Work Together, Play Smart: Collective Intelligence in *League of Legends* Teams

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1. INTRODUCTION

Are some teams characteristically smarter than others? Research on both face-to-face and online teams suggests that the answer is "yes." In recent work, we found that teams exhibited a characteristic level of collective intelligence, manifest in their performance across a wide range of tasks and that this measure of collective intelligence predicted future performance on more complex tasks , (Engel et al., 2015; Woolley, Chabris, Pentland, Hashmi, & Malone, 2010). However, this work focused on ad hoc groups of strangers with no previous experience of working together, and it looked only at artificial tasks conducted in a laboratory environment.

Here, we examine these questions in the context of existing teams in the multiplayer online video game *League of Legends.* In *League of Legends,* currently the most popular video game in the world with an active monthly player base of 67 million, players self-organize into teams and battle against other teams in a simulated fantasy world. In a study of 279 of these teams, we find that the existing teams exhibit the same kinds of group collective intelligence as previous ad hoc experimental teams did. We also find that their collective intelligence measures correlate with their actual performance in the game.

1.1 Background: Measuring Collective Intelligence

Psychologists have repeatedly shown that a single statistical factor—often called "general intelligence" or "*g*"— emerges from the correlations among *individual* people's performance on a wide variety of cognitive tasks (e.g., Deary, 2012; Spearman, 1904). Individual intelligence has furthermore been shown to predict a wide range of outcomes of individual's life span, from academic performance to career success and even life expectancy.

Our recent research sought to determine whether a similar kind of "collective intelligence" exists for *groups* of people. In our initial paper, we found converging evidence of a general collective intelligence factor that predicts a group's performance on a wide variety of tasks (Woolley et al., 2010). The groups in this study spent approximately 5 hours together in our laboratory, working on a series of tasks that required a range of qualitatively different collaboration processes (McGrath, 1984). A factor analysis of the groups' scores revealed a single, dominant, general factor explaining a large proportion of the variance in all of the groups' scores. In individuals, this factor is called "general intelligence;" for groups, we call this first factor "*collective intelligence.*" In addition, collective intelligence was positively correlated with proportion of women, social perceptiveness, and equal conversational turn taking.

More recent work has replicated these basic findings with groups working for just one hour on an online battery of tasks (Engel, Woolley, Jing, Chabris, & Malone, 2014), and in groups in multiple

cultures (Engel et al., 2015). However, this work has not examined intact groups and tasks outside the laboratory.

1.2 Background: Performance in online gaming environments

Whether or not teams in an online gaming environment will exhibit a level of collective intelligence that can be used to meaningfully predict their performance together is an open question. On one hand, it is not clear whether being collectively intelligent in a general sense would benefit game performance, which centers around tasks that are fairly specialized such as killing virtual monsters and sieging an enemy's base. On the other hand, in multiplayer online role-playing games, player characters possess different skills and strengths, and they need to work together to complete complex missions more efficiently (Huang et al., 2009). Leadership also emerges as certain members spearhead the team's strategies and tactics, analogous to real-world team and organizational contexts, though imperfectly (Reeves, Malone, & O'Driscoll, 2008). Thus, a team's ability to work together smoothly may contribute to their performance in online team-based games just like in any teamwork situation, above and beyond the sum of individual skills.

2. METHOD

To recruit currently active League of Legends teams, we posted our research advertisement on the community board at the *League of Legends* website and reddit.com/r/leagueoflegends. Of over 1,000 teams that signed up, a total of 279 five-person teams participated in the study. Teams' performance is internally rated based on Match Making Rating (MMR), similar to the Elo rating system, which quantifies teams' chances of winning. In addition, the game currently has seven different "tiers" based on teams' performance level: bronze, silver, gold, platinum, diamond, master, and challenger. Participating teams were rewarded in-game currencies worth approximately $15 (US) and a summary of study results.

Upon signup, team members were asked to fill out an individual survey and then complete our one-hour collective intelligence (CI) battery online as a group. The individual survey included basic demographic questions, a measure of social perceptiveness (i.e., Reading the Mind in the Eyes (RME) test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001)), a Big 5 personality test (Barrick & Mount, 1991), a typing speed test, and measures of team processes (e.g., satisfaction, psychological safety, learning, leadership, trust, and communication). The online CI battery consisted of a series of group tasks that require various collaboration processes (e.g., generating, choosing, remembering, executing). Groups' performance on the tasks was used to compute the CI score as a weighted average of the individual task scores with the weights chosen to maximize correlation with all the tasks (Engel et al., 2014). In addition, Riot Games provided the teams' in-game data such as highest tier achieved, and team members' average MMR, which quantifies the teams' chance of winning against other teams in their division (there are five ranked divisions in each tier).

3. PRELIMINARY RESULTS

Factor analysis using the principal components method yielded one factor with an initial eigenvalue accounting for 40.77% of the variance whereas the next factor explained 12.34%, consistent with previous research (Engel et al., 2014; Woolley et al., 2010). Cronbach's alpha of task scores was .73, suggesting a moderate level of internal consistency among the tasks in the collective intelligence battery. The team collective intelligence scores were also significantly correlated with the teams' performance in the game as measured by the average MMR ratings (r = .13, p < .05) and by the highest tier they reached (r = .14, p < .05). Figure 1 shows the mean CI scores of teams by tier.

Platinum teams' CI scores were significantly higher than bronze teams' ($t(57) = -2.32$, $p < .05$); other pairwise differences did not reach statistical significance.

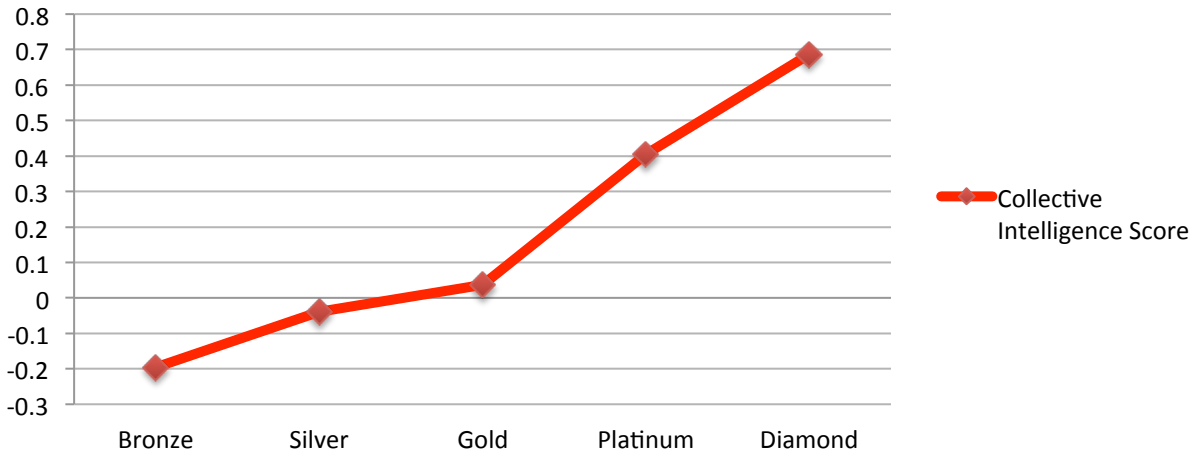

Fig. 1. Average collective intelligence score by team performance tier. There were only three teams higher than diamond in our sample. They were removed from this comparison, as the means could not be compared meaningfully.

Next, we ran a regression using the CI score as the outcome variable and the three factors predicting collective intelligence of face-to-face groups in previous research (Woolley et al., 2010) (i.e., proportion of females, social perceptiveness, and equal communication distribution) as the predictor variables. Team members' average typing speed was added as a control variable to rule out the influence of basic computer skills on CI score. When entered together, only social perceptiveness as measured by the RME test had a significantly positive effect on CI ($\beta = .21$, $p < .001$).

In addition, CI was positively correlated with the total amount of chat during the collective intelligence battery ($r = .15$, $p < .05$). Among team self-report variables, perceived equality of leadership was negatively correlated with CI ($r = -.16$, $p = .01$). Thus, the equality that seems to be a hallmark of collective intelligence in traditional teams may not carry over to the online gaming environment. Like the previous experiments, however, none of the other team variables such as satisfaction, psychological safety, learning, trust, and communication were correlated with CI.

4. CONCLUSION

The primary goal of this research was to examine whether general collective intelligence emerges in teams with previous experience working together and whether it also predicts the teams' performance on tasks that are not just laboratory tasks. Our preliminary results with the popular online multiplayer game *League of Legends* suggest that the answer to both questions is "yes." These intact teams appear to have a collective intelligence factor as did the ad hoc laboratory teams studied previously. And the team collective intelligence factor appears to be correlated with a team's performance in the game. In addition, as in face-to-face settings, teams' average social perceptiveness was a significant predictor of their collective intelligence.

Also, surprisingly, collective intelligence did not covary with most of the team-related variables that are commonly studied in team literature. In fact, the social and cognitive aspects of team processes measured via self-report were strongly correlated with each other, broadly capturing how team members perceive their teams' effectiveness and well-being. They did not, however, correlate with the extent to which the team actually performs well.

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