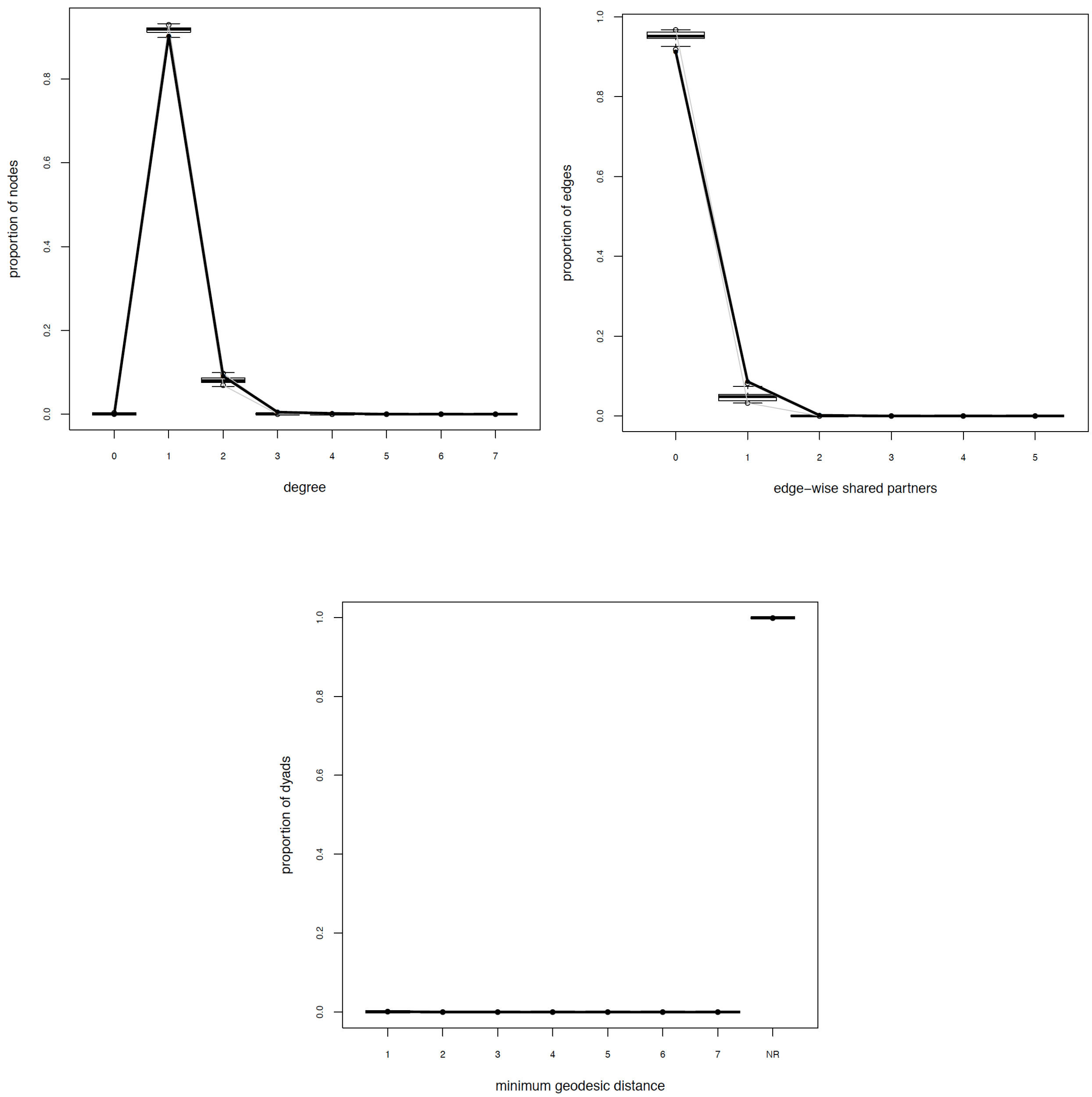

Figure 51. Goodness-of-fit diagnostics for the Hypothesis 10 ERGM analysis; successful dyads only (as seen in Table 20). (*n* = number of individuals = 1,027; *l* = number of teammate relationships = 580)

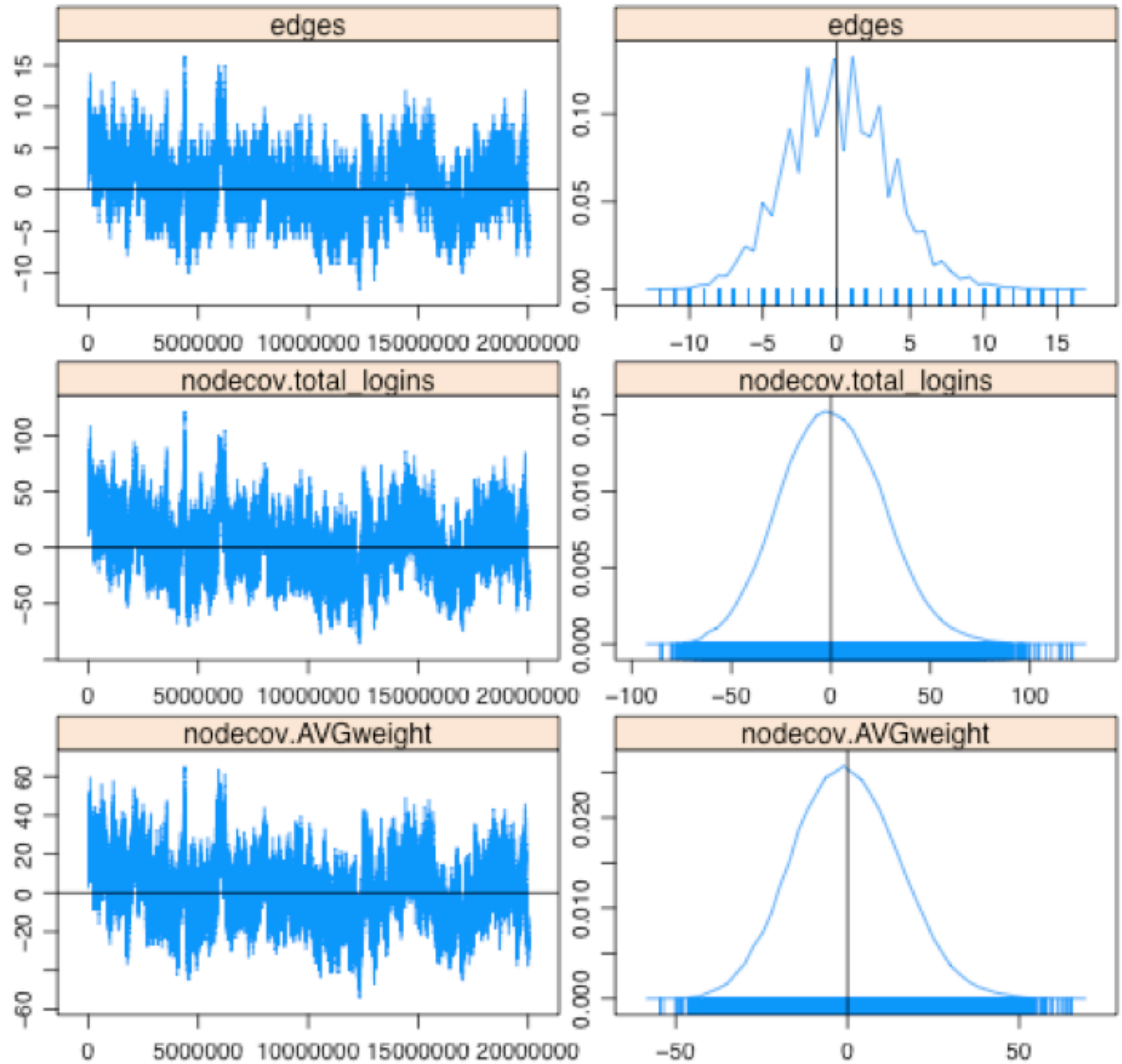

Figure 52. Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; mixed dyads only (as seen in Table 20). (n = number of individuals = 337; l = number of teammate relationships = 191)

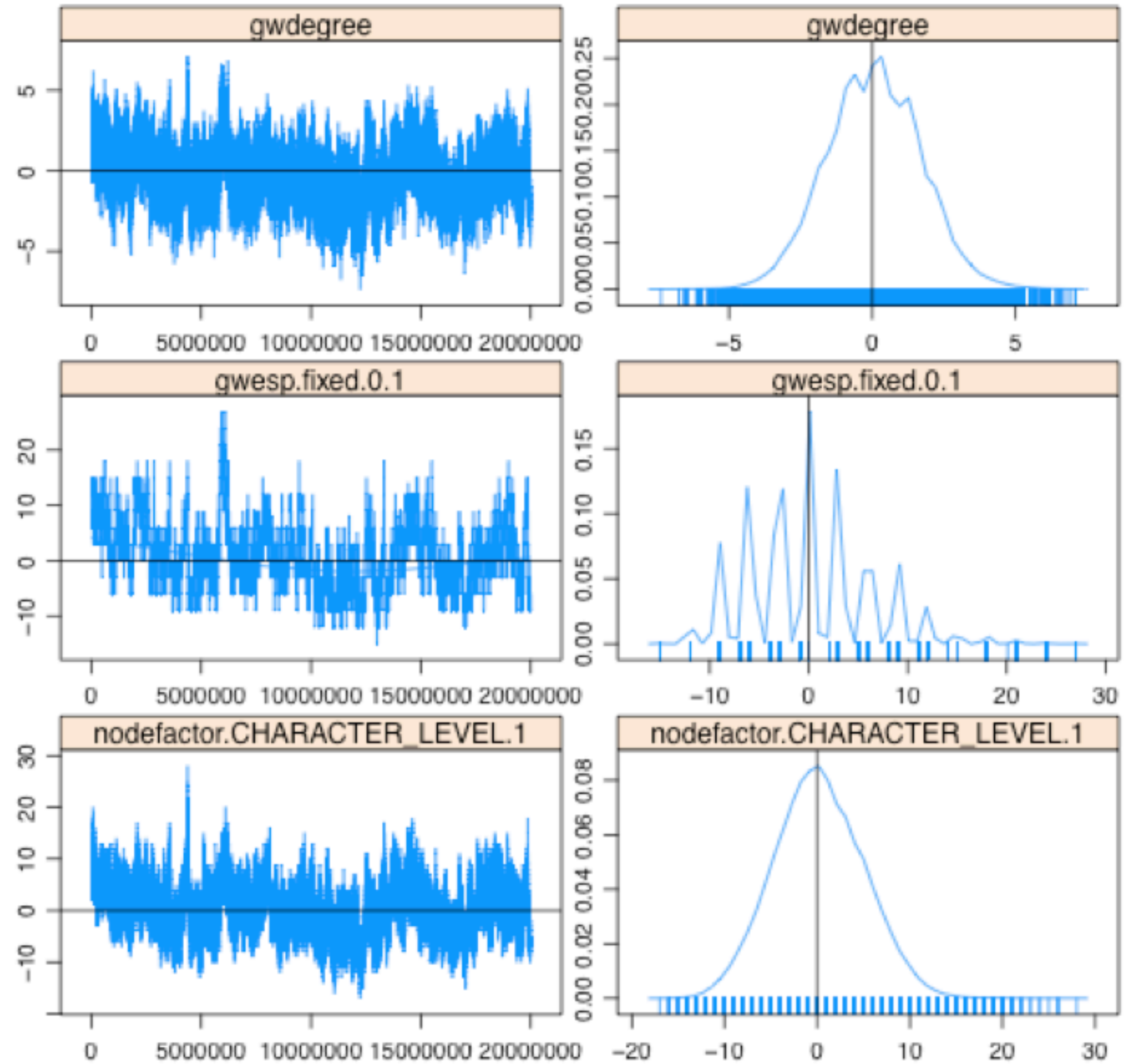

Figure 52 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; mixed dyads only (as seen in Table 20). (*n* = number of individuals = 337; *l* = number of teammate relationships = 191)

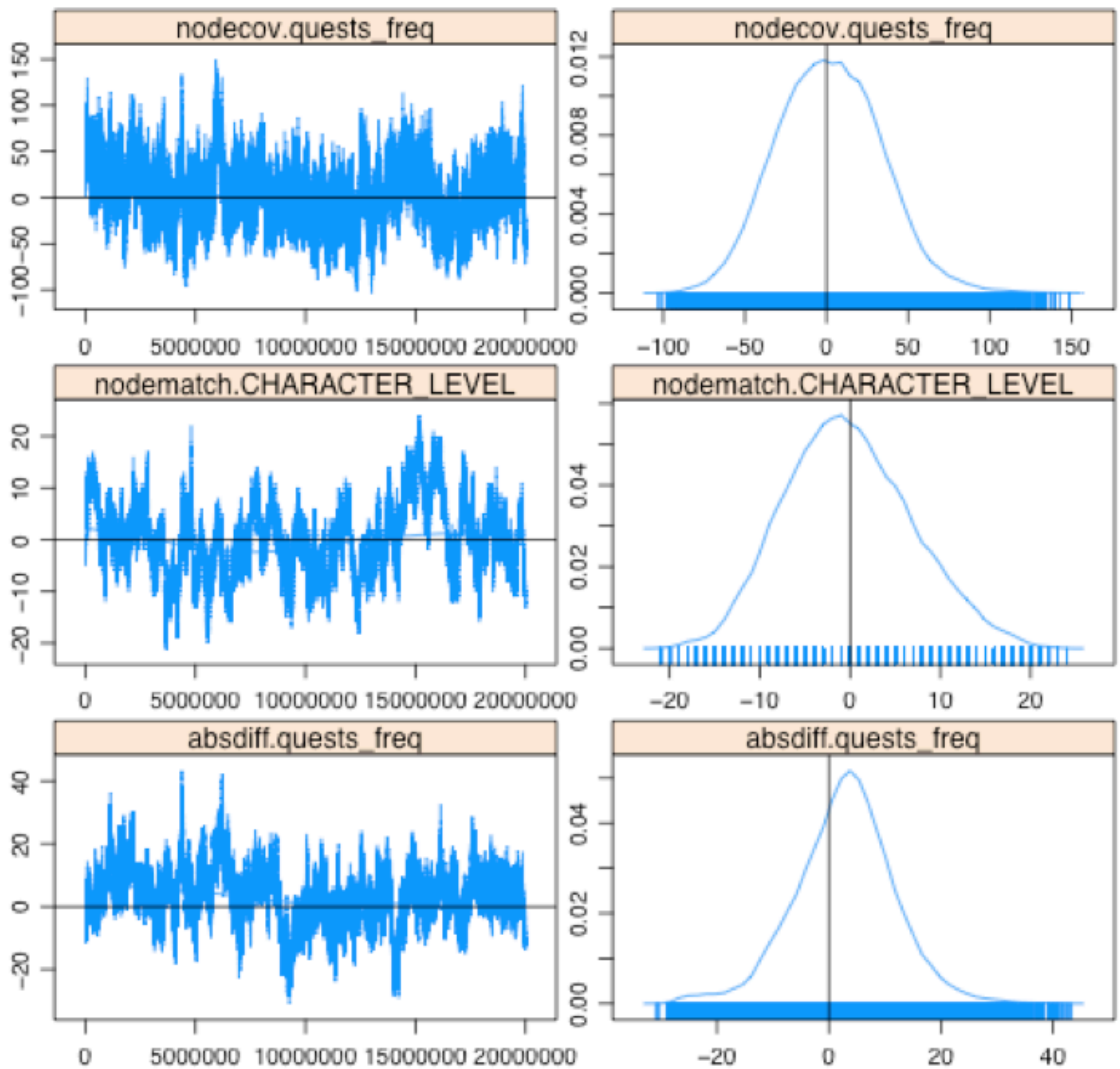

Figure 52 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; mixed dyads only (as seen in Table 20). (*n* = number of individuals = 337; *l* = number of teammate relationships = 191)

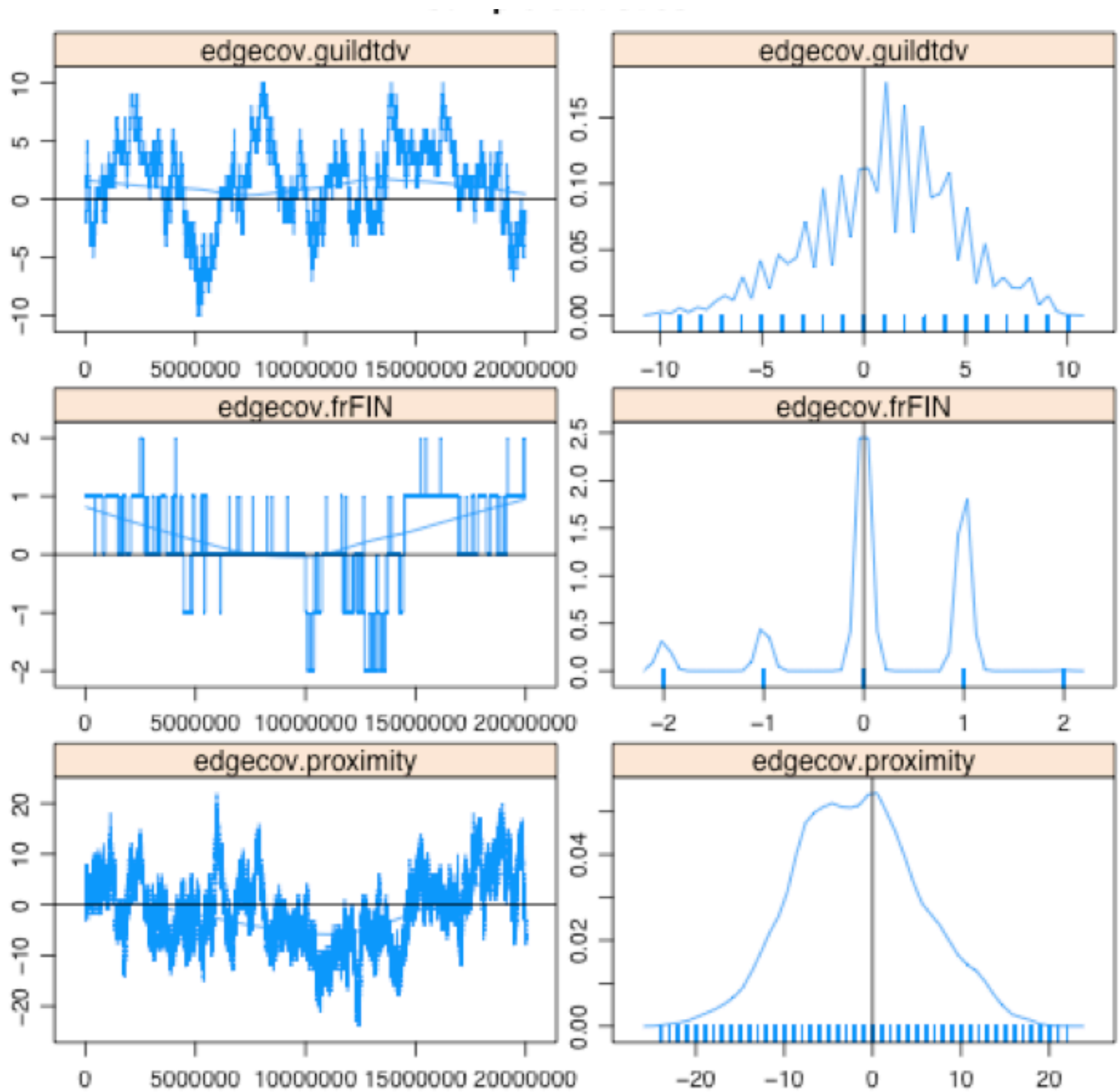

Figure 52 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; mixed dyads only (as seen in Table 20). (*n* = number of individuals = 337; *l* = number of teammate relationships = 191)

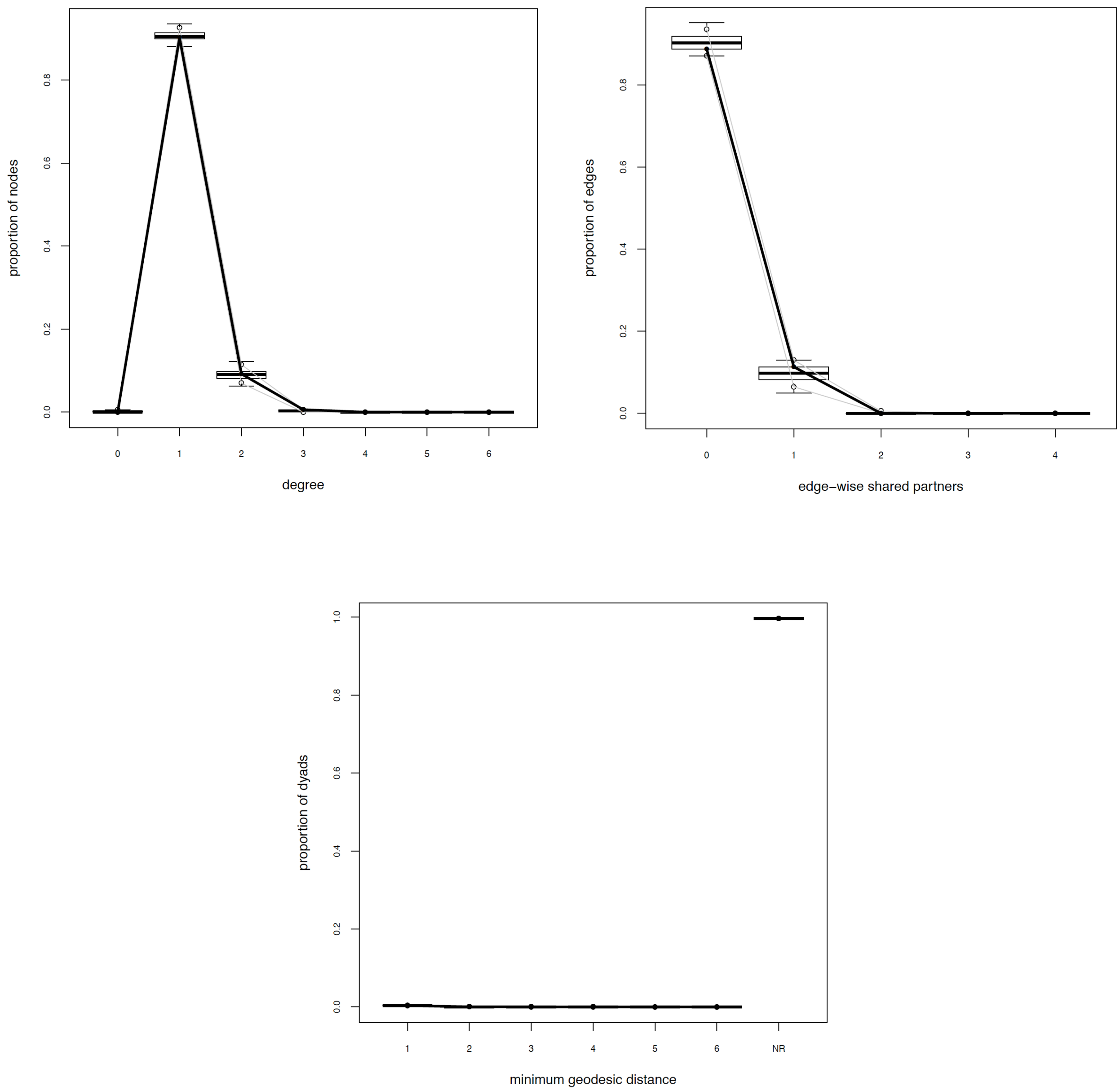

Figure 53. Goodness-of-fit diagnostics for the Hypothesis 10 ERGM analysis; mixed dyads only (as seen in Table 20). (*n* = number of individuals = 337; *l* = number of teammate relationships = 191)

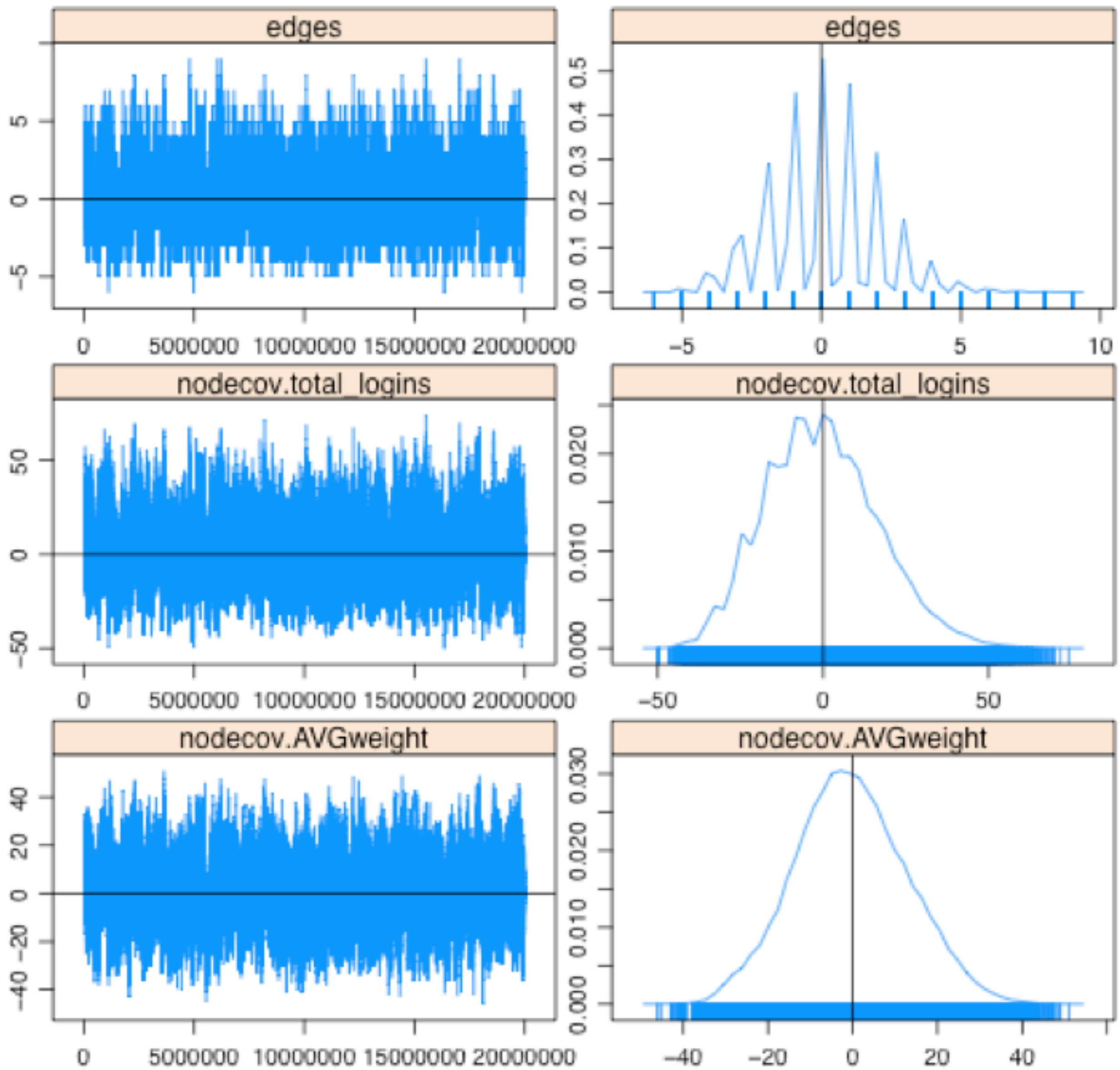

Figure 54. Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; unsuccessful dyads only (as seen in Table 20). (n = number of individuals = 92; l = number of teammate relationships = 56)

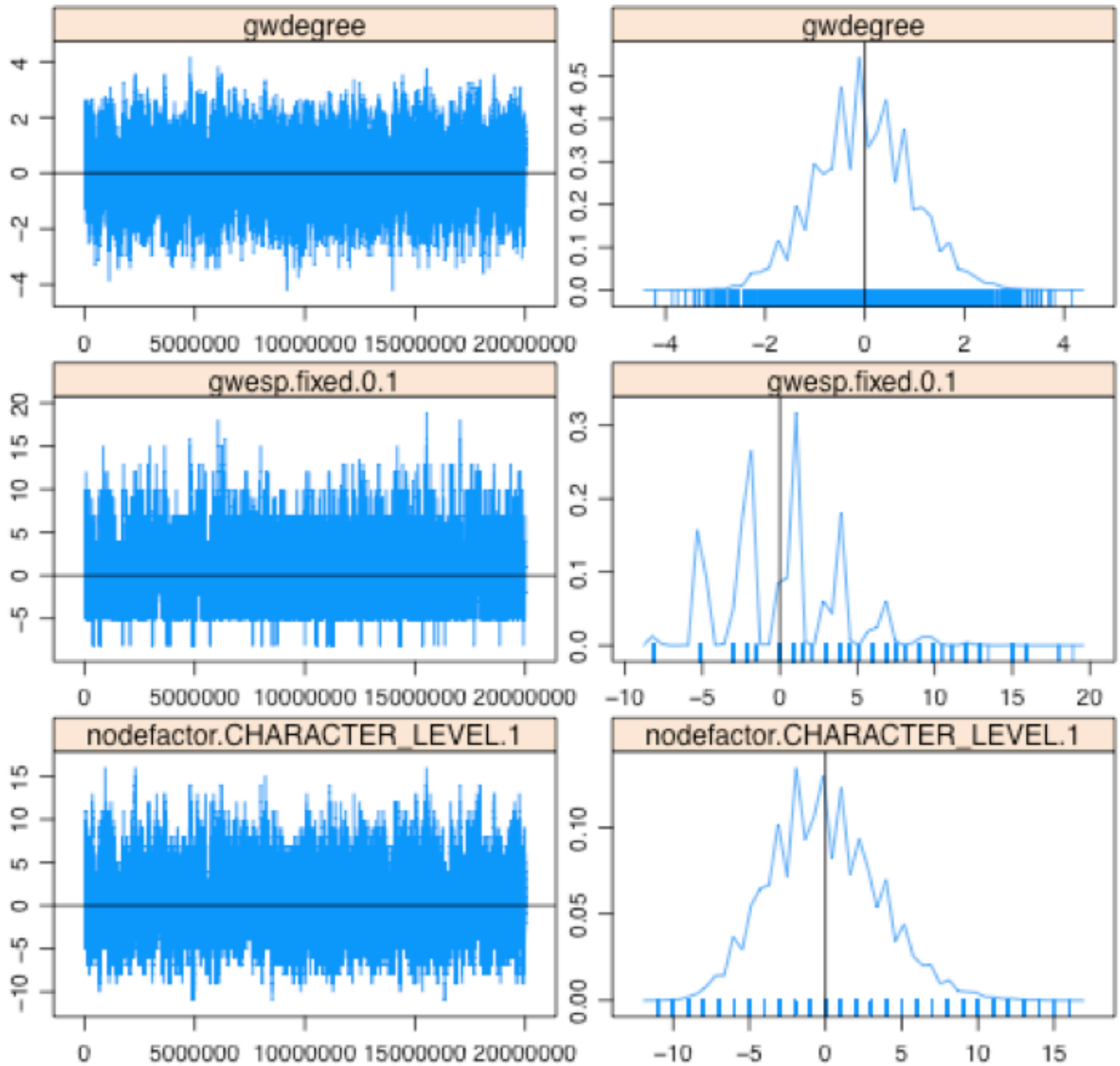

Figure 54 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; unsuccessful dyads only (as seen in Table 20). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

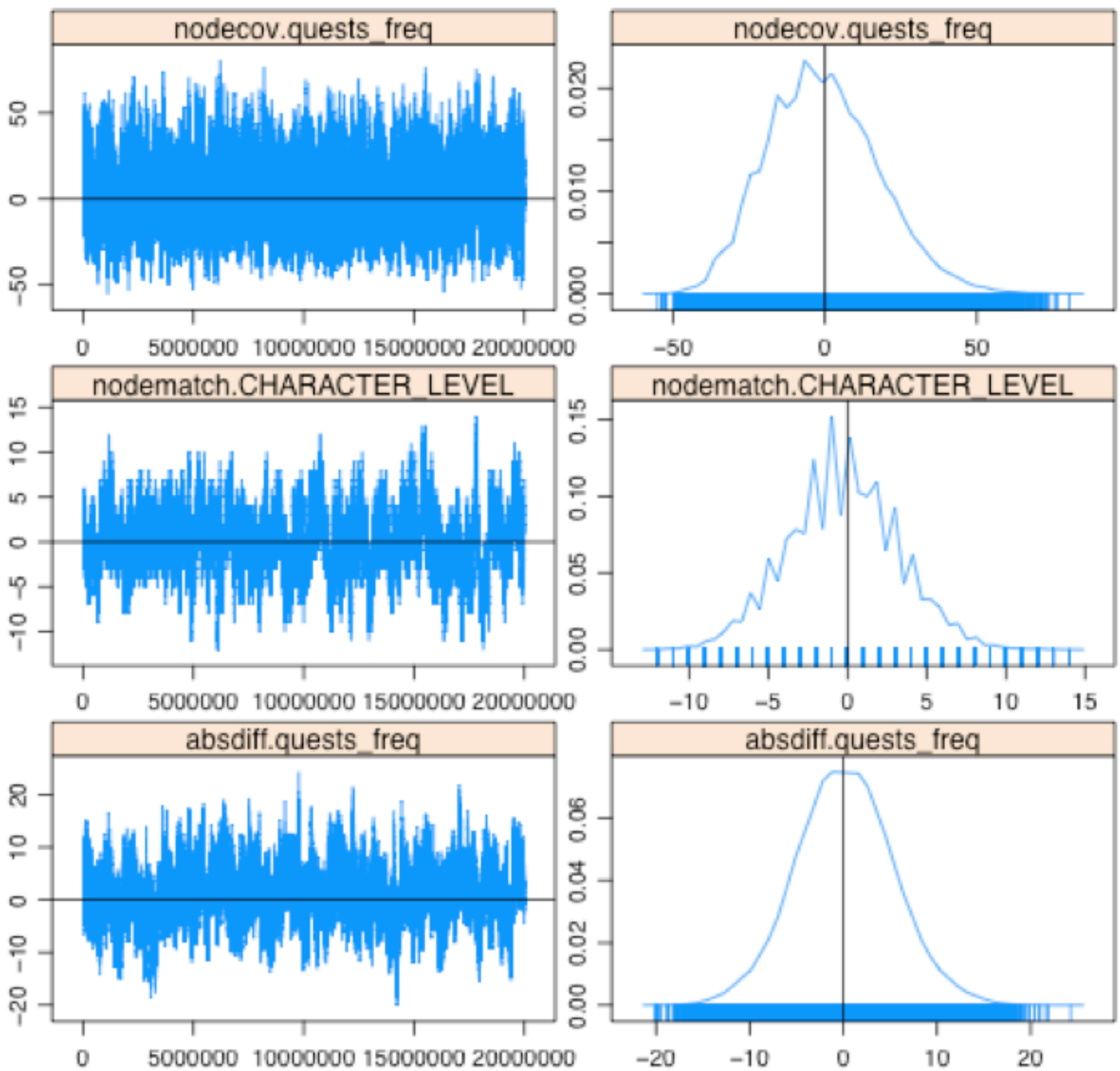

Figure 54 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; unsuccessful dyads only (as seen in Table 20). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

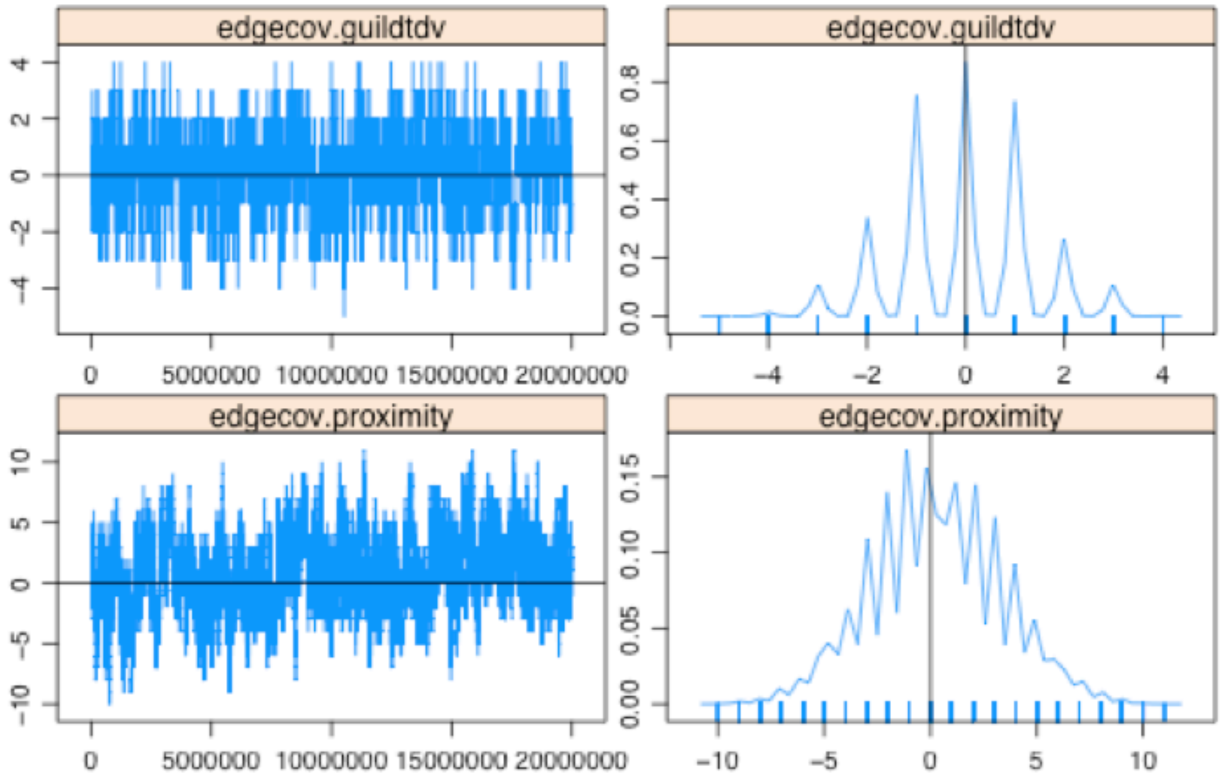

Figure 54 (continued). Markov Chain Monte Carlo diagnostics for the Hypothesis 10 ERGM analysis; unsuccessful dyads only (as seen in Table 20). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

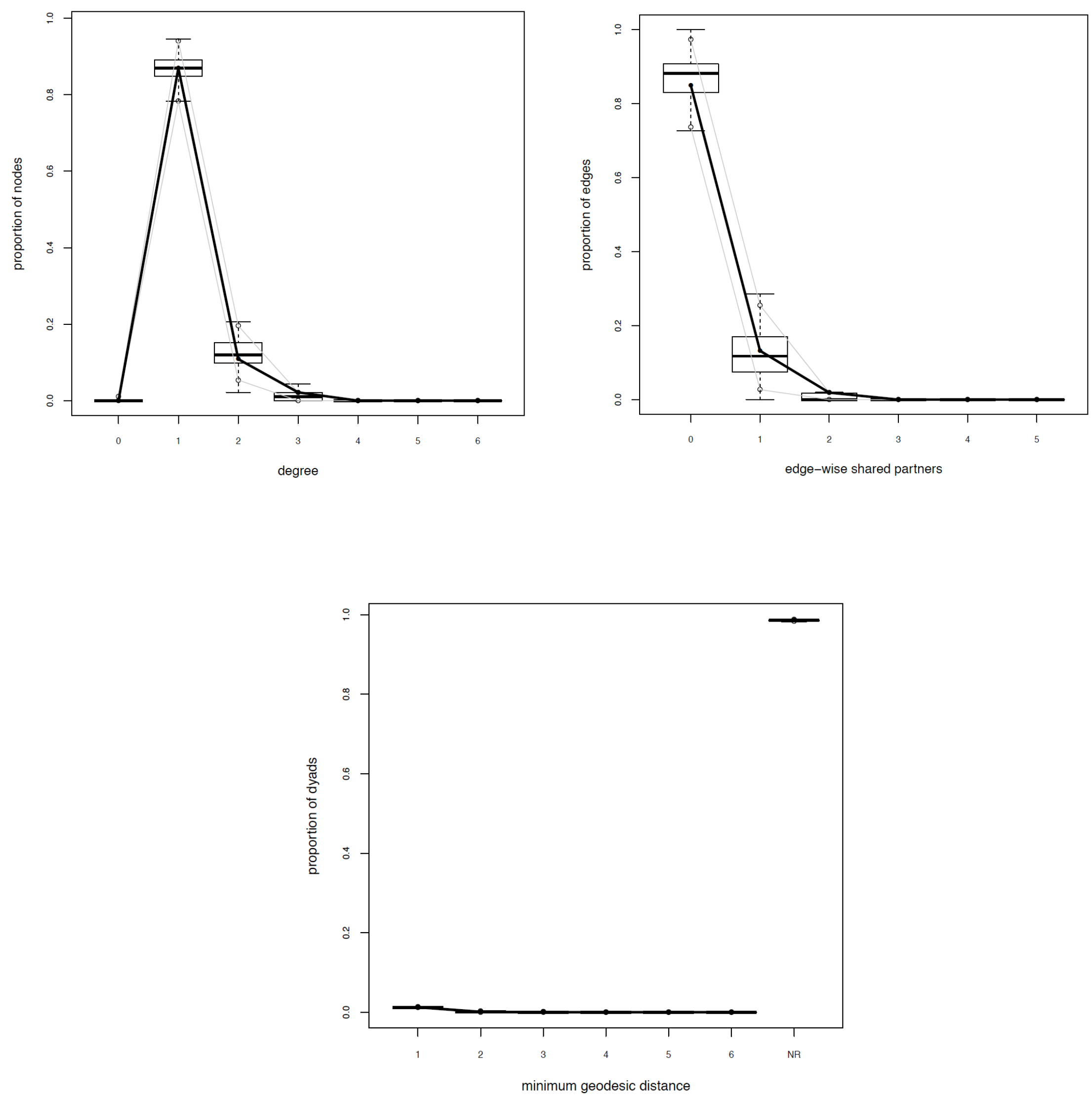

Figure 55. Goodness-of-fit diagnostics for the Hypothesis 10 ERGM analysis; unsuccessful dyads only (as seen in Table 20). (*n* = number of individuals = 92; *l* = number of teammate relationships = 56)

Interestingly, the lowest AIC and BIC values for the full sample and all three performance groups occurred for the "full" model (i.e., the models in Tables 11 and 20). This pattern indicates that the full models do the best job of fitting the data. In addition, it appears that AIC and BIC values are strongly impacted by sample size. For instance, AICs/BICs were consistently smallest for the smallest (unsuccessful) performance group, and were consistently largest for the largest (successful) performance group.

MCMC model diagnostics "can help determine whether the estimating algorithm has converged or there are degeneracy problems and if the model itself or the estimation settings need adjustment" (Harris, 2014, p. 74). However, similar to AIC and BIC values, it is critical to consider this diagnostics in conjunction with other information on convergence/goodness of fit, rather than in a vacuum (Cowles & Carlin, 1996). MCMC diagnostics are only produced for ERGMs that include structural parameters; therefore, the models from Tables 8, 9, 10, 17, 18, and 19 do not have associated diagnostic plots. Figures 40, 42, 44, 46, 48, 50, 52, and 54 display the MCMC diagnostics for the ERGMs presented in Tables 7, 11, 16, and 20. Statistics fluctuating stochastically around a mean of 0 indicate that a model has converged. Overall, the MCMC model diagnostics for the ERGMs from the current study indicate model convergence.

Goodness-of-fit plots provide a comparison between the proportion of nodes in the observed network with a given characteristic and the proportion of nodes in the simulated network with the same characteristic. In terms of interpretation, the thick black line that appears on each plot represents the observed network, while the two thin grey lines represent the 95% confidence interval of the simulated network; if the black line falls between the grey lines, this is an indication of good fit (Harris, 2014). Again, plots were only produced for the ERGMs that included structural parameters. Figures 41, 43, 45, 47, 49, 51, 53, and 55 display the goodness-of-fit plots for the ERGMs presented in Tables 7, 11, 16, and 20. Overall, the plots indicate good model fit.

Selection Bias

Three steps were taken to assess the potential threat of selection bias: 1) Levene's tests were conducted in order to evaluate the appropriateness of ANOVAs versus Kruskal-Wallis one-way analyses of variance; 2) Kruskal-Wallis one-way analyses of variance were used to compare the three independent samples; and 3) post hoc Nemenyi tests were carried out to achieve pairwise comparisons. First, as seen in Table 21, descriptive statistics were calculated for the excluded team and solo players. Average task difficulty was calculated at the individual for the primary sample of team players by computing each individual's mean difficulty level across all instances of teaming that occurred at least twice. However, most excluded team players and all solo players did not have any instances of repeat teaming, so average task difficulty for these two groups was calculated across all instances of teaming, rather than simply across repeat instances. Subsequently, Levene's tests were carried out on six variables of interest. As seen in Table 22, all six Levene's tests were statistically significant, F values ranging from 16.09 to 9,262.70, $p<.001$, indicating a pervasive inequality of variances across the three groups. In other words, the most appropriate method to test for selection bias was nonparametric analyses of variance. Next, Kruskal-Wallis one-way analyses of variance were carried out for the six variables. As visible in Table 23, all six test statistics were statistically significant, χ^2 values ranging from 18,493.06 to 40,204.72, $p<.001$.

Finally, post hoc Nemenyi tests were conducted for pairwise comparisons, and a number of interesting patterns emerged. First, the primary sample of team players and the sample of excluded team players both had significantly higher player levels, more completed quests, more money, more logins, and higher average task difficulties than did the solo players. However, the solo players had significantly more skill points than either group of team players. This pattern is generally in line with the correlations presented in Table 4; skill points are negatively associated with player level, completed quests, money, and logins. In addition, the primary sample of team players and the excluded team players only differed in terms of three variables: player level, completed quests, and average task difficulty. The excluded team players had significantly higher levels and average task difficulties than the current sample of team players, while the current sample of team players had significant more completed quests than the excluded team players.

Summary

Overall, analyses of the digital trace Dragon Nest data set rendered several significant findings. As expected, ERGM analyses revealed that individuals tend to self-assemble into teams that are homogenous in terms of player level, guild affiliation, and guild role, and also tend to form teams based on prior friendship, closure, and geographic proximity. However—deviating from hypothesized outcomes—results also suggested that: attractiveness as a teammate is not proportional to popularity as a teammate; individuals do not tend to self-assemble into teams that are homogenous in terms of character class, skill points, completed quests, money, or logins; and situational attraction mechanisms are not the most influential on team self-assembly. In terms of performance analyses, only two hypothesized differences between performance groups were supported: unsuccessful teams were more homogenous in terms of completed quests than successful teams were, and successful teams formed based on friendship more often than unsuccessful teams did.

Semi-Structured Interviews

In order to take mixed method approach to understanding team self-assembly and the generalizability of MMORPG samples, I also conducted semi-structured interviews. As seen in Figure 56, American interviewees reported playing a wide variety of team-based online games; on average, each American participant reported playing 2.42 different games (*SD*=1.24, minimum=1.00, maximum=6.00). All Chinese interviewees were players of Dragon Nest, but most reported playing other games as well. As seen in Figure 64, Chinese participants reported playing 3.26 games (*SD*=2.54, minimum=0.00, maximum=11.00), in addition to Dragon Nest. Importantly, not all of the games listed in Figures 56 and 64 are technically MMORPGs, but all are online and multiplayer, and most involve role-playing. A number of games were popular across both samples, including League of Legends (played by 52% of the American sample and 60% of the Chinese sample) and World of Warcraft (played by 19.23% of the American sample and 28% of the Chinese sample).

In order to establish coding agreement, I had a panel of four subject-matter experts sort a subset (n = 68) of interview quotations into the categories/subcategories that I developed. Interrater reliability was then assessed using Fleiss' kappa. Fleiss' kappa is the most appropriate measure of interrater reliability because it examines the reliability of agreement between a fixed set of raters who have assigned categorical ratings to a target (Fleiss, 1971). Fleiss' kappa was calculated for each of the higher-order categories to evaluate their validity. Analyses revealed substantial to near perfect interrater agreement for absolute attraction mechanisms (κ = .77), relative attraction mechanisms (κ = .93), relational attraction mechanisms (κ = .90), situational attraction mechanisms (κ = .94), and the mapping principle (κ = .76)[9].

Absolute Attraction Mechanisms

American participants reported using three absolute attraction mechanisms to form in-game teams[10]: capability, agreeableness, and communication skills. First, as seen in Figure 57, 22 of the 26 American respondents (i.e., 84.62%) said that they factored in absolute levels player capability (i.e., game experience and/or skill) when choosing virtual teammates. For example, one interviewee remarked[11]:

> It's easy to get members if you're really skilled in the game, because everybody wants to play with a guy that's really good. As long as you're good/you do good, people say, "Well, how do I play with you guys? How do I be in your group or clan?"

Another American respondent said:

> I could actually go and I can look in at their—there's a whole other tab where it shows if you're proficient in that dungeon or not, how many times you've played it. If you've never done this dungeon before chances are you're not skilled in it, so I wouldn't take them [as a member of my team].

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[9] Kappa values above .41 represent moderate agreement, and values above .61 represent substantial agreement.
[10] Across both samples, when tallying up the number of times each attraction mechanism was mentioned, mechanisms that were mentioned fewer than five times were excluded from all reporting of results.
[11] Instances of participants saying filler words/phrases such as "like," "well," "just," "kind of," "and stuff (like that)," "I guess," and "so" were redacted from all quotes.

Furthermore, it's interesting to mention that 18 American participants said that in-game social status is a direct function of experience and/or skill. For example, one participant explained: "There's definitely a social hierarchy. Everybody wants to be the cool guy who's been doing this for years, who has all this stuff[12]." Another American interviewee commented: "If you know how to play the game, then you're probably good at it, and if you're good people want to know you."

The second most cited absolute attraction mechanism used to form in-game teams by American participants was agreeableness; 57.69% of respondents said that they sought teammates who were friendly, amicable, playing for fun, and not prone to trolling (i.e., purposefully trying to aggravate/annoy other players), flaming (i.e., purposefully trying to anger other players) or raging (i.e., expressing anger that is extreme and disproportionate to its stimulus). For example, one interviewee remarked: "When I look for a team, I make sure everyone has a good attitude. As long as no one's raging, I'm completely fine. It's great." Another American respondent described his ideal teammates: "People who are funny and like to converse and talk while we're playing. And then, people who don't take it too seriously because…it's not the end of the world. We're not going to die. Nothing is going to happen." Interestingly, the specific notion of "not taking the game too seriously" resurfaced many times when American participants described their ideal teammates.

[12] "[A]ll this stuff" refers to items that are awarded to players for succeeding in quests/missions; in some games, players' items are used as a proxy for their skill level.

Additionally, 23.08% of American interviewees said that they want their in-game teammates to have good communication skills. One participant described the necessity for choosing teammates with adequate communication skills:

> That's a big thing for me—willing[ness] to talk. Often people don't communicate, which I think hurts a team. You can be amazing and go, I don't know, 26 kills and die no times. But you can still lose because you don't help your other teammates get assists off of those kills. Or you don't tell them, "Oh, there's a person coming down," and then they die and you're the one person good on your team. You can still lose.

In addition, American participants also reported using three absolute attraction mechanisms to form real-world teams: conscientiousness, agreeableness, and communication skills. First, as seen in Figure 57, 17 of the 26 American respondents (i.e., 65.38%) said that they preferred conscientious teammates who were hardworking, responsible, and/or, in the words of many participants, "pull their own weight." For example, one interviewee remarked:

> I've been in group projects with people who could be classified by others as…people who don't pull their weight in the work, don't do the work they are supposed to do, so other people have to pick up the slack. And when you end up with people like that, there are things you can do like peer evaluations and so forth, but in general, usually you can't wait until that class or project is over so you can move on and not have to deal with the stress or the difficulties that come with everyone not being on the same accord.

Another American respondent similarly described the frustrating social loafing tendencies of her past teammates; specifically, she illustrated what is sometimes referred to as the “sucker effect” (Kerr, 1983; Houldsworth & Mathews, 2000):

> No one wants to do [the group project]. Everyone’s waging on how much they put in as their token. Everybody else has to match that because I’m not going to do anything more or less than anybody else does…It is for a grade, but it’s the mentality of I’m only going to do—I’m in it for myself. Let’s see how much I can personally get out of it without doing as much work as everyone else.

The second most cited absolute attraction mechanism used to form real-world teams was communication skills; 26.92% of American participants said that they sought teammates who were good communicators and/or listeners. For example, one interviewee, when discussing important qualities in potential teammates, remarked: “What I think about teamwork is that communication is a very important thing. Communication needs to be maintained. And the quality of the communication needs to be good, as well. I think that’s the most important part.” Another American participant cited both being hardworking and having good communication skills as the two characteristics that he looks for in a potential real-world teammate:

> I would say the biggest thing is obviously communication in a team, which is the pinnacle. And I found that in every single team I worked with basically. If you don’t communicate, you don’t tell people, “I’m not going to be here for that meeting.” Or, “I didn’t do this. I didn’t do that.” Or, “I need this, I need that,” it all falls apart. Even if you’re not strong academically, strong anything, it doesn’t

matter, as long as you can communicate and you're willing to devote time to it. That's it. Communication and willingness to do something.

Third, 19.23% of American participants said that they looked for agreeableness in their real-world teammates. For example, one interviewee described what he looks for in potential teammates: "You want them to be good to work with, friendly; they don't even necessarily have to bring anything to the table."

Chinese participants reported using the same three absolute attraction mechanisms to form in-game teams as American participants: capability, agreeableness, and communication skills. As seen in Figure 65, 19 of the 25 Chinese respondents (i.e., 76%) said that they factored in absolute levels of player capability when choosing virtual teammates. For example, one interviewee remarked[13]: "It is about the quality of players. Usually when I form a group with a person in the game, if his quality is not really that good, I will not group up with him anymore." Another Chinese respondent said: "For some weak people, it is difficult to find friends in the game. You can only find friends if you are quite good because, in the game, many people will see that you are able to help them." Furthermore, similar to the American participants, 64% of Chinese participants reported that in-game social status is a function of experience and/or skill. However, distinct from the American participants, 60% of Chinese participants also said that in-game social status is a function of the amount of money that a player invests in the game. For example, one participant explained:

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[13] Most translated quotes were edited slightly in order to improve their clarity and readability, without changing their essential meaning.

> Renminbi players[14] and ordinary players—there is a gap in classes…Yes, and another way to differentiate is in terms of skill: [advanced player], ordinary [player], noob[15]. These are the two classifications—one is money investment, another one is level of skill.

Another interviewee elaborated on the subject of Renminbi players:

> There is distinction between rich kids and normal civilians…Rich kids are basically very free. They like to show off their equipment on the street, but civilians are not able to have such enjoyment—they can't afford this type of fun…Overall, one will feel the difference in class.

The second most cited absolute attraction mechanism used to form in-game teams by Chinese participants was agreeableness; 56% of respondents said that they sought kind, considerate teammates. For example, one interviewee remarked:

> It is mainly about getting along. When we are playing a game together, we can see whether the person has good qualities or a sense of humor. When we are playing together, let's say you have easily accomplished a level—[a very advanced player] will tell jokes, or make funny faces or something…In short, it is about whether we can get along.

Another Chinese respondent described his ideal teammates:

> I certainly do not mind if the person is particularly cheerful. For example, I used to play with players from the northeast region. Those girls are particularly loud;

[14] Renminbi is the official currency of China. Chinese participants referred to players who use money to gain in-game social status as Renminbi players.
[15] An Internet abbreviation of the word "newbie," which is a slang term meaning novice.

> they are very open-minded and can talk about everything. I like that type…I am not demanding in terms of characteristics, it is all about feeling; as long as it feels good, any characteristic will do.

Additionally, 28% of Chinese interviewees said that they want their in-game teammates to have good communication skills. One participant described the relative importance of communication skills and gaming ability: "The most important thing is you must communicate with others. If you have any thoughts you must speak up…so everyone can know. Secondly is his ability—whether his ability is good is next in importance."

However, Chinese participants also mentioned two additional absolute attraction mechanisms that they look for in potential in-game teammates, which were not routinely mentioned by American respondents: leadership/teamwork skills and honesty/sincerity. First, 48% of Chinese interviewees said that they sought effective leaders and/or individuals with teamwork skills as teammates. For example, one respondent remarked: "Emphasis on teamwork—of course they need to care about it, or else they would not have joined the team. Since everyone has joined the team, we should help each other to achieve the goal." Furthermore, the results of a chi-squared test[16] indicated that Chinese participants were significantly more likely than American participants to report using leadership/teamwork skills as a basis for choosing in-game teammates, χ^2=12.63, *p*<.001. Second, 28% of Chinese participants said that they wanted teammates who were honest

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[16] Differences between Chinese and American participants' reported use of absolute, relative, relational, and situational attraction mechanisms were evaluated using chi-squared tests. Cultural disparities were tested for all routinely mentioned attraction mechanisms, but only significant results are reported here.

and sincere. Another Chinese respondent described his aversion toward dishonest players:

> When I am playing together with others, the main thing is to look at one's qualities, such as whether he steals items during the game…Whoever does not comply with rules or practice good qualities, I would not befriend this type of person.

In addition, Chinese participants also reported using the same three absolute attraction mechanisms to form real-world teams as were mentioned by American participants: conscientiousness, agreeableness, and communication skills. First, as seen in Figure 65, 18 of the 25 Chinese respondents (i.e., 72%) said that they sought out conscientious teammates. One interviewee remarked:

> I prefer working with people who do more work and speak less nonsense—the practical type. I would not work with those who do not know a single thing, or are not willing to do anything, or are very picky. Of course, everyone likes to work with people who are honest and hardworking.

Another Chinese respondent described a frustrating real-life experience of social loafing:

> The lecturer wanted us to form a group in class to research a specific topic. The group leader randomly invited several people, and when we were assigning jobs, everyone hoped to do a little less. Because—I think that the distribution of tasks by the leader should be equal. Hence, I didn't say anything; I just randomly picked one. In the end, the leader gave me a task that, in my opinion, was heavier than the others. When I saw that others had less, I felt unhappy.

Second, 60% of Chinese participants said that they looked for agreeableness in their real-world teammates. Interviewees described their ideal real-world teammates using adjectives such as: “approachable,” “polite,” “good-tempered,” “friendly,” and “enthusiastic.” Furthermore, the results of a chi-squared test indicated that Chinese participants were significantly more likely than American participants to report using agreeableness as a basis for selecting real-world teammates, χ^2=5.88, p<.05. The third most cited absolute attraction mechanism used to form real-world teams was communication skills; 36% of Chinese participants said that they sought good communicators/listeners as teammates. For example, one interviewee remarked: “I dislike those who have a dominating voice and always grasp the authority to speak. Everyone will have to go according to his direction.”

Chinese participants also cited four additional absolute attraction mechanisms that they value in real-world teammates: general ability, leadership/followership skills, modesty, and flexibility. First, 40% of Chinese interviewees said that they sought real-world teammates with high ability levels. For example, one respondent explained: “If the task is only to accomplish the goal, I will try to pick those with ability. Someone who helps in pushing the goal forward.” Furthermore, the results of a chi-squared test indicated that Chinese participants were significantly more likely than American participants to report using ability as a basis for selecting real-world teammates, χ^2=4.99, p<.05.

In addition, 28% of Chinese participants said that they sought teammates who with excellent leadership and/or followership skills. For instance, one individual commented:

> First of all in a group, there will definitely be a leader. The person who leads is definitely very important. This leader has to be very assertive, has to have his own thoughts, and also must be very capable. Secondly are the people he picks; his skill of judging others is very important. If he selects lousy, terrible people into the group, the group definitely will not go far. That is to say that the most important factor is the leader, but teammates are quite important, too.

Moreover, 24% of the Chinese sample mentioned the importance of choosing modest real-world teammate. One interviewee noted: "As long as he is not a very arrogant person, I am fine with him… I dislike those—the arrogant type." Finally, 20% of Chinese participants said that they desired accommodating, tolerant, open-minded real-world teammates. As one respondent explained: "You have to be more flexible, not too stubborn." Additional quotations on absolute attraction mechanisms from both the American and Chinese samples can be found in Table 24.

Relative Attraction Mechanisms

American participants reported using six relative attraction mechanisms to form in-game teams: functional heterophily, capability homophily, agreeableness homophily, gaming style heterophily, guild membership homophily, and goal homophily. First, as seen in Figure 58, 15 of the 26 respondents (i.e., 57.69%) said that they constructed teams based on functional diversity. For example, one interviewee remarked: "You have different roles that people play, and they have their game names. You would fill up your team with people that specialize in different roles." Another American respondent echoed his sentiment:

> Can we have a team that's balanced? Do we need another person who can deal out damage, or do we already have enough of those people? I think that's something that everyone keeps in mind when they're setting up on those teams.

The second most frequently mentioned relative attraction mechanism was homophily in terms of experience/skill; 34.62% of participants said that they tend to pick teammates who are at or around their skill level. For instance, one participant explained:

> Whenever I want to get into a game, I do look at who is around me and try to figure out, okay, that guy is like 20 levels ahead of me. He probably won't want to hang out with a dude like me. But I do try to look for the people who are similar to my skill set.

Interestingly, another American participant hypothesized that the skill homophily effect is the result of the distribution of skill being a power law:

> There's a high population of very low-level people (because obviously the least amount of time that's required to have one of those characters, you just start up). And so, obviously, the number of players decreases as the levels go up, because it's difficult to—this is a big time investment, the number's going to go down, actually. I think that there's a lot of low-level characters that end up teaming together to complete the low-level content.

The third most cited relative attraction mechanism was homophily in terms of agreeableness; 23.08% of American participants said that they tend to pick teammates who are similar to them in terms of playing for fun and/or not taking the game too seriously. As one interviewee explained: "I don't rage much, so I'll tend [to choose a] player who doesn’t like care about the game, just like me. If you care a lot, you tend to rage at other people.” Another American respondent explicated:

> In Destiny[17], there are four different things that you can do with an E-pad[18]. You can wave, you can sit. One of them is dancing. And for me, I’m a happy personality, so whenever I see somebody dancing, it gives off an air of, “Hey, I’m having a good time.” Whenever I do that, I’ll go dance with them a little bit because, why not? And then I’ll try to see if any of them are willing to get into a particular mission.

Three relative attraction mechanisms were mentioned by 19.23% of American interviewees when discussing the formation of in-game teams: gaming style heterophily, guild membership homophily, and goal homophily. First, one participant explained the importance of creating a team diverse in terms of gaming style:

> I prefer other players that are different because I don't—I don't want to see the style I play, four other people play. I want to see something different. I play the game to see all the different things that could be possible.

A second American respondent described the importance of teaming up with fellow guild members: “If you have a guild, you can be like, ‘Okay, I want my guild—guild members, help me take out this boss.’” Alternatively, another American interviewee explained the frustration of not being able to virtually link up with his fellow guild members (i.e., “guildies”): “None of my guildies are on, so I'm like, ‘Crap, I really wanna do this dungeon.’ Because it's a daily thing that you get a reward, if you do it once a day.”

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[17] Destiny is a massively multiplayer online first-person shooter game with role-playing elements.
[18] This is referring to a functionality of the PlayStation 4 controller.

Finally, another American participant explicated the importance of creating a team with homogeneous goals:

> I could enjoy playing with someone who has a low skill level but if their goals are in line with mine. I'm not gonna enjoy playing with people whose main goals are PvP[19] or maybe role-playing because I'm gonna wanna be like, "Hey, man, you wanna do dungeons?" And he's gonna be like, "No, I'm busy getting married in the game," or something like that, you know…If our goals aren't aligned that's a problem.

As for real-world teams, no relative influence was mentioned more than four times cumulatively in the American sample.

Chinese participants reported using the same six relative attraction mechanisms to form in-game teams as were reported by the American participants: goal homophily, guild membership homophily, functional heterophily, capability homophily, gaming style heterophily, and agreeableness homophily. First, as seen in Figure 66, 16 of the 25 Chinese respondents (i.e., 64%) explicated the importance of creating a team with homogeneous goals. One participant explained the importance of goal homogeneity:

> Then there is a common goal among the members, or they are willing to complete the task, willing to join the group. As long as they are cooperating, this is not that important, as long as there is a goal.

Another interviewee echoed this opinion: "Everyone has a firm common goal—I think this is the most important (the rest is less important). Everyone has a common goal to

[19] This means "player versus player"—in other words, many games allow players to battle against other real players instead of against a virtual opponent.

accomplish." Furthermore, the results of a chi-squared test indicated that Chinese participants were significantly more likely than American participants to report goal homogeneity as a basis for selecting in-game teammates, χ^2=8.78, p<.01.

The second most cited relative attraction mechanism by Chinese participants was guild membership homophily; 48% of the sample said that they preferred to join forced with fellow guild members. One respondent described how guild homophily serves as a mechanism for team self-assembly, in his experience: "We are all a guild group. I usually go to the guild to meet my group. Others randomly form groups with strangers or have fixed groups every week; I have not participated in these groups."

Furthermore, 9 of the 25 Chinese respondents (i.e., 36%) said that they constructed teams based on functional diversity. For example, one interviewee explained:

> I prefer people with different roles, especially different game characters, because I think different roles complement each other. When you are carrying out tasks, you can complete it better—each role has designated tasks. Only then can the progress of game can become faster.

Another Chinese respondent discussed the tradeoff between functional diversity and friendship:

> When I play with friends I know, we are not very concerned about coordination in the group. So, no matter what their roles are, we will play together; it is mainly to play together. But when I form group with online players, I will put more consideration into the equilibrium of the group. For example, if I am a sorceress, when I am forming a group, my usual friends are archers. But, when I am

choosing friends to form a group with, I will take those who make up for my shortcomings, such as warrior, cleric, and other roles.

In addition, 36% of the Chinese sample also said that they preferred their gaming teams to be homophilous in terms of experience/skill. As one participant explicated:

> You cannot invite those with mismatched levels, or those with very low levels. You definitely cannot allow him to join the group. Usually it is someone who is similar to you or someone better to lead you, or someone you have played with before.

Moreover, 8 of the 25 Chinese respondents (i.e., 32%) mentioned gaming style heterophily as a relative attraction mechanism. First, one participant explained the benefit of choosing teammates diverse in terms of gaming style: "If he has unique features in his way of playing it is even better, because this is a type of learning—a learning in the game."

Additionally, five of the 25 Chinese respondents (i.e., 20%) said that agreeableness homophily was an important relative attraction mechanism that they used to form their in-game teams. As one interviewee explained: "They must have good qualities like me: enjoy chatting, enjoy interaction, like to joke a little…I prefer someone who is similar." Another Chinese respondent explicated:

> When I am playing the game I usually seldom curse. I also dislike people scolding me, because cursing will waste the time of the game. I am more concerned about group collaboration, because in the game items are randomly distributed; if others need it, I will give it to them. I hope others treat me the same.

Chinese participants also cited an additional relative attraction mechanism for choosing in-game teammates: general personality similarity. Specifically, 32% of Chinese respondents said that they prefer that their teammates have similar personalities to themselves. For instance, one interviewee said: "I prefer people similar to me—to work with people with similar personalities—because I think it is easier to cooperate… I only want them to have the same mentality, the same attitude." Another person echoed: "Of course it is better to have similar personalities, because if you have similar personalities, it is easier to talk." Moreover, the results of a chi-squared test indicated that Chinese participants were significantly more likely than American participants to report personality homogeneity as a basis for selecting in-game teammates, χ^2=4.58, p<.05. Furthermore, Chinese respondents reported seeking real-world teammates with similar personalities, as well; 28% of the sample reported striving to create real-life teams homogenous in terms of personality. As one participant explicated: "The personalities of the group members may not match mine. Their efficiency in completing tasks and their personalities may lead to the entire process to complete the task becoming not really smooth. I dislike this." Additional quotations on absolute attraction mechanisms from both the American and Chinese samples can be found in Table 25.

Relational Attraction Mechanisms

American participants reported using two relational attraction mechanisms to form in-game teams: real-world and in-game familiarity. First, as seen in Figure 59, 25 of the 26 respondents (i.e., 96.15%) said that they constructed online gaming teams with real-world friends. Virtually every American participant had an anecdote about being recruited by or recruiting friends/relatives to play an online game. For example, one interviewee remarked:

> I spoke to people about this game—advertising it, maybe. Then, some of my friends told me, "Yeah, I play this game, too." We…would play the game. We would call each other or text each other and say that, "I'm playing right now, if you want to come on right now. We'll do this quest together, right now."

Similarly, another American participant talked about being recruited by a family member: "TERA[20] and Guild Wars II[21], I wouldn't have started them unless my cousin had told me…He doesn't have anybody to play the games with that he knows. He always invites me to play the games with him."

Second, 21 of the 26 American respondents (i.e., 80.77%) said that they constructed online gaming teams with in-game friends. For example, one interviewee described the benefits of developing online friendships:

> I interacted with people online and then, when I play with people online, sometimes I will figure out that a particular dungeon or challenge is easier when I play with certain people as opposed to other people. That's when friend requests come into play. You send them a friend request like, "Hey, I would like to play with you again." Then, when you or the other person log on, you can do things together and it will make it easier to build off each other.

Another American participant described the process of forming friendships online:

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[20] Tera is an MMORPG.
[21] Guild Wars II is an online role-playing game that emphasizes player-versus-player battles.

> Usually, if you think like one of your teammates—you get a good synergy with it, with him or her, then you can add as a friend after the game, and you can play future games together…It's more fun when you play—actually form [a] good friendship and play with your friends, even if you don't know them in real life.

Finally, a third American participant described a longtime virtual friendship:

> I got one of my good buddies, Elliott, I met him—and, I don't know what he looks like. I've never seen him in real life. But I've been playing with him for a really long time on League of Legends[22], since I started almost. And he's one of my friends.

Moreover, 26.92% of American participants directly compared the importance of absolute levels of experience/skill versus friendship, and noted that the latter outweighs the former. For example, one interviewee commented on playing with newcomers to the game: "Usually, that will only happen if it's my friends in real life. If I actually know them, and they're newcomers, then I'll go play with them."

Furthermore, American participants reported using just one relational attraction mechanisms to form real-world teams. As seen in Figure 59, 6 of 26 respondents (i.e., 23.08%) said that they tended to form real-world teams based on prior friendship relationships. In line with recent research results that indicated that teams that form based on friendship end up having decreased levels of motivation to work for the team (Wax et al., 2014), one respondent articulated his negative experience in a team that self-assembled based on friendship:

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[22] League of Legends is an online, multiplayer, battle arena game. As seen in Table 56, it was—by far—the game that was played by the largest number of participants.

> I think the worst team I've ever been on was this lab group I had in physics in 11th grade. And we had to make this formal lab write-up and I basically—it just—it was a train wreck the whole time. From the beginning we set up meetings and then—first we had problems getting everyone in the same place because everyone was busy. And then, once we got there, we were really unproductive. We didn't get anything done. We got distracted and we kept listening to music or going here or there or playing a game. And then, eventually, it came down to the last night. It was due the next day and I couldn't reach to—I couldn't get any—into contact with any of them and, so, I ended up having to do the whole thing by myself until, like, 5:30 a.m. It was really miserable.

Chinese participants reported using the same two relational attraction mechanisms to form in-game teams as did American participants: real-world and in-game familiarity. First, as seen in Figure 67, 21 of the 25 respondents (i.e., 84%) said that they constructed online gaming teams with real-world friends. For example, one interviewee recalled:

> At that time it was someone else who first saw the game, at the very beginning, very early. He saw it, and then he invited me to play. I thought it is quite good, so I told another friend, and then that friend also played. She is also a girl. It was a guy who invited me to play. Then I asked a girl to play, because after I played I thought, "It is quite interesting."

Similarly, another Chinese participant talked about recruiting a friend to play Dragon Nest:

> I first asked, "Have you played Dungeon Fighter?" He said he played before but it is not interesting. Then I said, "There is Dragon Nest. You should play. It is

> quite fun." Then he said, "Okay, since I have nothing to do." Then I led them. It was during freshman year.

Second, 84% of the Chinese sample reported constructing online gaming teams with in-game friends. For example, one interviewee described the benefits of developing online friendships:

> I definitely make friends, because in a group if there is someone I can get along with, I like to continue chatting with him, playing with him. In a group, we need to cooperate and communicate with each other. This may mutually enhance our…standard [of gameplay]. We will also talk about skill, experience, and the like. We can help each other to improve.

Another Chinese participant described the process of forming friendships online:

> I like meeting people in the game, making friends. Usually I chat with them, and if we have an agreeable talk, we will add each other on QQ[23] and continue to chat when we are offline. Next time, we will be playing together.

Finally, a third Chinese participant described his accumulation of Dragon Nest friendships: "I have come to know a lot of new people in Dragon Nest. Since the first day I started playing until now, I come to know two hundred—or at least a hundred—people."

Chinese participants also cited an additional relational attraction mechanism for choosing in-game teammates: reciprocity. Specifically, 36% of the Chinese sample said that they tend to form real-world teams based on reciprocity. Participants cited such

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[23] Tencent QQ is a popular Chinese instant messaging service.

reciprocal relational characteristics as “mutual understanding and patience for error” and “mutual tolerance and cooperation” as having an influence on the self-assembly process. Furthermore, the results of a chi-squared test indicated that Chinese participants were significantly more likely than American participants to report using reciprocity as a basis for selecting in-game teammates, χ^2=3.88, p<.05. As for real-world teaming, no relational influence was mentioned more than four times cumulatively in the Chinese sample. Additional quotations on absolute attraction mechanisms from both the American and Chinese samples can be found in Table 26.

Situational Attraction Mechanisms

American participants reported using three situational attraction mechanisms to form in-game teams: geographic proximity, geographic dispersion, and temporal proximity. First, as seen in Figure 60, 11 out of 26 respondents (i.e., 42.31%) said that they constructed online gaming teams with individuals that were geographically proximal to them. For example, one participant described his tactic for finding people to team up with online: “I guess I was walking in the halls and I said, ‘Do you guys want to play League [of Legends]?’” Other American participants described the experience of befriending players online that, unbeknownst to them, were locals. For instance, one interviewee recalled:

> I was playing with this one person and it happened to be from my same town. That was really interesting at how that worked. We kept playing and I was like, “What's your—what's your name and where are you from?” And he was like, “Oh, wait, we're in the same town.” We actually went to the same school, too.

However, 19.23% of American participants indicated the exact opposite—that they tended to pair up with geographically distal, rather than proximal, teammates. For instance, one interviewee explained: "My friend got me into the game, so mainly…I use it as method to hang out with my friends because they're on the other side of the country right now." Another American participant commented: "I actually tried to use it to connect with my old friends from Pensacola. I used to live in Florida, and now I don't live there anymore. It's a good way to connect with some old friends."

Finally, 23.08% of American interviewees said that they tended to choose teammates based on scheduling constraints. For example, one respondent explained his scheduling tactic for playing online games with his real-world friends:

> When it comes to Call of Duty, I had a group of people in my high school that played. I told them, "Hey guys, 10:00 p.m. today. Let's play Call of Duty[24]." Everyone was like, "Okay. Let's set up a grouping."

Another American participant, however, described the difficulties of scheduling time with friends to play games: "The people I knew, chances are, they are not online at the same time when I was online." As for real-world teams, no situational influence was mentioned more than four times cumulatively in the American sample.

Chinese participants reported using the same three situational attraction mechanisms to form in-game teams: geographic proximity, geographic dispersion, and temporal proximity. First, as seen in Figure 68, 10 out of 25 respondents (i.e., 40%) said that they constructed online gaming teams with individuals that were geographically

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[24] Call of Duty is a first- and third-person shoot game with online multiplayer functionalities.

proximal to them. For example, one participant described his discovery of Dragon Nest, which occurred while playing online games in close proximity to his good friends:

> In our hometown, a few of us agreed, "I am in a good mood today. Let's go to the cybercafé." Then we saw there is Dragon Nest. Basically, we sat in a row and played together.

Another Chinese participant recalled the experience of unknowingly befriending a schoolmate online:

> There is also a quite funny experience. Once I met someone in the game. We had a good chat, and after chatting for some time a lot of things are matching. For example, our city and school are matching. In the end, we discovered we are schoolmates, but he usually does not talk much. I think this is a good platform to meet people; hence, this is what happened.

However, 32% of Chinese participants indicated that they tended to pair up with geographically distal, rather than proximal, teammates. For instance, one interviewee explained:

> Dragon Nest is definitely a cross-regional game. Southern districts, southwest districts…it is across several provinces. There is no need to know each other offline, unless you particularly get along very well—that is your soul mate. Then you should have a video call or meet up. Usually we are already considered quite close after opening a YY[25] account.

Another Chinese participant discussed a long-distance in-game friendship:

[25] YY is a video-based social network that is popular among gamers.

> It is a geographical issue. I am in Shanghai, he is in Chongqing; it is quite far, so we can't meet. Perhaps when we are offline we can add each other on QQ and chat. We have not met…if the distance was closer, then we could meet.

Finally, 36% of Chinese interviewees said that they tended to choose teammates based on scheduling constraints. For example, one respondent explained his scheduling tactic for playing online games with his real-world friends: "We went out for dinner and we talked about this topic—"Let's open the game at 8 o'clock today. Let's play together." Then later, after 7 o'clock, we started talking in YY. Everyone entered the [chat] room." Another Chinese participant, however, described the difficulties of scheduling time with friends to play games: "The time I play Dragon Nest may not coincide with others, so I might meet different people." As for real-world teams, no situational influence was mentioned more than four times cumulatively in the Chinese sample. Additional quotations on absolute attraction mechanisms from both the American and Chinese samples can be found in Table 27.

Mapping Principle

American participants identified three primary similarities between teaming in online games and teaming in the real world: identification of personal characteristics, role designation, and communication. First, as seen in Figure 61, 20 out of 26 respondents (i.e., 76.92%) said that they felt that they could identify some personal characteristics of other players with a reasonable degree of accuracy. Specifically, 53.85% of the sample said that they could roughly determine the age of another player based on indicators such as the sound of her/his voice, conversation content, grammar, and cursing/disrespectful language. For instance, one participant described, in detail, how he uses grammar and mature behavior as proxies for age:

> I can generally tell by the way they talk what age group they're in, because you can especially tell—you can easily identify anybody 12 and under because of the amount of mistakes in the words that they type. It's ridiculous. And they abbreviate everything. There are players between 16 and 25 that abbreviate everything, too, but in their abbreviations there are no mistakes. They're using the correct abbreviation. Twelve and under, you can usually tell who they are…And then you can tell when they're above a certain age. I don't know if 25 would be the right mark off, but you can tell when they're above a certain age because of their maturity level. I mean, not everybody that's older is necessarily more mature. But for the most part, you can tell when—it's usually the guild leaders. People who have been playing since the beginning of the game, who are older. And you can usually tell because there's some sort of debate between two people, and they'll be on the chat of the entire game for the server. There will be like a debate between two people. And it starts getting into some pointless debate about something stupid, and they're starting to yell at each other. And some random guy will step in and start typing, "Guys, calm down. This is just a game," and start trying to explain—they'll start to logically and maturely start to try to diffuse the situation. Then you can usually tell that they're older and that they're more mature.

Second, 46.15% of American participants felt that the way that roles are designated in online games is similar to role designation in the real world. For example, one interviewee explained:

> The teamwork that's involved; the dividing up of labor, you can say. You can't rush into something—"Oh hey, we're gonna do this and let's go, let's do it." No, when you're in a, for a good example, my computer science project that I'm making. We're making a game right now. John, he's the U.I.[26] guy, I'm the backend Java[27] guy, the controller Caleb; you have to divide it up. Same thing with in the game, you divide up the roles, who's doing what.

The third most frequently mentioned similarity between online and real-life teaming in the American sample was the role/importance of communication. For instance, one respondent said:

> I really do see a connection because, when you get used to working as a group in a game like Destiny, you want to coordinate. You want to communicate. Communication is very important. You want to make sure everyone is doing what they're best at. And that is exactly how you want to do school projects. You want to make sure you're constantly communicating with each other so you're not stepping on each other's toes, and to make sure that you're not falling behind on your projects. You want to make sure every person is doing what they know how to do best. And that's not just at school, but I'm sure once you get into the work force, that's how it is as well. You're going to be working on projects,

[26] User interface.
[27] Java is a programming language.

> too. It's actually quite beneficial and educational to play games and experience that. You learn how to work in teams.

Contrastingly, American participants also identified four primary differences between teaming in online games and teaming in the real world: anonymity, social status, disinhibition, and importance of outcomes. First, as seen in Figure 61, 22 out of 26 American respondents (i.e., 84.62%) said that the virtual world is far more anonymous than the real world. Specifically, 42.31% of the sample said that race was very difficult/impossible to determine online. For instance, one participant explained:

> One of the things I really like about online game is that, that—even if you're not a judgmental or stereotypical person, there's always a level of, if you see somebody, oh, this person is this race. This person is that race. But in the game world, it's been my experience that, as long as you can't see each other, that's not there, and that's one of the reasons why I like gaming so much, is because everything is pretty much equal. That kind of anonymity really makes it quite an engaging experience because there is very little discrimination.

Furthermore, 80.77% of the American sample indicated that social status in the real world does not map on to social status in the virtual world. For instance, one participant said: "High status in the game really depends on how good you are. In real life...some people might, but I don't really care if someone's good at a game or not." Many people hypothesized that social status online and in the real world are negatively correlated. For example, one American respondent said: "In general, people who play video games are usually not [high status]—or, who go to a certain extent of being really hardcore[28]." Some American interviewees mentioned the time commitment of gaming, and discussed how people who spend more time building up their status in the virtual world inevitably spend less time doing the same in the real world. One participant explained the disconnect between online and real-life status:

> I think the reason being is that they're investing so much time and money into this game, and to be at that level where you're taking it so seriously, you are at a point where you're definitely trading off other things in the real world. And to achieve a social status in the real world, you also have to invest time (and money, in some cases) to be able to talk to people and be able to become recognizable, to distinguish your social status.

The majority of the American sample (69.23%) also saw the online gaming world as differing from the real world because of the proclivity of individuals to behave uninhibitedly when interacting online. Some participants talked about how players express disinhibition in relatively benign ways; for instance, one interviewee described a player he knew who falsified her appearance online:

> There was a girl that I was actually playing with that is a pretty good friend of mine. Her avatar was slim, and she wasn't slim. And, I mean, not that I particularly care, because we play the game online, but, I mean, it was awkward, because when she added me—I think it was on Instagram[29]—and then I was like,

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[28] Hardcore gamers differ from casual gamers in that they spend the majority of their free time playing online games (Bosser & Nakatsu, 2006).
[29] A social media application for sharing photographs.

> "What?" She's like, "You look just like your avatar." I was like, "That's not you, though."

Another American participant talked about how gamers express a different side of their personalities online than they express in the real world:

> I think by the way the people play the game, there can be some information about the personality of the person. And sometimes, I think, during playing games, the people can show some aspect that they don't normally show like in the real world…I feel like people are more extroverted in the game. They normally say hello to everybody. And that's something you don't normally see in real life. I think that's something that—maybe it's just another psychology thing, that people are normally more outspoken on the Internet than they really are in real life.

Other people described the tendency of individuals to act antisocially online as a result of disinhibition. For instance, one American interviewee talked about how anonymity influences people to be less polite in virtual settings: "In the real world, you're probably going to be more formal and not say whatever comes to your mind. Online you can say whatever and get away with it because no one knows who you are." A number of American participants talked about trolls (i.e., players who purposefully try to aggravate/annoy other players) and/or catfish (i.e., players who attempt to seduce other players using false identities). For example, one respondent recalled instance where his friend engaged in gender swapping/switching (i.e., role-playing as a character of a gender other than the one to which you identify; Hussain & Griffiths, 2008; Martey, Stromer-Galley, Banks, Wu & Consalvo, 2014) in order to catfish another player:

> What I'm getting at is if a guy pretends to be a girl and flirts with a guy, he might give the guy who's pretending to be a girl items or better stuff in games. One of my friends, actually, he was doing that with this other guy, this guy who had everything in games like great. He started flirting back and forth, but the guy wasn't too convinced that he was girl, which is a problem. In order to prove it he got on TeamSpeak[30] (which is one of those voice communicator programs), got his real life girlfriend to come sit down and talk to him, had him flirt with her a little bit—so, that way, he'd give her all these items.

One American interviewee described the negative teaming consequences of being a troll:

> In this game, TERA, there's this guy who is completely famous in the whole game. Everybody knows him because what he does is, I don't know how he has enough money to do it, but he goes, and he buys every item in the auction. He buys every single listing of a specific item in the auction house, and it's really valuable, and everybody needs it all the time. He buys every listing of it, and there are thousands and thousands of listings. And then he puts them all up for way higher prices…But the issue is when that happens, he'll get black listed. People will be like, "Oh, we're not going to party up with that guy because he's doing this." They won't group with him or anything. He has to play solo all the time.

In addition, 23.08% of American participants said that outcomes matter less online than they do in reality. As one participant explained:

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[30] Voice communication software commonly used by online gamers.

> I feel like working in teams in an MMO is definitely a lot different than [working in teams in the real world], especially with a job because, first of all, you're doing it for fun when you're a team. You're doing it to play the game and enjoy yourselves. And also, it's usually not as structured, at least for me. Of course, I'm not hardcore, so I ask a bunch of my friends, "Do you guys want to play right now?" And then we don't research into the best strategies. But when I'm working, I always try my hardest when I—especially if it's a job where I'm being supervised or being watched over. But for MMOs, it's like you try, but if you mess up, it's not a big deal.

Another American participant echoed:

> Well, there's certainly less pressure. I mean, I know there are those people who take the game so seriously. And, not that I don't. Technically, I'm a serious gamer, but I don't really know what that means. I play. I like progressing, but I also play to have fun. In that regard, and my friends who I usually play with, there's not as much pressure. If you're working in real life on, whether it's a school project or a work project, there's a lot of pressure. You have to do this. You have to get it right. If you don't, you get a bad grade, or you're worse in the work industry. Whereas in the game, if you fail, oh well. You try again. It's just a game. If anything, the way I would look at it is that the video game world is a safer environment to learn how to work as a team without the major risks.

Finally, a lone American participant mentioned the fact that virtual team self-assembly is more flexible and involves a much larger pool of potential teammates than real-world team self-assembly:

> In the real world…in college or something, in this class, I'm assigned these five people. Or maybe I had to find this group, but none of my friends are taking this class, because they're taking the class at 2:00. So, it's like, in some ways, you have more flexibility in who you take in a game as opposed to in real life, where you're either assigned or you have a small pool of people. And you have to choose a group by a specific time. While in a game, if there's nobody that I want to play with, I don't have to play.

Chinese participants also identified three primary similarities between teaming in online games and teaming in the real world: identification of personal characteristics, having a common goal, and role designation. First, as seen in Figure 69, 15 out of 25 Chinese respondents (i.e., 60%) said that they felt that they could identify some personal characteristics of other players with a reasonable degree of accuracy. As one participant explicated:

> First is…his way of speaking. If he's a certain age, it is reflected in his way of speaking. A person with a lower level of education speaks differently. Another thing is to see the extent of his spending in the game. If he is a junior high school or primary school student, he does not have the spending power, so he will not put in too much. So, there is difference in terms of game equipment, as well.

The second most frequently mentioned similarity between online and real-life teaming in the Chinese sample was having a common goal, which 48% of Chinese participants mentioned. For instance, one respondent said:

> The similar point would be to achieve a common goal…When you form a group, there must be a goal—whether it is to help someone, whether is to get some

> equipment, or to accomplish a certain level, get an achievement or something. Basically there is a common goal; this is a similarity.

Third, 24% of Chinese participants felt that the way that roles are designated in Dragon Nest is similar to role designation in the real world. For example, one interviewee explained: "The similarity is everyone has his own responsibility. For example, in a group—whether it is Dragon Nest or offline—everyone carries out his own duties." Another participant further developed the sentiment:

> For example, [in Dragon Nest] you are a backup—you are there to defend…you are supposed to do what you are assigned to. In real life, you are an accountant. I am security in the security room. There are things you are not supposed to do, or you'll mess things up.

In contrast, Chinese participants also identified four primary differences between teaming in online games and teaming in the real world: anonymity, social status, disinhibition, and complexity. First, as seen in Figure 69, every single participant in the Chinese sample mentioned the virtual world's disproportionate amount of anonymity, when compared with the real world. Respondents typically emphasized the normalcy of concealing their actual identities online. Specifically, 72% of Chinese interviewees mentioned that players typically capitalize on the anonymity that the Internet affords them by concealing their personal information, or in other ways. As one respondent put it:

> The Internet is full of uncertainty; this is the fundamental feature of the Internet. Concealing personal information is a sure thing. For example, if someone

randomly asks me for my home address, telephone number and other information, I will not tell. This is a matter of principle.

Another Chinese interviewee explained the potential social benefits of Internet anonymity: “There is no discrimination… If you are a minority, nobody will discriminate against you.”

The second most frequently mentioned difference between online and real-life teaming in the Chinese sample was that social status in the real world does not map on to social status in the virtual world, which 76% of Chinese participants mentioned. For instance, one participant explained:

> Some people may have thrown all the money they earned in real life into the game. In real life, he does not have much spare cash. It is all invested in the game, so he may look very strong in the game, when in fact he is quite poor in reality. Or, these days, many primary school students ask for pocket money from parents to buy equipment in the game. In fact, he is a schoolboy, in reality.

Another Chinese interviewee provided a personal anecdote related to the mapping principle and social status:

> A classmate in my dorm downstairs, everyone is calling him an [expert player], or something, but in real life he fails a lot of subjects. Everyday he gets scolded by teachers, teachers always reprimand him, or during conversations he seems anxious to learn. During class he is anxious about marking attendance and writing homework. Everyday borrows homework from the rest. He is really busy. I think this is totally different from situation in the game.

Third, 16 out of 25 Chinese respondents (i.e., 64%) described the online disinhibition effect. However—unlike the American sample—the Chinese participants brought up far fewer anecdotes about vicious, malicious online behavior, and far more instances of benign disinhibition. For example, a sizeable fraction of the Chinese sample (specifically, 36%) discussed the act of gender swapping, which exemplifies benign online disinhibition. As one interviewee elaborated:

> This is their freedom, but I think that it is not really good…I feel like I'm being cheated. In the game, the ID of "ladyboy" is very common… Maybe he wants to play a female role, becoming a female, but in fact he is a guy. Perhaps he just wants to be led…It may enhance communication in the game. It is human nature; male players prefer to lead female players. By concealing his own gender, claiming himself to be a girl, perhaps the two will chat for a while. If both are boys, the chance to chat is relatively small.

Finally, 24% of Chinese participants said that real-life teaming is more complicated/complex than virtual teaming. As one participant explained:

> Group collaboration in reality is more complex than gaming, because sometimes collaboration will lead to some other issues. For example, issues in the group. Whereas in the game, if it is merely a quest. If you do not play together for a long time, this situation will not occur. The group is dismissed after the quest is cleared.

Another Chinese interviewee responded similarly:

> Dragon Nest is, after all, an online virtual activity. Some matters cannot be the same as actual situations in real life. Group collaboration in real life—offline—is

more complete, more complex, and bigger in size, as compared to group collaboration in Dragon Nest.

Emergent Themes

One emergent theme was the automatization of the team self-assembly process. Of the 26 American participants, 57.69% mentioned that they have the option of teaming up with entirely random groups of people, and/or can fill empty slots on their self-assembled teams with random players. Of the 25 Chinese participants, 24% mentioned playing with random teammates. Another 26.92% of the American sample said that their game enforces some sort of level homophily; in other words, players are only allowed to play with/against similarly skilled others.

A second theme that emerged was the importance of having fun; 23.08% of the American sample explicitly mentioned that they online play online games for the joy of it, and 52% of Chinese interviewees said that they play for reasons of fun and/or friendship. Furthermore, when asked to describe positive and negative experiences of real-life teams, a few interesting patterns emerged in terms of interviewees' responses. As seen in Figures 62 and 70, American and Chinese respondents recalled positive examples of self-assembled and staffed teams more often than negative examples, while the opposite was true for recollections of randomly assigned teams. Similarly, as seen in Figures 63 and 71, American and Chinese respondents recalled positive examples of athletics, military, and non-athletic extracurricular teams more often than negative examples, while the opposite was true for recollections of class project teams.

Summary

In terms of absolute attraction mechanisms, both American and Chinese participants saw themselves as forming in-game teams with experienced/skillful, agreeable, and communicative gamers. Chinese participants also reported factoring in leadership/teamwork skills and honesty/sincerity. Similarly, both American and Chinese participants saw themselves as choosing real-world teammates based on conscientiousness, agreeableness, and ability to communicate. Additionally, Chinese participants frequently cited general ability levels, leadership/followership skills, modesty, and flexibility as being important to consider when choosing real-life teammates.

The two samples of participants also reported using relative attraction mechanisms in similar ways. When discussing in-game teammate selection, both groups indicated the importance of heterogeneity (functional, gaming style) as well as homogeneity (capability, agreeableness, guild membership, goals). Moreover, Chinese participants noted their perceived importance of personality homophily, both in choosing in-game and real-world teammates.

In terms of relational attraction mechanisms, the groups were unanimous about the importance of playing with familiar others. Specifically, the participants indicated forming in-game teams with real-world friends as well as virtual friends. Chinese participants also mentioned forming in-game teams based on relational reciprocity. Furthermore, Americans tended to emphasize the importance of real-world familiarity when selecting teammates in the real world.

Table 24

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Task-Relevant Characteristics (In-Game Teaming)	
One person will start something called a free company, or just a group…And if he sees another player that he thinks is experienced, or thinks he could be an asset, and then he sends them an invite to join the party.	I previously formed a group to explore a nest. First, we needed to find people who listen to instruction, do as they're told. He should not be running around and playing randomly. This person must also communicate with you; for example, if there is an unexpected situation, immediate communication is a must. He must pour his thoughts out. Secondly, we will view at level, equipment, skill, and those subsidiary elements.
He knows how to play the game; that is the main priority. Because there's no purpose, there's no point, in inviting some people who doesn't know anything about the game. We invite friends based on their skills, based on their familiarity with the games.	It mainly depends on my level of communication with my group, and whether the others are coordinating and listening to instruction, and it also depends on the ability of the members, too. For example, to open up new quest, you need to have skillful people with good equipment to form a group. Even if a person follows instructions, if he can't play well it is pointless.
Some people, they are genius at the game, so they have earned their pride and that's why they got high status, and people recognize this.	I will find some elite members with better equipment. If he is an [advanced player], I am definitely more willing to play with him; his personality does not matter.
I only team up with better players than I am, so I can take advantage of that situation.	If you play really well, I would like to play with you.
Obviously, if a level 10 applies—"Hey, no. I'm sorry." And if I'm feeling like a jerk, I'm like, "Hey, no. Sorry, man. You're not good enough."	This game is a competition—you can't play too badly. If your skill is very lousy…you keep being a drag and that's not fun. Unless you are the wife of so and so, or something, if we play the game together and you keep becoming a drag, definitely everyone will not want to work with you.
Skill and experience, and whether or not they're good in the dungeon.	If the quality of the group is too low, we can't [engage in] combat.

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Task-Relevant Characteristics (In-Game Teaming)	
When forming parties to try to do that, it's—you've got to be top-of-the-line, no messing around. You gotta know what you're doing, you gotta be skilled in everything else, you've gotta have the best items.	I have a classmate who is very professional in game…He can quickly reach the level of second specialization. I have just achieved first specialization. I prefer playing with these high-end players.
If you play the game well, people will tend to send you messages saying, "You're a good player. Can we be friends?"	I don't like playing with noobs; I need to explain things to them slowly, many times.
Better players are highly regarded.	If the fighting ability of our whole group is too weak, I don't think we will be able to attack, so I will quit the group.
I think you look for people with good stats.	It does not matter, as long his level is high enough.
Just if they know the dungeon well and they're good at it.	The core of the group, this person has good leadership skills.
People…have a prerequisite—that's like, you have to be really good at this dungeon, or something. They track your stats, or whatever.	For those who do not qualify, I will directly ask him to quit the group.
When you play games on occasion on your own, or even with a friend, there'll be another person in your party that's good, and you might friend request them, since they're so good.	They are too noob…Whenever they are playing they randomly use their skill and then they die. My fatigue points are wasted, my equipment is also wasted—it is a waste of my time and effort.
We look at people we've played in the past, and if we remember their names then they typically played well enough that we still remember them. And we look at their recent match history, and based on that, we will invite them or not invite them. And then, if they choose to accept, we will go into the game.	The person who creates a group as the leader—he must have experience in attacking and the ability to command, or he has extraordinary skill. As for members, usually it is sufficient to have knowledge or skill.
Sometimes people add you just because you're good or something—like, they think you're good—and then that's up to you if you want to play with them or not.	In Dragon Nest, for many instances, an individual mistake can cause the failure of the entire group. New players are not good at this; they lack questing experience. Their shortcoming will cause the effort of the entire group to go to waste. That is why sometimes I do not want to form groups with them.
If you have a good score then you're—"Oh, do you want to play another game with me?"	Definitely members who listen to command—they should avoid mistakes they should not make.

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Task-Relevant Characteristics (In-Game Teaming)	
They want the best player for each position possible.	Communication and interaction among players is quite important. They can provide a lot of information, which enables us to quickly understand the progress or update of the entire game, and other information.
Most importantly is that they do good.	There are several types of situations where I will choose to collaborate with different people [other than my friends]. For example, if his level is higher, he plays well, he has played for a long time, or he can lead me to play this game better.
If you're good, it's not difficult. But if you're not that good, then nobody wants to play with you.	All new players have not played for long. They are not familiar with a variety of skills, so it causes the speed of completing tasks to become slower. They also do not have much experience, so I do not like playing with new players.
I'm really new to the game, so all the people on my floor who are the most experienced are the ones that I try and team up with, because they know what they're doing.	For example, to quest together—this person has good skills. He plays well. We will add each other as friends, so that we can have long-term collaboration.
Newbies, they don't have any assets to them yet. That sucks for them, which is sad, but they just die quickly. There's not really a point to team up with them.	The precondition for long-term collaboration is you have to play well.
Someone who's good at communicating. That's very important. And also, skill level.	If I think this player is not bad, we will add each other as friends.
It's all based on communication. In order to win the competition, you have to practice often, how to communicate.	The equipment must be good, so that we can lead the group to complete some quests successfully.
People know how to work together and know how to do strategy and things of that nature.	I saw a sorceress; he played quite well. I said, "How do you do this? You are so good. Can you teach me how to play?"

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Social Characteristics (In-Game Teaming)	
I like people who are—I know this sounds cliché but they are playing to have fun.	Whether he swears, if he always swears, or whether he speaks reasonably. Playing the game is about qualities, too—personal qualities are very important. If you pretend to be good, think that the rest are not as good as you, or despise others as you please, this type of person is just annoying. Everyone respects each other—the game is a mutual thing.
I don't really care…as long as I know he's a good guy.	[If he is] scolding others or quarreling and grabbing items, I definitely would not want to play with that kind of person, with bad qualities.
It depends on if they're nice or not. You know what I mean? Those people are mean and I don't like those people.	If the person is very boring, does not say a single word, who cares about him? I feel that it is more meaningful when everyone gets together and chats—not that type of deliberate and pretentious conversation. I prefer to play with that kind of person.
If they're mean, then I don't want to talk to them.	It is all about the feeling, if I like playing with this person. That's to say that if you see a character created by another player, your first impression can be irritation and dislike, or you may like him. This will determine if you want to play with him. A game is all about fun; if you are not happy with it, what's the point of playing?
Communication, not being able to rage easily, because most people get angry over a game. You have to be cool-headed and not take it too seriously, and common sense.	If you are very isolated or you are easily irritated then we can't accept you, but if you are a friendly person it is easy to join. We will not demand you to have any ability.
When you're playing the game, there are people who are very, language-wise, very violent; they swear a lot. And whenever one teammate makes a mistake, they blame them for everything, so I really don't like those kinds of people.	For example, in the game he thinks that everyone in the group is very lousy and that he is really great, and he accuses the group for being a drag—all types of verbal abuse. I will feel very unhappy.

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Social Characteristics (In-Game Teaming)	
This might be the same for all gamers, but I don't really like people who blame other people for losing the games.	There are many people who like swearing while they are playing. Because, I don't really swear. Then, if you are playing a game with your friend, and he is always swearing, then maybe I would stop playing with him, because I think I don't like it.
If people tend to be very annoying—like complaining all the time, or, mainly complaining all the time—then it makes me reconsider.	If the new player is keen to learn and he has a friendly attitude, I will be willing to guide him, share some experience, provide him with help.
Some people are complaining, and they're like, "Oh no, why is this happening? This is so stupid. You're doing so bad." Then that usually brings down the rest of the team. And so everybody starts doing worse, and nobody is enjoying it anymore. And, after all, it's a game. If you're not enjoying it, then you really don't want these complaining people, because they always make it worse.	I think the most important thing is whether he likes to talk, likes to collaborate. If he is someone who likes to interact and cooperate with others, I will collaborate with him—mutual contribution. If his personality is quite boring, monotonous, and he prefers to be alone, I will not force him.
I really like them to work hard at whatever we're doing. I like them to be optimistic overall. It's really, really helpful if people are optimistic.	If you are agreeable when you talk; maybe when you are playing you talk about things in everyday life.
Let's say there will be a guy who is really fun, or he's fun to talk to, then I'll usually friend—the people that I liked from the group, I'll usually friend them and then group up with them later.	First is honesty. The second thing is keep straight to the point and do no conceal information. That's all—I think these two are very important.
How…fun it is to play with them. I guess, maybe, you don't want somebody—you don't want to play with somebody with an annoying voice.	If I haven't played with that person before, some people get very irritated when something happens. This is very unpleasant. I hope he is a more open-minded person.
I prefer people who are polite and not overly serious about if they lose or anything like that.	If there are people in the group who I dislike, I might consider [switching groups].

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Social Characteristics (In-Game Teaming)	
Even though people will swear a lot, it's just in chat, sometimes it makes me uncomfortable. But usually, people who are…more relaxed, more laid back, and the game is to have fun. The game is not their life and that type of thing.	Because I know his personality—whoever makes a mistake, we would not blame each other. For new people, you can't be sure of their personality. There are some who curse in the group. I don't like it. I hate this type.
There are some people who just aren't emotionally mature, I guess you could say. It's like, they rage, they like to do things that are just childish, and you're sitting there wondering. Then of course there are some that are generally nice people, great, and you're just like, okay. Those people you automatically add as a friend. You're just like, "Let's play together," honestly.	First of all, it is his attitude and way of speaking that determines if we can get along.
I find someone that I think, "Hey, he's pretty cool. He has a great attitude."	Some new players are quite rude—mainly, this is the personality [characteristic] of new players. If he is more humble and not rude, I am willing to collaborate with him.
The biggest one is just a good attitude. It has to have that. I don't care if you're a really bad player, as long as you're not raging, you're not trying to—just like calling out everyone, like everything, being an annoying person. As long as you have a good attitude, I don't care how bad you are. I will play with you.	It really won't do. He runs aside, not attacking boss, but starts typing, starts to complain, "What are you doing?" You are in a bad mood and you complain to me, then what kind of interaction is that? If this happens, I will quit the fight, I will just ignore him, or let them kill each other—I am too lazy to care.
Task-Relevant Characteristics (Real-World Teaming)	
People who are motivated as well…if you're into it, and want to do a good job on it, then I generally work well with those types of people.	First in a group, you must work with an active attitude, active in doing things. On top of being active, the quality of your completed task must be good. You must be willing to do it and do it well. This is definitely the most important thing.
They're not planned, they're not organized; they're really smart and really gifted, and they do stuff and they expect people to know the same thing. I don't like working with those kinds of people.	People who are not willing to complete their own task, or do not listen to command. They are not doing things for the group, but for their personal benefit. They are more selfish. I am not willing to work with them.

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Task-Relevant Characteristics (Real-World Teaming)	
Maybe someone's not pulling their own weight, or someone's not doing the job that's fulfilled to them**.**	The leader is important. The leader needs to care about others, make everyone feel recognized.
I don't like working with lazy people.	Those with a more serious working attitude; if you have some matters and you look for him, he can do it well.
I work well with people who get stuff done, basically.	Those who push responsibility away.
Anyone who's slow or just can't get to meetings on time.	There are some people who make promises, yet they keep procrastinating. This is difficult to get along with.
Anybody who is willing to pull their weight.	The most important thing is to have a sense of responsibility. Since you want to join the team you definitely have to do it. You can't quit halfway.
People that are not very hardworking, people that like to throw the work to his or her teammates.	Those who are unwilling to communicate and arrogant.
Some people who is not too showing off and who has some self-esteem, and absolutely highly skilled and have good knowledge at that field.	He can arrange everything well, or depending on who is good at doing what, some people have strong leadership abilities—I am willing to work with him.
I don't like to work with people who are inept about the subject and that don't have a passion for it, to get the project done. I like people who know their things, think differently, and think outside the box so we can all work together.	Those who only comment but do not provide suggestions, those who procrastinate, and inefficient person—I don't really like those.
Quick people, people who are flexible and aren't afraid to exchange ideas back and forth, because I think the best ideas come from having a lot of fluency and flexibility, things like that.	Does not talk, does not know how to do work, even if he works he can't do it well, and doesn't have high expectations.
My biggest frustration is when people aren't…the same speed as me**.**	Those who are willing to contribute, willing to work hard. Those who can put in their best effort to achieve this goal
The people that I find difficult to work with are the people who aren't really good at communicating**.**	Those who are greedy for personal interest and do not care about the group.
People who don't value communication.	Those who are able to complete their own tasks and still help others.

Table 24 (continued)

Selected Quotations about Absolute Attraction Mechanisms

American Sample	Chinese Sample
Task-Relevant Characteristics (Real-World Teaming)	
I like people who are open minded, who offer ideas, or bring ideas to the table, and basically aren't against receiving ideas as well. People who are manageable to work with, as far as, reasonable, give and take, compromise.	I prefer people with ability, higher efficiency to complete task, and better personality.
People who are over controlling or micromanaging. I really don't like being micromanaged.	He doesn't do his own part well, always submits it late, the thing he submits is very casual—I don't like to work with such people. I always prefer working with people who do it well.
Social Characteristics (Real-World Teaming)	
It doesn't really matter, as long as they're nice.	Those who are more humorous, more enthusiastic.
Happy people.	Someone who is more polite, and people with stronger team spirit.
People who are considerate, because hard working, intelligent—those things you can work with and work around, but when there's people who aren't considerate or flexible then that's where everything stops.	Friendly attitude, humble, eager to learn, or willing to point out my faults. That's all, basically.
Anybody who isn't polite. Anybody who really is bossy or not fun to work with.	Those who are more sensible, reasonable. A person who is more loyal yet flexible; he should not be too rigid.

Table 25

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Heterophily (In-Game Teaming)	
You need a medic, you need some kind of engineer, and you need some kind of…dealer, and certain offenses.	If I want to form group, I prefer people who are different. Some people like to run at the frontier. I will find him to play together.
It would happen in the sense that I would get on (and say if I was playing my priest, which is a healer) and the people would pass and say, "Hey, man, we need a healer to come do this dungeon. Come on."	Yesterday, when I was practicing…some missions brought me to low-level villages. I bumped into a player of level 4 or 5 who was shouting, "Anybody here? Anybody to play together?" I then answered and asked, "Are you a girl or a boy?" She is a girl, so we started chatting there, and I led her through challenges.
You're supposed to get a team that has a bit of everyone.	I prefer that they have different roles from mine, so that our equipment can complement each other.
I think it's…a damage dealer, a tank, a fueler; so, I think it's more like diversity.	Fighting skills—knowledge of the game is different.
You get people from all sorts.	If everyone rushes for the position of archer, and nobody chooses assassin, the efficiency of the group definitely will not be very high.
You need a good team composition. You need both damage, someone to take the damage, and a healer—stuff like that, so you want to make a team for that.	I don't want others to have too similar of qualities; I hope there are differences.
You need to have a set structure where you have two people who will do damage modes, and then one person is healing, and one person who can take the most damage and try and get the things to attack them so they don't kill the other people. And if you don't fit that mold, then it's very difficult to complete those tasks because each one is a very distinct sort of role in the group.	I prefer to play with players of opposite sex. For example, when a girl is looking for mentor or a mentor is looking for an apprentice, a guy mentor seeking a girl apprentice or a girl mentor looking for a guy apprentice—this is a type of mutual attraction. When a boy is playing a game he likes to have a girl playing along. When he is achieving good results, the girl by his side will compliment, "You're real good." A girl will definitely like to play with a boy, because boys can usually play better than girls. If a boy is leading, it is easier to clear a level.

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Heterophily (In-Game Teaming)	
I want people that are slightly more aggressive than me. I will play a more cautious game. I'll definitely be offensive when I need to be, but I won't be the one that pushes all the time. I'll play a more strategic game. And I need someone that will go head first in, and I don't know, be that sacrificial lamb.	I am sometimes over cautious. During this time, I need someone with decision-making ability—a confident person to tell me that I should not tolerate too much. Although he and I are two totally different people, our personalities complement each other; it can make up for my shortcomings, for better performance.
Some of my friends…spend a lot of time thinking about it—trying to optimize what skills each person has and how to put them together in the best way.	I think I prefer interacting with people who complement me. I may be better in one aspect and do not do that well in others. During this time, I need someone to tell me how to improve. His personality, ability, and features complement with mine, and we improve each other.
People develop their own personal strategy pretty quickly, and it's really easy to get stuck in that strategy and not think about approaching it from a different way. Seeing how other people go through their process is really enlightening sometimes.	When I do things over a long period of time I am quite lazy, because normally when we have extra-repetitive tasks I am very lazy to play. This will cause the number of people who are online to decrease; our guild appears to be deserted. There are some who are quite hardworking. They will go online every day to settle the repeating tasks. This is pretty good.
You need one of each role.	I am not good at commanding, and so on. I hope others have leadership skills to command.
You need to have a few people that are in tanks, a few people that are in heals, and then the vast majority of the other people are doing damage.	Sometimes I am quite lazy. If he is an impatient person, he can always hurry me or remind me to work harder.
It's fun to find people who aren't necessarily like me in that sense, because it's fun to have a new perspective and to do new stuff.	Sometimes when we want to attack, we will specifically form a group with…variety of roles.
If I'm mid-lane, I don't want four other mid-laners, because only one person can go in that lane. That doesn't really benefit the team at all. Only one person can play at that point.	Many people are playing the game…It is this variety of elements that makes the game rich and colorful.

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Heterophily (In-Game Teaming)	
If I have someone who has the same exact characteristics that I do in this exact same task and all that, then—it is occasionally beneficial, but it gets boring.	The group…needs different roles. For example: output, nanny, defense. Everyone needs to practice his own skill well. Then [the team] will be united.
I don't want a team of all hunters or something, because then you'll have the same powers…I definitely, in a game like Destiny, want to look for diversity in a fire team.	Sometimes I am quite lazy, because I have other things or I am really lazy. As for the more difficult quests I have less ideas on how to clear it. During this time perhaps I hope that there is someone who is very enthusiastic about the game. He is aggressive when we are playing together. He will come up with a plan.
Homophily (In-Game Teaming)	
There are some interactions in dungeons between new players and more experienced players, but usually you end up playing a dungeon with people who are around the same level as you.	Of course I prefer people with similar personalities…Sincere and honest, more honest towards others.
My cousin and myself—we are really good players. Two of my friends are really good players. So, when the four, five, or six of us get together, we tend to form a pretty good team.	It is difficult to find someone who is like-minded, has good qualities, and likable characteristics. I definitely would like to find someone with similar qualities.
You can search for other people that are looking for the same goals as you.	Our ages are similar. We have common topics to talk about, and when we play together it is less boring.
I prefer similar—similar as I can tell from what they're saying. Their personality.	I usually find people in the guild to play with. I hardly find others outside, so it is always the same people.
If everyone's sharing the same objective, which is to get the thing done, then there's not an issue.	Since I started playing, we formed a group to complete missions, sought apprenticeship, and joined a guild. Once we were in a guild, everyone entered the nest together.
If you guys are all at different levels, it's a little bit more difficult.	I want to quest seriously, not bring you to play randomly. I will go with people of a similar level [to myself].

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Homophily (In-Game Teaming)	
If you're a high-level—let's say you're the highest level—it's difficult to pair up with those lower levels, because there's such a big content gap between the two that you don't end up doing the same sort of dungeons at all, because you have different level characters.	First of all, everyone wants to play the same challenge. You will coordinate the choice for level of difficulty. Then you have to see if the people you want to form a group with are willing to team up with you. If the difference between levels is too much, they will not form a group with you.
If you notice that someone might be doing the same mission as you…there are times when you can approach them and that expedites things.	The first common quality is to be honest… Secondly is to have more topics in common to talk about.
We advertised on group chat and we got people to ask their friends, "Would anyone be interested in killing this boss?"	First is age. If we are both students, then we will have more topics—interest will be similar. Therefore, we will have more communication.
I prefer people that are similar to me, in the sense that they're willing to work with the team. When I play a game, I'm generally more relaxed while I'm playing…I'm not one of those high-stress people that are yelling at one another. And I don't really work well when people are yelling at each other instead of focusing on the game and trying to reach an objective with the team.	To have a common strategic goal.
That's why I usually play with my friends—because they're more similar to me than playing with some guy from somewhere in the world that I really don't know.	This is usually in a guild, after you are familiar. You get to know a lot of people. Everyone is in the habit of attacking…a nest or something. Everyone will not leave the guild.
If I'm just starting out I don't care, but if I am good then I definitely want people either on my level or higher.	If I interact with similar people, it is because our personalities are matching.
I don't really like to type in games, so I like people who are quiet playing games.	If everyone comes to form a group for a common goal, the game can be played better, and the fun will also increase greatly.
People being similar to me is always easier to deal with.	A common interest or hobby.

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Homophily (In-Game Teaming)	
It's like sometimes, I like finding people who are like me because I have times when…I want to get into the dungeon, and I want to clear it as fast as possible.	Those with similar personalities. I will communicate more with those I can get along with.
You can see that guy is 20 levels ahead of me. He's going to be on a whole different mission, and I don't want to bother him.	Those with the same characteristics as you. I think it's how like-minded friends can stay close with each other.
Someone who's right below me but not too far because that would take forever.	If you join a guild, you can get to know more people, it is convenient to form group, and it is more convenient to find the partners you want.
Similar in the way like they're more relaxed.	Everyone must have similar skills; you should not have an [expert player] and then also a noob [on the same team].
New people would be mainly from similar interests, like quests.	The common quality is being considerate to others; do not merely think of your own self.
Similar is good in terms of attitude and approach to the game. So some people play really, really competitively, and I really can't deal with that. Because when people get really competitive, they get really mean and ugly honestly on the inside. So that part I don't like. But different in terms of strategy and their approach to everything, that's okay. It's just attitude needs to be similar.	There must be a common goal. Everyone will work hard towards this goal, and everyone must have the ability to accomplish this goal. Everyone must be united and be able to cooperate and work together. Only then a good team can be formed.
Heterophily (Real-World Teaming)	
At first it was very difficult to work with them—trying to mesh all of our ideas together. We each had a different way to go about things, but we stuck with it and worked through it, and at the end I think we created something that I never could've done myself.	—
I'm more like a leader, not a follower—so, people who will listen to me.	

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Heterophily (Real-World Teaming)	
There really is such a diverse collaboration that I really—it was really the first time—you know, I collaborated with plenty of people on group projects for school work, but this was the first time that I really felt, like, wow. This is, not only is it fun, but it's so diverse, and it's complicated (but in a good way) because you really get to meet so many different people you work with, so many people—kind of get a taste for what they're doing when you have to talk to them and coordinate with them.	—
I work well with people who are different than I am. So I'm very much the "let's all get along and how can we distribute this" person. I can't work on a team with five other of those because then we're all Kumbaya-ing and don't get anything done. Yeah, so, someone who's a big picture person and someone who's the small details. I'm keeping everyone together. Just a large collaboration of different people.	—
Homophily (Real-World Teaming)	
I like people who are open-minded, because I myself am open-minded.	People of the same age—schoolmates. Schoolmates with similar personalities.
I would say people who are similar to myself. Maybe not even similar to myself, but people who maybe have a similar background to me.	Those with similar personalities… Our abilities complement each other. We can learn from each other. The main thing is personality… Personalities of the two must be similar. In terms of ability we can learn from each other.
The team formed since a lot of us have similar interests.	Those who share similar opinions as me.
I do like working in teams, but I feel like if I'm working in a team, I have to have the same thinking process as them. I should have the same—not the same ideas, but be more accepting.	The main thing is you and him have a common goal. As long as the goal is similar, the direction of working will be the same. Then you may collaborate better with others, you will communicate your own thoughts and exchange your ideas. Secondly, everyone must put in effort.

Table 25 (continued)

Selected Quotations about Relative Attraction Mechanisms

American Sample	Chinese Sample
Homophily (Real-World Teaming)	
People…who are the same age as me and the same academic level as me.	The main thing is that we are the same type of person and we have many topics in common. When we are playing our roles we have a lot of common topics and we feel friendly.
I work well with people who have same ideas with me. For example, if I wanted to build something, and there are a lot of ways to build a product, and I like people who think about the same thing.	Messy mindset, different views from mine, we have clash in terms of principles, and those with very different habits—these make me feel uncomfortable.
If you have different ideas on how to approach the same problem you might have a lot of conflict.	Of course I prefer those with matching personalities. Someone who is more fun, and can get along well.

Table 26

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (In-Game Teaming)	
I introduced a couple of my friends to the game.	I led my classmates to play Dragon Nest.
I then started playing with some people that I already knew outside of the game.	It was my friends in everyday life who introduced me to playing Dragon Nest.
It's easier to do it with my friends that I introduce to the game. Since we know each other outside of the game, we can collaborate and decide when we are going to play. And that is easier…hooking up with them and going in the dungeons as opposed to trying to get in touch with someone that you can only contact through the game.	I play Dragon Nest with many of my friends. Previously we were from the same high school, so we often have offline activities.
He was my very close friend to me, so I already knew him before I played the game.	I prefer partnering with someone I am familiar with.
My team, we all really love the game and every time, every Saturday night, we hang together and guys play with them; it's a normal, like a frequent activity every week.	[My friend and I] become quite close, then I asked if he plays Dragon Nest.
When I work with teams online, basically we talk about the games; we focus on how to deal with this situation, basically everything about this game. When the whole group is off the game, we are off the game and we go out and we hang out for normal life event, for normal life social activities. We talk about something else because we are already close friends to each other, so there are a lot of topics outside the games that we can talk about.	We arrange with friends to open a YY voice chat. Then we enter together to play. It's the same area—everyone can enter the same area and play together…many friends.
My roommate actually has been—he's played for a lot longer so he helped me a couple months back	Because my friends are more powerful, they will lead me to play. Then we complete missions, upgrade level, do tasks together.
Four of my friends and I used to play. We would talk about it in school.	Usually it is setup by my friends, by inviting a few people to join.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (In-Game Teaming)	
My cousin and I were sitting online, on his computer. Then, we bumped across this game called Runescape. So, we made an account on it.	Usually in college life there is homework. Sometimes during weekends—or when I have nothing to do—I will play with my course mates. It is considered spending leisure time.
A friend of mine actually introduced me to DotA 2. He said, "Make an account. I'm going to help you get better at it. Then, we'll play together as a team."	I play together with my classmates.
I usually only interact with…the guys who got me into the game, and I'm not much of a gamer, actually. But, it's like, they wanted me to play and they're like, "Oh, this is a great game," so I was like, "Alright."	With my own friends; I hardly form [teams] with others.
My other friend, he got me into the game…sometimes he's like, "Oh, do you want to play?" And I'll get on and play.	I promised my friends to play together, so we formed a team together.
My offline friend, I dungeon with him all the time.	Most of the time it is classmates, because I don't play that frequently; I only play once in a while. It's [preferable] to form a team with people I know.
When I started playing it, I didn't really know that many people that played it…Eventually you meet those people and you're like, "Okay, yeah, let's meet up. Let's try it out." Then it's a lot easier because you can talk to them via chat, or if you're in the same room, you can talk to them like that.	I play together with the people in the dormitory. There are four of us who play together. Four of us fight together.
Typically I play with my friends and my siblings.	Usually I collaborate with people I know.
If someone does really bad on their team, if it's a friend, typically I'm playing just for the fun of it, so I won't get rid of them, wouldn't you think, because I know them.	Last time when I was playing, there were high school friends. Now, because I am in college, I play with my roommates.
With my brother, typically we get on, and if we want to play with people we know, we have a friend list.	I play together with my classmates; I interact with them.
Most of the time, it's me and my friends—like the people I already know. We'll go online and then we play the game.	The frequency of interaction with classmates I know is higher. I do not interact with players who are strangers.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (In-Game Teaming)	
My boyfriend at the time got me into Halo and so it started. I would go over there and play, and he has some roommates that he lives with, so it would be my boyfriend and I on a team and his roommates.	When we have a few schoolmates playing together, we will choose to form group; we complete tasks together.
In both games I started playing because my friends were playing, so they helped me start off, and then you branch out on your own.	My classmates and I realized the game is not bad. We played together.
Some of them were my friends; like, they're, "Oh, play this game," and I was like "Oh, I'll try it."	I just replayed this game with other classmates a few days ago. They usually form a group with people they know. Among our classmates…this is our interdependence and trust.
I and my friends decided to make a team.	I personally do not like forming a group with strangers. I always form group with classmates I know.
When I made my team, we were at lunch at school, and then we were [like], "Why don't we try this?" They were like, "All right, let's do it," and we did.	I play the game to enhance interactions with my classmates, to strengthen friendships.
Usually, someone calls me like, "You wanna play with me?" Then, I play with them.	I always form groups with my schoolmates.
There is a group of friends that I usually play with.	My junior high schoolmates. I used to ask my junior high schoolmates to try playing. During that time I played together with them. After a while they got bored and stopped playing.
A lot of times, I'll play with my friends that I know in real life.	First is whether I know these people in real life. If I do not know them, perhaps after playing I will quit the group.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (In-Game Teaming)	
I and my two friends wanted to do a raid. And so we decided we're going to do this raid on Friday night. And so we got on and saw if any of our usual friends were on that we don't know in real life but we knew in the game. And so we invited them. And they said, "Yes, good." And that's two or three people less we had to find. And for the rest of the people we had to find, just sit in a city and keep saying, over and over, "Looking for three people to do a specific thing," until you get the people.	I prefer interacting with offline acquaintances, because it is more convenient to communicate… Everyone is more familiar with each other, very familiar. After all, people online are more like strangers.
There are times when I care more about playing with my friends than actually doing really, really well. Because I know if I'm playing with my friends, we can communicate.	We were previously schoolmates—basically during junior high school a group of schoolmates were playing Dragon Nest together. We will interact, discuss the feelings of playing the game, and so on.
In League of Legends, one of the people that got me into the game was one of my good buddies, and he helped me out a lot.	I prefer playing with people I know; the coordination is better.
Whenever my offline friends are online, I play some games with them.	The person who invited me is my schoolmate—is someone I know in real life.
A lot of it are people who have friends from other games that they played, and they all transferred to the same game.	I play together with my classmates.
I prefer to stay with my friends if I could.	I hope to play with people I know in real life. If I am playing alone it is quite boring.
It's all my friends basically, they're all at Georgia Tech, and they all actually got me interested in the game.	My classmates and I—or, good friends—play together.
So for that one, I do create my own teams, and I get friends together—"Hey, let's go do this."	Last time it was a friend who led me to play this game. I mainly communicate with him.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (In-Game Teaming)	
When I first started League of Legends—any time you start a game, honestly, when I start a game, it's usually because my friend told me, "This is really fun. You should try it." And I'm like, "Okay," and then we play together for a while. They teach me, and I'm like, "Okay," and then I get better at it, and then so it goes.	First there must be someone you know in real life. You can't have all people you meet in the game. It is best to have your best friends in real life to help you and to assist you. Moreover, it should be someone you are close with; the core members of the group should be someone you know in real life
In-Game Familiarity (In-Game Teaming)	
You send them a friend request, like, "Hey, I would like to play with you again." Then, when you or the other person log on, you can do things together and it will make it easier to build off each other.	Usually when I am online I will take a look at friends, mentors, and guilds to see if there are people I recognize or I am familiar with. If there is anyone, I will check the missions I am completing at the moment…[and] then I will ask them to go together.
We would collaborate for a quest and that was it, but I would add them to my friends list. Then, once in a while, you could sort of send them a message if they were online. They would receive the message and you could chat about what you were doing.	When we are questing we need to form a group. When we play together we get along well, so we add each other as friends… If next time I am online, and both of us are online, we will quest together.
I have met people online and become friends with them.	I will ask friends I met in the game to play together.
Then you keep playing and building relationships—well, not a relationship, but it's bonding—and you get to know the person really well in terms of the game. Then sometimes, you become friends in real life too, which is interesting, as well.	I passed by somewhere and saw someone with an interesting ID, so I added him as a friend. We chatted for a while. If he is not bad, we can still play together in the future—that's how it goes.
Some strangers are more chattier than others, and some of them are chatty and have personalities that I like. So I would end up talking to them for longer than other people that are not chatty or they're annoying. And then you do the thing you're doing with them.	If there is vacancy for a role I will take it. After playing for some time, if we feel it is not bad, then whenever they form a group they will ask me to join. After playing several times we get to know each other.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
In-Game Familiarity (In-Game Teaming)	
You get to be friends with them from playing with them for a long time. It ends up to the point that I've Skyped with people I've talked to.	If you think that you enjoy chatting with a person or you guys log on to YY and open a voice mail for chat, it feels friendly. This makes thorough understanding an easy thing; it depends on the extent you would like to understand [one another].
As we go and we meet more people, we'll party up with them and continue to play with those people.	Group formation is very simple in Dragon Nest. As long as you create a group, there will be a notification—other players can see it. One thing you can do is to invite people; by doing so I will definitely form a group with friends I know.
People are generally really cool. They're just—you wave at somebody, and you're like, "Hey, do you want to help me with this mission I'm going to do?" And they're like, "Yeah, sure."	You don't know a person, but you know each other due to the game. Then, after playing, you build a friendship and mutual understanding. There will be some communication and understanding.
I'll introduce myself, but I don't like, "Hey, do you want to exchange numbers?" or anything—not usually. But we can refer to each other while we're fighting or whatever.	There are some who I know through playing the game. Then, we add each other as friends. When we are offline we chat on QQ.
If you see somebody, you can actually wave to them by pressing a direction on the D-pad. And if they wave back, then you open up a line of communication. And you can be like, "Hey, join me on this fire team."	We form a group to attack. After attacking for a long time we add each other as good friends. When he is online I will invite him to play along.
We do a quest together. We chat while we're doing it. Then, we do more quests together and things like that nature.	I usually work with a particular person. After some time we are familiar with each other; I am used to working with him…If that person is not online then I will find some strangers. As we play, we add each other as friends, and become closer—that is possible too. I end up having more friends and it is easier to look for [someone to play with].

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
In-Game Familiarity (In-Game Teaming)	
It's cool, meeting new people online. I mean, you don't really know them, but you get a gist of them.	We have to know each other better and determine, initially, if it feels all right. In short, if at an initial stage you mingle around and feel that this person is quite friendly, you then add him as a good friend. But, if you want to have in-depth understanding, you should be more than just good friends in game. You may have to exchange QQ and chat.
I'm definitely more comfortable with friends that you know. And then you can just ask them or call them up and be like, "Oh, do you want to play a game right now?" And that's comfortable.	Sometimes, if I want to play with him on a long-term basis, I will add him on QQ.
When you queue up and you find random people that you like to play with, you might add them as a friend and then keep playing, basically.	For example, if I want to fight a Monster and I can't find anyone at the moment, sometimes perhaps he sends requests to form group with me, or I send a request to form group with him. After we play once or twice we are familiar, so we add each other on QQ.
I met some person who was like, "Do you want to join my guild?" after we went through a few quests.	It is possible to become friends or develop a closer relationship.
Reciprocity/Transitivity (In-Game Teaming)	
If they accept you back, you will play a game with them afterwards, and if it goes well, typically you interact with them more and play more matches with them.	Sometimes my friends will ask some other people to join. They will tell me in advance that they're bringing a few people in.
I was playing with some of my brother's friends, so I met them first through that.	When I am playing a game I usually play with my roommates or friends—those I know—or meet friends of friends.

Table 26 (continued)

Selected Quotations about Relational Attraction Mechanisms

American Sample	Chinese Sample
Real-World Familiarity (Real-World Teaming)	
I think it started off with a couple of us being in Physics I together, and then, when we went to register for new classes, you'd say, "Hey, are you taking this class?" He's like, "Yeah, I am taking it." "Oh, who are you taking? I'm taking the same person, the same subject." And then either that person will meet someone who they think is pretty cool, or who would be cool to work with, or I'll meet someone, and then we'll invite them to do homework with us. And then each person at random times may run into someone they think would be nice to work with and they invite them to come and do homework with us.	Everyone often hung out together. Then we trusted each other. We had some agreeable conversation. We then formed a group, and we invited in those who are close. Then the relationships became closer.
Most of my teammates are from my classes and from my labs, from my work place.	We are good friends, are all schoolmates. Our relationship is very good. We are all good friends.
My teammates were already my friends.	I prefer being with people I am familiar with.
Some of them were friends and some of them were not, but I knew most of them since our school wasn't really big.	If everyone is not familiar with each other, if when we are together we don't talk—I hate this kind of group.
Reciprocity/Transitivity (Real-World Teaming)	
If they need help then, and we know someone that might be able to help them, we'll invite them, and they'll help. Because of course, there is that old saying and proverb, "You never know when someone will be able to help you, depending on the situation you end up with."	When our departments have dinner gatherings, we go out and get to know each other…I follow a friend out, and he brings someone else who he knows. We go out together, and then we get to know each other.

Table 27

Selected Quotations about Situational Attraction Mechanisms

American Sample	Chinese Sample
Geographic Proximity (In-Game Teaming)	
My cousin plays Call of Duty online, too. He's actually made a few friends online that are actually in his city. He's actually met them.	Usually it is roommates—I am more connected with those in the dormitory.
You sometimes play in the same room with a group of friends, and it's typically more efficient to be able to yell out a command or talk to them while you're playing, so they know what's going on with you and what's happening with them.	I play Dragon Nest with my newly met roommates in college. We can communicate offline on how to attack instance. Then we go online to play the game.
I've even met a couple of people in real life because we were playing together, and then we found out that we lived really close to each other, in the same town.	During college I also invite my roommates to play with me.
My friend actually met up—found out that one of the guys lives really close to his dad's scuba diving shop.	[The president of my guild and I] have occasionally met, once or twice. He had treated people from nearby cities for dinner. Everyone become very good friends—a friend circle with him as the core was formed.
If I go up to visit my dad in Connecticut, and I found out that one of the gamers that I game with is in Connecticut, then I'd meet up with them if I wanted to.	—
I have a really good friend now; his name is Mark…I played with him a lot on the game, and then we met in person.	—
In League of Legends I only play with people on my floor, at my dorm.	—

Table 27 (continued)

Selected Quotations about Situational Attraction Mechanisms

American Sample	Chinese Sample
Geographic Dispersion (In-Game Teaming)	
He basically told me, "You should try out this game, Terra," because he goes to Florida Institute of Technology, and…he doesn't have anybody to play the games with that he knows. He always invites me to play the games with him.	Because, as a game, it definitely spreads around different regions. People of different regions are communicating together—they may develop into online friends.
In Clash of Clans I actually am in this clan that was people from—exclusively from Singapore.	People in our guild are scattered in various cities all over the country, so there is less opportunity to meet.
Temporal Proximity (In-Game Teaming)	
I mean, that has a lot of variables: time of day, day of the week, and what game you're playing, how popular is it, and what server.	Because I play the game in college, I hardly play alone; I always have appointments with classmates to play.
Geographic Dispersion (Real-World Teaming)	
Not necessarily local either, because there's some guy coming from Tennessee. It's people interested in the sport who wanted to play it.	—
Temporal Proximity (Real-World Teaming)	
I guess schedules conflicting, so it's not as easy to—when I want to work or something I can work any time, but in a team I don't like having to be dependent on the people.	The free time available, this is important too. Because usually when you are assigning tasks and you choose a time where everyone is not available to complete the task, this makes everyone busy. This is not really good.

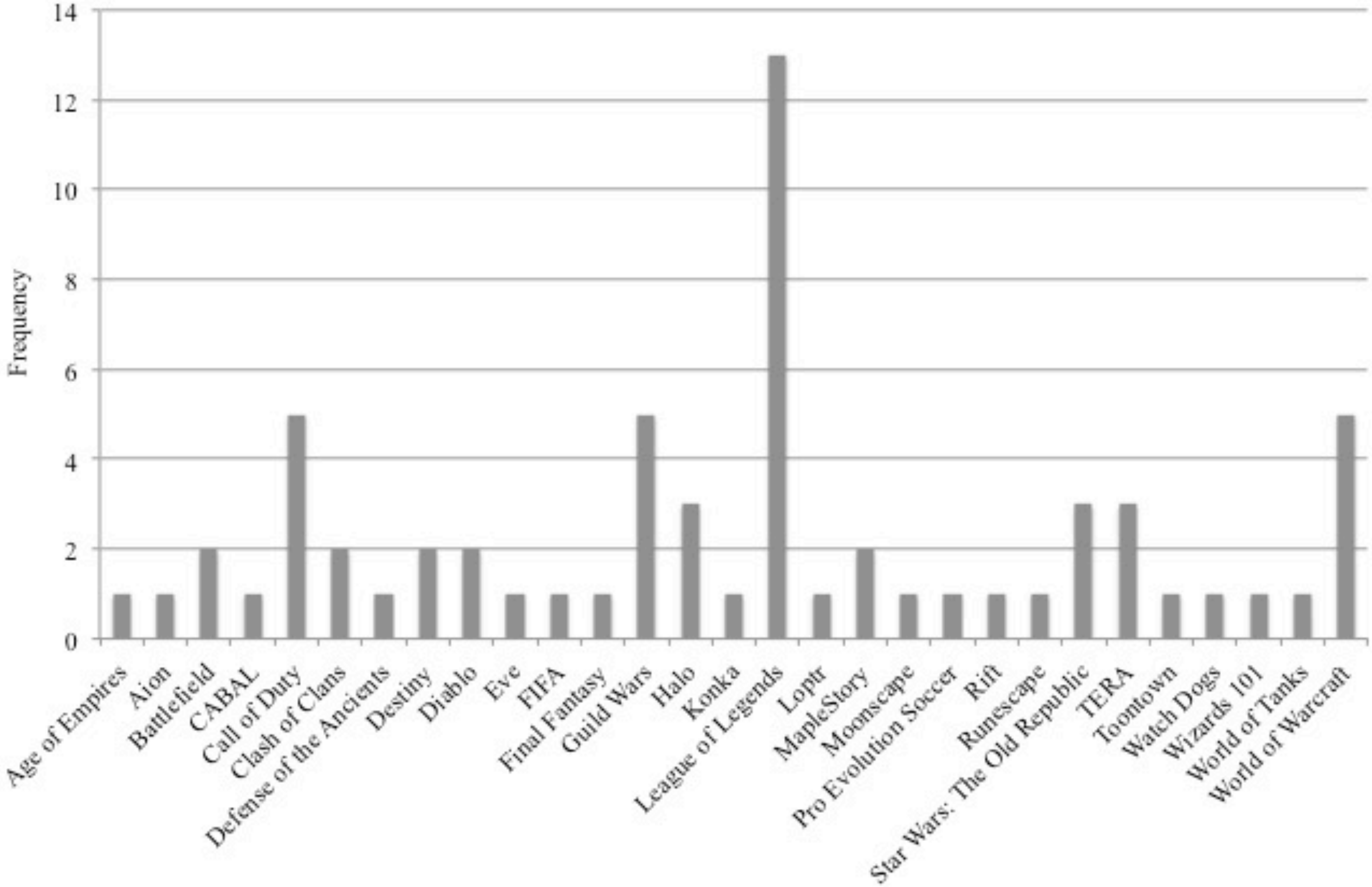

Figure 56. Frequency distribution of team-based online games played by the American sample. (*n* = number of individuals = 26)

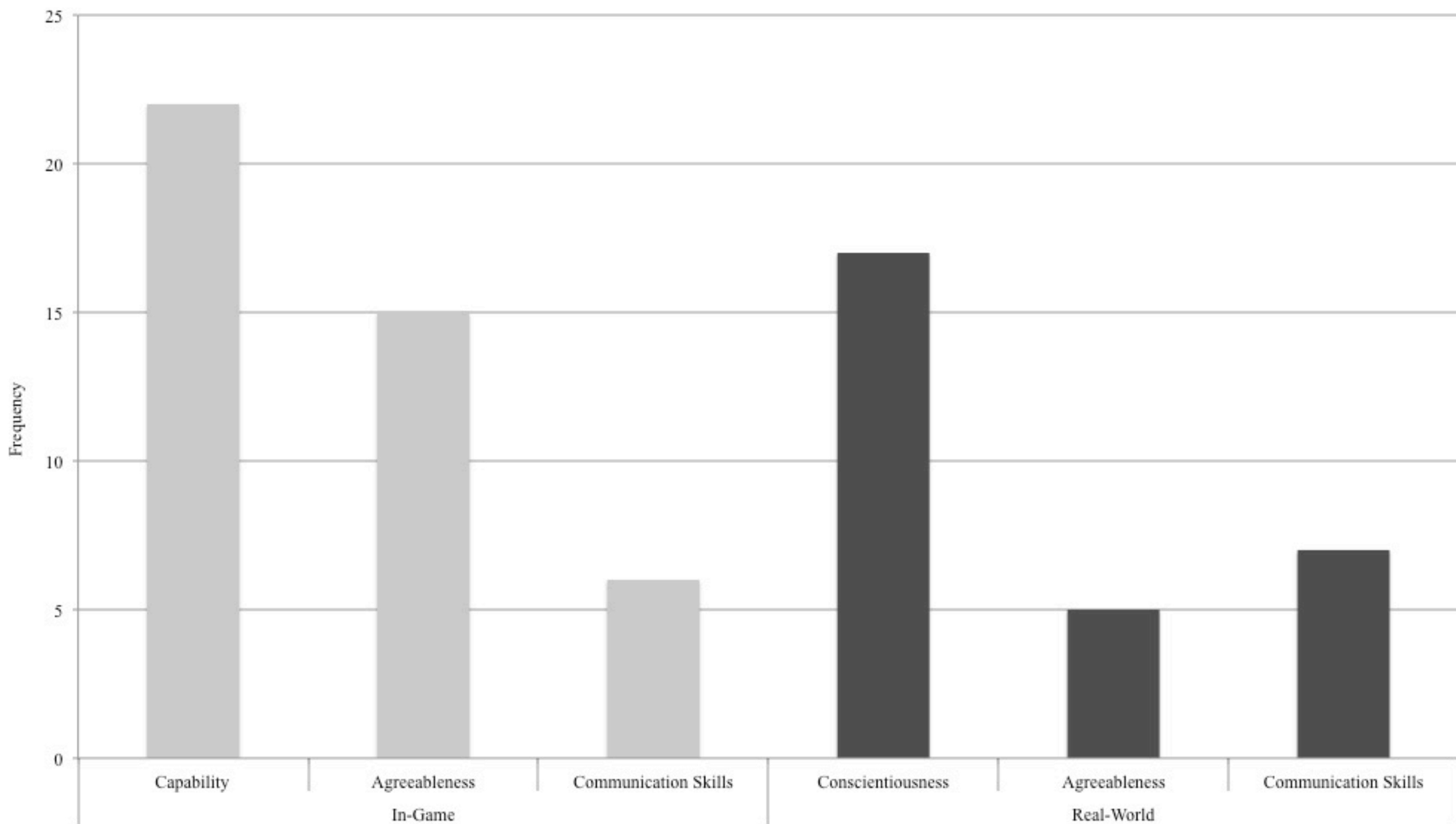

Figure 57. Frequency distribution of reported use of absolute attraction mechanisms for the American sample. (*n* = number of individuals = 26)

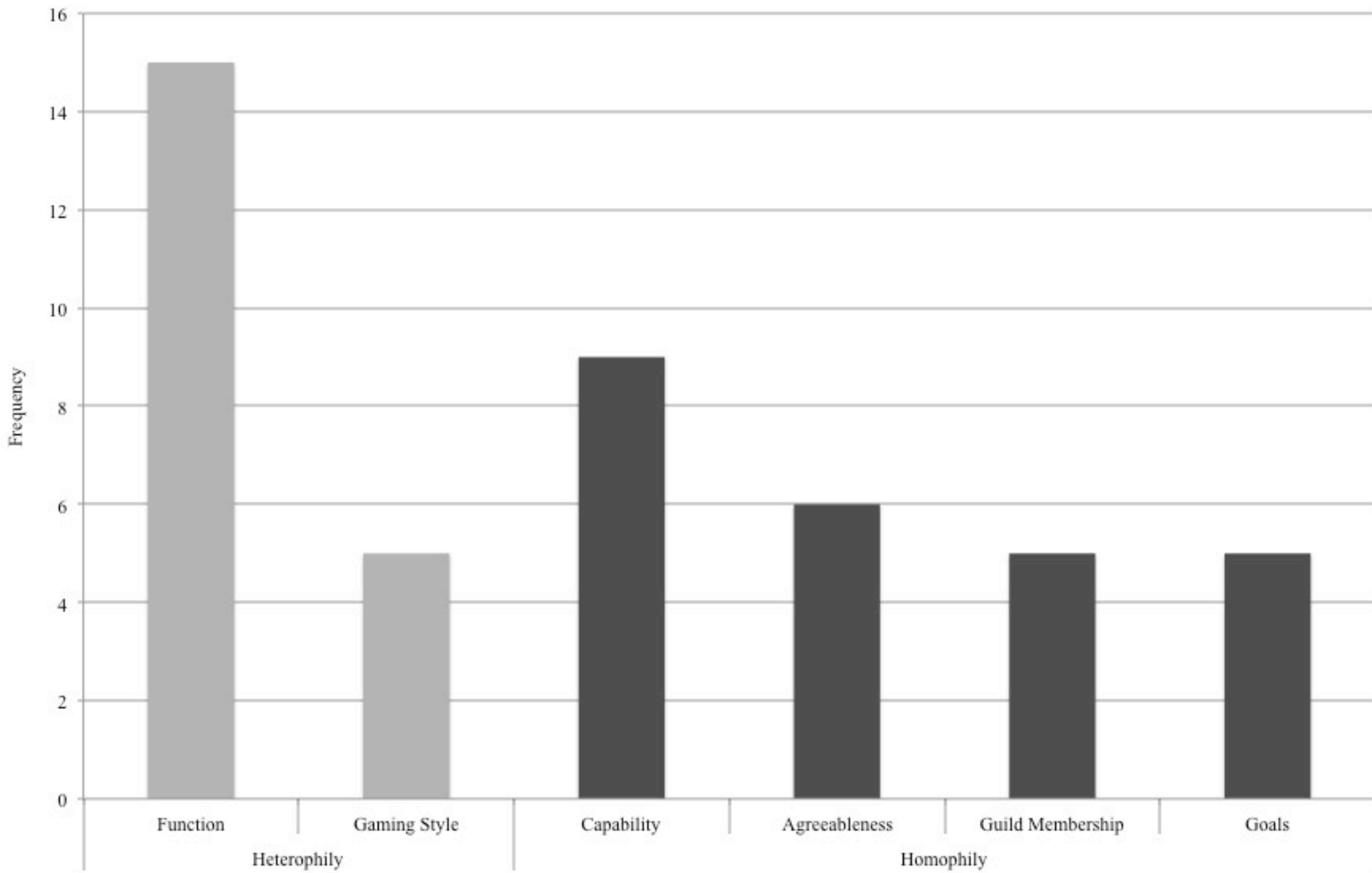

Figure 58. Frequency distribution of reported use of relative attraction mechanisms to form in-game teams for the American sample. (*n* = number of individuals = 26)

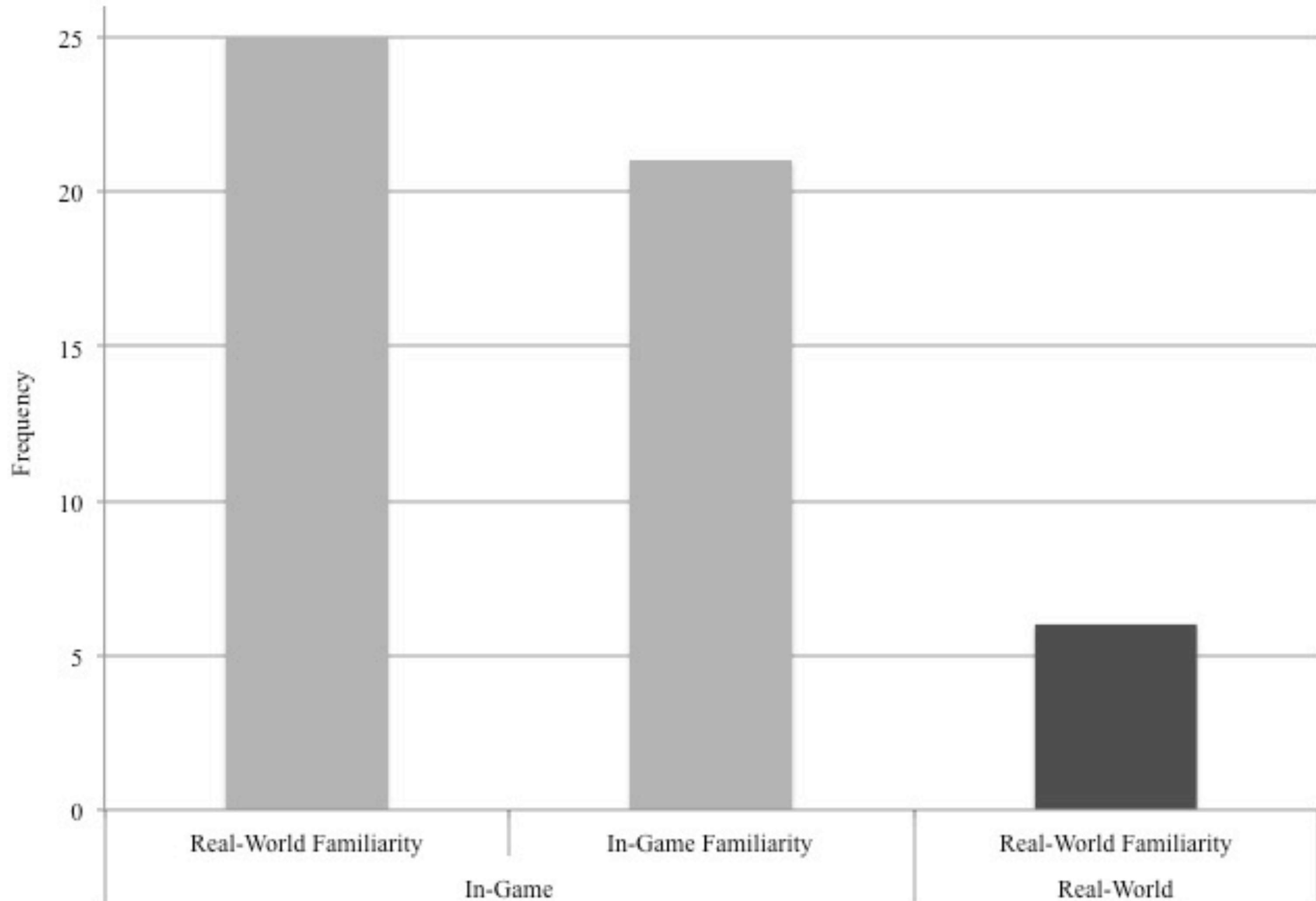

Figure 59. Frequency distribution of reported use of relational attraction mechanisms for the American sample. (*n* = number of individuals = 26)

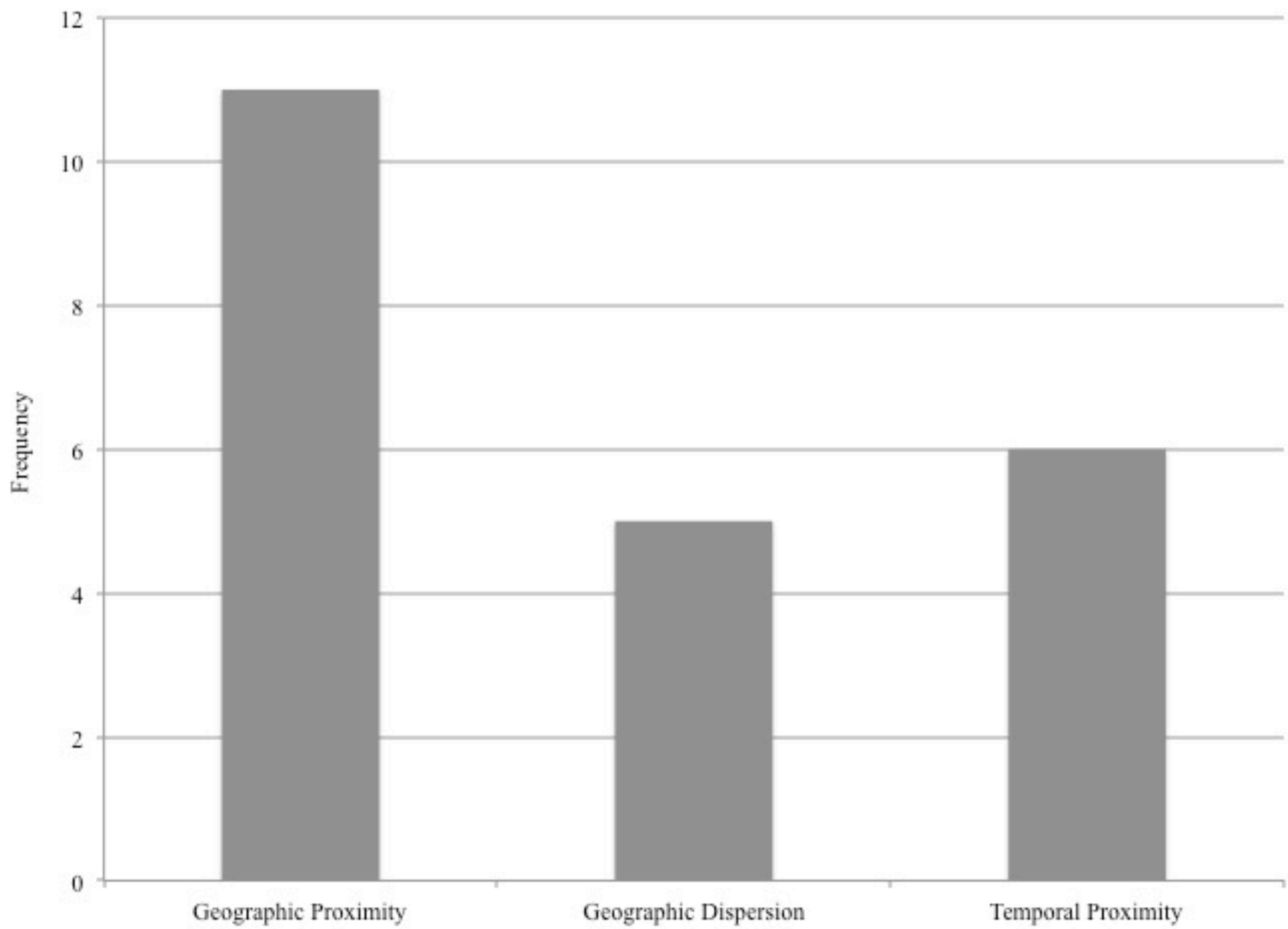

Figure 60. Frequency distribution of reported use of situational attraction mechanisms to form in-game teams for the American sample. (n = number of individuals = 26)

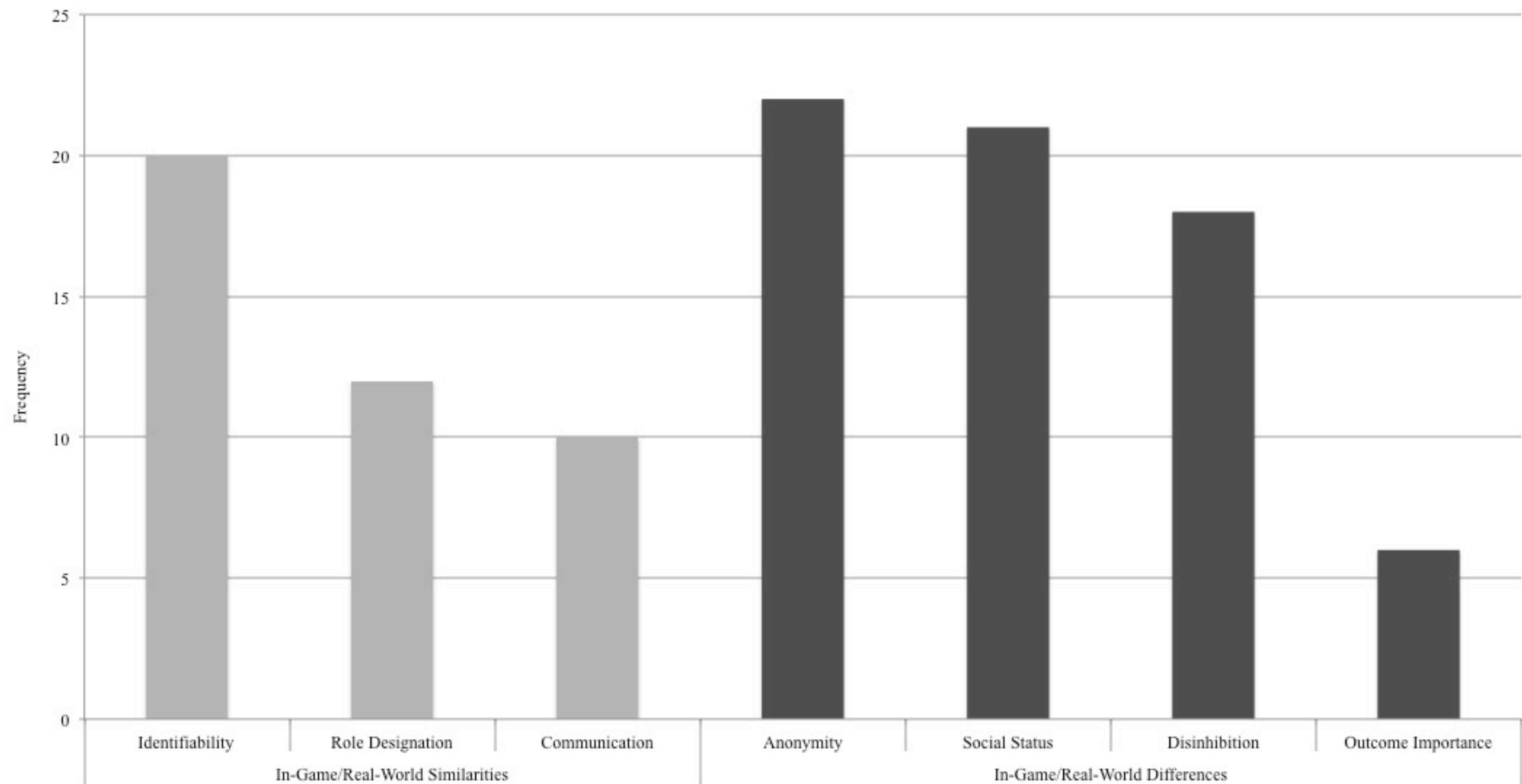

Figure 61. Frequency distribution of reported in-game/real-world similarities and differences for the American sample. (*n* = number of individuals = 26)

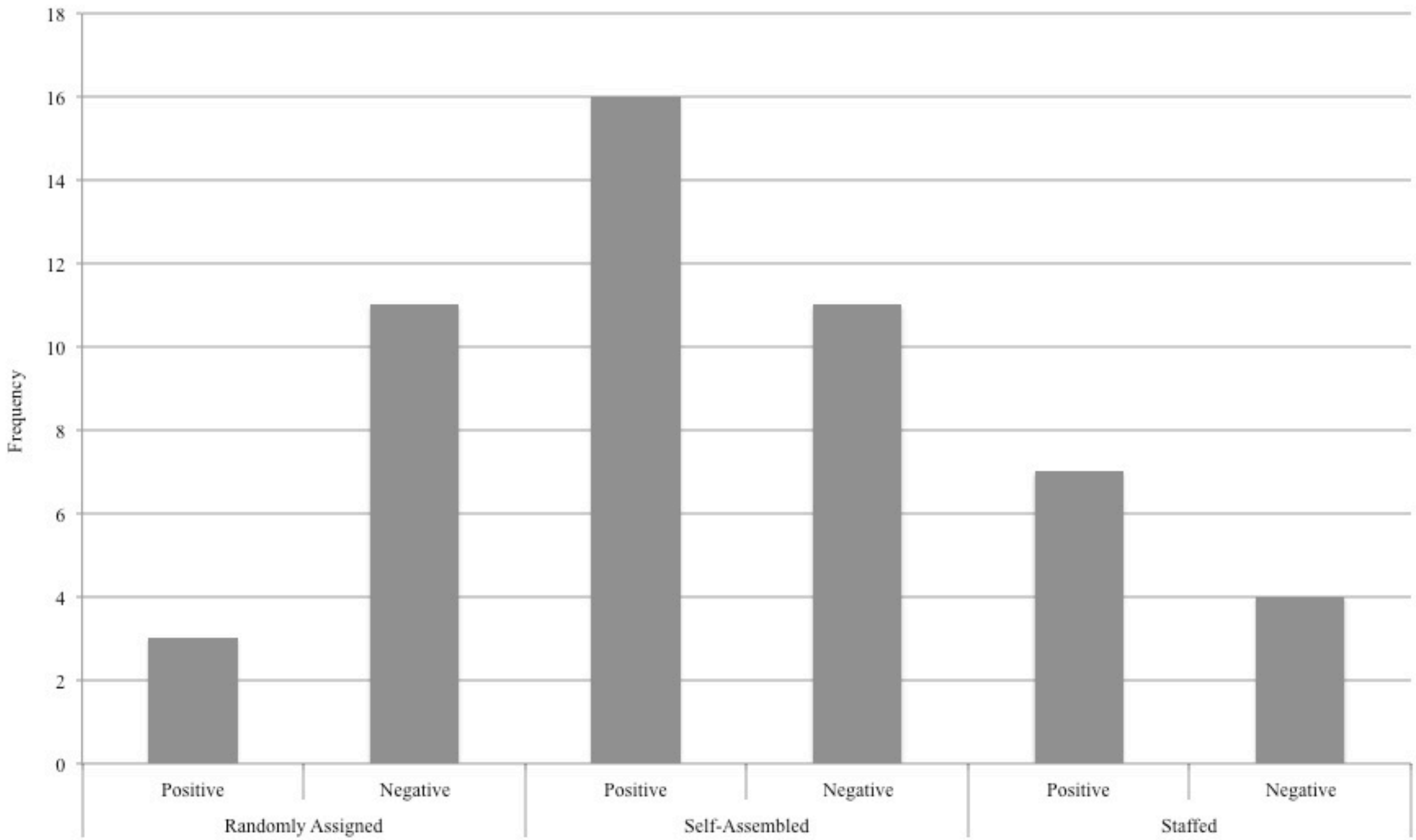

Figure 62. Frequency distribution of real-world positive and negative examples of teams for the American sample, sorted by team assembly type. (n = number of individuals = 26)

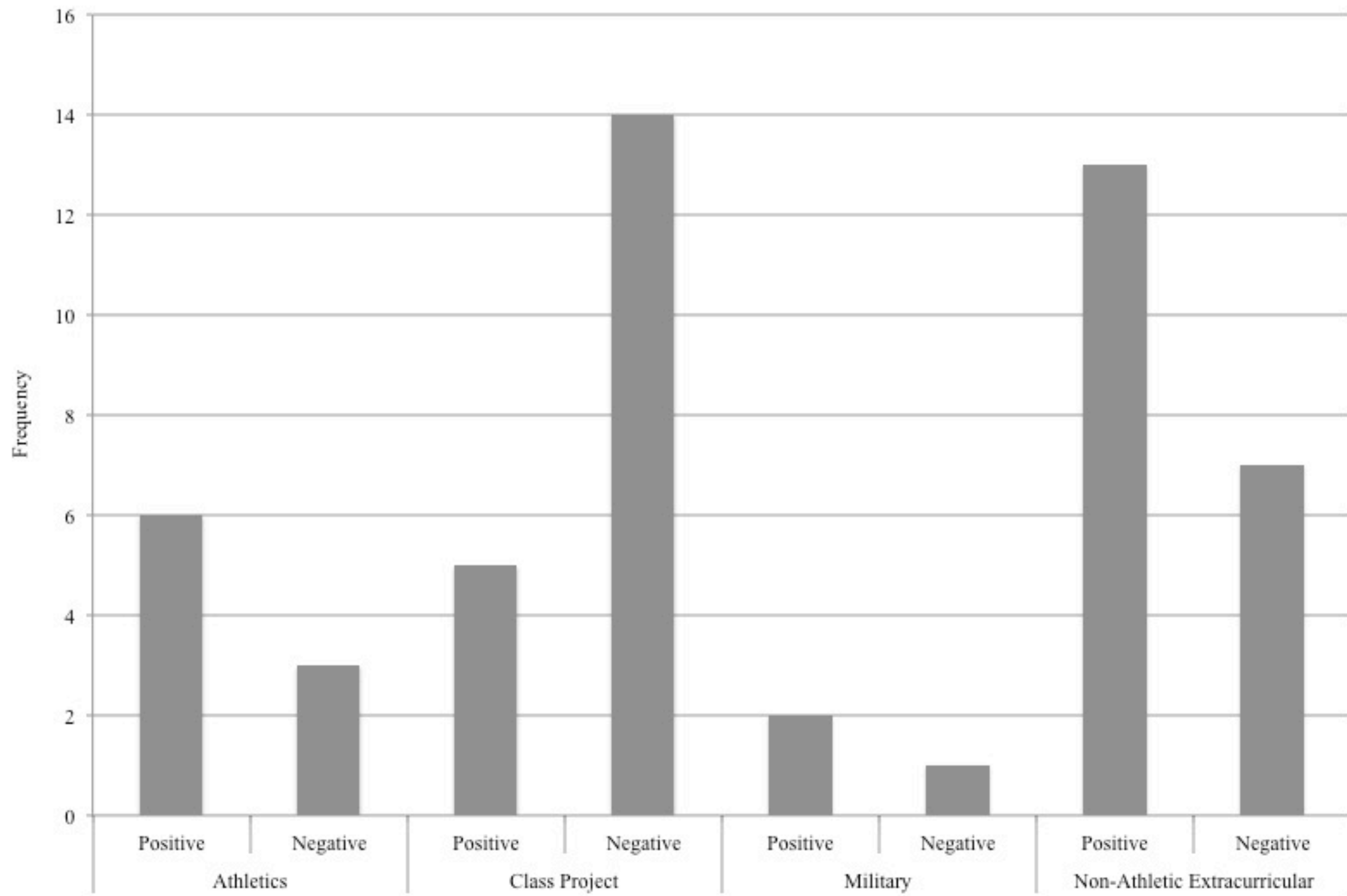

Figure 63. Frequency distribution of real-world positive and negative examples of teams for the American sample, sorted by team function. (*n* = number of individuals = 26)

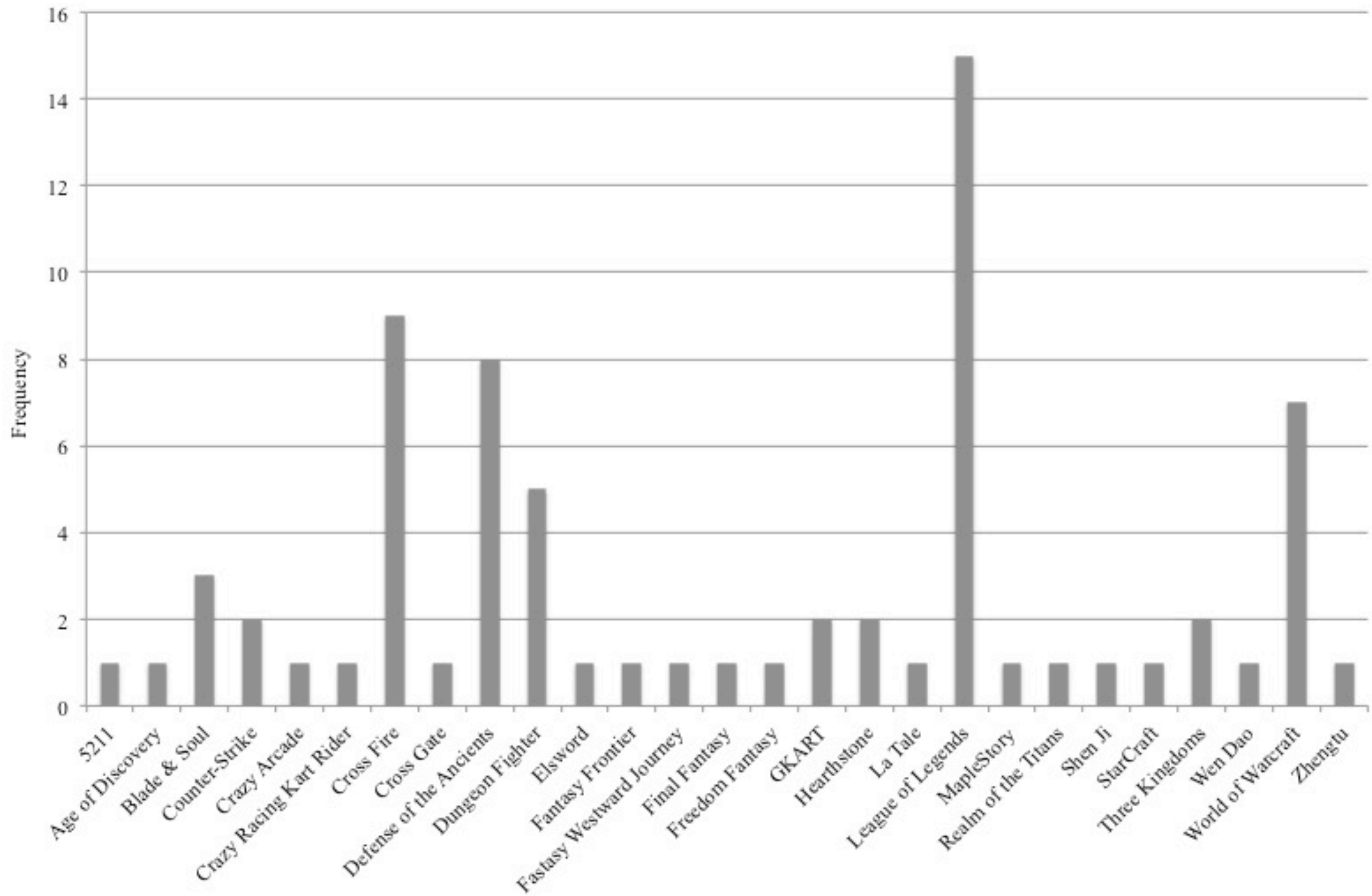

Figure 64. Frequency distribution of team-based online games (other than Dragon Nest) played by the Chinese sample. (*n* = number of individuals = 25)

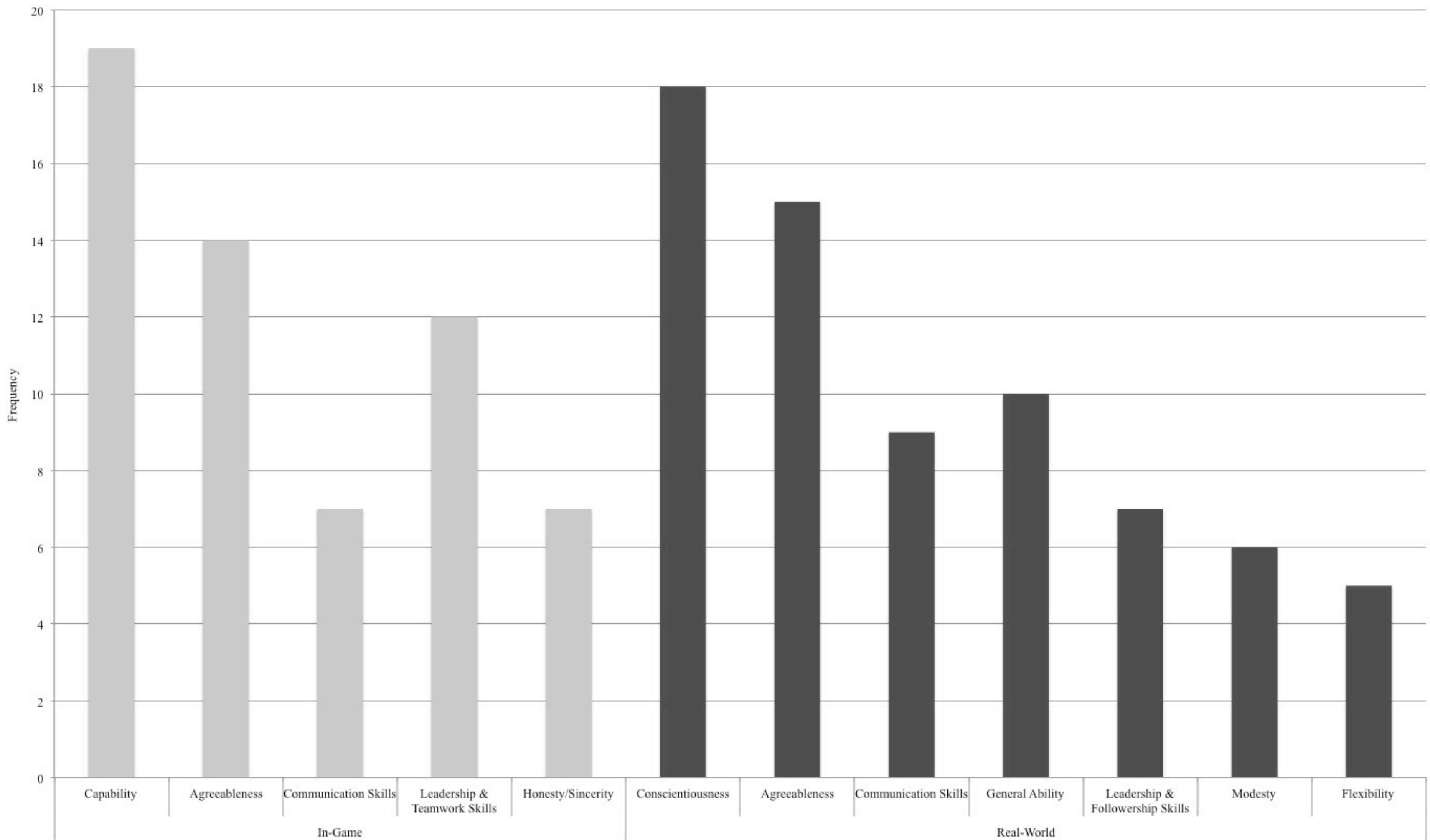

Figure 65. Frequency distribution of reported use of absolute attraction mechanisms for the Chinese sample. (*n* = number of individuals = 25)

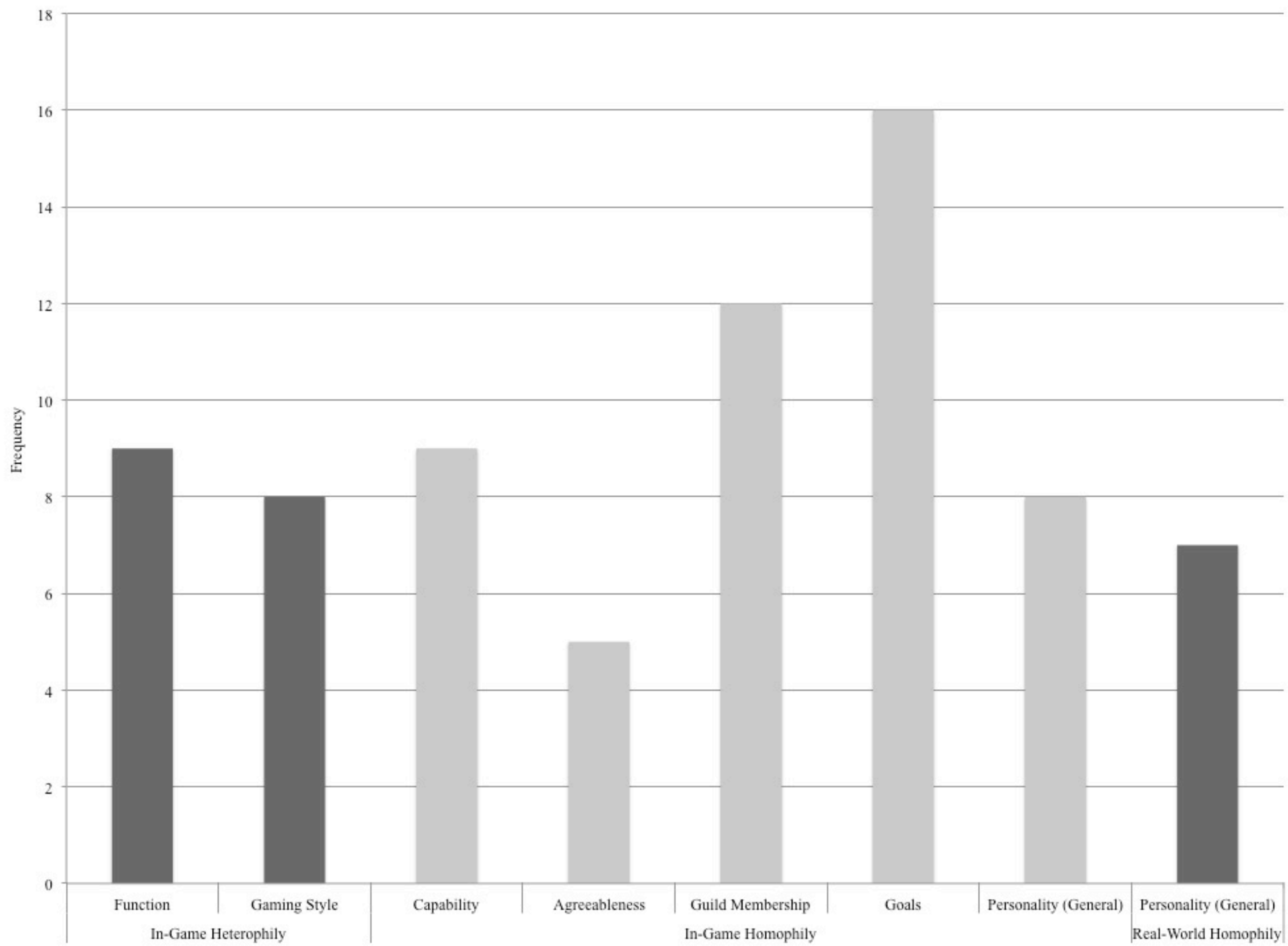

Figure 66. Frequency distribution of reported use of relative attraction mechanisms for the Chinese sample. (*n* = number of individuals = 25)

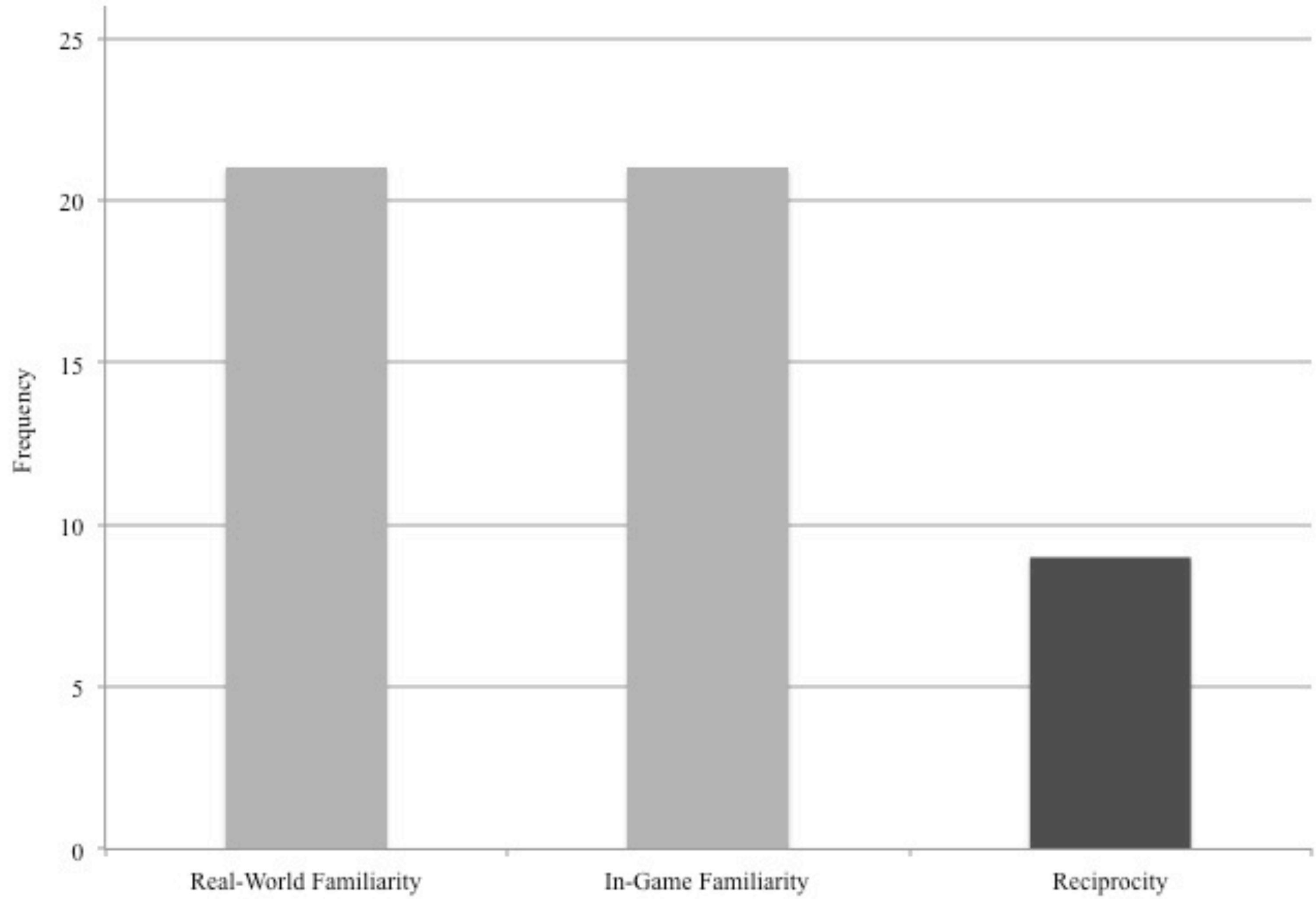

Figure 67. Frequency distribution of reported use of relational attraction mechanisms to form in-game teams for the Chinese sample. (*n* = number of individuals = 25)

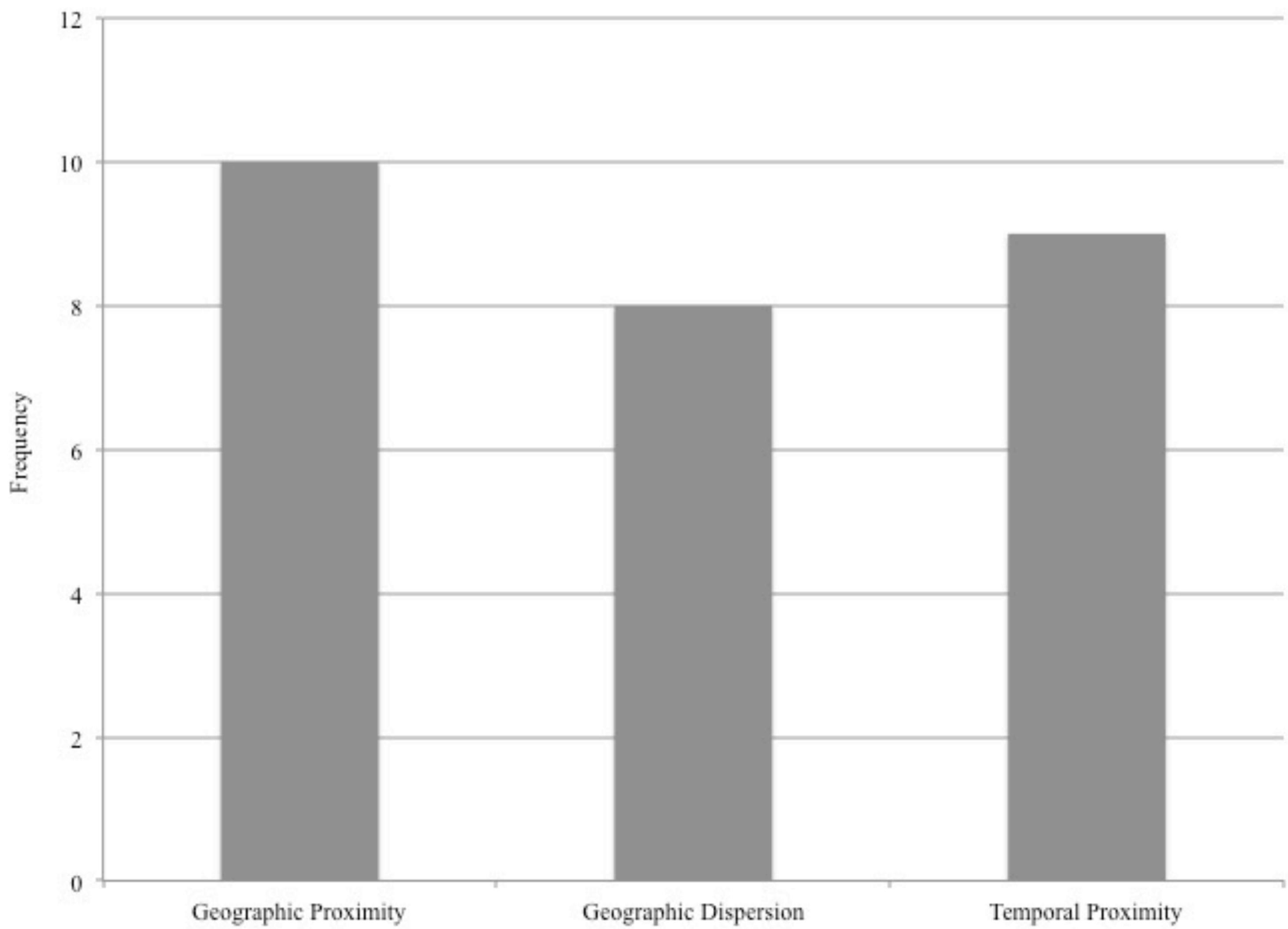

Figure 68. Frequency distribution of reported use of situational attraction mechanisms to form in-game teams for the Chinese sample. (*n* = number of individuals = 25)

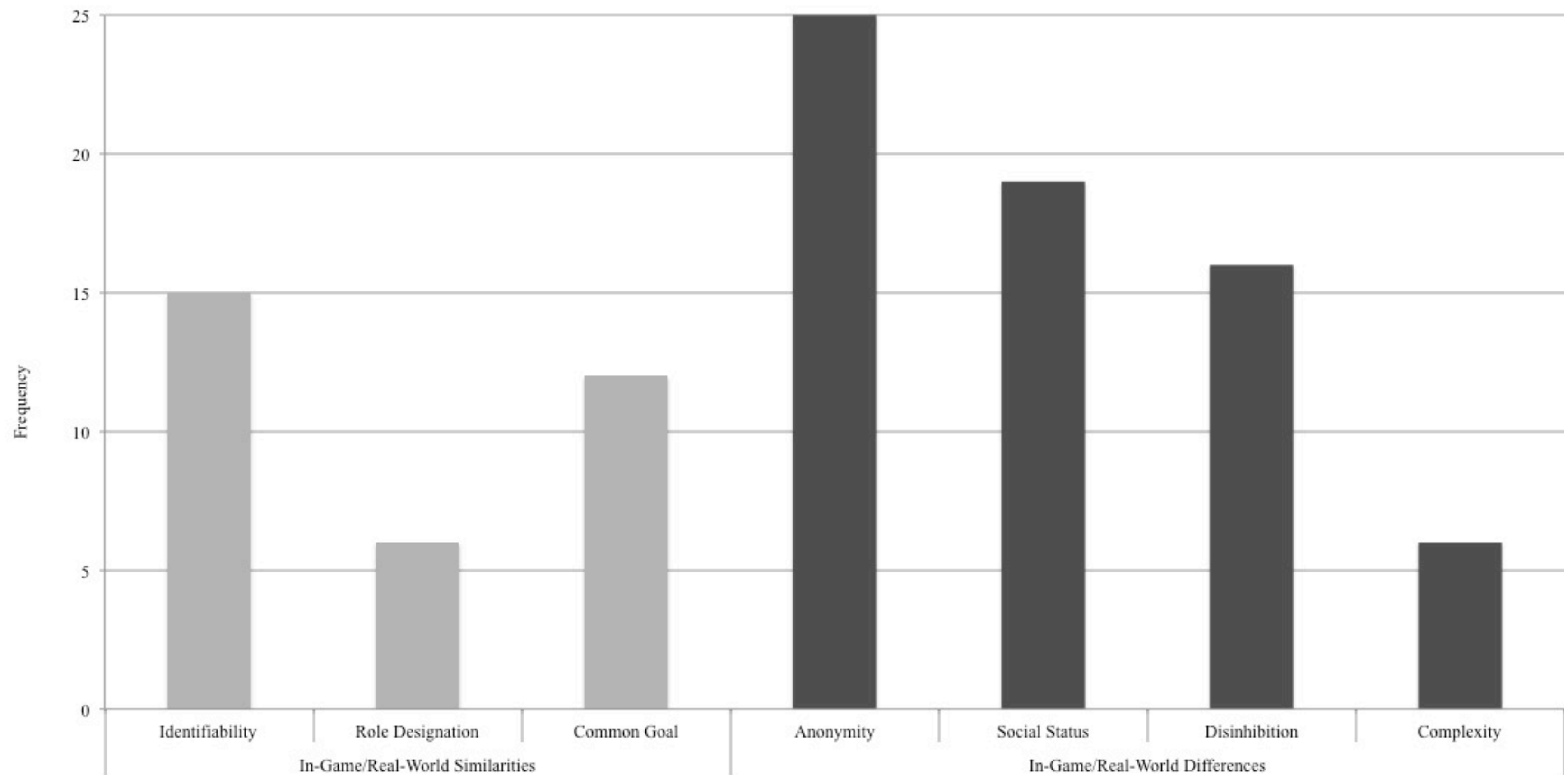

Figure 69. Frequency distribution of reported in-game/real-world similarities and differences for the Chinese sample. (n = number of individuals = 25)

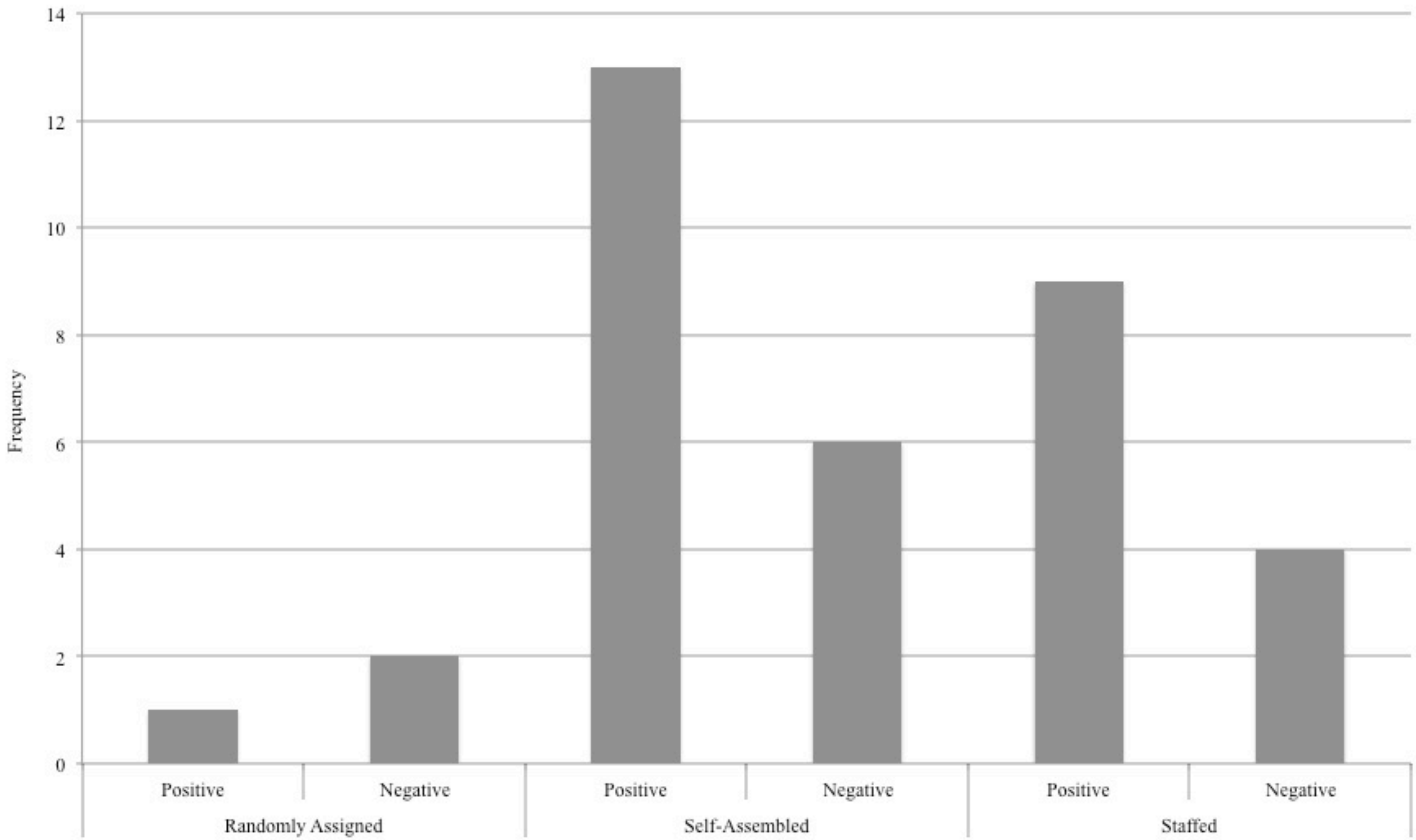

Figure 70. Frequency distribution of real-world positive and negative examples of teams for the Chinese sample, sorted by team assembly type. (n = number of individuals = 25)

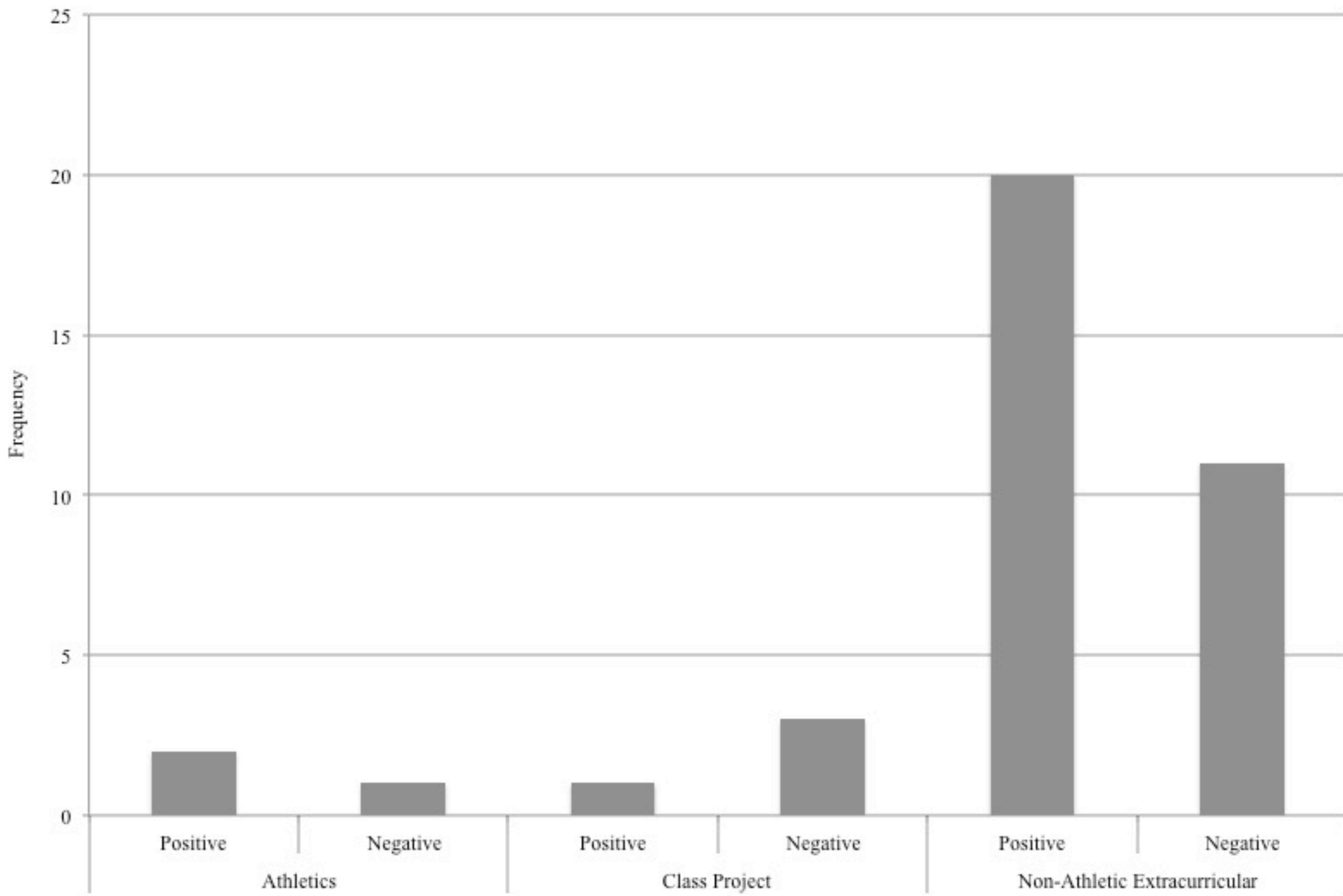

Figure 71. Frequency distribution of real-world positive and negative examples of teams for the Chinese sample, sorted by team function. (*n* = number of individuals = 25)

American and Chinese participants reported using the same three situational attraction mechanisms: geographic proximity, geographic dispersion, and temporal proximity. Additionally, the two groups referenced many common arguments in support of and against the mapping principle. Specifically, in support of the mapping principle, both set of participants mentioned how the virtual and real worlds both involve identifiability and role designation. Arguing against the mapping principle, both American and Chinese interviewees discussed how the real world differs from online in terms of anonymity, definitions of social status, and disinhibition.

Integrating Trace Data and Semi-Structured Interview Results

Overall, the results of the ERGM analyses of digital trace data and the semi-structured interviews converged on several points. First, ERGM analyses revealed that individuals tend to self-assemble into teams that are homogeneous in terms of player level and guild affiliation, and interviewees also reported teaming up with fellow guild members of similar skill levels. Second, both trace data analyses and semi-structured interviews indicated that players form teams based on prior friendships. Third, results of ERGM analyses revealed a robust effect of geographic proximity on teaming, an effect corroborated by the interview data.

However, there were also a couple of patterns that emerged from the results of the trace data analyses, which were not reflected in the semi-structured interview content. First, ERGM analyses revealed that players assemble into teams that are homogeneous in terms of guild role, but this relative assembly mechanism did not appear in the semi-structured interviews. Second, the trace data analyses indicated that individuals form teams based on closure, but semi-structured interview respondents did not consistently mention this factor (although, as seen in Table 26, a few participants did describe transitive teaming relationships).

Furthermore, there were three patterns that emerged from the content of the semi-structured interviews, which were not reflected in the results of the trace data analyses. First, individuals reported preferentially selecting teammates based on a variety of characteristics including capability, agreeableness, and communication skills, leadership/teamwork skills, and honesty/sincerity. However, there was no observed effect of preferential attachment in the trace data, meaning that—regardless of the basis for interpersonal popularity— attractiveness as a teammate is not proportional to popularity as a teammate. In fact, there was a significant effect of preferential avoidance, meaning that the network's degree distribution was remarkably uniform as compared to a scale-free network (i.e., a network with a degree distribution that follows a power law). Second, individuals perceived themselves as having formed functionally diverse teams, but the trace data indicated that teaming relationships weren't significantly heterogeneous (or homogeneous) in terms of function. Third, many semi-structured interviewees indicated on their proclivity to choose geographically distal teammates. However, the results of ERGM analyses revealed just the opposite—that geographic proximity drives teaming.

Finally, there were three patterns that emerged from the content of the semi-structured interviews that were not evaluated via trace data analyses. First, respondents consistently mentioned a variety of individual differences that were not included in the digital trace data set. Particularly in the context of relative attraction mechanisms, interviewees routinely mentioned the importance of gaming style, agreeableness, and general personality. However, the Dragon Nest trace data set does not include information on any of these, or any similar, individual differences. Second, Chinese interview participants described forming teams based on reciprocal relational attraction mechanisms, but Dragon Nest team assembly outcome network is undirected, meaning that hypotheses related to reciprocity cannot be meaningfully tested. Third, many interviewees said that temporal proximity shaped their teammate selection decisions; in essence, situational factors such as timing, scheduling, and time zones may shape the composition of self-assembled teams. Again, the Dragon Nest trace data set lacks information that could potentially serve to reflect this aspect of users' experiences.

CHAPTER 4

DISCUSSION

An interesting implication of the shift toward empowered work teams is that individuals have increasing autonomy not only in choosing how to work together, but also in choosing whom to work with. This change raises the question, what are the interpersonal mechanisms of attraction in teams? What factors influence individuals' decisions of whom to work with? These decisions have important implications for the resulting skill mix present within the team, the quality of members' teamwork interactions, and the ultimate success or failure of the team in reaching valued goals. Thus, the purpose of this dissertation was twofold: to investigate how people *do* form into teams and how people *should* form into teams. The discussion of results will also be presented in three major sections. First, quantitative results based on digital trace data analyses will be considered. Second, the qualitative results of American and Chinese semi-structured interviews will be explored. Third, quantitative and qualitative results will be juxtaposed and discussed holistically.

Digital Traces

The results of the primary study supported a number of the proposed hypotheses. First, several patterns emerged regarding the attraction mechanisms that drive team performance. Self-assembled teams formed based on surface-level homophily, familiarity, closure, and proximity more often than would be expected by chance. Based on these results, it is reasonable to conclude that relative, relational, and situational attraction mechanisms are crucial in driving the self-assembly process of MMORPG teams. Furthermore, teams that self-assembled based on surface-level homophily and/or familiarity outperformed teams that assembled based on deep-level homophily. Accordingly, it follows that relative and relational attraction mechanisms also have important implications for self-assembled team performance outcomes.

Attraction based on Absolute Attributes

In order to assess the impact of absolute attraction on self-assembled team membership, Hypothesis 1—which predicted that attractiveness as a teammate would be proportional to popularity as a teammate—was tested, and ultimately was not supported. In fact, a very strong, highly significant preferential avoidance effect was observed in the team membership network. There are several reasons why this may be the case. First, it is possible that certain MMORPGs are unlikely to incur popularity effects. A few studies that have assessed preferential avoidance in large MMORPG networks, and the results have been mixed. For instance, Huang, Shen, and Contractor (2013a) found that the Everquest II self-assembled team membership network exhibited a significant preferential avoidance effect. However, when Huang et al. (2009a) looked at other outcome networks in the Everquest II data set apart from team membership, such as networks with ties based on being in the same virtual location or instant message history, the researchers discovered significant effects of preferential attachment. Similarly, Huffaker et al. (2009) found that high-level, expert players were disproportionately likely to receive communications from other players. These patterns of results indicate that popularity is likely a reality in Dragon Nest, but perhaps is not reflected in the self-assembled team membership network.

Another explanation for the Hypothesis 1 result is that very popular Dragon Nest players are likely very high level, and therefore only engage in extremely challenging tasks, which were excluded from analyses. This possibility is probable, given that famous gamers generally tend to be very experienced and accomplished (Armelin, 2012); specifically, this is true for famous Chinese gamers (Hu & Sørensen, 2011). Still another conceivable explanation for the results is that many of the well-known players are trolls, or individuals that make provocative comments and/or behave annoyingly in order to incite negative reactions. Trolls, while notorious, are not typically well liked; it follows that famous trolls would be unpopular teammates, thus explaining the lack of a popularity effect in the observed data.

Attraction based on Relative Attributes

To evaluate the impact of relative attraction mechanisms on self-assembled team membership, Hypotheses 2a and 2b were tested. First, Hypothesis 2a—that self-assembled teams would be homophilous in terms of surface-level characteristics—was tested using 4 variables: character class, player level, guild affiliation, and guild role. Results for player level, guild affiliation, and guild role supported the hypothesis, while results for character class failed to support the hypothesis. Previous research by Ahmad, Ahmed, Srivastava, and Poole (2011) on Everquest II trust networks also failed to find support for character class homophily; however, these researchers uncovered a sizeable effect of character class heterophily. The fact that the current study's character class effect estimate was nonsignificant may be the result of players using teaming tactics differentially, depending on the task at hand; it is possible that Dragon Nest players intentionally try to diversify their teams for certain quests, and default to homophily tendencies for others, resulting in an overall near-null effect magnitude. Hypothesis 2b—that self-assembled teams would be homophilous in terms of deep-level characteristics—was also tested using 4 variables: skill points, completed quests, money, and logins. However, Hypothesis 2b went completely unsupported. One explanation for this is that the deep-level attributes of other people, which are nebulous even during face-to-face interactions, may be nearly impossible to precisely detect in MMORPGs.

Attraction based on Relational Attributes

Hypotheses 3a and 3b were used to evaluate the impact of relational attraction mechanisms on self-assembled team membership. First, Hypothesis 3a posited that self-assembled teams would form based on familiarity more often than would be expected by chance, and was fully supported by the results. Analogously, Hypothesis 3b—that self-assembled teams would form based on closure more often than would be expected by chance—was also fully supported.

Attraction based on Situational Attributes

In order to assess the effect of situational attraction on self-assembled team membership, Hypothesis 4—which predicted that the self-assembled teams would exhibit a propinquity effect—was tested, and was supported. This finding buttresses similar research on Everquest II team membership networks, which indicated a strong player preference for geographically proximal teammates (Huang et al., 2009a). In other words, the Internet is not necessarily the great equalizer it is purported to be; although individuals have the opportunity to communicate across large distances, they still tend to abide by the law of propinquity.

Overall Attraction

To compare and contrast the relative effects of absolute, relative, relational, and situational attraction on team self-assembly, Hypothesis 5—which posited that the propinquity effect would be stronger than the other effects—was tested, but was not supported. In reality, an absolute attraction mechanism (i.e., preferential avoidance) had the most profound effect of teaming tendencies, followed by a relative attraction mechanism (i.e., guild membership homophily), followed by a relational attraction mechanism (i.e., closure), followed by the hypothesized strongest influence, a situational attraction mechanism (i.e., proximity). Additionally, an interesting point is that, although friendship was previously found to be a significant driver of teammate relationships in the Hypothesis 3a analysis, the friendship effect estimate in the Hypothesis 5 model was not statistically significant. This is likely due to the fact that, with the guild membership model in the network, the friendship network was largely redundant.

Absolute Composition and Performance

To evaluate the impact of absolute composition on self-assembled team performance, Hypothesis 6—which posited that self-assembled teams composed of many popular members would outperform self-assembled teams composed of relatively few popular members—was tested, but was not supported by the data. In fact, although all three performance groups tended strongly toward preferential avoidance, this preference was the weakest in the unsuccessful group (rather than the hypothesized successful group). To understand why the observed self-assembled team membership network exhibited such a complete lack of preferential attachment, it is important to understand how popularity effects are differentially applicable to different types of social networks.

In the first place, it is clear that certain types of networks are prone to exhibiting popularity effects. For instance, Guimerá, Uzzi, Spiro, and Amaral (2005) found evidence that the formation process for Broadway musical teams was driven, at least in part, by preferential attachment. These teams emerged from a large, densely connected network of Broadway musical professionals, where a small number of celebrities acted as brokers between different groups of people. However, individuals embedded in more "mundane" network structures are given fewer opportunities to associate with others outside of their own clusters (Aldrich & Kim, 2007). Accordingly, it is possible that the tendency of the Dragon Nest team membership network to exhibit preferential avoidance is simply an inherent property of the type of network that it is. Especially when only considering dyads that engage in repetitive teaming, it follows that networks of online gamers will be much more likely to repeat interactions within their individual clusters, without venturing to forge new relationships, and thereby will have more uniform degree distributions than networks akin to the Broadway musical team network.

Relative Composition and Performance

In order to assess the impact of relative composition on self-assembled team performance, Hypotheses 7a and 7b were tested. First, Hypothesis 7a—which predicted that teams that assembled based on surface-level heterophily would outperform teams that did not assemble based on surface-level heterophily—was tested using four variables: character class, player level, guild affiliation, and guild role. Across the three performance groups, none of the patterns of effect estimates conformed to the hypothesis; accordingly, Hypothesis 7a was not supported. Furthermore, in the case of player level, the successful group actually exhibited a homophily effect, while the other two performance groups did not. Thus, dyads that are relatively homogeneous in terms of level tend to outperform dyads that are disparate in terms of level. On one hand, this may be because homogeneous dyads engage in quests that are appropriately difficult for both players, and consequently each individual is equally incentivized to expend effort in order to complete the task. On the other hand, for level-heterogeneous dyads questing undoubtedly involves a task that is either too easy for one player or too difficult for the other; the former situation may lead to poor performance on the part of the expert as a result of lack of motivation or boredom, while the latter situation will undoubtedly lead to poor performance on the part of the novice. The significant effect of completed quests heterophily in the unsuccessful group can likely be explained via the same mechanism; in other words—as seen in Table 4—player level and completed quests are positively correlated with one another, and may potential be proxies for each other.

Hypothesis 7b—which postulated that teams that assembled based on deep-level heterophily would outperform teams that did not assembly based on deep-level heterophily—was also tested using four variables: skill points, completed quests, money, and logins. Across the three performance groups, patterns of effect estimates conformed to the hypothesis for a single variable; the unsuccessful and mixed performance groups exhibited homophily in terms of completed quests, while the successful performance group did not. Consequently, Hypothesis 7b was partly supported.

Relational Composition and Performance

In order to gauge the impact of relational self-assembled team composition on performance, Hypotheses 8a and 8b were tested. First, Hypothesis 8a—which predicted that teams that assembled based on familiarity would outperform teams that did not assemble based on familiarity—was tested. Out of all the performance groups, the effect of friendship on team membership was the most pronounced for the high performers. Contrastingly, the unsuccessful performance group had no reported friendships, whatsoever. Accordingly, the results supported Hypothesis 8a. However, Hypothesis 8b—which proposed that teams that assembled based on closure would outperform teams that did not assemble based on closure—was not supported, due to the fact that all performance groups exhibited similar levels of transitivity. Some researchers argue that closure is not as integral to performance as once thought; for example, several studies have indicated that structural holes may be the more critical structural drivers of success (Soda, Usai, & Zaheer, 2004; Zaheer & Bell, 2005). Thus, perhaps there are simply other relational network structures that are far more influential on performance outcomes than is closure.

Situational Composition and Performance

To evaluate the impact of situational composition on self-assembled team performance, Hypothesis 9—which posited that teams that assembled based on propinquity would outperform teams that did not assemble based on propinquity—was tested, but was not supported by the data. Based on these results, it appears that the use of geographic proximity as a mechanism of team self-assembly simply does differentiate high- from low-performers, perhaps due to the fact that the effect of propinquity is universally prevalent. Especially when considering individuals collaborating virtually via the Internet, physical proximity may not be fundamental to the successful completion of a task. Specifically in the context of MMORPGs, a player's location in the virtual world of

Dragon Nest may have more of an influence on their team member selection decisions and subsequent performance levels than their actual, physical location.

Overall Composition and Performance

Finally, to compare and contrast the relative effects of absolute, relative, relational, and situational self-assembled team composition on performance, Hypothesis 10—which postulated that teams that assembled primarily based on heterophily would outperform teams that assembled primarily based on other attraction mechanisms—was tested, but was not supported. For successful dyads, an absolute attraction mechanism (i.e., preferential avoidance) had the most profound effect of teaming tendencies, followed by a relative attraction mechanism (i.e., guild membership *homophily*), followed by two relational attraction mechanisms (i.e., friendship and closure), followed by a situational attraction mechanism (i.e., proximity). For unsuccessful dyads, an absolute attraction mechanism (i.e., preferential avoidance) had the most profound effect of teaming tendencies, followed by a relative attraction mechanism (i.e., guild membership *homophily*), followed by one relational attraction mechanisms (i.e., closure), followed by a situational attraction mechanism (i.e., proximity), followed by another relative attraction mechanism (i.e., completed quests *heterophily*). As seen in Table 4, level and completed quests positively correlated with one another, and both can be used as proxies for player experience. Thus, following the logic used to explain the results of Hypothesis 7a, it is possible that for heterogeneous dyads (in terms of completed quests) any given task was either too easy for the relative expert or too difficult for the relative novice, and either way this led to a performance detriment.

Selection Bias

Firstly, the results of the selection bias analyses were somewhat foreseeable, especially in terms of the stark contrast between the patterning of team-based players' versus solo players' results. In Dragon Nest—as is true in many MMORPGs—questing individually is popular among lower-level players who work on relatively simple tasks, but is not feasible for more experienced players, who must exploit the power of teamwork in order to successfully complete the complicated tasks that are required of them (Huang et al., 2013b). In other words, the observed disparities between team-based and solo players reflect differences in the types of work that are requested of novices versus experts in Dragon Nest.

The arguably more important issue regarding the results of the selection bias analyses is the three discrepancies that emerged between the two team-based groups. First, the excluded team players had significantly higher levels and average task difficulties than the primary sample of team players. This incongruity is likely due to the fact that teams that engaged in very high-level tasks were excluded from the primary sample. Second, the primary sample of team players has significantly more completed quests that the excluded team players. At first glance, this result appears somewhat unusual. However, as seen in Table 5, task difficulty and quest success are negatively correlated. In other words, high-level players who attempt difficult tasks tend to complete fewer quests than lower-level players who attempt easier tasks. This occurs not for lack of effort, but because the difficult tasks are less likely to result in success than simple tasks.

Semi-Structured Interviews

The results of the semi-structured interview study indicated that American and Chinese gamers have remarkably similar experiences of team self-assembly. Across the American and Chinese samples, gamers consistently perceived themselves as forming teams based on certain absolute, relative, relational, and situational attraction mechanisms. Differences between the two groups' responses appear to be cultural in nature.

Absolute Attraction Mechanisms

A number of patterns resulted from the semi-structured interviews. First, participants across both samples reported using similar absolute attraction mechanisms in virtual and real-world domains. For example, the most frequently cited desired qualities for in-game and real-world teammates, across both samples, were strictly task-relevant; participants said that they desired highly capable in-game teammates and highly conscientious real-world teammates. Furthermore, both groups of participants saw in-game social status as primarily being a function of player capability. However, Chinese players also mentioned the importance of real-world wealth in determining in-game status. This disparity can be attributed to the fact that all of the Chinese respondents were discussing the same game, while the American interviewees talked about a variety of games. Different games involve real-world money in different ways (Guo & Barnes, 2007), and it happens that Dragon Nest is a game where real-world currency can elevate the status of your avatar, making this a more common point of focus among the Chinese respondents. American and Chinese participants also mentioned factoring in levels of agreeableness and communication skills when choosing in-game and real-world teammates. Thus, both groups perceived themselves as using socially relevant absolute attraction mechanisms, in addition to task-relevant.

However, Chinese interviewees routinely discussed a number of absolute attraction mechanisms that were not regularly mentioned among the Americans. When explaining in-game teammate selection, Chinese individuals said that they considered leadership/teamwork skills and honesty/sincerity. When explaining real-world teammate selection, Chinese individuals said that they considered general ability, leadership/followership skills, modesty, and flexibility. With the exception of general ability, these disparities between groups can be attributed to reasons of culture. To quote Harry Triandis (2001):

> People in collectivist cultures, compared to people in individualist cultures, are likely to define themselves as aspects of groups, to give priority to in-group goals, to focus on context more than the content in making attributions and in communicating, to pay less attention to internal than to external processes as determinants of social behavior, to define most relationships with ingroup members as communal, to make more situational attributions, and tend to be self-effacing. (p. 907)

Thus, this cultural difference, between the United States (and individualistic culture) and China (a collectivistic culture) explains why Chinese participants cited group-oriented absolute attraction mechanisms such as leadership, teamwork, and followership skills more so than did American participants. Cultural collectivism may also be the reason why so many more Chinese than Americans found agreeableness to be an important characteristic of a real-world teammate.

Furthermore, Chinese people have historically valued honesty and sincerity, as they are fundamental to Confucianism and Taoism thinking (Chen, 2002). Chinese people also tend to exhibit a modesty bias, meaning that they evaluate themselves less favorably than they evaluate others; in comparison, Americans tend to evaluate themselves more favorably than they evaluate others (Farh, Dobbins, & Cheng, 1991). Interestingly, because modesty is a prevalent norm in China, the modesty bias in Chinese people is associated with high implicit self-esteem (Cai et al., 2011). Thus, it follows that, because of the cultural significance of honesty, sincerity, and modesty in China, Chinese participants would desire their teammates to possess these characteristics.

Relative Attraction Mechanisms

With a sole exception, relative attraction mechanisms were only mentioned in the context of online games. One potential reason for this apparent discrepancy is that people may be more willing to discuss relative attraction mechanisms in the context of online gaming than discuss real-world homophily/heterophily. On one hand, many people reported looking for online teammates similar to/different from themselves in terms of relatively innocuous characteristics that only apply to experiences in the virtual world, such as gaming style and guild membership. On the other hand, people often attempt to portray themselves as socially desirable (Crowne & Marlowe, 1960); thus, participants may have been unwilling to discuss preferences for similar/different others in the real world, where striving to form teams based on homophily/heterophily may be perceived as socially undesirable. Similarly, people may harbor implicit attitudes, or attitudes that they are not aware of having (Olson & Fazio, 2003), which may guide influence their formation of homophilous/heterophilous teams in the real world, unbeknownst to them. Furthermore, it is possible that relative absolute attraction mechanisms such as functional diversity—which could potentially apply to both the virtual world and the real world—appear so often in descriptions of online teaming and so rarely in explanations of real-life teaming because the guidelines and tactics for choosing teammates in the virtual world are more clearly spelled out than they are in the real world. Many participants mentioned that forming a functionally homogeneous team, while technically possible, would render the task at hand virtually impossible to accomplish. In the real world, tasks and roles are rarely so clearly defined.

Only a few discrepancies emerged between the American and Chinese samples, with regard to relative attraction mechanisms. First, Chinese participants cited goal homophily as a driver of in-game team formation more frequently than did American participants did, although the pattern was present in both samples. Again, this discrepancy can be explained via the theory of individualism and collectivism; collectivistic cultures tend to emphasize shared goals more so than do individualistic cultures (Parsons & Shils, 1951; Kluckhohn & Strodtbeck, 1961). Second, the Chinese participants mentioned guild homophily more often than the Americans did. This pattern that can be explained as a result of Chinese participants' culturally based tendencies to form collectives. However, it may also be the case that this pattern is an artifact; all of the Chinese gamers played Dragon Nest, a game that involves guilds, while many of the Americans played games that do not involve guilds. Finally, Chinese participants reported using personality homophily to form in-game and real-world teams, whereas American participants made no such claim. Like before, this result can be culturally attributed. The Confucian value of harmony is fundamental to Chinese culture (Leung, Koch, & Lu, 2002); thus, the desire on the part of Chinese participants teammates with similar personalities is likely borne of the cultural emphasis on harmony, balance, and equilibrium.

Relational Attraction Mechanisms

In terms of relational attraction mechanisms, participants cited real-world and online friendships as being the drivers of in-game teaming far more frequently than they mentioned familiarity as the impetus for offline teaming; in fact, the Chinese group of participants did not consistently mention familiarity as relational attraction mechanism, at all. On one hand, this result reflects previous research that has suggested that MMORPGs are environments replete with social interaction, where players develop and maintain meaningful, long-lasting social relationships (Cole & Griffiths, 2007). On the other hand, this finding (along with the absolute attraction interview results) is in line with the results of other previous research, which suggested that people tend to underestimate the role that prior familiarity plays in guiding the self-assembly of real-world teams, while simultaneously overestimating the importance that absolute levels of task-relevant characteristics have on shaping teaming decisions (Wax et al., 2014). Furthermore, the Chinese participants were unique in their recognition of the role that reciprocity played in forming their in-game teams. This disparity between groups likely appeared, again, because of the Chinese cultural emphasis on social balance (Leung et al., 2002). In other words, although the norm of reciprocity is likely universal (Gouldner, 1960), it is probable that people in collectivistic cultures are more consciously aware of it than are those in individualistic cultures.

Situational Attraction Mechanisms

Similar to relative attraction mechanisms, situational attraction mechanisms were only consistently mentioned in the context of online teaming; participants saw themselves as forming in-game teams based on geographic proximity, geographic dispersion, and temporal proximity. The fundamental attribution error—the tendency of individuals to overestimate the impact that individual attributes have and underestimate the impact that situations have on behavior (Jones & Harris, 1967)—helps to explain this finding, in part. Because individuals in real-life scenarios are prone to ignoring situational contexts of behavior, it logically follows that this bias would apply to real-life team assembly. What is arguably more interesting is the fact that so many respondents discussed situational influence on teaming behaviors in the context of online games. It may be that the fundamental attribution error is less prevalent online than it is in the real world.

Mapping Principle and Emergent Themes

Regarding the validity of the mapping principle in general, two major differences between online and real-world teaming that the semi-structured interviews made abundantly clear were anonymity/identifiability and disinhibition. Anonymity and disinhibition are closely related phenomena; namely, anonymity facilitates disinhibition. Suler (2004) proposed that individuals have far fewer behavioral inhibitions online than they do in the real world due to a series of factors such as anonymity, invisibility, and minimization of authority, which all interact to produce the online disinhibition effect, or the tendency of individuals to express themselves more freely and openly online than in face-to-face situations. According to Suler, online disinhibition comes in two forms: benign and toxic. First, benign disinhibition occurs when individuals express their unspoken thoughts, feelings, desires, dreams, and fears more readily online than they do in person. Indeed, interviewees expressed a number of anecdotes that reflected benign disinhibition, such as instances of acting in extraordinarily generous ways to other gamers and innocuous experiences of gender swapping.

On the other hand, toxic disinhibition generally occurs when people are more willing to verbally abuse others online than they are in person. The online world creates a social context that lends itself to deindividuation, or an individual's loss of their personal sense of identity, which oftentimes is associated with aggressive behavior. Heightened arousal, relative anonymity, and reduced feelings of individual responsibility are physical/psychological states that contribute to feelings of deindividuation (Zimbardo, 1969), and are ubiquitous in MMORPG contexts. Indeed, quasi-experimental research on MMORPG players has indicated that anonymity is strongly predictive of aggression (Hughes & Louw, 2013). In concordance with past research, the majority of semi-structured interviewees—in particular, the Americans—emphasized the tendency of many to behave more maliciously online than they would dare to in person.

An additional pattern that emerged from the interviews was the tendency for American participants[31], in particular, to subtly indicate their distaste for being labeled as a gamer. Adrienne Shaw dubs this phenomenon (of gamers who do not identify as such) "guilty gaming" (2012). This proclivity likely comes from the fact that the gamer identity is still highly stigmatized in America (Arnott, 2009), oftentimes being associated

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[31] Although it did not seem like the Chinese participants were as shy about identifying as gamers as were the Americans, it is hard to say with certainty because of linguistic nuances that may have been lost upon translation.

with characteristics such as being nerdy, geeky, antisocial, or generally uncool. Therefore, it follows that participants preferred to distance themselves from an official self-identification. However, it is possible that the (almost) complete anonymity afforded to online gamers is related to the stigmatization of their identity. If gamers do not want their virtual personas being associated with their real-life personas, then online anonymity is the most straightforward solution. The inability to identify the true, diverse gamer demographic has led to a systematic overrepresentation of White, male characters in video games, and systematic underrepresentation of female, Hispanic, Native American, child, and elderly characters (Williams, Martin, Consalvo, & Ivory, 2009). Thus, addressing the stigma of gaming would serve two purposes: 1) future gamers would not have to hide behind voice changing technology, deceptive avatars, or misleading handles (i.e., nicknames), and 2) game content would subsequently better reflect the actual demographics of the market.

Furthermore, despite their potential to serve "as 'petri dishes' for…scholars" (Williams, 2010, p. 451), the semi-structured interviews made clear that online games are just that—games. For instance, numerous respondents reported being plagued by issues of social loafing in the real world, but very few indicated that this was a problem online, and many specifically explained that, because online games are pleasurable and optional, chronic social loafing in MMORPGs is a moot point. However, although virtual and real-world teaming may not perfectly map on to one another, online teaming behaviors are inherently important to understand, regardless of their ability to generalize to other types of behaviors. Millions of people play MMORPGs (Castronova, 2002) and the economies of certain virtual worlds (such as EverQuest's Norrath) are comparable in size to the economies of large, real-world countries (such as Russia; Castronova, 2001). Thus, it is possible consider virtual behaviors in a vacuum, as these human tendencies are becoming increasingly fundamental. Furthermore, as our world progresses to a state of ubiquitous computing, MMORPGs are being used by more people and in wider variety of venues (such as in the classroom; Susaeta et al., 2010). Therefore, as our virtual lives become richer and complexify, the demand to understand them will only increase.

Finally, there was a substantial degree of convergence between the American and Chinese semi-structured interview responses. Specifically, the two groups' responses were coded for 12 absolute attraction mechanisms, 8 relative attraction mechanisms, 4 relational attraction mechanisms, 3 situational attraction mechanisms, and 9 trends related to the mapping principle. Of these 36 potential points of disparity, 6 cultural specificities surfaced.

First, in terms of absolute attraction mechanisms, Chinese participants were significantly more likely than American participants to say that leadership/teamwork skills were important to them when choosing an in-game teammate. This patterning of results is in line with previous research on American-Chinese intercultural differences. For instance, people in collectivistic cultures are more likely than people in individualistic cultures to prioritize group goals (Triandis, 2001); thus, it makes sense that Chinese people mentioned the importance of leadership and followership (i.e., individual attributes that lend themselves to group-level processes) more often than Americans.

Second, Chinese participants were significantly more likely than American respondents to say that agreeableness was important in choosing a real-world teammate. This patterning of results is also in line with previous research on American-Chinese intercultural differences. The Confucian value of harmony is central to Chinese culture (Leung et al., 2002), which leads Chinese people to value attributes—such as agreeableness—that function to maintain social harmony.

Third, Chinese participants were significantly more likely than American participants to say that general ability (i.e., KSAOs) were important when choosing a real-world teammate. This cultural disparity potentially resulted from the fact that the Chinese education system is very high-pressure and competitive (Ren, 2014), so Chinese students may feel the need to select teammates based on ability more often than Americans do.

Fourth, Chinese interviewees also mentioned goal homophily as a driver of in-game teaming significantly more frequently than American participants did. Collectivistic cultures tend to emphasize shared goals more so than individualistic cultures do (Parsons & Shils, 1951; Kluckhohn & Strodtbeck, 1961), providing an explanation for this result.

Fifth, Chinese individuals mentioned personality homophily as a driver of in-game teaming significantly more frequently than American people did. This finding supports the aforementioned social harmony argument; Chinese people are more likely than Americans to emphasize attraction mechanisms that buttress social harmony.

Sixth, Chinese gamers were more likely than American interviewees to mention reciprocity as a relational in-game teaming mechanism. This result is in agreement with previous research that has indicated that the norm of reciprocity is stronger in China than it is in western countries (Shen, Wan, & Wyer, 2011).

Discussion of Trace Data and Semi-Structured Interview Results

The results of the trace data analyses and semi-structured interviews converged on three assembly mechanisms: individuals tend to team up with similarly skilled, fellow guild members who they are already friends with, who are geographically proximal. Still, two patterns emerged from the trace data analyses that did not surface during the structured interviews; the ERGM results indicated that players assembled into teams based on guild role homophily and closure, but neither of these factors were mentioned consistently during the structured interviews. First, it is possible that players simply failed to mention guild role homophily because they did not think to discuss it. With the exception of guild leaders, players' guild roles may not be particularly salient, or may not be seen as important—especially when compared with guild affiliation. Second, previous research has indicated that individuals harbor certain biases when reflecting on the relational structure of their social networks (Kilduff, Crossland, Tsai, & Krackhardt, 2008); specifically, people tend to have biased perceptions of network closure (Kumbaser, Romney, & Batchelder, 1994; Krackhardt & Kilduff, 1999). Based off this previous work, it follows that interviewees had difficulty reflecting on and reporting closure as a relational attraction mechanisms.

Furthermore, interviewees highlighted three attraction mechanisms that were not confirmed by the results of trace data analyses. First, interviewees saw themselves as preferentially choosing teammates based on certain absolute characteristics; however, the results of ERGM analyses indicated a robust effect of preferential avoidance. Second, respondents perceived themselves as forming functionally diverse teams, but the trace data did not reflect this claim. Both of these disparities have been addressed by previous research, which indicated that individuals tend to overweight the impact that absolute and relative attraction mechanisms have on team self-assembly. Specifically, people tend to overestimate the impact that functional diversity plays during team formation (Wax et al., 2014). Third, interviewees reported that geographic dispersion was a driver of team self-assembly, when the trace data results indicated that, in fact, team formation was driven by geographic proximity. A simple explanation for this finding is that some players may use the virtual world of an MMORPG as a platform for keeping in touch with a few geographically distant friends (explaining the prevalence of these types of anecdotes in the semi-structured interviews), but that they—along with the rest of the players of the game—predominately play with local friends.

Finally, semi-structured interview participants routinely mentioned three attraction mechanisms that were not included in the trace data analyses: individual differences such as gaming style, agreeableness, and general personality; reciprocity; and temporal proximity. First, the ERGM results were based on the analyses of digital trace data, which are virtual by-products of human interaction, rather than the result of an intentional data collection process using instruments designed for research purposes. Thus, due to the unobtrusive, surreptitious nature of the data collection, no self-report data was acquired. Second, the Dragon Nest team membership network is inherently undirected, so reciprocity could not be tested as an attraction mechanism. Third, information on players' daily schedules, which would need to be obtained via self-report, is outside of the scope of the Dragon Nest digital trace data set. In the current data set, inferring temporal information via time zones is also not a viable option; the primary sample is almost entirely from China, which has a single, unified time zone.

Limitations

There are several important limitations of primary study of this dissertation. First, in terms of sampling, I employed a digital trace data set, which only reflects users of the Internet. Although China has the most Internet users in the world by far (DeSilver, 2013), this only accounts for a little more than 55% of China's adult population (Rainie & Poushter, 2014), meaning that the current sample only has the potential to generalize to less than half of China's population. For purposes of comparison, about 85% of America's population is online, although the United States still trails China in overall Internet usage. Furthermore, American Internet users tend to be disproportionately young, well-educated, wealthy, and urban (Pew Research Center, 2014b). In general, however, the growing popularity of the Internet is a trend that is true on a global scale: "[i]n a remarkably short period of time, internet and mobile technology have become a part of everyday life for some in the emerging and developing world…At least 20% use the internet daily in 15 of the 24 nations surveyed" (Pew Research Center, 2014a). However, the current study utilized digital trace data specifically from a MMORPG. Although social demographics vary greatly from one online game to another, it is clear that players of MMORPGs are diverse in terms of age, gender, marital status, and profession (Yee, 2006), and therefore are likely comparable to the population of Internet users at large. Overall, it would be inappropriate to generalize the results of the proposed research to certain social groups (e.g., elderly people), or to certain subsets of the world population (e.g., countries with limited Internet connectivity such as Indonesia or Nigeria; Pew Research Center, 2014a), but in general findings based on digital trace data are largely generalizable, to a large number of settings across the globe.

In addition, the current study was entirely descriptive in nature. In order to regard the conclusions of this dissertation with the highest degree of confidence, caution was taken to ensure that independent variables temporally preceded the dependent variable, and that potential confounds were controlled for. Even so, causality cannot really be determined without conducting a true experiment, (i.e., including an experimental manipulation, random assignment, and a control group). Furthermore, although the Dragon Nest data set is very large and includes a variety of different variables, I did not have access to many subject variables. In terms of evaluating certain questions, such as the impact of homophily on team self-assembly, knowledge of individuals' social identities would have been optimal.

One final limitation of this dissertation is the possibility that aspects of the Dragon Nest context and game design drive some of the findings about teammate attraction and its consequences. As an example, Dragon Nest provides players with a party (i.e., team) creation interface, which allows them to generate and join teams with strangers. Some of the participants in this study may have used the party creation interface, negating meaningful inferences that assume individual agency when choosing teammates. Because the digital trace data set does not make it apparent which teams were groups of strangers who joined forces using the party creation interface and which were preexisting groups, I attempted to control for this feature of the game by only including dyads that worked together at least twice over the course of the day. My reasoning behind this decision was that players who choose to continue working with one another must be psychologically driven to do so, and therefore it can be inferred that an attraction mechanism is motivating their teaming. However, it is also possible that individuals continue playing in teams of strangers that they formed using the party creation interface for completely arbitrary reasons. For instance, perhaps an individual is playing with a group of complete strangers and simply does not want to take the time or effort to use the matchmaking system again, so she repetitively teams with the same group. Thus, although this dissertation operated under the inference that the Dragon Nest teaming relationships are psychologically meaningful, these ties may be weaker/more evanescent than was previously assumed. In other words, the teaming relationships in the Dragon Nest data set may be relatively transient and short-lived. Although this limitation does not impact the findings of this dissertation per se, it is important to acknowledge it when interpreting the study's results. As Amy Edmonson (2012) implied, contemporary teams are increasingly fluid and less stable than the traditional, well-established teams of the past. Dragon Nest teams are undoubtedly a prototypical example of the modern, ephemeral team, and therefore the findings from this dissertation should be interpreted and generalized accordingly.

Future Research

Future research could test the hypotheses set forth in this dissertation with more experimental rigor by conducting a large-scale, virtual quasi-experiment with the goal of collecting digital traces. This type of methodology is still relatively rare, but is increasingly being embraced by researchers of various disciplines. One scholar who pioneered a number of innovative techniques for conducting big data research so as to maximize internal validity is Sinan Aral. For example, Aral, Muchnik, and Sundararajan (2009) employed a sample of 27 million users of Yahoo! instant messenger. Their research focused on the underlying causes of users adopting a new product offered by the company—Yahoo! Go (a mobile phone application). The researchers used a methodology of their own development, known as dynamic matched sample estimation, which "controls for confounding factors and overcomes selection bias by comparing observations that have the same likelihood of treatment" (p. 21546). Using this framework, they concluded that when homophily effects are left unaccounted for, social influence effects tends to be overestimated. Similarly, Aral and Walker (2012) used a sample of 1.3 million users of a commercial Facebook application. The researchers randomized receipt of notifications from the application so that only a randomly selected subset of friends of users of the application would receive passive viral messages. They discovered that older people are more influential than young people, and young people are more susceptible than older people. Furthermore, they concluded that older people tend to influence younger people more than younger people influence older people. Additionally, the results of the research indicated that women were less susceptible than men. This particular study demonstrated strong internal validity; randomizing the sending of viral messages circumvented the selection bias, the homophily/assortativity bias, and other confounding factors.

In addition, future research could address the hypotheses of the primary study using a mixed methods approach. Collecting and analyzing both digital trace and self-report data would provide a more holistic view of the team self-assembly process. The administration of a self-report survey in conjunction with big data collection would allow future researchers to test hypotheses related to a variety of subject variables—such as personality variables—that not easily deduced via digital traces. Moreover, in the future scholars could carry out field research to evaluate team self-assembly in populations of people that do not routinely use the Internet, such as older people in the United States.

Future research could also evaluate reciprocity as a potential relational attraction mechanism by measuring and assessing a directed team assembly outcome network. Finally, future research could gauge the impact of temporal proximity on team self-assembly in two different ways. First, researchers could use a mixed methods approach, and ask participants to self-report their schedules. Second, a team assembly network from an area with a wide variety of time zones could be analyzed.

Scientific Advancements

The study of self-assembled teams is yet in its infancy, and this dissertation made an important contribution to the growing body of scholarly knowledge regarding the attraction mechanisms that influence the formation of self-assembled teams. Specifically, the results of the primary study of this dissertation revealed that individuals tend to self-assemble into teams that are homogenous at the surface-level, and also tend to form teams based on prior friendship, closure, and geographic proximity. Furthermore—deviating from hypothesized outcomes—results also suggested that: attractiveness as a teammate is not proportional to popularity as a teammate; individuals do not tend to self-assemble into teams that are homogenous in terms of deep-level characteristics; and situational attraction mechanisms are not the most influential on team self-assembly. This dissertation also made a significant contribution to the growing body of scholarly knowledge regarding the performance of self-assembled teams. Specifically in terms of performance analyses, a number of significant differences between performance groups were evidenced: unsuccessful teams were more homogenous at the deep-level than successful teams were, successful teams were more homogenous at the surface-level than unsuccessful teams were, and successful teams formed based on friendship more often than unsuccessful teams did.

One of the main theoretical contributions of this dissertation was to evaluate which theories of interpersonal attraction may be applicable to the context of teaming. Based on the results, similarity-attraction (Byrne, 1971; McPherson et al., 2001), familiarity-attraction (Zajonc, 1968, 2001), closure (Heider, 1958), and propinquity (Festinger et al., 1950; Newcomb, 1956) theories all seem suitable to apply to the workplace, while preferential attachment appears to be less appropriate. However, it may also be possible to apply the results of this study back to the context of interpersonal attraction. The interpersonal attraction literature has largely centered on the impact of exogenous variables (e.g., individual differences) on friendship and romance. Endogenous predictors, on the other hand, are not independent of the relational structure of the network, but are defined by the structure of relationships; for example, closure (Hunter et al., 2008). While popular in the context of network science, exogenous predictors tend to be removed from the scholarly discussion of the psychology of attraction. The results of this dissertation imply that endogenous variables are indeed important to consider when predicting team self-assembly ties. For instance, across many different models, one clear conclusion of this research is that dyads who share a common teammate are much more likely to be teammates themselves than dyads who do not share a common teammate. Based on these robust findings, it is clear that endogenous variables should be considered as potential predictors of interpersonal attraction, as well as teaming relationships.

Implications for Practice

Based on the results of this dissertation, a couple of recommendations for teaming are clear. First, the results of the trace data analyses indicated that unsuccessful teams were more homogenous than successful teams in terms of completed quests (i.e., a measure of deep-level experience). This finding supports the notion that homogeneity—specifically deep-level homogeneity—is bad for performance. Furthermore, semi-structured interviewees clearly voiced the desire to create teams homogeneous in terms of player capability (i.e., game experience/skill). Therefore, individuals should be wary of their natural predilections to team up with similarly skilled others, as this may result in inferior performance. In other words, having a variety of ability levels on a team may be good for performance.

Second, the results of the analyses of digital trace data indicated that successful teams formed based on friendship more often than unsuccessful teams did. Moreover, semi-structured interviewees also explicated the desire to form teams based on friendship. Therefore, it appears that prior familiarity is an effective mechanism for team self-assembly, and one that most people are already cognizant of using, which may make it easier to harness.

Generalizability

This dissertation has three primary issues of generalizability: are the teaming mechanisms and their consequences that were found in this study generalizable to 1) teams in the workplace, 2) teams that interact offline, and/or 3) teams outside of China (e.g., teams in the United States of America)?

The first generalizability issue is: do this study's findings on teammate attraction and its consequences extend to teams that would be found in typical work settings? Teams in Dragon Nest are relatively short-lived and membership is highly fluid. Although teams like this do exist in the real world—such as virtual teams of software developers and cyber security teams that rapidly assemble in response to a specific threat—the vast majority of workplace teams are still traditionally staffed groups of employees. Therefore, the generalizability of this study may be relatively narrow. Moreover, an additional issue of generalizability stems from the fact that online gamers tend to be disproportionately young and educated, so that results of this study may not generalize to older, less educated groups of people. It may be the case that younger and older workers differ in their teammate selection rules. As individuals choose teammates and then witness the consequences of those decisions, they likely refine their implicit policies. This may affect the types of factors individuals consider important.

The second generalizability issue is, do the findings of teammate attraction and its consequences found in this study extend to teams that form and interact offline? The semi-structured interview portion of the current study asked individuals to self-report real-world teaming experiences of any variety. Participants described an assortment of teams that they had been a part of, including class project teams, sports teams, and military teams. Admittedly, the current study conflated these examples, combining them into a single category without regarding their vastly different purposes. While the current data do not speak to the issue of team function, this is an interesting avenue for future research. Furthermore, it is clear from the semi-structured interview portion of the study that one of the main perceived differences between the real world and the virtual world is the degree of anonymity that players are afforded online, and the relative degree of difficulty that they have discerning the attributes of other players. Therefore, it is possible that teams in face-to-face contexts may rely on different attraction mechanisms, based on stimuli that are more salient in those contexts. For instance, individuals in the real world may rely more heavily on similarity-attraction, because of the salience of surface-level characteristics.

Finally, this dissertation looked at cultural differences in the use of teammate attraction mechanisms, and found that there were a number of systematic differences between Chinese and American interviewee responses regarding teammate selection. Specifically, Chinese participants were significantly more likely than American participants to say that they made teammate selection decisions based on leadership/teamwork skills, agreeableness, general ability, goal homophily, personality homophily, and reciprocity. These disparities can largely be attributed to differences between interpersonal relationships in collectivistic and individualistic cultures. Therefore, although the results of this study indicated that the majority of teammate attraction mechanisms may be cross-culturally generalizable, there may be nuances related to the ideas, customs, and/or social behavior of a particular society that make certain teammate attraction mechanisms more or less prevalent.

Conclusion

It has been suggested that MMORPGs are the online laboratories that will mold the skills of the future leaders of tomorrow (Reeves, Malone, & O'Driscoll, 2008). This dissertation explored this suggestion; how might online relationships help explain offline relationships? Specifically, this study investigated the attraction mechanisms that guide teaming in the virtual world, the performance implications of said attraction mechanisms, and the potential similarities and differences of the virtual and real worlds. The results of the trace data analyses and semi-structured interviews both indicated that self-assembled teams form via three assembly mechanisms: homophily, familiarity, and propinquity. However, certain patterns emerged from the trace data analyses that did not surface during the structured interviews—such as self-assembly based on closure—while interviewees highlighted other attraction mechanisms that were not confirmed by the results of trace data analyses—such as preferential attachment, functional diversity, and geographic dispersion. Moreover, results of the trace data analyses indicated that unsuccessful teams were more homogenous in terms of certain characteristics than were successful teams, and successful teams formed based on friendship more often than unsuccessful teams did. Overall, the results of this dissertation clearly, explicitly indicated that preferential avoidance, homophily, closure, and propinquity drive the formation of self-assembled teams. This research also shed new light on a number of attraction mechanisms that possibly drive the formation of high- and low-performing self-assembled teams.

APPENDIX A

R CODE FOR SIMPLE RANDOM IMPUTATION

```
random.imp <- function (a){
	missing <- is.na(a)
	n.missing <- sum(missing)
	a.obs <- a[!missing]
	imputed <- a
	imputed[missing] <- sample (a.obs, n.missing, replace=TRUE)
	return (imputed)
}
```

APPENDIX B

R CODE FOR GEOLOCATING I.P. ADDRESSES

```
library(rjson)

freegeoip <- function(ip, format = ifelse(length(ip)==1,'list','dataframe'))
{
  if (1 == length(ip))
  {
    # a single IP address
    require(rjson)
    url <- paste(c("http://freegeoip.net/json/", ip), collapse='')
    ret <- fromJSON(readLines(url, warn=FALSE))
    if (format == 'dataframe')
      ret <- data.frame(t(unlist(ret)))
    return(ret)
  } else {
    ret <- data.frame()
    for (i in 1:length(ip))
    {
      r <- freegeoip(ip[i], format="dataframe")
      ret <- rbind(ret, r)
    }
```

```
        return(ret)
    }
}
```

APPENDIX C

SEMI-STRUCTURED INTERVIEW SCRIPT

Introduction

Hello! Thank you for volunteering to participate for this study.

[pause]

My name is [insert interviewer name], and I'm interested in learning more about the experiences of people that play massively multiplayer online role-playing games (MMORPGs) that involve teamwork.

[pause]

Before we begin, I have a consent form that I'd like you to read over and sign.

[hand participant the consent form;
give participant time to read it over]
...
[check to make sure that they have indicated their consent]

Great! Now, just to double check, you're 18 years of age or older and a current regular MMORPG player, correct?

[pause for response]

Great! Do you have any questions for me before we begin?

[pause for response]

Excellent. Let's begin.

[turn on audio recording device]

Social Interactions in MMORPGs

In this interview, I'm hoping to better understand the kinds of social interactions that you engage in with other MMORPG players. Some examples of social interactions might be becoming friends, chatting, and/or teaming on quests in general or dungeon quests in particular. There may also be other ways you interact in MMORPGs. I hope you can help me understand all of your social interactions. [Note to the interviewer: we define social interaction very broadly to include any interaction with another person, regardless of the reason for the interaction.]

1. Do you interact with other people in the MMORPGs that you play?

[if response is "yes, I interact with other people" then continue with this list of questions, pausing after each one for response and follow up questions such as: (a) please give me an example, (b) please tell me more about that, (c) please explain, (d) why not, or (e) why?

or

if response is “no”, then skip to Question 32]

2. Please tell me more about the ways in which you interact with other MMORPG players?

3. Do you interact with people in the game that you already knew offline? Do you tend to interact with people who you are familiar with outside of the game?

4. Do you meet new people in the game? If so, why and how? If not, why not?

5. How often do you interact with others while playing? What influences how much you interact with others?

6. Do you form teams in the MMORPG(s) that you play? If not, why not? Do you form teams in other online social activities? Why or why not? What about other work related contexts? Why or Why not?

[if response is “yes, I form teams” then continue with this list of questions, pause for response

or

if response is “no”, then skip to Question 27]

6. When and why do you form teams in the MMORPGs that you play?

7. Are there different types of teams that you form? What are the different types?

8. How do these teams form?

9. Who initiates these teams? Are you usually the initiator of the team, or do you ask to join teams, or do you wait to be asked to join a team?

10. How difficult is it to find people to play with?

11. Could you provide a step-by-step example of a situation where you formed a team, and how it came together? (i.e., who asked whom, how did they know each other, etc.)

12. Is the process of forming teams something you think about or does it just come together? In what ways?

13. Do you always team with the same people or do you team with new people all the time?

14. How do you decide to continue with a team or to change teams?

15. What do you look for in a team? What factors are important to you?

16. In general, how strategic are you about putting your teams together? Are other people casual about this or pretty serious?

17. Do you ever team up with newcomers who have just started playing?

[if response is “yes, I have teamed up with newcomers” then ask Questions 18 & 19 or

if response is “no”, then skip to Question 20]

18. In what ways do you enjoy working with newcomers? What are the benefits?

19. In what ways do you not enjoy working with newcomers? What are the drawbacks?

20. Do you ever team up with mentors within the game(s) that you play?

[if response is "yes, I have teamed up with mentors" then ask Questions 21 & 22

or

if response is "no", then skip to Question 23]

21. In what ways do you enjoy working with mentors? What are the benefits?

22. In what ways do you not enjoy working with mentors? What are the drawbacks?

23. Do you ever team up as a mentor to others?

[if response is "yes, I have played as a mentor" then ask Questions 24 & 25

or

if response is "no", then skip to Question 26]

24. In what ways do you enjoy teaming as a mentor to others? What are the benefits?

25. In what ways do you not enjoy teaming as a mentor to others? What are the drawbacks?

26. In what ways do you think working in teams in MMORPGs is similar to and different from working in teams more generally offline?

27. Do social connections matter in MMORPGs? How so or why not? Do you think there's a social hierarchy in MMORPGs? What determines who has high or low status? Do you think these are the same people who have high or low status offline as well? In what ways is it similar or different?

28. When you interact with others in MMORPGs, in what ways are you able to determine people's personal characteristics like age, gender, or ethnicity? Is it easy or difficult to determine people's personal characteristics? Do people ever try to hide their identity? If so, do you think that's a problem?

29. When you interact with others in MMORPGs, do you prefer people who are similar to you or who are different from you? In what ways? Are there certain qualities that you like to have in common? What are some examples? Are there qualities you like in others that are different from you? What are some examples?

30. Do you ever first meet people first in MMORPGs, and then meet up offline? Please tell me more about that...

31. Is there anything else about online interactions in MMORPGs that you think is relevant or important?

Social Interactions in General

The second set of questions is about the way that you team up with people more generally. You may think of teams that you have been on at work, at school, or in social settings like sports or clubs.

32. What are some the teams that come to mind?

33. Next, please think of a specific team that you enjoyed being a part of, that was important to you. Please tell me a little bit about this team: what was its goal? When were you on this team? Who were your teammates? How did you first meet these teammates? How did this team form?

34. Next, please think of a specific team that you did not enjoy being a part of, that was frustrating to you. Please tell me a little bit about this team: what was its goal? When were you on this team? Who were your teammates? How did you first meet these teammates? How did this team form?

35. In general do you like working in teams? If given a choice, do you prefer working alone or in teams?

36. What kinds of people do you work well with in teams? What kinds of people do you not like to work with in teams?

37. Do you think you are a good team player? Why or why not?

38. Is there anything else about your experiences working in teams that you think is relevant or important?

Online Interactions in General

The third set of questions is about your online interactions in general.

39. How often do you play MMORPGs? How many hours each week (or month) do you spend playing MMORPGs? How do you decide when to make time to play?

40. What online games do you play? How many hours each week (or month) do you spend playing those online games?

41. Other than games, what types of social media do you use to interact with others (e.g., email, Skype, Twitter, Facebook, Instagram, etc.)? How many hours each week do you spend interacting with others online? How do you decide when to make time to play?

42. Do you ever meet new people or make new friends online that you don't already know offline? Please give me an example of when/how this happens?

43. Is there anything else about your experiences interacting online that you think is relevant or important?

Conclusion

[turn off audio recording device once participant is done talking]

Thank you so much for participating in this research study! Do you have any questions for me?

[pause for response; answer questions if necessary]

APPENDIX D

DEFAULT ERGM SETTINGS

seed=100

burnin=3000

interval=200

MCMCsamplesize=10000

maxit=20

control=control.ergm(steplength=.25)

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