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The influence of task demand and social categorization diversity on performance and enjoyment in a language learning game

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ABSTRACT

Task demand type (e.g., competitive, cooperative, conjunctive) is an important factor influencing learning motivation and performance in a group. Limited research is available regarding conjunctive task demand for learning tasks, especially for the lower performing individuals. Additionally, group composition or social categorization diversity in a group is another important yet relatively understudied factor. To fill the research gap, this study attempted to examine the effects of task demand and social categorization diversity in a group on motivation and performance in a computer-based foreign language learning game. Seven conditions were included: 2 (social categorization diversity: in-group or out-group) \times 3 (group task demand: competitive, conjunctive, or cooperative) plus an individual task demand control condition. A total of 102 undergraduates without prior Italian language background were randomly assigned to one of the seven conditions to play an Italian learning game on the computer in the laboratory for about 15 min. We found that for inferior group members, a conjunctive task was the most effective for the performance of learning Italian vocabulary. Significant interaction effects between social categorization diversity and task demand were found for both task performance and enjoyment. Implications for serious games and mediated educational tool design are discussed.

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1. Introduction

The effects of the competition and cooperation aspects of group task demand on motivation, engagement, and task performance have been researched in a wide range of domains, including physical persistence, motor performance, learning, and group decision making (Deutsch, 1949; Johnson, Johnson, & Stanne, 1986; Lungu & Debas, 2013; Tauer & Harackiewicz, 2004). As competition and cooperation are the basic mechanics present in most computer and video games, particularly multiplayer gaming, scholars are beginning to examine the effects of competition and cooperation in digital games on

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enjoyment (Schmierbach, Xu, Oeldorf-Hirsch, & Dardis, 2012), motor performance (Peng & Crouse, 2013; Peng & Hsieh, 2012; Staiano, Abraham, & Calvert, 2012), and aggression (Eastin, 2007; Ewoldsen et al., 2012; Schmierbach, 2010; Velez, Mahood, Ewoldsen, & Moyer-Guse, 2012).

The effects of group task demand on lower performing (inferior) individuals is relatively understudied. Understanding how lower performing individuals are impacted by task demand and identifying ways to promote performance and motivation are critical for serious games (Ritterfeld, Cody, & Vorderer, 2009) and mediated educational tools because it is crucial to benefit all users when leveraging serious games and other technology-based tools for motivation and performance enhancement. Otherwise, this might result in “the poor get poorer”. To the best of our knowledge, the current research in serious games and computer-based education lacks evidence regarding lower performing individuals. Therefore, the first goal of the present study is to add research evidence regarding the effects of task demand type on lower performing individuals.

One type of group task demand that has received considerable attention in the group process and motivation literature are conjunctive tasks, in which the group’s overall performance depends on the results of the inferior group member(s). Studies have consistently found that conjunctive tasks are effective in promoting inferior members’ motivation, particularly in physical and motor performance tasks (see Weber & Hertel, 2007, for a meta-analytic review). However, conjunctive tasks have not been fully explored as a game mechanic or in cognitive performance tasks. Given its motivational potential in the physical and motor performance domain, research is needed to examine whether conjunctive tasks would result in similar motivational gains for the low-performing partner in game contexts or cognitive performance contexts. If similar results are found, conjunctive task demand can be applied for motivational gain and may have significant impact for educational games or academic learning. Further, there is very limited research evidence on the effects of conjunctive task demand on cognitive tasks, especially learning outcomes. Thus, it is almost unknown if a less capable individual would also benefit from conjunctive tasks when it comes to the educational context. Therefore, the second goal of the present study is to fill the gap in the current body of research regarding the effects of conjunctive task demand on motivation and performance in the domain of learning and cognitive tasks (i.e., a foreign language learning computer game).

Additionally, motivation gain related studies targeting inferior group members predominantly center on extrinsic motivation, while overlooking intrinsic motivation. Intrinsic motivation, which is mostly operationalized as enjoyment of task, is an important component for both explaining and predicting human activities (Deci & Ryan, 1985). The assumption of gaming is based on the premise of engaging players via a fun experience. Understanding how task demand type influences enjoyment is critical for the development of games to increase motivation. Therefore, the third goal of the present research is to examine the effects of competitive, cooperative, and conjunctive task demands on intrinsic motivation as well as performance for lower performing individuals in a cognitive task using a digital game.

Competitive, cooperative, and conjunctive task demands all operate in the group setting. As such, social categorization diversity of the group is an important factor to consider. However, only limited evidence is available regarding the potential moderating effects of social categorization diversity in multiplayer gaming and these studies mostly focus on physical exertion games or violent video games (Peng & Hsieh, 2012; Velez et al., 2012). Therefore, the fourth goal of the present research is to expand empirical evidence regarding the potential interaction effects of social categorization diversity and group task demand on motivation and performance to the serious games for learning domain.

2. Literature review

2.1. Task demand type, motivation, and performance

Working in a group elicits an increase in effort of individuals when compared to working alone (Allen & Hecht, 2004; Hüffmeier & Hertel, 2011). The most frequently studied task demands in group settings include competitive, cooperative, and conjunctive tasks. Competitive tasks involve at least two individuals attempting to outperform the others in a zero-sum manner. Cooperative tasks involve at least two individuals working together to attain a common goal (Johnson & Johnson, 1989). It needs to be noted that cooperation can exist in forms of outcome-interdependence and means-interdependence (Johnson & Johnson, 1989). Outcome-interdependent cooperation exists when “each group member receives the same reward for successfully completing a joint task” (Johnson & Johnson, 1989, p. 24). Means-interdependent cooperation exists “when individuals perceive that a task is structured so that two or more individuals are required to coordinate their efforts to complete it” (Johnson & Johnson, 1989, p. 25). In the current study, cooperative tasks are conceptualized in the form of outcome-interdependent cooperation, which are similar to additive tasks. In the conjunctive task setting, the overall performance of the individuals involved in the group task is determined by the results of the lower performing individual. An increasing body of research has found group task demand to be superior relative to working alone in triggering motivation for motor performance (e.g., weighted exercise bracelets) and cognitive maximizing tasks (e.g., simple math calculation) (Kerr & Tindale, 2004; Lount & Phillips, 2007; Pettit & Lount, 2010).

Recently, the task demands of competition and cooperation have been examined in video game play settings. A majority of the research focuses on the direct comparison between competition and cooperation and their combined effects on enjoyment and aggression. Very few studies compared group-based task demands (e.g., competition, cooperation) with individual/single player conditions. Among the existing studies that compared multiplayer conditions with individual conditions, it was found that multiplayer conditions provided players with more enjoyment (Peng & Crouse, 2013) and produced higher motivation and performance (Peng & Hsieh, 2012) than the individual/single player condition in the physical persistence

context, even for individuals who lost the competition. Although the above research was conducted in the context of motor performance, we expect similar findings in the context of a cognitive learning task as competition is likely to motivate people to be more engaged in the group task than the individual task, which results in greater performance. We hypothesize that competitive task demand will result in greater performance for lower performing group members than that of individual task demand in a foreign language learning game (H1).

We lack direct evidence of motivational gain in cooperative task demand for lower performing players in the video game context. However, the ample evidence regarding the effects of motivation gain for lower performing individuals in additive tasks in other domains (Hüffmeier, Krumm, Kanthak, & Hertel, 2012; Kerr & Hertel, 2011; Weber & Hertel, 2007) suggests that outcome-interdependent cooperative task demand should result in similar motivational gain in the gaming context. We propose the following hypotheses: Cooperative task demand will result in greater performance for lower performing group members than individual task demand in a foreign language learning game (H2).

A well-studied phenomenon that clearly shows the motivation gain in conjunctive tasks is the *Köhler effect*. The Köhler effect mainly investigates the motivation gain of individuals who are less capable in one's ability in carrying out the conjunctive task (Stroebe, Diehl, & Abakoumkin, 1996). Inferior group members exerted greater effort in conjunctive tasks since the overall group performance was dependent on the individual performance result of the least capable group member (Stroebe et al., 1996). In particular, when a partner is moderately better to complete the task than the inferior person, maximized results in motivation gains were observed (Köhler, 1926; Messé, Hertel, Kerr, Lount, & Park, 2002). A meta-analytic review on motivation gain of group members revealed that individuals who were inferior in one's ability to complete a task increased their efforts during conjunctive task demand compared to working alone (Weber & Hertel, 2007). The robustness of the Köhler effect on increasing motivation has received ample support, including in the context of promoting physical exercise among less competent individuals in health games (Feltz, Kerr, & Irwin, 2011; Irwin, Scorniaenchi, Kerr, Eisenmann, & Feltz, 2012).

Although there is no direct evidence of motivation gain in conjunctive tasks for lower performing individuals in the cognitive learning task setting using a digital game, the consistent evidential support for motivation gain in conjunctive tasks for lower performing individuals in other domains (Weber & Hertel, 2007) leads us to expect similar findings. As such, we hypothesize that conjunctive task demand will elicit greater performance for the inferior group members than the individual condition in a foreign language learning game (H3). Finally, we explore which of the group tasks—conjunctive, cooperative, and competitive—result in the greatest performance in a foreign language learning game (RQ1).

2.2. Social group diversity and task demand type

Among the three types of group task demand, the composition of the group has been identified as an important moderator for motivation gain (Insko, Kirchner, Pinter, Efav, & Wildschut, 2005; Kerr & Tindale, 2004; Pettit & Lount, 2010). Specifically, whether the group consists of in-group or out-group members has been found to have significant moderating effects in different task demands (Lount & Phillips, 2007).

People tend to work harder and put more effort when they anticipate being compared to an out-group (Kerr & Seok, 2011; Ouwerkerk, de Gilder, & de Vries, 2000). In competitive task demand, the theoretical foundation for the moderating effect of in-group and out-group members on motivation gain stems from social identity theory (Tajfel & Turner, 1986). According to social identity theory, belonging to a social group with perceived commonalities among its members (in-group) also differentiates them from others in separate groups (out-group). This awareness and value in group membership can enhance motivation to achieve goals that are meaningful to the group. A self-enhancement tendency (Sedikides, Gaertner, & Toguchi, 2003) is the basis for perceiving in-groups to be superior to out-groups on dimensions relevant for the comparison (Tajfel & Turner, 1979). Competition can take the form of behaviors performed by members of a group to enhance the reputation of their in-group relative to salient out-groups. In competitive tasks, especially when one perceives themselves to be the lower-performing individual in a trial assessment, outperforming the out-group member may be more important than outperforming the in-group member for an individual to make a favorable comparison of their group. Pettit and Lount (2010) examined motivation gain as a function of status differences in the competitive context of group performance (e.g., higher status out-group members vs. lower status out-group members). Their findings were explained in relation to social identity theory. The outperformance by lower status out-group members led to a perceived threat to their social identities, which ultimately elicited increased effort to defend their current social positions and favorable impressions of their own group (Tajfel & Turner, 1986). Therefore, we propose the following hypothesis: In competitive task demand, the presence of out-group members will result in greater performance for low-performing group members than that of in-group members (H4).

In cooperative task demand, the outcome is determined by the combined outcomes of the participating individuals. Two competing mechanisms may work in opposite directions when working with higher performing in-group or out-group individuals. On one hand, we expect that working with an in-group member may result in greater motivation than working with an out-group member, based on social identity theory (Tajfel & Turner, 1986). When the participating individuals are from the same group, exerting greater effort in the task will enhance self-image as well as the group image. On the other hand, the social loafing literature (Karau & Williams, 1993) indicates that lower performing individuals may not be motivated when they are working with a higher performing in-group member. The rationale is that they may expect the in-group member's higher performance is enough to increase their group's status or performance. As for cooperating with an out-group member, the combined outcome of the cooperative task will not have an impact on their in-group, and thus does not elicit increased

motivation and effort. Additionally, when the resulting performance is combined with an out-group member, the lower performing individual will not care and thus not be motivated to work harder. Therefore, there may not be any difference between working with an in-group or out-group member in cooperative task demand, especially when the individual is the lower performing one. Given the inconsistent theoretical prediction, we propose the following research question: Will the presence of out-group members result in different performance for low-performing group members than that of in-group members in cooperative task demand (RQ2)?

In conjunctive task demand, some evidence has been found that lower-performing individuals increased motivation and effort when working with an out-group rather than an in-group member (Lount & Phillips, 2007). The primary mechanism identified to explain the Köhler effect is social comparison. Individuals try to follow social standards and adjust their level of effort to meet societal expectations through upward comparison with superior others (Festinger, 1954). In particular, the motivation gain effect occurs when the inferior members perceive those standards as possible goals to achieve (Collins, 2000; Hertel, Niemeier, & Clauss, 2008; Major, Testa, & Blysm, 1991). When social comparison was made with an out-group member rather than an in-group member, the lower-performing individuals will be more motivated to exert greater effort to enhance one's social identity. Motivation gains were produced as a result of the increased perception of negative social comparison with the out-group members. Therefore, based on the above evidence and rationale, we propose the following hypothesis: In conjunctive task demand, the presence of out-group members will result in greater performance for low-performing group members than that of in-group members (H5).

2.3. Intrinsic motivation, task demand type, and social categorization diversity

Research on motivation gain in lower-performing individuals in different task demands primarily focuses on extrinsic motivation. To our best knowledge, virtually no previous work examines the effects of task demands on intrinsic motivation. According to self-determination theory (Deci & Ryan, 1985), intrinsic motivation refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation refers to doing something because one desires the outcomes it leads to. If one is put in a task which has a potential to be fun and enjoyable, like playing a learning game, it is worthwhile to investigate how different task demands impact intrinsic motivation that is usually operationalized as enjoyment (Ryan, Rigby, & Przybylski, 2006). In this study, we explore the following research questions. Which task demands—conjunctive, cooperative, competitive, and individual—results in the greatest enjoyment (RQ3)? Will the presence of out-group members or in-group members result in greater enjoyment for low-performing group members in competitive task demand (RQ4a), cooperative task demand (RQ4b), and conjunctive task demand (RQ4c)?

3. Method

3.1. Study design

The study employed a 2 (social categorization diversity: in-group or out-group) \times 3 (group task demand: competitive, conjunctive, or cooperative) +1 control (individual task demand) design. The individual task demand condition serves as a control group to compare with the six group task demand conditions. To examine the task demand effects on performance and enjoyment, comparisons were conducted among the individual game play condition, the competitive conditions (including both in-group and out-group members), the cooperative conditions (including both in-group and out-group members), and the conjunctive conditions (including both in-group and out-group members). To examine the effect of social categorization diversity (in-group vs. out-group) as well as its interaction with group task demand type (competitive, cooperative, and conjunctive) on performance and enjoyment, only six conditions were included. The control condition (individual task demand) was not included as social categorization diversity was only applicable when more than one person worked together on the task.

3.2. Participants

One hundred and twenty five college students from two large Midwest universities participated in the study. The recruitment survey screened out those who had prior experience in learning Italian to remove any confounding effect of fluency in Italian. Four participants were excluded due to assignment error. Among the remaining 121 participants, 19 of them were excluded from the analysis because they failed to correctly identify their task type, their own or their partner's group identity. Among the 102 participants included in the final data analysis, 33 were male (32.4%), 68 were female (67.3%), and one did not disclose their biological sex. To eliminate a possible gender effect, participants scheduled to come at the same experiment session were of the same biological sex.

3.3. Procedure

A screening survey was conducted to test participants' eligibility for the experiment (Fig. 1 summarizes all the steps in the study). Based on the result of the online screening survey, only those who knew less than 5 Italian words were invited to the lab experiment. The screening survey also included a Minimal Group Paradigm (MGP) dot estimation test (Gerard & Hoyt,

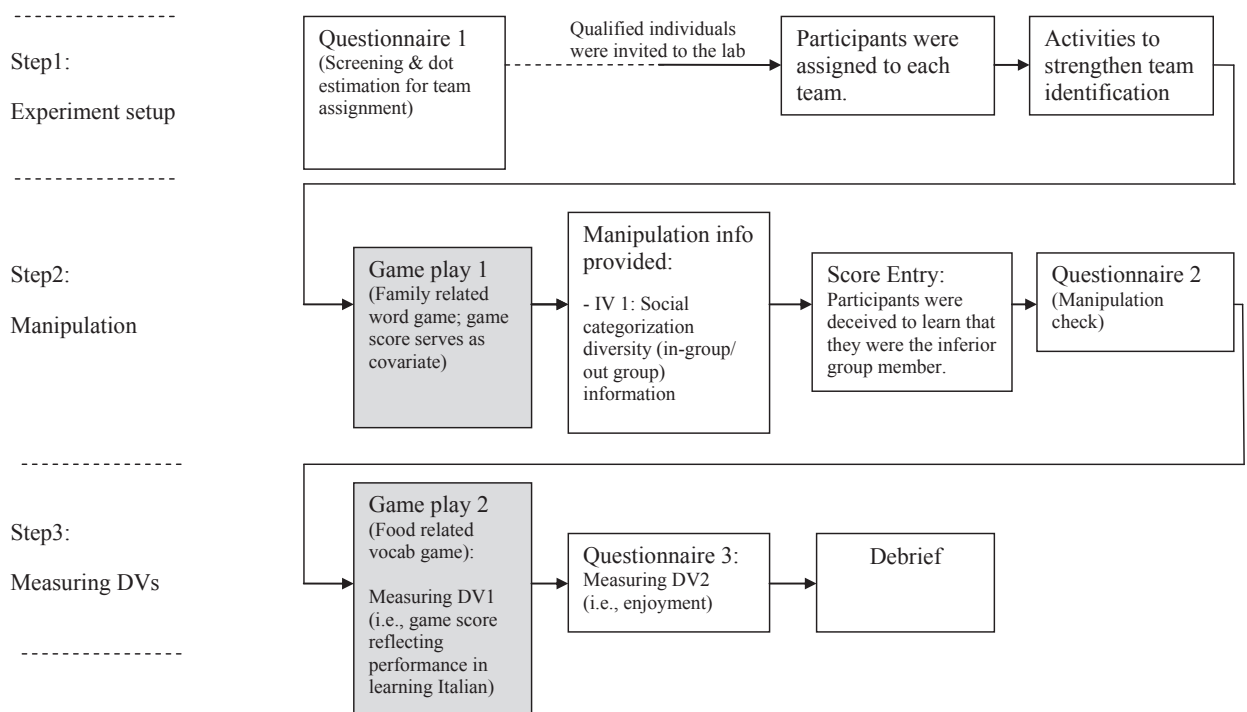


Fig. 1. Procedure of the Experiment. Note: IV: independent variable; DV: dependent variable.

1974; Lount & Phillips, 2007; Tajfel, Bilig, Bundy, & Flament, 1971), which was used to establish two groups for social categorization (i.e., in-group vs. out-group). Section 3.4 explains how the MGP dot estimation test was used to manipulate social categorization diversity.

Experiments were conducted at two sites. In order to ensure standardization of the experimental procedure, several strategies were adopted. First, a script for the entire process of the experiment was composed. Researchers were asked to read exactly what was written and follow the given instruction word for word. Second, voice-recorded instructions were created and played during the experiment using Acrobat Presenter 9. Finally, several rounds of pilot tests were conducted at both sites and then researchers had follow-up meetings to improve standardization of experimental procedure. The whole laboratory session lasted for about 50 min. Each session accommodated up to 12 participants.

Based on the screening survey, we stratified the sample by biological sex and randomly assigned participants into one of the seven conditions. In each session, participants were seated far apart so that they would not be able to observe the other participants' conduct. Participants were informed that they turned out to be an over-estimator or under-estimator based on the results of the dot estimation test, and were then assigned to the red or blue team respectively. To strengthen the perception of in-group or out-group manipulation, participants were asked to put on a necklace of their team color. Participants were provided with a colored score sheet corresponding to their team name (i.e., red or blue) to record their game scores as well as their study ID that began with their team categorization (e.g., RED123).

Before playing the main Italian learning game, each team had a simple task of playing a find-the-difference game (<http://www.hiddenobjectgames.com/difference-games.php>) to build a sense of group cohesion. About 3 people from each team shared one computer to play the game. Participants in the individual task demand condition were not primed for a team and played the find-the-difference game alone.

Then, each participant was seated in front of a separate computer to start the main portion of the experiment. The participants were seated apart and did not know specifically who their partner was in the dyadic conditions. While most of the instructions were based on the pre-recorded Acrobat Presenter instruction, a researcher's verbal instructions were also provided to make sure that participants in the same session were synchronized to start and finish the group tasks at the same time. When participants reached the end of a recorded instruction, they were asked to put a "done" sign on the upper left-hand corner of their computer monitor to show they were ready to proceed.

The participants played two sets of the Italian vocabulary game (trial and main sessions; see Stimuli section for details). First, participants played the Italian vocabulary game focusing on family-related words for the trial session and their game performance score was used as a baseline assessment and controlled in statistical analysis. Then participants were told that they were going to play another Italian word game (food-related vocabulary). Each set of game included 3–4 min of learning vocabulary from a list followed by the 3-min play of the *Whack-a-Word* game (see section 3.5 for details regarding the stimulus).

Before playing the second game, several instructions for manipulation were given. First, reward information was explained such that three people would be randomly chosen to win a raffle prize up to \$30. Although the chance of winning a raffle prize was completely random, once selected, the amount of the raffle prize was dependent upon the game points of the second set of game. This was done to increase participants' involvement in the study and was consistent with previous research (Lount & Phillips, 2007).

Second, all participants, except for those who were in the individual condition, were told that they were going to play with another person in the second game. To manipulate social categorization diversity, each participant was informed of the study ID of the participant whom they were going to play the game with (e.g., RED123). To remind the characteristics of each team and strengthen the manipulation of social categorization diversity (i.e., playing with in- or out-group partner), researchers once again explained to each participant whether he or she was [over- or under-estimator] while the partner was [over- or under-estimator].

Third, the task demand type was explained (see section 3.4 for the details regarding the manipulation of the task demand type). Fourth, a carefully designed procedure was implemented, so that all the participants in the study were manipulated to perceive themselves as the lower performing individuals. Those who were playing with another person (i.e., competitive, conjunctive, and cooperative conditions) were told that they were going to enter their game score from the trial session on the Google document-based online score sheet which was simultaneously shared within each game playing dyad. They were also informed that the score sheet would show the updates in real time. Thus, both participants in each dyad believed that they would see their partner's score as it was entered online. In fact, the Google document was not at all shared within the dyad. Instead, each person was given an independent online score sheet, which was pre-programmed in such a way that upon each individual's entering his/her score, the document would show the faux-performance of the other person which was always 1.2 times better than the manually entered score. Thus the participants always found themselves as the lower performing individuals. The choice of 1.2 times was based on previous literature on the Köhler effect (Weber & Hertel, 2007).

After all the instructions were delivered, participants were directed to the Google document of online score sheet and asked to enter their trial game score and observe the other person's 'score'. Then the participants filled out a questionnaire for manipulation check. After that, they played the second set of the game, *Whack-a-Word*, focusing on the food related Italian words. They were again reminded that the second game score would determine the reward and that their second game score would be determined depending on their task demand type. After completing the second game, participants completed the final questionnaire which included measures of enjoyment of the game and demographic information, followed by debriefing.

3.4. Manipulation of the independent variables

The MGP dot estimation test was used to manipulate social categorization diversity. Pictures of dots were shown for 6 s and participants were asked to estimate the number of dots in each picture. It was impossible to count the dots in the given time; participants were prompted to estimate and not count the dots. Then, participants' team categorization (i.e., over- or under-estimator) was randomly determined, but participants were told that their team categorization was determined based on their dot estimation test results. Participants assigned to the in-group conditions ($n = 44$) were either dyads of two over-estimators (both from the red team) or dyads of two under-estimators (both from the blue team). Participants assigned to the out-group conditions ($n = 42$) were dyads of an under-estimator and an over-estimator (one from the red team and one from the blue team).

To manipulate task demand type, the following instructions were given. In the competition condition ($n = 30$), participants were told that they were going to compete with the other participant in the second set of food-related vocabulary game. They were told that if they beat the other person, their points would be converted to the raffle prize, if they were chosen in the raffle. If they did not beat the other person, their points would be zero and could not win the prize even if they were chosen in the raffle.

In the cooperative condition ($n = 28$), participants were told that their score in the second game would be determined by the average of their points and the other player's points. If they were chosen in the raffle, the average of their points would determine the amount of the prize. Note that although they were assigned to cooperate with someone, they were not allowed to interact with or help the other person. In other words, cooperation in this study was operationalized as outcome-interdependent only, similar to additive task, not means-interdependent.

In the conjunctive condition ($n = 28$), participants were told that both of their game scores from the second game would be determined by the lower points of the two. In addition, the following example was given: "If your points are 200 and [Red/Blue xxx]'s points are 240, both your points and [Red/Blue xxx]'s points will be 200. If your points are 240 and [Red/Blue xxx]'s points are 190, both your points and [Red/Blue xxx]'s points will be 190." They were then told that if they were chosen in the raffle, the aforementioned rule for points would determine the amount of the prize.

In the individual task demand condition ($n = 16$), participants played the game on their own. They were asked to do their best to get the most points. In addition, they were informed that three people would be randomly chosen to win a raffle and the amount of the prize would be determined by the points they obtained in the second round of game play.

3.5. Stimuli

The Italian learning computer game, *Whack-a-Word*, was available from <http://www.moltobeneitalian.com/>. The cognitive task in this game focused on learning new knowledge. Two different sets of vocabulary games at the beginner level were

administrated. The participants played the game on a desktop computer. First, the participants started by listening to the pronunciation of a list of Italian words and reading their spelling and the corresponding English spelling in the website. Then, users would click on a game button to play *Whack-a-Word* for 3 min. In the game, a single Italian word would show and five bubbles with different English words would flash in and out consistently. Players were supposed to pick one bubble out of the five choices with the correct corresponding English word. As the English words would be continually moving and flashing in and out, quickly identifying the correct corresponding English word while it stayed on screen was essential for getting a high score. Each correct identification was worth of 100 points. If the wrong English translation of the Italian word appeared and the player clicked it, the player would lose 100 points.

3.6. Measures

The game score of the food-related Italian vocabulary in the second game was used as the dependent measure of performance of learning Italian. The trial session of the game score (family-related Italian vocabulary) was used as a covariate to control for language ability in data analysis.

For the assessment of intrinsic motivation (enjoyment), participants used a 9-point scale ranging from “describes very poorly” to “describes very well” to rate how the following 7 adjectives described enjoyment of the Italian word game (Song, Peng, & Lee, 2011): boring, enjoyable, entertaining, exciting, fun, interesting, and pleasant (Cronbach's $\alpha = 0.935$).

3.7. Manipulation check

Four questions were asked to test whether the participants understood their tasks based on the assigned conditions. First, to check task demand type manipulation, the participant was asked which one of the four statements best described how they would play the game: competing with another player and only the winner will be eligible for the prize [competitive task]; paired with another player and the average of their combined score will determine the amount of the prize if they win the raffle [cooperative task]; paired with another player and the score of the lower performing one will determine the amount of the prize if they win the raffle [conjunctive task]; and play on their own and their individual score will determine the amount of the prize if they win the raffle [individual task]. The second question asked which team the participant was in and the third question asked which team the player's partner was in (not applicable to individual task condition) (social categorization diversity manipulation check). The fourth question was an open-ended question to check whether they had suspicion about the manipulation that each participant was automatically determined as the lower performing one, regardless of their game scores.

4. Results

To examine the effects of the four task demand types (individual, competitive, cooperative, and conjunctive tasks) on performance, a one-way analysis of covariance (ANCOVA) was conducted. The game score of the trial game session (i.e., family-related Italian words) was used as the covariate to control for individual difference in language learning. ANCOVA results indicated that the four study conditions resulted in significant difference in performance of learning of food-related Italian vocabulary, $F(1, 97) = 2.74, p = 0.047, \eta^2 = 0.078$. The trial Italian game (family-related vocabulary) score was also found to be a statistically significant covariate, $F(1, 97) = 8.15, p = 0.005, \eta^2 = 0.078$. Post-hoc comparison using Bonferroni correction indicated that only the conjunctive task demand condition resulted in significantly greater performance than the individual task condition ($p = 0.02$, one-sided) (H3 was supported). Neither the competitive ($p = 0.50$, one-sided) nor the cooperative task demand ($p = 0.50$, one-sided) resulted in statistically different performance than the individual task condition (H1 and H2 were not supported). The three group task demands, competitive, cooperative, and conjunctive, did not result in different performance, $F(1, 98) = 6.72, p = 0.51$ (RQ1). The contrast test confirmed that conjunctive task was the best way to increase performance among all the group-based tasks, $t(61.57) = 2.14, p = 0.036$.

For the analyses of the effects of task demand type on enjoyment, individual difference in language learning was not used as a covariate and a series of analyses of variance (ANOVA) were used. The four task demands did not result in significant differences in enjoyment, $F(1, 98) = 1.00, p = 0.40, \eta^2 = 0.03$ (RQ3). The means and standard deviations of the dependent variables for the four task demand types are reported in Table 1.

To examine whether group task demand type and social categorization diversity had interaction effects on performance, a two-way ANCOVA was conducted, using the trial game score as the covariate. No main effects were found ($F(1, 79) = 3.10, p = 0.08, \eta_p^2 = 0.04$, for social categorization diversity; $F(2, 79) = 2.21, p = 0.12, \eta_p^2 = 0.05$, for task type demand), although the

Table 1
Means and standard deviations of the dependent variables by condition.

Dependent variables	Individual ($n = 16$)	Competitive ($n = 30$)	Cooperative ($n = 28$)	Conjunctive ($n = 28$)
Performance	2512.50 (458.80)	2703.33 (688.57)	2757.24 (458.20)	2985.71 (485.89)
Enjoyment	6.54 (1.17)	6.69 (1.03)	6.70 (1.58)	6.16 (1.49)

Note: Standard deviations are reported in parentheses.

trial game performance was found to be a significant covariate, $F(1, 79) = 4.79, p = 0.03, \eta_p^2 = 0.057$. As we expected, we found a significant interaction effect, $F(2, 79) = 3.67, p = 0.03, \eta_p^2 = 0.085$. To further examine the interaction effects, post-hoc pairwise comparisons with Bonferroni correction were conducted. It was found that playing with in-group resulted in greater performance of learning Italian than with out-group in the competitive task demand condition, $F(1, 27) = 8.37, p = 0.005, \eta_p^2 = 0.096$, which was the opposite of H4. In the conjunctive task demand condition, in-group or out-group playing did not result in different performance of learning Italian ($p = 0.34$): H5 was not supported. In cooperative task demand, in-group or out-group playing also did not result in different performance of learning Italian ($p = 0.78$), answering RQ2. Post-hoc pairwise comparisons with Bonferroni correction were also conducted to compare the task demand type within in-group conditions and within out-group conditions. It was found that when playing with in-group team members, task demand did not matter. However, when playing with out-group team members, task demand made a difference, $F(2, 41) = 5.55, p = 0.006, \eta_p^2 = 0.12$. Post-hoc pairwise comparisons with Bonferroni correction indicated that conjunctive task demand resulted in greater performance of learning Italian than competitive task demand ($p = 0.005$) when playing with out-group members. Additionally, conjunctive task demand resulted in marginally greater performance of learning Italian than cooperative task demand ($p = 0.078$) when playing with out-group members.

A two-way ANOVA was used to examine whether group task demand type and social categorization diversity had interaction effects on enjoyment. No main effects were found, ($F(1, 80) = 0.02, p = 0.88, \eta_p^2 = 0.00$, for social categorization diversity; $F(2, 80) = 1.43, p = 0.25, \eta_p^2 = 0.03$, for task type demand). However, an interaction effect was found, $F(2, 80) = 4.58, p = 0.013, \eta_p^2 = 0.10$. Post-hoc pairwise comparisons with Bonferroni correction were conducted to further examine the interaction effects. Specifically, when playing in the cooperative task, participants enjoyed it more when they played with in-group members than with out-group members ($p = 0.02$), answering RQ4b. However, playing with in-group or out-group members did not make a difference for enjoyment in the competitive ($p = 0.77$) or conjunctive task demand ($p = 0.068$), answering RQ4a and RQ4c. Additionally, we found that when playing with in-group members, cooperative task resulted in greater enjoyment than conjunctive task ($p = 0.007$). The means and standard deviations of the dependent variables for the six groups are reported in Table 2.

5. Discussion and conclusions

This study attempted to examine the effects of task demand type as well as its interaction with social categorization diversity on performance and enjoyment in a cognitive task—learning Italian in a digital game. Consistent with previous literature on task demand type in physical persistence tasks (Weber & Hertel, 2007), we found that conjunctive task demand was the most effective in the cognitive domain—learning new knowledge. No difference was found for enjoyment among the four task demand types. A significant interaction effect between task demand type and social categorization diversity on performance was found. Specifically, playing with an in-group member resulted in greater Italian learning performance than playing with an out-group member in competitive task demand, which was unexpected. However, no difference was found between playing within in-group and out-group in cooperative or conjunctive task demand. Additionally, a significant interaction between task demand type and social categorization diversity was found for enjoyment. Playing with an in-group member was more enjoyable than an out-group one in the cooperative demand condition, and social categorization diversity made no difference in the competitive and conjunctive task demand conditions.

5.1. Implications for group-based tasks in mediated contexts

The findings of this study have several contributions to the current research on motivation gain among low-performing individuals in different task demands. The findings have implications for group-based tasks in mediated contexts. First, we add evidence for the Köhler effect, especially for the rarely studied task domain—complex cognitive task in a game format in which new knowledge is acquired. Previous research on the Köhler effect predominantly focused on physical persistence (Feltz et al., 2011; Irwin et al., 2012) or well-mastered cognitive task (Weber & Hertel, 2007). The current study on foreign language learning expands the research evidence of the Köhler effect (Köhler, 1926) into a new domain, which has significant implications in educational contexts, especially for those using computer-mediated tools. Foreign language learning represents new knowledge attainment and requires rote memorization and practice before one can master the language (Ellis, 1993). The finding reveals that conjunctive task demand is the most effective among all types of task demands to promote performance in such context. This finding implies that conjunctive task demand may be utilized in an online foreign language learning platform to motivate learners. For instance, in online foreign language courses, individuals can be compared in a

Table 2
Means and standard deviations of the dependent variables by condition.

Dependent Variable	Competitive in-group (n = 15)	Competitive out-group (n = 15)	Cooperative in-group (n = 15)	Cooperative out-group (n = 13)	Conjunctive in-group (n = 14)	Conjunctive out-group (n = 14)
Performance	2980.00 (549.29)	2426.67 (718.60)	2873.33 (402.61)	2623.08 (496.91)	2885.71 (491.24)	3085.71 (476.94)
Enjoyment	6.62 (1.17)	6.76 (0.90)	7.25 (1.26)	6.05 (1.71)	5.69 (1.42)	6.62 (1.46)

Note: Standard deviations are reported in parentheses.

conjunctive task with a better performing computerized agent. Although our study only examined the foreign language learning task, it is reasonable to expect that the findings could be extended to other cognitive tasks of knowledge acquisition. Future research can expand to other cognitive tasks, e.g., mathematics, physics, social studies, for empirical evidence.

5.2. Interaction effects of social categorization diversity and task demand type

The second contribution of the study is the added evidence of the interaction effects of social categorization diversity and task demand type on performance. Previous research primarily examined how in-group and out-group impact coercive, additive, and conjunctive tasks (Kerr & Tindale, 2004; Lount & Phillips, 2007; Pettit & Lount, 2010). This study adds support for the impact of social categorization diversity in competitive (Tajfel & Turner, 1986) and cooperative tasks (Gómez, Kirkman, & Shapiro, 2000; Popov et al., 2014). We found that working on the competitive task with in-group members led to greater performance than working with out-group members, which is opposite to our expectation. Several conjectures can be provided to explain these unsupported hypotheses. First, the context of the current study is learning new knowledge, which has not been tested in the previous studies. It is possible that the effect of social categorization diversity is task specific. Future studies should further examine this issue by testing with various task contexts. Second, the partner's performance was systematically manipulated to be 1.2 times better, so that all the participants would be the lower performing ones. Thus, our findings regarding competitive task condition should not be applied to general competitive learning settings. In other words, it is not clear if pairing with in-group in comparison to an out-group partner would always lead to better performance under competitive task demand regardless of the performance gap between dyads. Our hypotheses regarding the social categorization diversity effect in cooperative and conjunctive tasks (Lount & Phillips, 2007; Peng & Hsieh, 2012; Velez et al., 2012) were not supported. Inconsistent with Lount and Phillips (2007), we did not find that working with an out-group resulted in additional motivation or performance gain than working with an in-group in the conjunctive task where participants needed to learn new knowledge. Post-hoc analysis also revealed that conjunctive task demand resulted in greater Italian learning game performance than competitive task demand when playing with out-group members. Additionally, conjunctive task demand resulted in marginally greater Italian learning game performance than cooperative task demand when playing with out-group members. The findings suggest that conjunctive task demand is the best one to implement when people work with out-groups, especially when they are the lower performing ones.

The third contribution of the study is our finding regarding the effects of task demand type and social categorization diversity on intrinsic motivation. Intrinsic motivation was rarely examined in previous research on motivation gain among lower performing individuals, partly because the tasks in the research were simple, repetitive, or even boring, and extrinsic motivation matters in these tasks (e.g., Goudas, Biddle, & Fox, 1994). However, we think that using video games to teach new knowledge leverages an individual's intrinsic motivation. Additionally, intrinsic motivation has been found to be more important than extrinsic motivation to produce sustained motivation and life-long learning (Ryan & Deci, 2000). We found that the conjunctive task, which showed the highest level of performance, resulted in a similar level of enjoyment, further demonstrating the advantage of this task demand type for a better learning experience and higher performance.

Additionally, the results demonstrated that playing with an in-group was more enjoyable than an out-group in the cooperative task demand condition. These findings have implications for instructional design and digital game based learning design. For instance, if an online foreign language tool is available, the tool should have an internal matchmaking mechanism to pair individuals with the appropriate partner (i.e., in-group or out-group). The results also demonstrated that the cooperative task was found to be more enjoyable than the conjunctive task when playing with in-group members. This implies that if the goal of the motivation gain is primarily on intrinsic motivation rather than extrinsic motivation and group task is involved, cooperative task demand should be implemented.

5.3. Boundary conditions

It is important to note that the current findings need to be interpreted within the boundary conditions. For example, participants in this study had short-term interactions and they did not actually know the real identity of their interaction partner. If the paired participants were already friends or expected to meet again in the future, concerns about negative evaluation by the partner may result in even greater effects in the conjunctive task than what we have observed in this study. In addition, same sex composition was adopted in creating dyads to control for possible gender effects in the current study. Thus, there may be different results when dyads have mixed biological sexes. Third, the perceived partner's performance was manipulated to be always 1.2 times better than the participant's. In other words, the participant was always the lower performing one. We chose a moderate gap based on previous literature on the Köhler effect (Weber & Hertel, 2007). However, the gap may not be optimal for cooperative and competitive tasks. We found that working cooperatively was no different than working alone in terms of performance and enjoyment. This may be the case due to low social accountability because participants expected their partner would keep up the good performance while thinking their own contribution would not matter much (Paulus & Dzindolet, 1993). Fourth, feedback of performance was not updated in real-time in this study. Previous research indicated that knowledge of a partner's ability is a moderator for group motivation gain (Messé et al., 2002). Therefore, results should be interpreted in the boundary condition that knowledge of the partner was only limited to their previous performance, not a real time update of the ongoing task. Although performance was not updated in real time, it was updated immediately after completion of the task. Our findings may not be generalized to relatively asynchronous tasks (e.g.,

Le Hénaff, Michinov, Le Bohec, & Delaval, 2015). Fifth, the cooperative task implemented in the study was only outcome-interdependent, not means-interdependent (Johnson & Johnson, 1989), which is similar to additive tasks. Therefore, the findings may not be applicable to means-interdependent cooperation. Finally, the context of the study was a language learning game. The findings may not be generalized to other non-language acquisition cognitive tasks.

5.4. Limitations

The current study has a number of limitations. First, as noted above, the generalizability of the study is limited and the results should be interpreted within its boundary conditions. Future research is needed to replicate the findings in various contexts, such as different subject matters, different gender, or relationship composition of dyads. Future studies should also expand to test the effect of task demand types in the context of learning new knowledge by testing other potential moderators beyond social categorization diversity. For example, various characteristics of partners with whom individuals are paired for task demands (e.g., partner's biological sex), the status difference (comparison with lower status out-group vs. higher status out-group) (Petit & Lount, 2010), and the availability of partner-related performance information (e.g., continuous partner's performance-related feedback) (Kerr, Messé, Park, & Sambolec, 2005) all have substantial impact on the patterns of motivation and effort gains among group members. Second, we believe it would be meaningful to compare the current findings with a study focusing on high rather than low performing individuals. The level of performance in comparison to a partner plays a critical role in motivation gain or loss. Inferior and superior group members have been demonstrated to have a different motivation gain process (Stroebe et al., 1996). Comparing between studies focusing on high vs. low performing individuals may further reveal the role of task demand type in promoting motivation for individuals with different performance and skill levels. Third, the study had a small sample size. With a bigger sample size we expect to have better power to detect small effect size. The low power may result in Type II error and might explain the unsupported hypotheses. Finally, this study observed motivation gain in a conjunctive task when the participants only played the game for two rounds. However, if the participant remains to be the lower performing individual for multiple rounds over a long period of time, it is unclear whether conjunctive tasks will still produce motivation gain, as the participant might be demotivated due to sustained low performance.

5.5. Conclusion

In conclusion, this study provides additional support for the Köhler effect, while expanding the research of motivation gain by comparing various task demand types in conjunction with social categorization diversity in the new cognitive task domain with mediated group dynamics. The results suggest that a tailored design of mediated educational tools considering task demand types and social categorization diversity will be helpful in further promoting learning and motivation.

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