Clarifying the Link between Mastery Goals and Social Comparisons in Classroom

Settings

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Highlights

1. Mastery-oriented students base perceptions of competence on social comparisons

2. Mastery-oriented students respond less negatively to unfavourable social comparisons

3. Mastery goals are adaptive because they induce adaptive response to unfavourable

comparison

Abstract

Previous experimental studies have documented that competence evaluations are function of social comparison information pertaining to classmates' grades even among mastery-oriented students who are not supposed to base perceptions of competence on social comparisons. This study aimed to replicate this link between mastery goals and social comparisons by using a measure of achievement goals that captured the comparison standards that students intended to adopt in classroom settings. In addition, we examined whether mastery-oriented and performance-oriented students responded differently to social comparisons, particularly unfavourable social comparisons with more capable classmates. In a study that aimed to predict perceptions of competence among University students, we showed that mastery-oriented students who intended to adopt self-referenced standards of comparison based perceptions of competence on social comparisons. In addition, response surface analysis supported a "mastery goal advantage" effect whereby mastery goals yielded higher perceptions of competence than performance goals among students who engaged in unfavourable social comparisons. Findings suggest that mastery goals are adaptive not because they motivate students to not engage in social comparisons but because they lead students respond to unfavourable social comparisons in an adaptive way.

Keywords: achievement goals, social comparisons, "mastery goal advantage" effect, perceptions of competence

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1. Introduction

People adopt many and varied goals in their lives (Austin & Vancouver, 1996; Carver & Scheirer, 1998). However, there is a consensus of opinion among theories of achievement motivation that there are two major classes of goals that people tend to adopt in achievement settings (Hulleman, Schrager, Bodmann, & Harackiewicz, 2010). There are mastery goals where the aim is to progress and learn a skill. There are also performance goals where the aim is to demonstrate superior ability by trying to outperform others (Elliot & Murayama, 2008). Early research, drawing from Nicholl's (1984) achievement goal theory, conceptualised and measured achievement goals in terms of how individuals defined competence in achievement contexts. Accordingly, instruments that aimed to measure mastery goals captured tendencies to define success on the basis of standards related to past or present performance (i.e., self-referenced standards of comparison) (Duda & Whitehead, 1998). In contrast, performance goals captured tendencies to define success on the basis of interpersonal standards such as performance exhibited by others (i.e., normative standards of comparison) (Fox, Goudas, Duda, Biddle, & Armstrong, 1994).

In the mid-1990s, this dichotomous conceptualisation of achievement goals was extended to include the valence of achievement goals in a 2 x 2 hierarchical model (Elliot, 1999; Elliot & Church, 1997). Elliot and McGregor (2001) differentiated mastery goals and performance goals into mastery-approach goals (i.e., understand and master a task), mastery-avoidance goals (i.e., avoid misunderstanding or making mistakes), performance-approach goals (i.e., try to do better than others) and performance-avoidance goals (i.e., avoid doing poorly relative to others). To date, evidence has shown that avoidance goals (mastery-avoidance or performance-avoidance goals) are associated with maladaptive outcomes such

as anxiety, disorganised study habits, fear of failure, self-handicapping, and low achievement or task interest (Elliot & McGregor, 2001; Senko, Hulleman, & Harackiewicz, 2011; Senko & Miles, 2007). In contrast, approach goals are associated with adaptive outcomes such as intrinsic motivation, interest, and use of deep learning strategies (Harackiewicz et al., 2002; Harackiewicz et al., 2008). Moreover, there is evidence that the two approach goals predict different outcomes. Specifically, whereas performance-approach goals exhibit a stronger relationship with academic attainment than mastery-approach goals, mastery-approach goals yield higher levels of intrinsic motivation than performance-approach goals (Senko et al., 2011; Van Yperen, Blaga, & Postmes, 2014).

One of the main differences between the two types of approach goals concerns social comparison processes (Ames, 1992; Maher & Midgley, 1991; Midgley, Kaplan, & Middleton, 2001; Nicholls, 1989). According to theory, people are concerned with social comparison when they pursue performance-approach goals and not when they pursue mastery-approach goals. Recently, however, a number of studies have documented that mastery-oriented students are not completely oblivious to normative information pertaining to classmates' grades (Butler, 1992, 1993; Darnon, Dompnier, Gillieron, & Buttera, 2010; Regner, Escribe, & Duperyat, 2007). Specifically, in a series of experimental studies conducted in educational contexts, Butler (1993) showed that students who were instructed to adopt mastery goals exhibited a marked interest in normative information pertaining to other students' grades. Likewise, Darnon et al. (2010) observed a similar effect but also for multiple-goal endorsement students who adopted both performance-approach and mastery-approach goals simultaneously.

In addition, Van Yperen and Leander (2014) provided insight into the processes by which mastery-oriented individuals responded to favourable and unfavourable social comparisons. In a series of experiments, they demonstrated that individuals instructed to

adopt mastery-approach goals or performance-approach goals reported lower perceptions of competence when they were confronted with unfavourable (upward) social comparisons that revealed inferior performance on a task than when they were confronted with favourable (downward) social comparisons that indicated superior performance. These findings are particularly noteworthy because they contradict the traditional hypothesis that mastery goals do not instigate social comparisons and they imply that both mastery- and performance-oriented students respond similarly to unfavourable (upward) and favourable (downward) social comparisons. However, there are still important gaps in this literature that warrant further clarification.

1.1. The Link Between Mastery Goals and Social Comparisons Revisited

Previous studies using the 2 x 2 hierarchical model of achievement goals to conceptualise and measure achievement goals have adopted Elliot and Murayama's (2008) achievement goal questionnaire (AGQ-R) to tap model constructs. Although the AGQ-R captures both goal adoption and goal valance, it is, we argue, somewhat ambiguous in terms of capturing the standards that people adopt during the process of evaluating personal competence. For example, the item "my aim is to completely master the materials presented in this class" captures the goals that people adopt (or pursue) in a context. However, the AGQ-R does not explicitly ask individuals to indicate whether they intend to use mastery information as a comparison standard during the evaluation process. This measurement issue is important because it leaves open the question of whether the relationship between mastery goals and social comparisons, observed in previous research, is due to unmeasured tendencies to adopt performance standards.

In contrast, measures of achievement goals that draw from earlier formulations of achievement goal theory are more explicit in capturing adoption of comparison standards. For

example, the item "I feel most successful in….. (i.e., statistics) when I learn new things"

derived from Duda and Whitehead's (1998) task and ego orientation questionnaire (TEOSQ),

is more explicit in capturing predispositions to base (or define) competence on learning and

self-improvement. This distinction between the AGQ-R and the TEOSQ has also been

supported by empirical studies demonstrating moderate relationships between mastery goals,

as measured by the TEOSQ and the AGQ-R (Barkoukis, Ntoumanis, & Nikitaras, 2007).

Accordingly, in the present study, we examine whether the link between mastery goals and

social comparisons could be replicated by using a different measure of achievement goals

that captured predispositions to adopt self-referenced versus normative comparison standards.

This conceptual replication of previous studies is important because the hypothesis that we

propose to test is concerned with the misalignment between the standards that mastery

oriented individuals explicitly state to adopt during evaluation of competence and the

standards that they actually use during self-evaluation (Van Yperen & Leander, 2014).

Hence, by using a measure of the standards that respondents are inclined to use during the

self-evaluation process, we aim to provide a more stringent test of the link between mastery

goals and social comparisons.

The second gap in the literature linking mastery goals to social comparisons is related

to direction of social comparison effects. Previous research has shown that unfavourable

social comparisons with more capable students undermine perceptions of competence for

both mastery-oriented and performance-oriented students (Van Yperen & Leander, 2014).

However, research has pointed out that individuals' reactions to comparisons with more

capable individuals is more complex and depends on goals or motives (Lockwood & Kunda,

1997; Van de Ven, Zeelenberg, & Pieters, 2011). Specifically, a number of studies have

demonstrated that in comparison to performance-oriented students, the mastery-oriented

students respond less negatively to situations that provide negative performance feedback

(Neff, Hsieh, & Desitterat, 2005; Sideridis & Kaplan, 2011). The reason for this is that mastery-orientated students interpret failure as an opportunity to improve their skills by investing more effort on learning (Lee & Kim, 2014). For this reason, mastery-oriented students tend to persist at tasks and report enhanced levels of confidence after receipt of negative feedback (Grant & Dweck, 2003). In contrast, performance-oriented students view failure as an indication of low ability. As a consequence, they withdraw from tasks after failure, either because they believe that their ability is low, or in order to protect self-esteem (Urdan & Midgley, 2001). Hence, due to higher levels of confidence that characterise mastery-oriented students in unfavourable situations of failure, there may be an underexplored "mastery goal advantage" effect, operating in classroom settings, suggesting that mastery students may also respond less negatively to unfavourable comparisons with more capable classmates than performance-oriented students.

1.2. Comparative Judgments and the Mastery Goal Advantage Effect

Unfavourable social comparisons with more capable individuals can improve self-evaluations through other processes that, at least on the surface, appear to be similar to processes engendered by mastery goals. Specifically, according to Mussweiler, Ruter and Epstude's (2004) selective accessibility model, social comparison processes involve a comparative stage during which individuals judge personal performance against the performance achieved by others. If personal performance is judged to be similar to that of others then upward social comparisons with more capable individuals will improve self-evaluations. The reason for this is that perceptions of similarity increase accessibility of favourable information indicating that personal performance shares some positive characteristics with higher performance levels of more capable individuals (Mussweiler, & Strack, 2000). In contrast, when personal performance is perceived to be considerably lower and dissimilar to the performance levels of others, upward social comparisons undermine

self-evaluations (Mussweiler, 2003). This is because perceptions of dissimilarity increase accessibility of negative information indicating that personal performance is inferior to that of others.

A unique characteristic of the selective accessibility model is that it provides a thorough and detailed analysis of how comparative judgements of similarity formulated during the social comparison process affect self-evaluations (Mussweiler et al., 2004). In contrast, approaches that are based on achievement goals (i.e., Grant & Dweck, 2003; Sideridis & Kaplan, 2011), which utilise perceptions of ability or confidence as a means of explaining responses to unfavourable situations, do not provide a detailed analysis of comparative judgements. Despite this, predictions made by the selective accessibility model are consistent with achievement goal theories when individuals judge personal performance to be slightly lower and similar to the performance levels achieved by others. In this case, perceptions of similarity are likely to increase perceptions of competence among performance-oriented and mastery-oriented individuals as they confirm personal ability or perceptions of controllability. However, the selective accessibility model contradicts achievement goal approaches when individuals judge their performance to be considerably inferior and dissimilar to performance levels achieved by comparison others. In this case, the selective accessibility model predicts that negative information will undermine self-evaluations for both mastery-oriented and performance-oriented individuals. In contrast, achievement goal approaches predict that enhanced levels of confidence will lead mastery-oriented individuals to report higher perceptions of competence than performance-oriented individuals. Accordingly, in the present study we employed a measure of comparative judgements as a moderator variable to examine whether the hypothesised "mastery goal advantage" effect held only when students judged their personal performance to be inferior to the performance levels of others.

1.3 Overview of the Study and Hypothesis

The purpose of the present study was twofold. First, we re-examined the link between mastery goals and social comparison in real-life classroom settings using a measure of achievement goals that captured individuals' predispositions to adopt mastery (self-referenced) or normative (other-referenced) comparison standards. In accordance with previous research (Van Yperen & Leander, 2014), we reasoned that if mastery-oriented students engaged in social comparison then they would base perceptions of competence on comparative judgments indicating the extent to which personal performance was inferior or superior to that of others. At an empirical level, this hypothesis would be supported if mastery-oriented students, who judged their performance to be inferior to that of others, reported lower perceptions of competence than mastery-oriented students who judged their performance to be superior to that of others.

The second purpose of the present study was to examine how mastery- and performance-oriented students responded to unfavourable (upward) social comparisons. Based on Lockwood and Kunda (1997), we hypothesised that among students who judged their performance to be inferior relative to others, the mastery-oriented students would report higher perceptions competence than the performance-oriented students (see also Van de Ven et al., 2011). This second hypothesis does not necessarily contradict previous research or our first hypothesis (i.e., Van Yperen & Leander, 2014). It is possible that unfavourable social comparisons will undermine perceptions of competence among mastery-oriented students. However, the undermining effect may be less pronounced for mastery-oriented students than performance-oriented students.

In the present study, we also measured a number of additional variables in order to statistically control for their effects on perceptions of competence or clarify social

comparison effects further. Specifically, the proposed "mastery goal advantage" effect is likely to be observed among students whose comparative evaluations indicate inferior performance. This effect is not likely to be observed among students whose academic performance is perceived to be similar to that of their classmates. However, comparative evaluations and perceptions of similarity are not mutually exclusive constructs (Mussweiler, Ruter & Epstude, 2004). For example, although mastery-oriented students may judge that their current performance on a course is inferior to classmates' performance they may also base their perceptions of competence on past episodes that signify equivalent performance (i.e., grades achieved by oneself and others in the past). Accordingly, in the current study we measured perceptions of similarity in order to rule out the possibility that the "mastery goal advantage" effect is due to perceptions of similarity. In addition, we statistically controlled for classmates' grades in our analysis because previous studies demonstrated that perceptions of similarity were most salient when students chose comparisons with classmates who achieve a slightly better grade to the grade that they themselves expect to achieve in the class (Huguet, Dumas, Monteil, & Genestoux, 2001; Huguet et al., 2009).

2. Method

2.1. Participants

Participants were second-year University students who attended a statistics course at a University in a European country ($N = 243$, M age $= 24.37$, $SD = 2.29$, Male $= 80$, Female $= 163$). Approximately 16% of the participants were mature students aged 22 years or older. All students were majoring in psychology or sociology. Participants were well informed of their course performance and performances of their classmates because they attended the course for a second consecutive semester. The course was delivered in small groups of no more than 30 students. In each group, students attended the course with the same classmates and each

group had an identical curriculum that was taught by the same teacher. Students' informed consent and permission from University's ethics committee were obtained prior to data collection. All students were informed about the study by their teachers and given the opportunity to decline participation.

2.2. Procedure and Design

In the current study, we measured psychological variables in the middle of the semester so that we could capture social comparisons that students might have formed anew (Huguet et al., 2001). Specifically, students initially completed measures of achievement goals and perceptions of competence. Next, participants were asked to nominate a classmate with whom they tended to compare their performance in statistics. Immediately after, students completed a series of measures that aimed to capture variables that underpin social comparison processes. Specifically, students reported (i) the absolute grade that their nominated classmate usually achieves in the course and (ii) perceptions of similarity that indicated how often the nominated classmate got the same grades as theirs in statistics. These two variables, perceptions of similarity and classmates' grades, aimed to control for the effects that these variables might have exerted on self-evaluations. Finally, students were prompted to compare their personal performance in statistics to the performance of their nominated classmate. This measure of comparative evaluations with the chosen classmate was the moderator variable that aimed to capture judgments indicating whether comparison with nominated classmates were favorable or unfavorable.

2.3. Measures

2.3.1. Achievement goals.

We used Duda and Whitehead's (1998) questionnaire to measure achievement goals (see also Fox, Goudas, Duda, Biddle, & Armstrong, 1994). This instrument comprises 13

items tapping achievement goals on 5-point scales ranging from *strongly disagree* (1) to *strongly agree* (5). The instrument was modified to reflect success in statistics. An example item for performance-orientation was: "I feel most successful in the statistics course when my performance is greater than the performance achieved by others". An example item for mastery-orientation was: "I feel most successful in the statistics course when I do my best". The alpha reliability for the mastery ($\alpha = .79$) and performance-orientation scales ($\alpha = .78$) were satisfactory[1].

2.3.2. Perceived competence

We used five items from McAuley, Duncan and Tammen's (1989) intrinsic motivation scale to measure perceived competence. An example item was: "I feel pretty competent in statistics". All items were measured on 7-point scales ranging from *strongly disagree* (1) to *strongly agree* (7). Higher scores indicated higher levels of competence in statistics. The alpha reliability for this scale was satisfactory ($\alpha = .87$).

2.3.3. Classmates' grades

Similar to social comparison studies conducted in classroom settings (Blanton et al., 1999; Huguet et al., 2009), classmates' expected grades were measured by asking participants to report the absolute grade that they thought their chosen classmate attain in statistics. Grades could range from 0% to 100%.

2.3.4. Perceived similarity

Following Huguet et al. (2009), perceived similarity was measured through a single item asking participants to report how often their nominated classmate got the same grade as theirs in the class. This item was rated on a 5-point scale (1 = never, 2= sometimes, 3 = one

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[1]For simplicity, we use the terms mastery and performance goals to refer to task and ego goals respectively.

time out of two, 4 = often, 5 = always). This was an ordinal-level variable with higher scores

indicating higher degree of similarity between personal and other students' grades.

2.3.5. Comparative evaluation with chosen classmate

This variable was measured through a single item asking participants to rate how

good they were relative to their nominated classmate in statistics. Students' ratings were

made on a 5-point evaluative scale (1 = much worse, 3 = the same, 5 = much better) (see also

Huguet et al., 2009). This was an ordinal-level variable with students who scored low on this

scale were considered to engage in unfavorable social comparisons. In contrast, students who

scored high on this scale were considered to engage in more favorable social comparisons.

2.4. Data analysis

In the present study, we initially calculated descriptive statistics for all psychological

variables. We also estimated Pearson's correlations to examine zero-order relationships

among study variables. For the main analysis, we conducted a quadratic regression analysis

and response surface analysis to examine our hypotheses (Edwards, 1994). This analysis is

appropriate when using ordinal-level variables because ordinal-level variables can be used as

independent variables in regression analysis (Tabachnick & Fidell, 2013). Following

Edwards and Parry (1993), we carried out a hierarchical regression analysis to examine

whether the second step of the following quadratic equation improved predictive validity of

the overall model:

$$PC = b_0 + b_1M + b_2P + b_3M^2 + b_4MxP + b_5P^2 + b_6C + b_7S + b_8CG \text{ (1}^{st}\text{ step)}$$

$$b_9MxC + b_{10}PxC + b_{11}M^2xC + b_{12}MxPxC + b_{13}P^2xC + e_{10} \text{ (2}^{nd}\text{ step) (1)}$$

In Equation 1, PC represents perceptions of competence and the terms M and P

represent participants' responses to items measuring mastery goals (M) and performance

goals (P). The term CG represents classmates' absolute grades. The terms C and S represent participants' responses to items measuring comparative evaluations with nominated classmate (C) and perceptions of similarity (S). The regression coefficients b_1 to b_{13} are unstandardized regression coefficients. The coefficient b_0 is the intercept of the regression equation and the coefficient e_{10} is the residual variance. In Equation 1, measures of comparative evaluations are treated as a moderating variable, the effects of which are estimated in the second step of the analysis. Important to note is that the quadratic model implied by Equation 1 is unconstrained in the sense that it does not impose any equality constraint on the parameters.

Equation 1 represents a non-linear quadratic (or polynomial) model in which perceived competence is function of main (b_1 and b_2), interactive (b_4, b_9, b_{10}, b_{11}, b_{12} and b_{13}) and quadratic effects (b_2 and b_5) associated with achievement goals. We employed a non-linear quadratic model, as opposed to a "main effect" or a cross-product model, because quadratic regression analysis provides more accurate estimates of main (i.e., b_1 or b_2) and interactive effects (i.e., b_4) of achievement goals on perceptions of competence than cross-product models. For example, we could examine the "mastery goal advantage" hypothesis by testing whether the following linear regression equation explained observations:

$$PC = b_0 + b_1M + b_2P + b_6C + b_9MxC + b_{10}PxC + b_7S + b_8OG + e_{10} \quad (1.1)$$

Equation 1.1 describes a cross-product model that estimates interactions between comparative evaluations with mastery goals (b_9) or performance goals (b_{10}). Importantly, Equation 1.1 does not estimate quadratic effects of achievement goals on perceptions of competence. In the context of the present study, Equation 1.1 would support the mastery goal advantage hypothesis if the coefficient that represents the interaction between mastery goals and comparative evaluations was negative and statistically significant (i.e., $b_9 < 0$) whereas

the coefficient that represents the interaction between performance goals and comparative evaluations was positive and statistically significant (i.e., $b_{10} > 0$). However, cross-product models can distort conclusions about sign and magnitude of interactive effects when quadratic terms that estimate nonlinear relationships between independent and depend variables are not included in these models (Aiken & West, 1991; Cortina, 1993; Ganzach, 1997; Kranz & Tverky, 1971; Lubinski & Humphrey, 1990). For example, Ganzach (1997) demonstrated that a linear regression analysis could mislead researchers to accept a spurious positive interactive effect when in fact there was an alternative quadratic model that supported a negative interaction. Given this evidence, we chose a quadratic model over a linear regression model because quadratic terms that are included in the quadratic model clarify magnitude and direction of main or interactive effects of achievement goals on perception of competence.

Following Edwards and Parry (1993), we examined our hypotheses if the second step of the hierarchical regression analysis improved predictive validity of the unconstrained quadratic model. Because in the present study the second step of the analysis made a significant contribution to the predictive validity of the unconstrained model, we tested the hypotheses by conducting response surface analysis. Specifically, we used Equation 1 and the unstandardized regression coefficients from the second step of the hierarchical model to estimate two simple quadratic functions (Edwards, 1994; 2001). Derivation of the two simple quadratic equations from Equation 1 is detailed in an Appendix. In addition, we utilised the two simple quadratic equations to estimate and plot two responses surfaces that depicted levels of competence associated with achievement goals in conditions of favourable and unfavourable social comparisons.

Figures 1 and 2 present two hypothetical response surfaces that are consistent with our hypotheses. A key feature of these surfaces is that they have a shape of a "bowl". The

reason for this is that mastery goals and performance goals exhibit convex relationships with perceptions of competence (Edwards & Parry, 1993). These convex relationships indicate that perceptions of competence (i) decrease (or remain constant) when responses to achievement goals are below the midpoint of the scale and (ii) increase when responses to achievement goals exceed the midpoint of the scale. In the current study, we expected to observe convex relationships because effects associated with achievement goals are expected to be particularly pronounced when responses to achievement goals indicate goal adoption such as when responses fall above the midpoint of the measurement scale. In contrast, achievement goals are not expected to influence perceptions of competence when they fall below the midpoint of the measurement scale because low scores on achievement goals indicate no adoption (or rejection) of achievement goals.

Another feature of the response surface analysis is that mean levels of competence for mastery-oriented individuals are higher in Figure 2 that depicts favourable social comparisons than in Figure 1 that depicts unfavourable social comparisons ($M = 7.0$ vs $M = 5.4$). This pattern of mean scores is consistent with our first hypothesis that predicts favourable social comparisons to yield higher levels of competence than unfavourable social comparisons among mastery-oriented students. In the present study, we formally tested whether such observed differences in levels of competence were statistically significant by estimating a constrained model that assumed favourable and unfavourable social comparisons to yield equivalent levels of competence among mastery students. This constrained model was estimated by imposing the following equality constraint on the unconstrained model (see Appendix):

$$b_6 + 2b_9 - 2b_{10} + 4b_{11} - 4b_{12} + 4b_{13} = 0 \quad (2)$$

Equality 2 provides a test of our first hypothesis because the linear combination of regression coefficients on the left side of the equality captures effects of social comparisons on perceptions of competence among mastery-oriented students. It is important to note that Equality 2 implies that social comparison effects are not function of a single regression coefficient that represents interactions between achievement goals and comparative evaluations. Rather, effects associated with comparative evaluations are function of a combination of coefficients that represent main, interactive and quadratic effects of achievement goals. Given this, our first hypothesis is rejected if predictive validity of the unconstrained model was higher than predictive validity of the constrained model that imposed Equality 2 on the combination of regression coefficients. In the current study, we used an incremental F-test to formally test whether the predictive validity of the constrained model differed from the predictive validity of the unconstrained model (Edwards & Parry, 1993). Our first hypothesis was supported if the incremental F-test was statistically significant and the residual variance of the constraint model was higher than the residual variance of the unconstraint model. Under this scenario, observed differences in levels of competence between mastery-oriented students who engaged in unfavourable versus favourable social comparison are statistically significant.

We examined our second hypothesis by analysing an important feature of the response surface, namely the incongruence line (see Figures 1 and 2). This line expresses the "mastery goal advantage" hypothesis because it captures, and hence compares, a mastery goal profile that involves a tendency to endorse mastery goals at high levels and performance goals at low levels and a performance goal profile that involves a tendency to endorse performance goals at high levels and mastery goals at low levels. When this line is considered in relation to the response surface, it reveals a slope (Edwards & Parry, 1993). In Figure 1, the slope of the incongruence line is positive and statistically significant. A positive slope

would be consistent with our "mastery goal advantage" hypothesis that predicts the mastery goal profile to yield higher perceptions of competence than the performance goal profile among students who judge their performance to be inferior to performance achieved by others. In contrast, in Figure 2 the mastery goal profile and the performance goal profile yield the same levels of competence because the slope of the incongruence line is not statistically significant.

We formally tested whether the slope of the incongruence line was statistically significant by estimating a second constrained quadratic model that assumed a zero slope for the incongruence line in the domain of unfavourable social comparisons (Edwards & Parry, 1993). A zero slope is consistent with the null hypothesis of "no mastery goal advantage" among students who engaged in unfavourable social comparisons. This constrained model was estimated by imposing the following equality constraint in the unconstrained model (see Appendix):

$$b_1 - 2b_9 - b_2 + 2b_{10} = 0 \ (3)$$

Likewise, we tested the slope of the incongruence line in the domain of favourable social comparisons by estimating a third constrained quadratic model that assumed a zero slope for the incongruence line in the domain of favourable social comparisons (Edwards & Parry, 1993). This additional constrained model was estimated by imposing the following equality constraint on the unconstrained model (see Appendix):

$$b_1 - b_2 + 2b_9 - 2b_{10} = 0 \ (4)$$

Equality 3 provides a test of the "mastery goal advantage" hypothesis because the linear combination of regression coefficients on the left side of the equality captures a slope that compares effects associated with mastery goals and performance goals in conditions of unfavourable social comparisons. As with Equality 2, Equalities 3 and 4 imply that effects

associated with achievement goals are function of a combination of coefficients rather than a single regression coefficient.

Following estimation of these constrained models we used incremental F-tests to formally test whether the residual variances of the constrained models were higher than the residual variance of the unconstrained model (Edwards & Parry, 1993). Our second hypothesis was supported if the incremental F-test was statistically significant for the constraint model that predicted a zero slope for the incongruence line in the domain of unfavourable social comparisons. We did not expect the incremental test to be significant for the incongruence line in the domain of favourable social comparisons as our hypothesis does not predict a "mastery goal advantage" effect in the domain of favourable social comparisons. Prior to this analysis, measures of achievement goals were scale-centred by subtracting the midpoint of the scale (Edwards, 1994). Finally, we estimated Cook's D and leverage values to identify potential outliers. However, no individual response exceeded the high cut-off value suggested by Bollen and Jackman (1990).

3. Results

3.1. Preliminary Analysis

Table 1 presents descriptive statistics and correlations among psychological variables. Correlations supported statistically significant and positive relationships between perceptions of competence with achievement goals or comparative evaluations. The correlation between perceptions of competence and classmates' grades was also statistically significant. This positive correlation supports our choice to control for the effects that this variable may exert on perceptions of competence. However, the correlations between perceptions of similarity with perceptions of competence or mastery goals were not statistically significant. This pattern of relationships provides some preliminary support to the conclusion that effects of

mastery goals on perceptions of competence are not due to perceptions of similarity. Finally, approximately 27% (n = 66) and 27.9% (n = 68) of participants made downward and upward social comparisons respectively. In addition, approximately 4.9% of participants failed the course whereas 9.5% of participants achieved a distinction (i.e., an 'A' grade).

3.2. Main Analysis

Table 2 presents results of the unconstrained hierarchical regression analysis. Mastery goals predicted perceptions of competence in both steps of the model. Likewise, effects of comparative evaluations and classmates' grades on perceptions of competence were all statistically significant in both steps of the model. Most critical, the analysis revealed that the second step of the analysis, in which we estimated quadratic effects and interactions between achievement goals and comparative evaluations, improved the predictive validity of the model by 4%. Overall, the unconstrained quadratic model explained 43% of variance in perceptions of competence. Given these findings, we used a response surface analysis to analyse the form of the interaction.

Table 3 and Figures 3 and 4 present parameters of the simple quadratic equations and the corresponding response surfaces. The response surface that described effects of achievement goals in the domain of unfavourable social comparisons did not have a shape of a bowl but that of a mountain with a rising ridge. The reason for this is that performance goals exhibited a concave, rather than a convex, relationship with perceptions of competence. However the concave relationship was not statistically significant. Despite this, in accordance with our first hypothesis, the two simple quadratic equations and response surfaces showed that mastery-oriented students based competence evaluations on social comparisons. As an example, based on our model, a mastery-oriented student who engaged in unfavourable social comparisons had a predicted level of competence of 4.35, while a mastery student who chose

to engage in a favourable social comparison had a predicted competence level of 5.53. Most critical, this observed difference in levels of competence was statistically significant. The incremental F-test showed that the sum of standardised residuals of the constrained model, in which we tested the null hypothesis that perceptions of competence between mastery students who engaged in unfavourable and favourable social comparisons would be equal, was higher than the sum of standardised residuals of the unconstrained model (see Table 4)[2].

Turning now into our second hypothesis, the response surface analysis showed that the slope of the incongruence line was positive and statistically significant for the model that captured unfavourable social comparisons. This is because the incremental F-test showed that the sum of standardised residuals of the constrained model, in which we tested the null hypothesis of zero slope for the incongruence line, was higher than the sum of standardised residuals of the unconstrained model (see Table 4). These findings support the "mastery goal advantage" hypothesis which predicts that mastery goals will yield higher perceptions of competence than performance goals among students who engage in unfavourable social comparisons. For example, a mastery student who engaged in unfavourable social comparison had a predicted competence level of 4.35. In contrast, for a performance-oriented student who also engaged in unfavourable social comparison had a predicted competence level of 0.57. Moreover, the slope of the incongruence line was not statistically significant in the domain of favourable social comparisons – a finding that corroborates the view that there is no "mastery goal advantage" effect in the domain of favourable social comparisons.

4. Discussion

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[2]Additional analysis showed that performance-oriented students also engaged in social comparisons. This is because these students reported higher perceptions of competence when they engaged in favourable social comparisons than when they engaged in unfavourable social comparisons (6.53 v .57, p < .001). However, we do not discuss this effect further because it does not constitute the focus of the present manuscript.

The purpose of the present study was to re-examine the link between mastery goals and social comparisons by using a measure of achievement goals that captured the more specific comparison standards that students intended to adopt in classroom settings. In addition, we examined whether mastery-oriented students and performance-oriented students responded differently to unfavourable social comparisons. In accordance with our first hypothesis, the quadratic regression analysis and response surface analyses supported a link between mastery goals and social comparisons. Broadly speaking, mastery-oriented students reported lower perceptions of competence when they judged their performance in a statistics course to be inferior, rather than superior, to performance levels achieved by classmates. Hence, at an empirical level, the current study replicates previous research that also showed social comparisons to drive competence evaluations of individuals who endorsed mastery goals (Van Yeren & Leander, 2014).

The present study, however, adds to achievement goal literature because it employed a different measure of achievement goals that captured the standards, not goals, that students were inclined to adopt during the process of competence evaluation. Accounting for standards is a unique component of the current research and it advances understanding of the nexus between achievement goals and social comparisons for the following reason. According to Van Yperen and Leander (2014), the link between mastery goals and adoption of normative standards indicates a misalignment between the explicit goals that mastery-oriented students report to adopt in a setting and the criteria that they ultimately use when evaluating their performances. Importantly, it was argued that this misalignment between goals and standards reflected the non-intentional or habitual character of the processes underlying adoption of normative standards. This is because self-reported goals were assumed to capture the standards that individuals intended to adopt in a setting whereas competence evaluations reflected students' actual preferences of comparison standards.

However, previous research employed measures of achievement goals that captured the explicit goals, and not necessarily the explicit standards, that participants intended to adopt in a setting. Hence, it could be argued that the link between mastery goals and adoption of normative standards observed in previous research might have not reflected operation of some non-intentional or habitual processes. This would be likely if participants who were classified as adopting mastery goals, as measured by the AGQ-R, they nevertheless intended to adopt normative comparison standards at some explicit level. This argument is also reinforced by previous findings supporting moderate relationships between instruments measuring adoption of mastery goals and instruments measuring adoption of normative standards (Barkoukis et al., 2007). Hence, by using a measure of the standards that individuals intend to adopt in a setting, the present study has provided additional support to the hypothesis that, for mastery-oriented students, the tendency to engage in social comparison is non-intentional or habitual.

Apart from clarifying the link between achievement goals and social comparisons, the current study examined how mastery-oriented and performance-oriented students responded to social comparisons, particularly unfavourable ones with classmates perceived to be more capable. In accordance with our second hypothesis, the regression analysis and the response surface analysis supported a "mastery goal advantage" effect whereby mastery-oriented students reported higher perceptions of competence than performance-oriented students when they engaged in unfavourable social comparisons. In addition, the current study showed the "mastery goal advantage" effect to be driven mainly by achievement goals and not by perceptions of similarity or classmates' grades. This is because the statistical analysis controlled for the effects associated with perceptions of similarity and classmates' grades. Hence, at an empirical level, the current study compares favourably with earlier research which also demonstrated achievement goals to moderate negative effects of negative

performance feedback on human motivation (Lee & Kim, 2014; Sideridis & Kaplan, 201). However, in those studies, negative feedback was not normative but task related. Hence, the current study adds to the achievement goal literature because it shows mastery-oriented students' tendencies to respond less negatively to negative feedback extends to unfavourable normative feedback pertaining to classmates' grades.

It is interesting to note that our findings are also consistent with approaches to social comparison that consider effects associated with social comparison to be function of beliefs about nature of academic ability (Dweck,1986). Specifically, in a series of studies, Lockwood and Kunda (1997) demonstrated that unfavourable comparisons with more capable students improved self-evaluations when individuals believed that ability was malleable and could be improved through hard work and effort (see also Van de Ven, Zeelenberg, & Pieters, 2011). The reason was that the tendency to construe ability as malleable led individuals to believe that the performance levels achieved by others were attainable in the future. In contrast, when participants construed ability as a fixed trait, unfavourable (upward) comparisons yielded a decrease in self-evaluation scores. This is because the belief that ability was a fixed or hereditary-determined trait led individuals to believe that the higher performance levels achieved by others were unattainable in the future (Luckwood & Kunda, 1997). This approach to social comparison may further explain the "mastery goal advantage" effect because there is some evidence to suggest that mastery-oriented students construe ability as a malleable trait whereas performance-oriented students believe that ability is a hereditary trait (Dweck & Leggett, 1988; Stipek & Gralinski, 1996).

In addition to establishing a "mastery goal advantage" effect, the current study adds to achievement goal literature in a number of other ways. First, the present study contributes to the debate on the adaptive function of achievement goals. Early formulations of achievement goal theory assumed that mastery goals were more adaptive than performance goals because

mastery goals were thought to orient students' attention away from social comparisons (Ames, 1992; Maher & Midgley, 1991; Midgley, Kaplan, & Middleton, 2001; Nicholls, 1989). This tendency of ignoring social comparisons was also considered to be associated with enhanced feelings of competence because, inevitably, it protects students from self-debilitating effects of unfavourable social comparisons (Nicholls, 1984). In contrast, normative standards and social comparisons, which focus students' attention on outperforming others, were assumed to facilitate feelings of competence, effort and enjoyment only among a select percentage of talented students who could achieve this goal (Dweck & Elliot, 1983; Nicholls, 1984). However, those who do worse relative to others were thought to experience low levels of competence and increased levels of pressure, and have a greater likelihood of withdrawing their effort on tasks because the decision to persist in face of failure involves a risk of demonstrating inferior ability.

The current study is partially consistent with Nicholls' (1984) premise that mastery goals are more adaptive than performance goals because it showed that mastery goals yield higher levels of competence than performance goals in the context of unfavourable social comparisons. However, the current study also shows that this "mastery goal advantage" effect is not due to the fact that mastery-oriented students do not engage in social comparisons. The regression analysis rules out this alternative hypothesis because it showed social comparisons to influence perceptions of competence of mastery-oriented students. Rather, the current study points out that mastery goals are more adaptive than performance goals because they lead students respond less negatively to unfavourable social comparisons.

Second, due to its methodology, the current study provides some insights into the magnitude or relative importance of effects associated with mastery goals and social comparisons. Do mastery goals eliminate, reverse, or simply reduce the otherwise negative effects that unfavourable social comparisons exert on perceptions of competence? Results of

the present study support the notion that mastery goals reduce, but do not eliminate, the negative effects that unfavourable social comparisons exert on perceptions of competence. This is because although adoption of mastery goals yielded higher levels of competence than performance goals in conditions of unfavourable social comparisons, at the same time, unfavourable social comparisons yielded lower perceptions of competence than favourable social comparisons for mastery-oriented students. Notably, previous experimental research could not ascertain the magnitude of the "mastery goal advantage" effect either because they did not observe it (Van Yperen & Leander, 2014) or because they did not induce both favourable or unfavourable social comparisons in the same study (Butler, 1992, 1993; Darnon, Dompnier, Gillieron, & Buttera, 2010; Regner, Escribe, & Duperyat, 2007). In a way, therefore, results of the current study show that the social comparison effect observed in previous research is stronger than previously thought in that it is not eliminated by mastery-oriented students' tendency to respond positively to unfavourable social comparisons.

It is important to note that, at least on the surface, results of the present study appear to be inconsistent with Van Yeren and Leander's (2014) experimental studies that did not observe a "mastery goal advantage" effect. This is despite the fact that the design of these experimental studies permitted evaluation of effects associated with mastery goals and performance goals in conditions of favourable and unfavourable social comparisons. However, there are important methodological differences between the current study and previous research. Specifically, in previous laboratory experiments, participants might not have been able to evaluate whether performance levels achieved by comparison others were attainable. The reason for this is that participants are usually unfamiliar with the abilities of others with whom they compare their performance levels in laboratory settings. In contrast, in the current study, participants might have been more knowledgeable of whether performance levels achieved by comparison others were attainable because the present study was

conducted in classroom settings where students were familiar with abilities of comparison others. As a consequence, previous experimental studies might have not observe a "mastery goal advantage effect" because, according to Lockwood and Kunda (1997), students tend to respond more positively to unfavorable social comparisons to the extent that they believe that performance levels achieved by others are attainable.

Finally, it would be remiss to not mention limitations of the current study that can provide directions for future research. Specifically, the present study did not adopt an experimental design. As a consequence, the current study is limited in that it does not test causality. Hence, it may be important to replicate findings of the present study using field experiments that manipulate achievement goals and social comparisons in real-life classroom settings. In addition, our measures of similarity and comparative evaluations may lack reliability as they were measured through single items. Therefore, future studies should attempt to replicate current findings by using more reliable measures. Relatedly, in the current study we opted for subjective (rather than objective) measures of similarity and classmates' grades. The reason for this is that the social comparisons literature focuses on the effects that subjective (and often biased) perceptions of similarity may have on self-evaluations (Huguet et al., 1999; Musweiller, 2003). Despite this, we do think that it may be important to replicate the "mastery goal advantage" effect by using more objective measures of comparative evaluations and similarity that indicate differences between students' and classmates' actual grades.

In the present study, we also used Duda and Whitehead's (1998) achievement goal questionnaire that measures the comparison standards that students intend to adopt in classroom settings. The decision to use this questionnaire was guided by the objective of the present study which was to examine whether the link between mastery goals and social comparisons generalised to instruments that measured adoption of different comparison

standards. However, it is unclear from the present study whether the "mastery goal advantage" effect generalises to instruments that are more consistent with Elliot and McGregor's (2003) 2 x 2 model.

In addition, results of the current study do not indicate whether the "mastery goal advantage" effect is due to mastery-approach or mastery-avoidance goals. However, the positive correlation between mastery goals and perceptions of competence provides some preliminary support to the conclusion that, in the present study, the "mastery goal advantage" effect was due to approach rather than avoidance goals (see Table 1). This is because mastery-avoidance goals are said to be related to maladaptive outcomes such as avoidance of challenging situations and relatively low perceptions of competence (Lee & Kim, 2014; Senko et al., 2011). Despite this, we think that it may be important to replicate current findings by using other measures of achievement goals that capture approach and avoidance reactions.

It is also important to keep in mind that the "mastery goal advantage" effect is not general but it may depend on additional factors. For example, in the present study we demonstrated that this effect was more likely to be observed among students who engaged in unfavourable social comparisons but not among students who engaged in favourable social comparisons. However, as we have already mentioned, this effect may also depend on the extent to which students believe that ability is a malleable trait. Hence, the "mastery goal advantage" effect observed in the present study may be explained more fully by considering mediators such as beliefs about ability (Dweck, 1986) or perceived attainability of performance levels achieved by comparison others (Huguet et al., 2001).

In conclusion, the present study successfully replicated previous experimental findings that supported a link between mastery goals and social comparisons by using a

measure of achievement goals that captured the more specific comparison standards that students intended to adopt in classroom settings. In addition, we demonstrated that a "mastery goal advantage" effect operates in real-life classroom settings in which mastery-oriented students responded less negatively to unfavourable social comparisons than performance-oriented students. At the theoretical level, current findings suggest that mastery goals are not adaptive because they motivate students refrain from engaging in social comparisons but because they lead students to respond to unfavourable social comparisons in an adaptive way.

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Table 1. Descriptive statistics and correlations between psychological variables

	M	SD	1	2	3	4	5	6
1.Mastery goals	4.07	.66	1.0					
2.Performance goals	3.56	.82	.28*	1.0				
3.Comparaitve judgment	3.00	.94	.10	.08	1.0			
4.Perceived similarity	2.81	1.00	.00	.08	.20*	1.0		
5.Classmates' grades	68.39	14.84	.21*	.19*	-.10	-.08	1.0	
6.Percetions of competence	3.65	1.16	.36*	.19*	.43*	.10	.30*	1.0

Note. Correlations with an asterisk are statistically significant at $p < .05$ level.

Table 2. Hierarchical regression analyses predicting perceptions of competence

| Variables	Step 1	Step 2
Intercept	2.05	2.05
Mastery goals	.45*	.45*
Performance goals	.10	.08
Mastery goals^2	.10	.10
Mastery x Performance goals	-.24*	-.28*
Performance goals^2	.17*	.18*
Comparative judgments	.52*	.43*
Perceived similarity	.02	.00
Classmate's grade	.02*	.02*
Mastery goals x comparative judgments		-.29*
Performance goals x comparative judgments		-.02
Mastery goals^2 x comparative judgments		-.01
Performance goals x Mastery goals x comparative judgments		-01
Performance goals^2 x comparative judgments		.13
SSE	199.30	187.16
R^2	.39*	.43*
ΔF		2.97*

Note. Parameters are unstandardized egression coefficients. Parameters with an asterisk are statistically significant at $p < .05$. The term SSE refers to the sum of squared residuals. The term ΔF represents the incremental F test.

Table 3. Parameters of simple quadratic equations and incongruence line

Model	b_{10}	M	P	M^2	MxP	P^2	Incongruence line (slope)
Unfavorable comparison	1.19	1.03*	.12	.12	-.26	-.08	.99*
Favorable comparison	2.91	-.13	.04	.08	-.30	.44*	-.17

Note. Parameters are unstandardized regression coefficients. Parameters with an asterisk are statistically significant at $p < .05$.

Table 4. Comparisons between constraint and unconstraint models

| Model	SSE	R^2	ΔF
Unconstraint	187.16	.43	
Constraint model 1 (No link between mastery goals and social comparison)	194.11	.40	8.48*
Constraint model 2 (No "mastery goal advantage" effect in unfavorable social comparison)	206.12	.37	23.10*
Constraint model 3 (No "mastery goal advantage" effect in favorable social comparisons)	189.18	.43	3.33

Note. The unconstraint model was estimated through the hierarchical regression analysis. The term SSE refers to the sum of squared residuals. The term ΔF represents the incremental F test.

Figure 1. A hypothetical response surface supporting a mastery goal advantage effect in context of unfavorable social comparisons
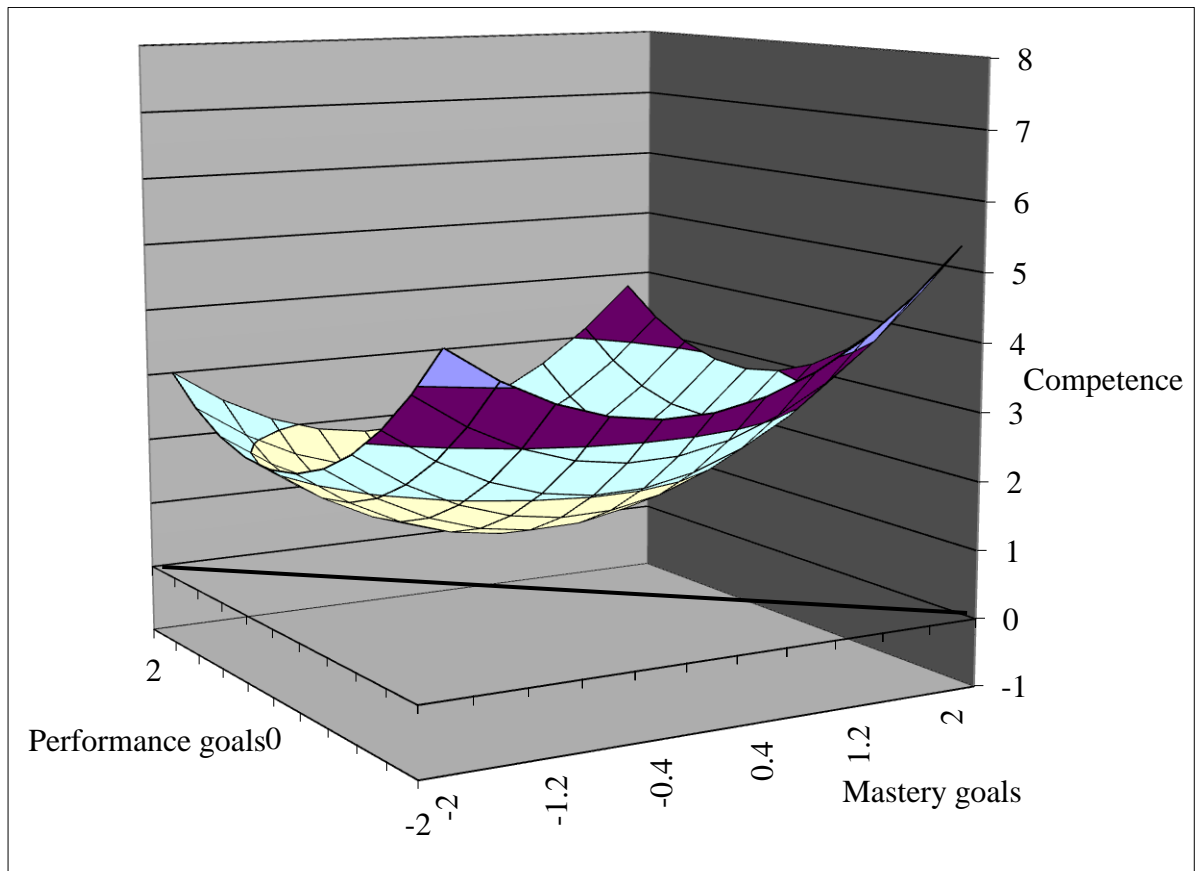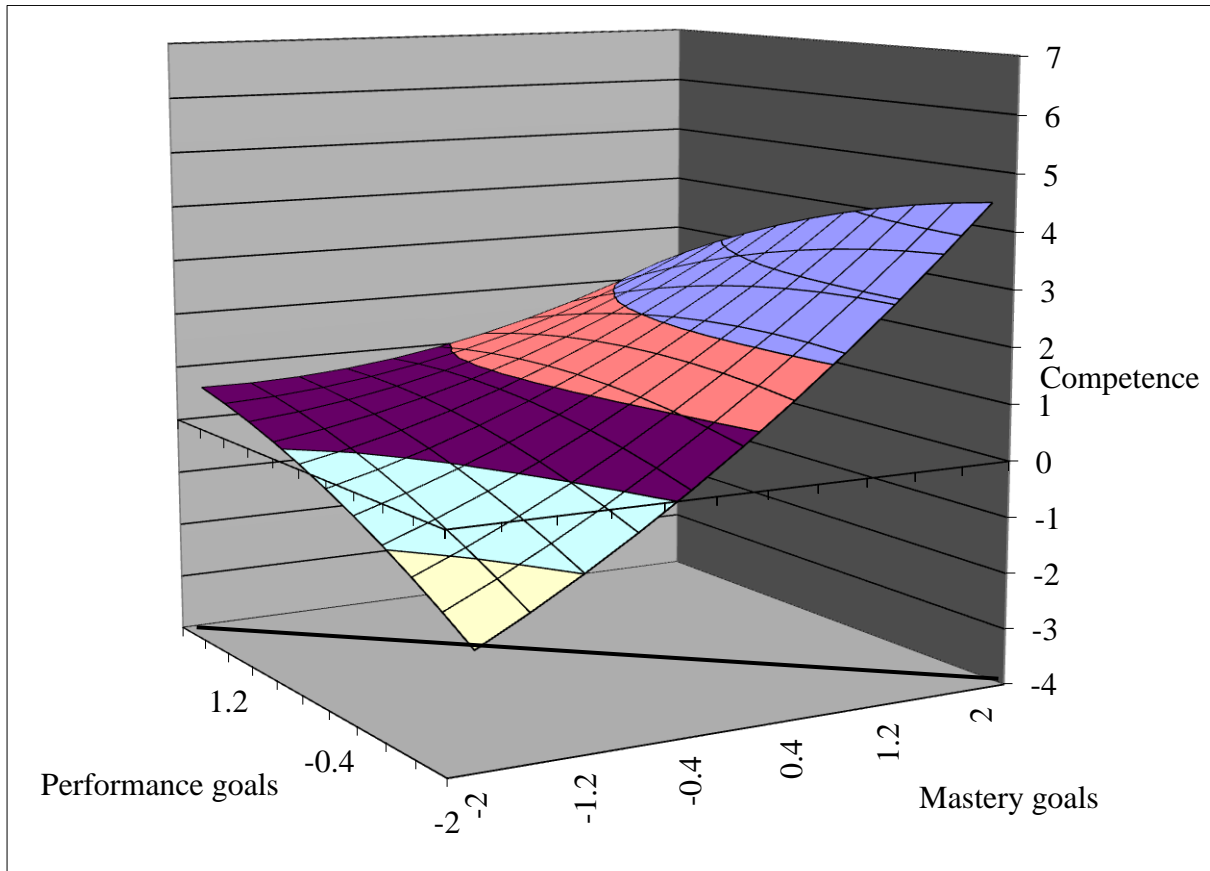

Note. The solid line on the floor of the figure is the incongruence line.

Figure 2. A hypothetical response surface that does not support a mastery goal advantage effect in context of favorable social comparisons
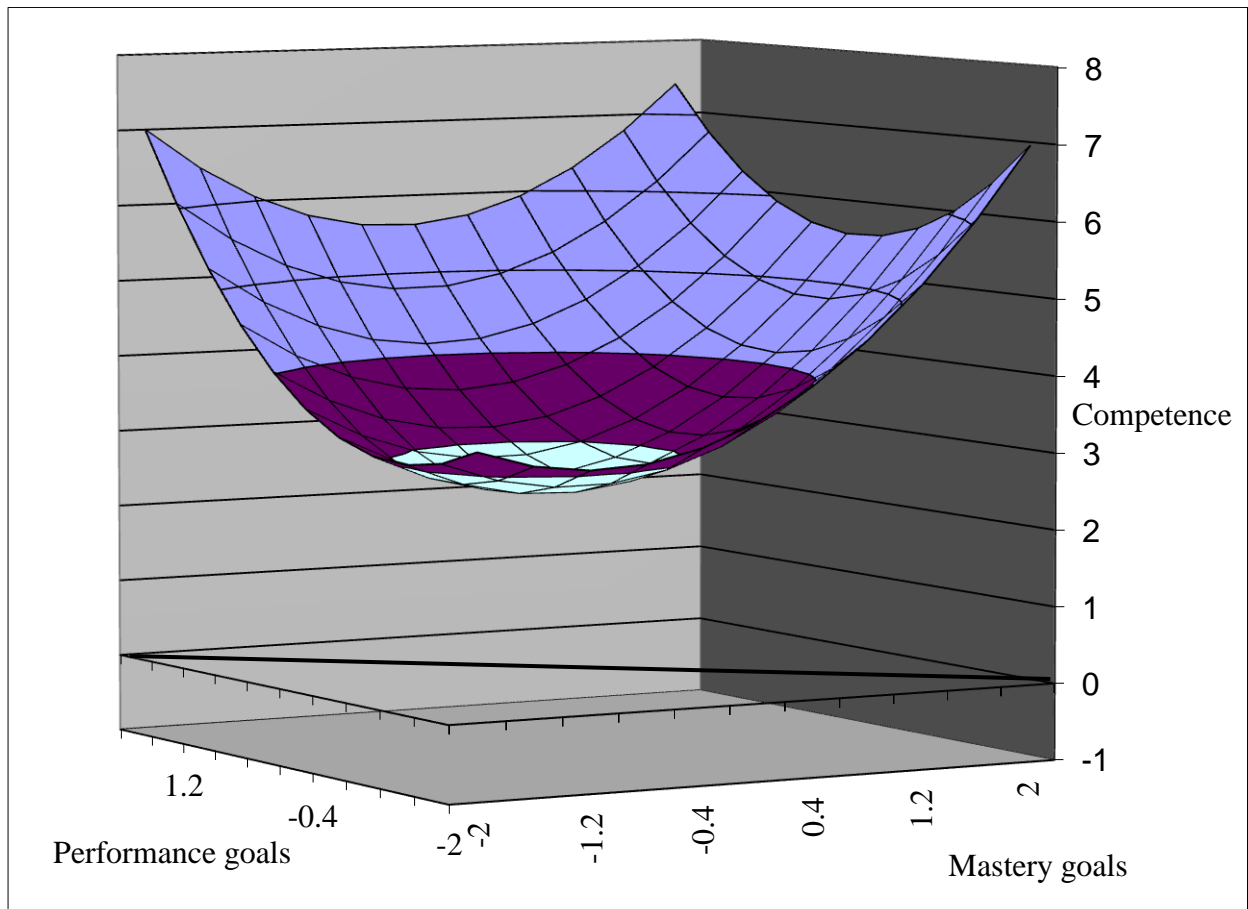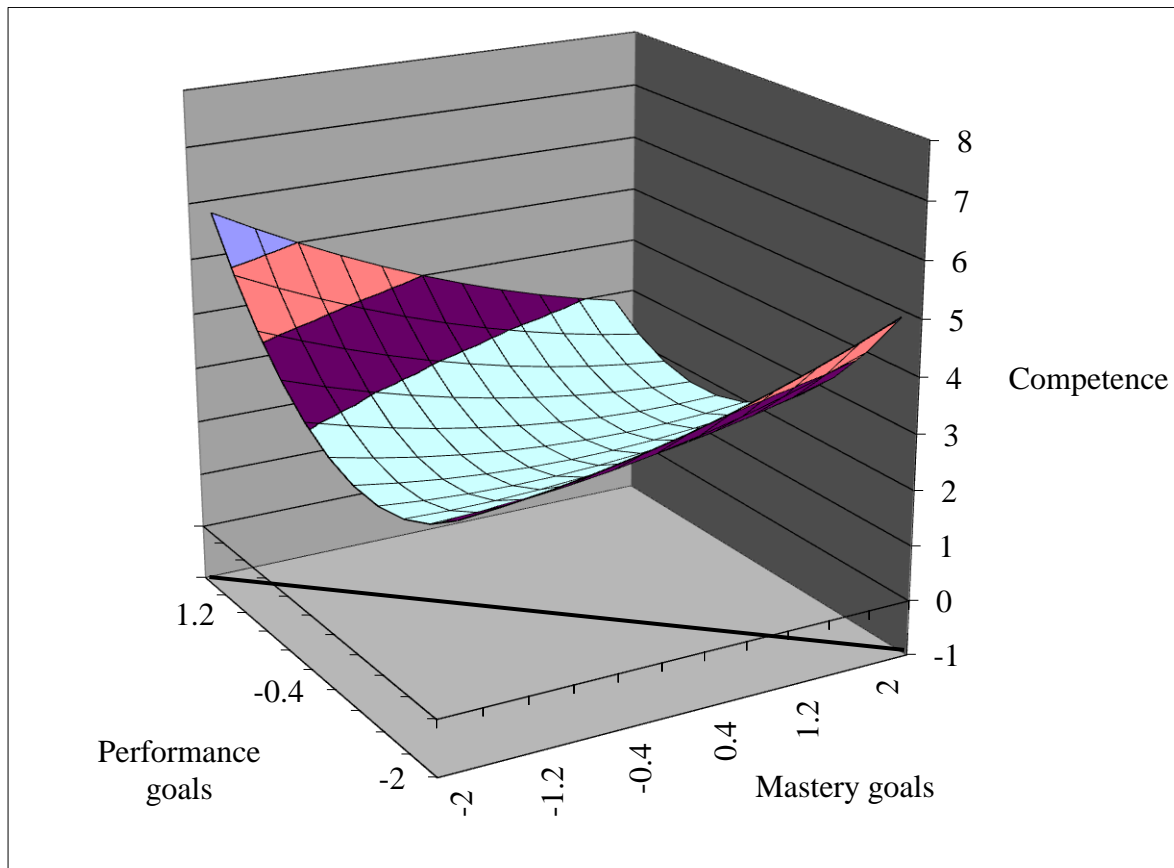

Note. The solid line on the floor of the figure is the incongruence line.

Figure 3. A response surface describing effects achievement goals on perceptions of competence in conditions of unfavorable social comparisons

Note. The solid line on the floor of the figure is the incongruence line.

Figure 4. A response surface describing effects achievement goals on perceptions of competence in conditions of favorable social comparisons

Note. The solid line on the floor of the figure is the incongruence line.

Appendix

Derivation of simple quadratic equations

In this section, we explain how we derived the two simple quadratic equations in the moderator analysis. Initially, we rearranged Equation 1 as follows (Edwards &Parry,1993):

$$PC = b_0 + M(b_1 + b_9C) + P(b_2 + b_{10}C) + M^2(b_3 + b_{11}C) + MxP(b_4 + b_{12}C) + P^2(b_5 + b_{13}C) + b_6C + b_7S + b_8OG + e_{10} \quad (1.2)$$

Next, we substituted the regression coefficients (b_1 to b_{13}) with the unstandardized regression coefficients that we estimated from the second step of the hierarchical regression analysis. These coefficients are presented in Table 2. The two simple quadratic equations can be derived by solving Equation 1.2 for meaningful values of comparative evaluations that represent favourable (C=2) and unfavourable (C= -2) social comparisons.

Derivation of the equality constraint that examines social comparison effects among mastery oriented students

Equality 2 provides a test of our first hypothesis because the linear combination of regression coefficients on the left side of the equality captures effects of social comparisons on perceptions of competence among mastery-oriented students. Hence, our first hypothesis is rejected if Equality 2 converges to zero. To show why Equation 2 captures our hypothesised social comparison effect we initially identify the equation of the incongruence line that captures the "high-mastery/low- performance" goal profile. According to Edwards and Parry (1993), this equation is analogous to $P = -M$. Substituting P for $-M$ ($P = -M$) in Equation 1.2 yields the following equation that describes effects of the "high-mastery/low-performance" goal profile on perceptions of competence:

$$PC = M(b_1 - b_2 + b_9C - b_{10}C) + M^2(b_3 - b_4 + b_5 + b_{11}C - b_{12}C + b_{13}C) + (b_6C + b_0) + b_7S$$

$$+ b_8OG + e_{10} \quad (1.3)$$

In Equation 1. 3, a high score on mastery goals (M = 2) represents a "high mastery/low performance" goal profile. Conversely, a low score on mastery goals (M = –2) represents a "high performance/low mastery" goal profile. Given this, the effects of social comparison on perceptions of competence among mastery-oriented students can be estimated by solving Equation 1.3 for high values of mastery goals that represent the "high mastery/low performance" goal profile (i.e., M = 2). Substituting M = 2 and rearranging Equation 1.3 yields:

$$PC = + C(b_6 + 2b_9 - 2b_{10} + 4b_{11} - 4b_{12} + 4b_{13}) + b_0 + 2b_1 - 2b_2 + 4b_3 - 4b_4 + 4b_5 + b_7S +$$

$$b_8OG + e_{10} \quad (1.4)$$

In Equation 1.3, the linear combination of coefficients on measures of comparative evaluations (i.e., C) represents the effects of social comparisons on perceptions of competence among students who endorse mastery goals. However, the sum of these coefficients is also identical to the left side of Equality 2. Hence, our hypothesis concerning the link between mastery goals and social comparisons can be rejected if the sum of these coefficients equals to zero or:

$$b_6 + 2b_9 - 2b_{10} + 4b_{11} - 4b_{12} + 4b_{13} = 0 \quad (2)$$

Derivation of the equality constraint that examines the mastery goal advantage effect

Equality 3 provides a test of the "mastery goal advantage" effect because the linear combination of the regression coefficients on the left side of the equality captures effects of the "high mastery/low performance" goal profile (as opposed to the "high performance/low mastery" goal profile) on perceptions of competence among students who engaged in unfavourable social comparisons. To show this, we use Equation 1.3 to identify the slope of

the incongruence line which captures the effects of "high mastery/low performance" goal profile (as opposed to the "high performance/low mastery" goal profile) on perceptions of competence among students who engaged in unfavourable and favourable social comparisons social comparisons. According to Edwards and Perry (1993), this slope equals the linear combination of coefficients on mastery goals (in Equation 1.3) or:

$$PC = M(b_1 - b_2 + b_9C - b_{10}C) \ (1.4)$$

In Equation 1.4, a high score on mastery goals ($M = 2$) represents a "high mastery/low performance" goal profile. Conversely, a low score on mastery goals ($M = -2$) represents a "high performance/low mastery". Given this, the effects of the mastery versus performance goal profiles on perceptions of competence among students who engaged in unfavourable social comparisons can be estimated by solving Equation 1.4 for low values of comparative evaluations (i.e., $M = -2$). Substituting $C = -2$ yields:

$$PC = M(b_1 - 2b_9 - b_2 + 2b_{10}) \ (1.5)$$

In Equation 1. 5, the linear combination of coefficients on mastery goals (e.g., M) represents the effects of the mastery versus performance goal profiles on perceptions of competence among students who engage in unfavourable social comparisons. Hence, our hypothesis about the "mastery goal advantage" effect can be rejected if the sum of these coefficient equals to zero. However, assuming a zero sum of coefficients returns Equality 3 or:

$$b_1 - 2b_9 - b_2 + 2b_{10} = 0 \ (3)$$

Similarly, the effects of the mastery versus performance goal profiles on perceptions of competence among students who engaged in favourable social comparisons can be estimated by solving Equation 1.4 for high values of comparative evaluations (i.e., $M = 2$):

$$PC = M(b_1 - b_2 + 2b_9 - 2b_{10}) \ (1.6)$$

In Equation 1.6, the linear combination of coefficients on mastery goals (e.g., M) represents now the effects of the mastery versus performance goal profile on perceptions of competence among students who engage in favourable social comparisons. Hence, our hypothesis about the "mastery goal advantage" effect can be rejected if the sum of these coefficients equals to zero or:

$$b_1 - b_2 + 2b_9 - 2b_{10} = 0 \quad (1.7)$$

which is identical to the equality constraint 4.