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Beyond Collective Beliefs: Predicting Team Academic Performance from Collective Emotional Intelligence

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Abstract

This study used data from 818 master's students, organized into 199 teams, to examine the influence of collective emotional intelligence (EI) on team academic performance (measured by a common academic grade based on two project reports at the team level) above the effects of collective general self-efficacy (GSE) and team level general self-efficacy, termed team potency. All three variables predicted team academic performance positively, beyond the effect of each other. The research model explained 20% of the variance in team academic performance. A negative interaction effect between collective EI and collective GSE was detected, indicating that the two variables may replace each other in teamwork. Exploratory analyses of the four EI dimensions showed that particularly other emotion appraisal (OEA) and regulation of emotions predicted team academic performance. Finally, maximum EI within each team predicted team academic performance at about the same level as collective EI.

The purpose of this study is to examine the influence on team academic performance from team mean emotional intelligence (collective EI) and two psychological beliefs at the group level, team mean general self-efficacy (collective GSE), and team potency. The study has two focal points. First, we investigate the incremental effect of collective EI above collective GSE and team potency on team academic performance. Even if past meta-analytic research has established that both collective EI (Bell, 2007; Chang, Sy, & Choi, 2012) and collective GSE and team potency (Gully, Incalcaterra, Joshi, & Beaubien, 2002; Stajkovic, Lee, & Nyberg, 2009) correlate positively with team performance, the incremental contributions to performance by using this team mental model seem to be largely unexplored.

Second, we extend our analysis by including several possible interaction effects between the explanatory variables and team academic performance, to delineate whether these constructs comprise a boosting combined effect or a substitutional effect in terms of creating high team academic performance. In addition, we explore to what extent the maximum and minimum level of EI accounts for the impact of EI on performance and finally whether possible differential effects of the dimensions of EI at the group level may reveal a more fine-grained picture of the collective EI and team academic performance relationship.

The concept of emotional intelligence has emerged as one of the most popular psychological concepts of the last decade (Zeidner, Roberts, & Matthews, 2004) and, somewhat ironically, probably also one of the most controversial (Becker, 2003; Davies, Stankov, & Roberts, 1998; Locke, 2005). In terms of theory building from an evolutional perspective (Weick, 1989), Jordan, Ashkanasy, and Härtel (2003) argued that the EI construct has left the variation phase and is under development somewhere between the selection and the final retention phase, a conjecture that seems to be relevant even at present. Many scholars agree that differences in definitions and operationalization notwithstanding, there is already sufficient evidence to consider the construct of EI as a scientific concept (J.D. Mayer, Roberts, & Barsade, 2008).

Prompted by the fact that a lot of the work in organizations is done by groups, scholars have increasingly become interested in the validity of EI as a group level construct (Druskat & Wolff, 2001). Group EI consists of individual EI attributes that group members can share and draw upon when needed (Conte, 2005; Elfenbein, 2006) and can be considered from several different perspectives. First, group EI can be considered a process which influences team members' interactions in various ways and is reflected in "the emotional savvy exhibited when team members interact with each other" (Elfenbein, 2006, p. 177). If this perspective is adopted, it may not be necessary to examine the individual EI scores of the

group. From a second perspective, group EI may be perceived as "a group level emergent state originating from individuals, amplified by their interactions, and manifested as a higher-level phenomenon" (Yang & Mossholder, 2004, p. 595). This referent shift consensus model requires that the level of focus of the measurement of EI is the group and that an emergent homogeneity among group members' EI scores is considered evidence of the validity of the construct (Chan, 1998).

In this study we apply a third perspective by considering EI as an individual ability (J.D Mayer, Salovey, & Caruso, 2008) measured by a self-report scale, the WLEIS (Wong & Law, 2002), which is relevant to the theoretical model proposed by J.D Mayer and Salovey (1997) and Davies, Stankov, and Roberts (1998). Ashkanasy and Daus (2005) termed this self-reported ability approach as a particular stream of research (Stream 2), distinguished from ability tests based on the Mayer–Salovey definition of emotional intelligence (e.g., the MSCEIT; J. D Mayer, Salovey, Caruso, & Sitarenios, 2003) (Stream 1), and research which comprises a group of broader, mixed models that include dimensions or components not included in the original definition of emotional intelligence (Stream 3). From an ability perspective (Stream 1 and 2), group members' EI abilities constitute a pool where the individuals can share EI and compensate for each other in order to create group dynamics (Chang et al., 2012; Elfenbein, 2006; Offermann, Bailey, Vasilopoulos, Seal, & Sass, 2004; Spector & Johnson, 2006). In this additive composition model (Chan, 1998), the higher level unit is a summation of the lower level units, regardless of the variance within these units. Evidence of homogeneity among group members is not required in the additive composition model, and the external validity of group EI depends on the strength of the correlation between group EI and the dependent variable (Chan, 1998). We consider the additive composition model of EI the most appropriate for analyzing self-reported ability-based EI at group level, hereafter referred to as collective EI.

The dependent variable in this study is team academic performance, evaluated in terms of grades for a final team assessment at the end of the working period. A meta-analysis of 115 studies at the individual level by Van Rooy and Viswesvaran (2004) included only 11 studies which investigated the relationship between EI and academic performance. The conclusion from this meta-analysis was that individual EI was positively related to academic performance, albeit the predictive validity was limited due to the small sample size. We note that the meta-analysis included a study conducted by Wong and Law (2002), in which the Wong and Law Emotional Intelligence scale (WLEIS)—which we use in this paper—was defined and validated (see below). The relationship between collective EI and group

academic performance remains largely unexplored and the current study is intended to contribute to expanded knowledge in this area.

Psychological Beliefs and Emotional Intelligence

There has been interest in the role of self-efficacy (Bandura, 1977, 1997) in the relationship between EI and performance (Chan, 2008; Offermann et al., 2004; Semadar, Robins, & Ferris, 2006; Tsarenko & Strizhakova, 2013). Self-efficacy is defined as "people's belief in their capabilities to mobilize the motivation, cognitive resources and course of action needed to exercise control over events in their lives" (Wood & Bandura, 1989, p. 364). Indeed, a specific form of EI, "trait emotional intelligence" is termed "trait emotional self-efficacy" and defined as a constellation of emotional self-perceptions located at the lower levels of personality hierarchies (Petrides, Pita, & Kokkinaki, 2007). In characterizing performance tests rather than self-report scales as the gold standard for intelligence research, Carroll (1993) argued that performance tests measure capacity to perform mental tasks, not just one's self-efficacy with respect to certain skills.

Bandura, Adams, Hardy, and Howells (1980) claimed that self-efficacy was stable across similar situations, but others have questioned whether self-efficacy generalizes across unrelated situations, and several definitions and scales of generalized self-efficacy (GSE) have been developed (e.g., Chan, 2004; Chen, Gully, & Eden, 2001; Schwoerer, May, Hollensbe, & Mencl, 2005; Tipton & Worthington, 1984). Common to these definitions is the notion that GSE describes a trait-like construct capturing "people's tendency to view themselves as capable of meeting task demands in a wide variety of situations" (Chen, Gully, Whiteman, & Kilcullen, 2000, p. 838). GSE is considered more resistant to ephemeral influences than task specific self-efficacy and may therefore be appropriate in analyses of the relationship between general, ability-based EI and academic performance.

To investigate the relationship between GSE and team academic performance, we aggregated individual GSE scores to yield a group level general self-efficacy construct, in this study termed *collective GSE*. It is important to note the theoretical distinction between collective GSE and collective efficacy (Katz-Navon & Erez, 2005; Stajkovic et al., 2009) or team efficacy (Gully, Incalcaterra, Joshi, & Beaubien, 2002) and herein called *team efficacy*; team efficacy is a task-based version of self-efficacy at the group level, consisting of the aggregate of individual beliefs based on homogeneity and where the level of focus of the measurement is the group, not the individual.

It is surprising that studies intended to validate EI have not considered the *team potency* construct (Guzzo, Yost, Campbell, & Shea, 1993; Shea & Guzzo, 1987); it has been

similarly neglected in studies of the relationship between collective EI and group performance. Team potency has been defined as "the collective belief of group members that the group can be effective. This belief depends on group members' sense that they have what they need to succeed – for example, training, skills, talented members, money, time, access to key organization members, and feedback about group performance" (Shea & Guzzo, 1987, p. 26). The construct is rooted in self-efficacy theory; both team potency and collective GSE relate to beliefs about individuals' capabilities in team contexts, and have been used to describe beliefs about performance (Baker, 2001; Gully et al., 2002). Unlike collective EI and collective GSE, team potency is a genuinely group level construct; empirical evidence for the validity of the construct comes from observations of a minimum level of emergent homogeneity in team members' assessments of their team's potency. On the basis of a meta-analysis, Stajkovic et al. (2009) concluded that although team efficacy (termed collective efficacy) and team potency were highly correlated (+.65) they were different constructs, a finding we assume also applies to the difference between collective GSE and team potency, since the level of focus of the measurement of collective GSE is the individual, not the group.

It is quite likely that that collective GSE and team potency have additive effects on performance (Gully et al., 2002), even if simultaneous research on these two cognitive components in social cognitive theory (Bandura, 1986) at the group level is limited, particularly in terms of their combined effect on team academic performance. Several researchers have described the indispensable connections between self-efficacy and potency within a period. At the beginning, team members bring their individually held beliefs to the group (collective GSE). Next, when the team members start to work, these beliefs gradually emerge to be shared (team potency), and: "Once a group belief has developed, the practical difference between what an *individual* believes about group performance and the individual's estimate about what the *group* believes about group performance may become negligible" (Baker, 2001, p. 457).

However, it is also possible that the effect of a trait like GSE may be largely resistant during the working period and coexist with team potency in its influence on performance. Indeed, Derue, Hollenbeck, Ilgen, and Feltz (2010, p. 3) argue that team efficacy may follow a pattern of emergent consensus as well as "a pattern of growing discord such that team members efficacy beliefs become more dissimilar Fover time." For instance, according to DeRue and colleagues and in the context of the current paper, team potency may emerge to the benefit of socially oriented emergent states (trusting, bonding), whereas the expected diverse collective efficacy construct may persist to the benefit of task-related team processes

(structuring, planning, learning, and adapting) (DeRue et al., 2010). In this paper, we intend to provide additional information about the emergent properties of collective GSE and team potency, however limited by the fact that this is not a longitudinal study.

Interactions

Our second focal point in this study is to explore whether there are interactions between collective EI and the two psychological beliefs, collective GSE and team potency, respectively. Self-efficacy is described as a belief associated with one's ability to exercise mastery and control over events: "People who are skeptical of their ability to exercise adequate control over their actions tend to undermine their efforts in situations that tax capabilities" (Bandura, 1982, p. 129). In the current study, we argue that EI may provide the level of factual mastery and control associated with academic performance that should be required to meet expectations emanated from high self-efficacy or team potency. The intriguing question then, is whether the coexistence of high EI (high expected mastery and control) and high GSE or team potency (high expectations of mastery and control) at the group level simultaneously is a necessary condition for optimal academic performance, or whether the pairwise effects of collective EI and respectively collective GSE and team potency may compensate for each other. This has to our knowledge never been investigated before. Of individual level studies, Rode et al. (2007) found that the interaction of EI and conscientiousness at the individual level predicted academic performance (GPA), supporting additive effects for these constructs. Chan (2008) reported some evidence in support of an interaction effect between teacher intrapersonal EI—in contrast to interpersonal EI—and self-efficacy in predicting active coping. However, we do not consider these findings as indicative for suggesting any hypotheses, given that the intrapersonal aspect of collective EI probably is much stronger at the group level than at the individual level.

Emotional Intelligence

Research on emotional intelligence has its origins in Thorndike's (1920) method of evaluating social intelligence in the laboratory, a simple process which involved matching pictures showing facial emotions with descriptions of emotions. Gardner's (1983) theory of multiple intelligences included social intelligence as one of the seven intelligence domains. The theoretical framework underlying recent research on EI is provided by the rapidly growing body of research inspired by the much-needed rediscovery of emotions by psychologists and neuroscientists (e.g., Buck, 1988; Damasio, 2008; LeDoux, 1996; Zajonc, 1980). Today it appears that the concept of emotional intelligence as a dissociable aspect of intelligence is here to stay: "Hence, general intelligence is the general ability to reason

correctly with abstractions (concepts) and solve problems. Emotional intelligence can be conceptualized as the ability to grasp and reason correctly with emotional abstractions (emotional concepts) and solve emotional problems" (Côté & Miners, 2006, p. 3).

Salovey and Mayer (1990) are generally credited with stimulating interest in the concept of EI over recent decades. These authors suggested that EI should be considered in terms of five, later reduced to four, main components and most researchers seem to agree that any definition of EI should encompass *perceiving, facilitating, understanding,* and *managing* emotions (J.D Mayer & Salovey, 1997). Most research into the external validity of the EI construct has been directed towards personality taxonomies, principally the Big Five (Costa & McCrae, 1992; McCrae & Costa, 1985; Norman, 1963), and cognitive intelligence (GMA). Recent meta-analyses have generally endorsed the validity of EI against personality and cognitive ability (Joseph & Newman, 2010; O'Boyle, Humphrey, Pollack, Hawver, & Story, 2011; see also Van Rooy, & Viswesvaran, 2004).

EI has sometimes been described in terms that gives the impression that it is a panacea for all organizational problems; particularly, that EI may be more important than cognitive ability in performance at work (Goleman, 1995). Conversely, critics have described this work as "anecdotal case histories, derivative models and, in some cases, pure rhetoric" (Dulewicz & Higgs, 2000, p. 346). Ashkanasy, Härtel, and Daus held that, "in actuality, emotional intelligence has no clear definition, nor has consensus been reached as to the breadth of the concept and what it should include" (Ashkanasy, Härtel, & Daus, 2002, p. 325). Indeed, some find reasons for questioning the usefulness of the EI concept at all (Becker, 2003; Davies et al., 1998; Locke, 2005). Even at current, scholars does not agree about fundamental questions concerning EI, such as whether EI may be considered as an ability (J.D Mayer, Roberts, et al., 2008), a personality trait (Petrides et al., 2007), a competence, in terms of a learned capacity (e.g., Boyatzis & Goleman, 1998; Offermann et al., 2004), or a mixture of these (e.g., Bar-On, 1997; Goleman, 1995).

Another controversy has been a strong tendency to dismiss the idea that it is appropriate to measure ability based EI by using self-report questionnaires, in contrast to general or expert consensus of test takers (herein called consensus tests and expert tests) (e.g., MacCann, Matthews, Zeidner, & Roberts, 2003; J.D Mayer, Roberts, et al., 2008). This general criticism is illustrated by the following quotation: "As is widely known… humans are notoriously poor at evaluating their own ability" (Gohm, 2004, p. 223). However, evidence from analyzes of SAT scores indicates a general high association between students' self-reports and actual standardized test scores (above .80 for SAT scores), and that the difference

largely may be found at the lower end of the scale (Kuncel, Credé, & Thomas, 2005; R. E. Mayer et al., 2007; Newman & Lyon, 2009).

Inspection of the evidence suggests that both streams of research have advantages and disadvantages. Consensus or expert tests have higher discriminant validity with respect to the Big Five personality traits than self-report tests, and higher convergent validity relative to cognitive intelligence (MacCann et al., 2003). The measures of consensus- or expert test have also been shown to have acceptable internal consistency (Conte, 2005). The disadvantages of this approach to measuring EI is that there is no algorithm for determining the correct answers when performance is measured relative to consensual norms or scoring based on expert judgments (knowledge of theories of emotion translates into emotional intelligence) (MacCann et al., 2003; Van Rooy, Viswesvaran, & Pluta, 2005). Consensus or expert tests have also been shown to have limited predictive and operational validity and are of limited practical value in organizational settings (MacCann et al., 2003). More specifically, some of the subscales of expert measures have only marginally acceptable internal consistency and test-retest reliability (Conte, 2005).

Self-report EI scales are shown to have reasonable predictive validity (MacCann et al., 2003) and have generally shown acceptable internal consistency (Conte, 2005). Self-report tests are cheaper, less time-consuming and easier to use than consensus and expert tests (MacCann et al., 2003); in the context of field research they are often the more practical option. Self-report questionnaires are more susceptible to faking than consensus- or expert tests, especially in situations where faking is beneficial, for example job applications (Day & Carroll, 2008); however, the social desirability bias in self-reports is probably relatively moderate (Moorman & Podsakoff, 1992).

This brief review indicates that consensus or expert tests and self-report measures of EI respectively may be only weakly related to each other. For instance, Goldenberg, Matheson, and Mantler (2006) found that self-reported EI scores were systematically related to self-reported coping styles and depressive affect, whereas consensus- or expert-based measures were more strongly related to age, education and being in receipt of psychotherapy. It is possible that consensus or expert tests and self-report tests actually measure different, but equally important aspects of EI, and that properly validated self-report measures of ability-based EI−such as the Wong and Law (2002) scale−may be a viable alternative to consensus- or expert-based measures when measuring EI (Spector & Johnson, 2006). On the other hand, it is also possible that consensus- or expert tests and self-report tests are measuring different aspects of the same constructs. For instance, in one of the first ERP studies to examine

emotional visual stimuli processing with respect to EI, (Raz, Dan, & Zysberg, 2014) were not able to conclude that the ERP differences were more strongly related to, or better explained by, the data provided by self-reports (trait EI) or analyzes of facial expressions (ability EI), or the combination of both.

Hypotheses

Collective Emotional Intelligence

Empirical studies have demonstrated a positive association between EI and academic performance at individual level (Libbrecht, Lievens, Carette, & Côté, 2014; Parker et al., 2004; Rode et al., 2007; Van Rooy & Viswesvaran, 2004). Durán, Extremera, Rey, Fernández-Berrocal and Montalbán (2006) found that perceived EI accounted for non-overlapping variance in academic burnout and engagement above and beyond that accounted for by GSE. In studies at the individual level which have used the WLEIS, EI has been shown to be positively related to several outcome variables such as, job satisfaction and job performance (De Dreu & Gelfand, 2008; Law, Wong, & Song, 2004; Wong & Law, 2002), trust (Chun, Litzky, Sosik, Bechtold, & Godshalk, 2010), charismatic leadership (Walter & Bruch, 2007) and, most importantly, academic performance (Song et al., 2010).

Concerning collective EI, a meta-analysis by Bell (2007) concluded that there was a positive association between collective EI and objective performance; recent research (Chang et al., 2012; Wang, 2015) supported this conclusion. We are not aware of studies investigating the relationship between collective EI and team academic performance. Nevertheless, the evidence mentioned above suggests that there may be a positive association between collective EI and team academic performance. We therefore formulate the following hypothesis,

Hypothesis 1: a) Collective EI is positively related to team academic performance, and b) makes a unique contribution to variance in team academic performance after the effects of collective GSE and team potency have been taken into account.

Collective General Self-efficacy

Chen et al. (2002) found that the SSE version of collective efficacy was positively related to team performance in their lab sample but not in their field sample, indicating that the association was moderated by context. The general conclusion from research on the relationship between collective self-efficacy and team performance seems however clear: a meta-analysis of 64 correlations concluded that there was a moderate relationship between collective efficacy and team performance (+.35) (Stajkovic et al., 2009) and this conclusion is

supported by more recent research (Raub & Liao, 2012). We have found no studies investigating the relationship between collective GSE and team academic performance. Realizing that predictions made at the individual level may be quite different from predictions at the group level (Gully et al., 2002), we nevertheless assume that the findings in the literature so far indicates adequate support to the assumption that collective GSE is positively associated with team academic performance:

Hypothesis 2: a) Collective GSE is positively related to team academic performance, and b) makes a unique contribution to variance in team academic performance after the effects of collective EI and team potency have been taken into account.

Team Potency

A meta-analysis of 29 correlational studies Stajkovic et al. (2009) concluded that there was a positive association (+.29) between measures of team potency and measures of team performance. Recent studies have generally supported these findings (Brueller & Carmeli, 2011; Collins & Parker, 2010; Lee, Farth, & Chen, 2011). Even if research on the relationship between team potency and particularly team academic performance is very limited (similar to GSE), we suggest:

Hypothesis 3: a) Team potency is positively related to team academic performance and b) makes a unique contribution to variance in performance after the effects of collective EI and collective GSE have been taken into account.

Method

Participants

The participants were 818 master students organized into 199 teams at the Norwegian University of Science and Technology (NTNU), who took part in a larger practical project called Experts in Teams (EiT). There were two cohorts: teams which took part in an intensive, one-month program (429 students in 108 teams) and teams which took part in a one-semester program (389 students in 91 teams). The average age of respondents was 25 years; 59% of respondents were men and 41% were women.

Measures

This study is based on research by Ashkanasy and Daus (2005), which encompassed various self-report measures relevant to the theoretical model proposed by John D Mayer and Salovey (1997) and Davies, Stankov, and Roberts (1998). Wong and Law drew on this theoretical tradition to develop a sixteen item self-report scale, WLEIS, to measure ability-based EI (De Dreu & Gelfand, 2008; Law et al., 2004; Shi & Wang, 2007; Wong & Law,

2002). The scale is organized into four dimensions: self-emotion appraisal (SEA), other-emotion appraisal (OEA), use of emotion (UOE), and regulation of emotion (ROE), each of which is assessed by four items.

The construct reliabilities (Cronbach's alpha) of the four-item subscales in the WLEIS were: (a) SEA, sample item: "I have a good sense of why I have certain feelings most of the time" (α = .84), (b) OEA, sample item: "I always know my friends' emotions from their behavior" (α = .79), (c) ROE, sample item: "I am able to control my temper so that I can handle difficulties rationally" (α = .76), and (d) UOE, sample item: "I always set goals for myself and then try my best to achieve them" (α = .80). The four dimensions of EI was averaged to create a multidimensional construct under the composite view, where the dimensions are considered to cover the total area of the EI construct (Law & Wong, 1999). For exploratory purposes, we also established three additional composition models of EI, *EI maximum*, *EI minimum*, and *EI diversity*. EI diversity was calculated as the intragroup standard deviation of EI.

Interdependence was measured using an eight-item scale constructed from the five-item scale developed by Zhang, Hempel, Han, and Tjosvold (2007), sample item: "I work closely with others in doing my work", supplemented by three items developed specifically for this study or adapted from other sources, sample items: "Collaboration with the other team is useful for me, time spent at meetings considering," "We have been mutually dependent on getting the necessary information or materials from each other to perform our tasks," and "My duties are pretty much a one-person job; there is little need to check or work with others" (Van Der Vegt, Emans, & Van De Vliert, 2000), (α = .73). *Collective GSE* was measured using five items adapted from Chen, Gully, and Eden (2001), sample item: "I will be able to achieve most of the goals that I have set for myself" (α = .78). *Team potency* was measured using four items from the eight-item scale developed by Guzzo, Yost, Gampbell, and Shea (1993), sample item: "Our team has confidence in ourselves" (α = .81).

Academic performance was measured by averaging the students' grades on two reports at the team level. The assignment was to decide a team task that should be completed in a process report and a project report. The team process report was about the student team's reflection on the cooperation. The project report described the student team's problem formulation and the result of the project work. The team receives one common grade. The project report and the process report were each worth 50% of the final grade. The criteria for achieving grade "A" and "B" are listed in Appendix A.

We collected data on several socio-demographic variables, namely the age and sex of team members, team size, and cohort. Data from the administration of the university showed that the distribution of age of the master students was markedly skewed; because of this, and to protect participants' anonymity and reduce the risk of social desirability bias, we coded age using a three-level scale that distinguished between *young students* (24 years or younger), *students of average age* (25 to 27 years) and *older students* (28 years or older). To control for possible systematic differences between the cohorts, we used a proxy variable (one-month cohort = 1, one-semester cohort = 2)

Preliminary analysis

Data validation

We used confirmatory factor analysis (CFA) to examine the individual level factor structures of the scales in order to confirm the measurement model. Model fit was assessed using cumulative fit index (CFI. Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), a comparative, sample-independent index which does not assume that all measurement indicators are completely independent, and the root mean square error of approximation (RMSEA, Cudeck & Browne, 1983). We also calculated the 90 % confidence interval for RMSEA, which captures the imprecision of model fit (MacCallum, Browne, & Sugawara, 1996). Fit indices of 13 models are provided in Table 1.

Using the terminology of the criteria for the RMSEA suggested by (O'Boyle & Williams, 2010), the approximate fit of the four-factor research model, including EI, interdependence, GSE and potency (model 1) was close, whereas the fit of an one-factor alternative model was poor (model 2). Similarly, the four–dimension model of EI (model 3) was close, whereas a one-dimension model of EI was poor (model 4). The fit of the EI dimension models (models 5-8) varied between close (OEA) to approaching a "reasonable level (UOR and ROE), and the fit of GSE (model 9) and potency (model 10) were reasonable. A two-factor psychological believes model of GSE and potency (model 11) had close fit (the correlation between the two latent variables was +.35), whereas a model in which the two constructs were collapsed into a single factor (model 12) was poor. Further, the fit of interdependence was reasonable appropriate (model 13). The CFI's for all variables included in our research model ranged between .96 and 1.00, all above the threshold of .95 (Hu, Bentler, & Kano, 1992), by Mathieu and Taylor (2006) characterized as excellent. For comparison reasons, we added Cronbach's alpha (reported earlier) to the composite reliability and variance extracted to Table 1. The results indicate that the items are measuring their respective latent variables at an acceptable level of consistence (> .70). The amount of variance in the items accounted for

by each of the latent variables varied between .42 and .59, as compared to a suggested threshold of .50, with the exception of the control variable interdependence, where the variance extracted was somewhat low (.30).

Aggregation at group level

First, the items measuring EI and self-efficacy were averaged and aggregated at group level to establish two composition models. An additive composition model is the aggregate of individual level data for a variable based on the level of focus of the items is the individual (Rousseau, 1985), and for which homogeneity of responses at group level is not expected (Chan, 1998). Our two group composition models were for ability based EI and trait like GSE, were the team members scores were not likely to be related to each other. It was therefore not appropriate to aggregate these two constructs as team EI and team GSE respectively. An ANOVA confirmed an insufficient level of homogeneity in self-reported EI ($F = 1.18$, $p < .05$, ICC1 = .03, ICC2 = .15), and the distribution of general self-efficacy beliefs within the teams was clearly not homogeneous ($F = .00$, *ns*, ICC1 = .00, ICC2 = -.01).

Unlike the measures of collective EI and collective GSE, the level of measurement of the items measuring interdependence and team potency was the group, implying a referent-shift model, where a sufficient level of homogeneity must be reached (Chan, 1998; Rousseau, 1985). An ANOVA revealed a significant group effect on interdependence ($F = 1.43$, $p < .001$, ICC1 = .07, ICC2 = .30), and on potency ($F = 2.16$, $p < .001$), ICC1 = .17, ICC2 = .54). Both constructs had ICC1 within the range from .05 to .20, which is considered typical (Bliese, 2000). ICC2 is equivalent to the overall sample-mean reliability estimate and the recommended criterion is ≥ .70, however ICC2 is a conservative statistic in that it supposes that a subsample is drawn from an infinite pool of potential raters or informants (Bliese, 2000). We concluded that the values of these indices justified aggregating interdependence and potency data at team level to create team interdependence and team potency variables respectively.

Results

Descriptive Statistics

Descriptive statistics are provided in Table 2. The correlations between collective EI, collective GSE and team potency were modest, varying between +.33 and +.39, indicating that multicollinearity was not a problem. Interdependency was positively correlated with team potency.

Hypothesis Testing

The hypotheses were tested by using stepwise ordinary least square (OLS) multiple regressions, see Notes: N = 104, listwise deletion. [a] Female = 0, Men = 1. [b] One-month intensive cohort = 1, One-semester cohort = 2**.** $^{*}p < .05$; $^{**}p < .02$; $^{***}p < .001$

Table 3. Direct and interaction effects of collective emotional intelligence (EI), collective generalized self-efficacy (GSE), and team potency on team academic performance

The analysis revealed that collective EI (step 2), collective GSE (step 3) and team potency (step 4) were all positively related to team academic performance, over and above control variables, including team interdependence. Thus, Hypothesis 1a, 2a, and 3a are supported. Step 5 demonstrated that *collective EI* ($\beta = .16$, $p < .05$), *collective GSE*, ($\beta = .17$, $p < .05$) and *team potency* ($\beta = .16$, $p < .05$), were all incrementally positively related to team academic performance, all in support of, and in support of Hypothesis 1b, 2b, and 3b. The estimated variance accounted for in the complete research model was 20 %, and 13 % above the control variables.

Interactions

We explored possible pairwise interaction effects among collective EI, collective GSE, and team potency with respect to team academic performance, see Table 3, step 6 - 8. The interaction between collective EI and collective GSE was negatively related to team performance (β = -.13, p < .05). Figure 1 illustrates that the performance for the high EI and low GSE conbinationd and the low EI and high GSE combination is quite similar to the performance for high EI and high GSE, indicating a compensatory effect of these two variables in terms of team academic performance.

Alternative models

EI dimensions. Reporting research on secondary school teachers in Hong Kong, Chan (2004, p. 1791) stated that "the reliance on a global score of emotional intelligence could mask that teachers might have different levels of emotional intelligence with respect to different components, although these components were substantially associated." In recognition of this possibility we used hierarchical, multilevel OLS regression analysis to investigate the relationships between team academic performance and the four dimensions of EI, namely SEA, OEA, UOE, and ROE.

The results of our analysis, controlled for the standard deviations of each dimension and before including collective GSE and team potency were that OEA (β = .20, p < .05), UOE (β = .21, p < .01), and ROE (β = .18, p < .05) were positively related to team academic performance, whereas SEA was not (β = -.12, *ns*). Explained variance (R^2) of team academic performance was 19 %, and 12 % above the effect of the control variables. When including collective GSE in the model, however, OEA (β = .19, p < .05) and ROE (β = .17, p < .05) were positively related to team academic performance, whereas UOE became insignificant (β = -.12, *ns*), together with SEA (β = -.14, ns). Explained variance was 20 %, and 14 % above the control variables. The inclusion of team potency did not alter any of the former main findings: OEA (β = .19, p < .05); ROE (β = .17, p < .05); UOE (β = .11, *ns*); SEA (β = -.15, *ns*). Explained variance was 21 %, and 15 % above the control variables.

Maximum and minimum EI. Steiner (1972) suggested that unitary group tasks, i.e., tasks that cannot be distributed to individual team members, should be a key consideration in evaluations of the most appropriate group level composition. Steiner suggested that intragroup maximum score for disjunctive tasks (tasks in which groups must adopt a single solution to the exclusion of all other solutions) and the minimum score for conjunctive tasks (tasks where all group members must contribute to the end product in order for it to be completed) would be respectively the most appropriate. Thus, we consider the maximum and the minimum model as informative in terms of (a) whether the *team maximum EI* score

indicates that the team member with the highest EI facilitates interaction and cooperation within the group, and (b) whether the *team minimum EI* score indicates that the team member with the lowest EI has disrupts interaction and cooperation within the team.

Our analysis revealed that maximum EI (a) was positively associated with team academic performance ($\beta = .28$, $p < .001$), and the maximum model explained 12 % of the variance of team academic performance and 6 % above the control variables, and (b) when including collective GSE in the model, maximum EI was still related to team academic performance ($\beta = .18$, $p < .05$), and the model explained 16 % of the variance in total and 10 % above the control variables.

As reported above, the collective EI model explained 20 % variance in team academic performance and 13 % above the control variables. However, maximum EI predicted team academic performance somewhat higher ($\beta = .18$) than collective EI ($\beta = .16$), but a check of the difference of the standardized betas by using the bootstrap technique supported the visual impression of a non-significance difference, indicating that the predictions of collective EI and maximum EI in terms of team academic performance are about equally strong. A supplementary examination of whether the two team members' with the highest EI had a stronger impact on performance than the one with the highest EI was inconclusive. Finally, minimum EI (b) was not associated with team academic performance ($\beta = .14$, *ns*). These findings highlights the importance of having at least one relatively high emotional intelligent team member in each team to perform well. The findings also highlight that the team members with the lowest EI score do not affect the performance of the team.

The teams had no team leaders selected by the administration, and they were not instructed to elect a team leader among themselves. When asking respondents whether they nevertheless had selected a team leader, only 10.6 % reported unanimously confirmative to the question, which makes it inappropriate to explore whether our examination of the disjunctive perspective (maximum EI) was contaminated by inordinate team leader roles.

Discussion

This study makes several contributions to the extant literature on the external validity of self-reported collective emotional intelligence (EI) ability and collective general self-efficacy (GSE) and team potency beliefs, associated with an objectively measured team performance. Concerning the first focal point of this study, we found that all three constructs predicted team academic performance positively, beyond the effect of each other. We consider the finding that each of the variables explains a unique proportion of the variance in academic performance as a key contribution to the extant literature, and, to our knowledge, no research

has established this finding before. The research model explained 20% of the variance in team academic grades, a considerable proportion, and 13% above the control variables.

Several researchers have investigated individual level EI alongside self-efficacy in various forms (Chan, 2008; Durán et al., 2006; Hen & Goroshit, 2014; Semadar et al., 2006; Tsarenko & Strizhakova, 2013). This approach seems sensible, given that there is always a risk that perceived ability-based EI is confounded with perceived general ability to master task demands (GSE). Our study indicates that there is no need to be concerned about confounding effects from collective GSE and collective EI on team academic performance.

Collective GSE represents an average of individual team members' beliefs that they are capable of meeting task demands on a general basis, whereas team potency represents the extent to which team members agree about the general capability of the team. From our analyses it is interesting to note that, whereas team members' perceptions of the team's potency clearly indicated emergent properties, the general self-efficacy among the team members did not, a pattern that conforms to theoretical expectations. Collins and Parker (2010) found that although both team efficacy and team potency were incrementally, positively associated with an objective index of performance, team efficacy was a stronger predictor of performance than team potency. The current study indicates that team potency predicted team academic performance at approximately the same level as collective GSE.

Interestingly, the ANOVA analysis revealed that whereas the between group population variance of team potency (mean square = .74) was much higher than collective GSE (mean square = .29), the within group variance of team potency (mean square = .32) was in fact somewhat *higher* than collective GSE (mean square = .28). Thus, we may speculate whether the emergent properties of team potency are grounded at the team level and not on the emergence of a shared within group belief on whether the team's potency is high or low, in contrast to what is commonly assumed. Only longitudinal comparison of collective GSE/collective potency (focus of the measurement at the individual level) and team GSE/team potency (focus of the measurement at the group level) may reveal whether these speculations hold true or not.

Our second focal point in this study was to explore whether the interactions of collective EI and respectively collective efficacy and team potency encompass additional or substitutional effects on high team academic performance. Perhaps the most striking finding in our study is that we bring evidence of a negative interaction effect between collective EI and collective GSE on team academic performance, indicating that the two variables may substitute each other in order to attain high academic grades on their teamwork. This finding

is notable, given that the shared variance between collective EI and collective GSE in the present study was moderate (R^2 = .17). Hence, the team members' averaged emotional intelligent ability and the team members' averaged level of general self-efficacy beliefs represent two moderately associated ways to achieve high performance in teams. We found however no interaction effects between collective EI and team potency on team academic performance, and neither did the interaction of collective GSE and team potency affect team academic performance.

This study investigated two additional models of collective EI. First, we investigated the external validity of the four EI dimensions. There has been little research into the four dimensions based on WLEIS data, and the results have been mixed. At the individual level, Huang, Chan, Lam, and Nan (2010) found that self emotion appraisal (SEA) and use of emotion (UOE) were positively and marginally positively related to performance respectively, but other emotion appraisal (OEA) and regulation of emotion (ROE) were unrelated to performance. The opposite pattern of associations was reported by Law, Wong, Huang and Li (2008) and De Dreu and Gelfand (2008), who found that OEA and ROE were positively related to performance, in contrast to UOE and SEA. In step one, we investigated the associations between group level operationalizations of the four EI dimensions and team academic performance, however without including collective GSE and team potency in the model. We found that collective OEA, UOE, and ROE respectively were positively associated with team academic performance. When introducing collective GSE in our research model, the effect of collective UOE became insignificant, whereas collective OEA and collective ROE were almost unaffected by the inclusion of collective GSE, even after team potency was added to the model. In a study of EI dimensions at the group level by using an abbreviated version of the mixed model (stream 3) scale (EIS) developed by Schutte et al. (1998), Chang et al. (2012) found that (other) EI appraisal (cf. OEA) strongly predicted team performance, whereas emotion utilization (cf. UOE) and mood regulation (cf. ROE) did not. Thus, the most robust dimensions of collective EI to promote effective teamwork in terms of team academic performance seem to be the ability to comprehend the other team members' emotions while keeping one's own emotions, however, under control. These findings are consistent with the results of an individual level study by (Law, Wong, Huang, & Li, 2008).

EI encompasses both intrapersonal (dealing with self) and interpersonal (dealing with others) abilities (Chan, 2008; Gardner, 1983; Law et al., 2004; Wong & Law, 2002). Wong and Law (2002) did not provide any classification of the four EI dimensions of the WLEIS scale attached to intra- and interpersonal abilities. On a preliminary basis we suggest that

OEA and UOE be perceived most typically as interpersonal abilities, whereas SEA be associated strongly with intrapersonal abilities. Concerning ROE, we assume that this dimension concerns "dealing with self with consequences for others." If these suggestions make sense, our findings fit reasonably well to our expectations; the positive relationships between respectively OEA and ROE and team academic performance are probably associated with the interpersonal aspects of these dimensions, in contrast to the intrapersonal aspect of SEA, particularly. For instance, Banki (2010) suggested that high EI may be beneficial when it is useful to detect other team members' true intentions, an ability that probably is closely associated with the combination of high OEA and the ability of hiding their own emotions (by ROE) if necessary. Consequently, as Wang (2015, p. 328) puts it: "Because individuals who are high on EI are better at accurately perceiving others' emotions, they can more easily infer information about their teammates' attitudes, goals, and behavioral intentions."

We also investigated maximum (disjunctive) and minimum EI (conjunctive) as a second alternative research model (Steiner, 1972). Huy (1999) suggested that it is not necessary for all members of a group to have high EI for the group to be emotionally capable. However, Jordan, Ashkanasy, Härtel, and Hopper (2002) argued that the average of group members' emotional intelligence is a better indicator of group performance than the maximum individual EI score (Wang, 2015). Our results provide some evidence in favor of an equal position between the two models. There is however no need to search for a final answer; the variation of findings may simply be mirroring whether the task in hand is disjunctive or not. Concerning the current study, we may assume that performance formally evaluated by academic grades quite often will be somewhat disjunctive.

Our findings indicate that the successful assignments of team reports as described in this study have been beneficially finalized in two ways: either largely due to the ability of the team member with the highest EI to facilitate the team effectively; or because a high average EI of the team members made them able to work successfully together by jointly using their resources effectively. Conversely, the tasks performed by the teams in this study were clearly not conjunctive, in that the team member with the lowest EI was not able—intentionally or not—to the lead the teams astray, as minimum EI was not related to team academic performance. Hence, if we add the interaction of collective EI and collective GSE to the list, we have found three criterions to indicate successful academic performance, a high average level EI, a high maximum level of EI, and a high average level of collective generalized self-efficacy.

We should note that our findings are highly contextual, both in terms of the task (project and process report) and in terms of the level of analysis (group). Concerning academic performance, it is well known that taking a very time limited exam is a stressful event and strongly associated with ambiguity, uncertainty, and anxiety (Rode et al., 2007) compared with completing a long term project and process report. In terms of the level of analysis, even EI at the individual level is found to predict academic performance requiring emotional related abilities (Libbrecht et al., 2014; Song et al., 2010) better than courses in math or science (Petrides, Frederickson, & Furnham, 2004). However, in a team, the benefit particularly of interpersonal aspects of emotional intelligence (dealing with others) will be much more needed in groups than at the individual level, and it is reasonable to expect an even stronger relationship between collective EI and an emotional associated team performance than what we may expect at the individual level. However, despite these contextual concerns, our findings may strongly apply to a broader arena than just the academic. The teams in our sample worked with practical oriented task assignments, partially suggested by external companies (46 % of the teams), which makes the relevance of our finding for practical work teams in companies outside academia very high.

From a theory building perspective the concept of EI is still under development, probably somewhere between the selection and the final retention phases of the evolutionary model of theory development (Jordan et al., 2003; Weick, 1989), and it is to be expected that theoretical controversies will persist for some time. The uncertain theoretical background is an unavoidable and important weakness of this study, as of many other studies of the external validity of EI. The interpretation of our results is influenced by whether one considers EI an ability construct, whether one considers it appropriate to index EI using self-report instruments, and more specifically whether one considers the Wong and Law (2002) scale an adequate measure of EI. We have set out the arguments for the theoretical and methodological choices we have made, but the generality of our findings remains open to question. During this phase of theoretical research into the EI construct, the most that we and other scholars can do is to pursue research from a variety of perspectives and hope over time the findings will converge, leading to a better understanding of the nature and properties of EI. We hope that the results presented here contribute to this project.

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Tables and figures

Table 1. Models of fit (CFA), composite reliabilities and variance extracted, and Cronbach's alpha.

	Models	Factors	Items	χ^2	*df*	RMSEA	RMSEA min	RMSEA max	CFI	Composite reliability	Variance extracted	Cronbach's alpha
1	Research model	Four factor model[1]	33	1252.58	443	.04	.04	.04	.96			
2	Research model	One factor model	33	1189.06	464	.15	.15	.15	.65			
3	EI	Four factor model[2]	16	372.39	98	.05	.05	.06	.98			
4	EI	One-factor model	16	4591.58	90	.25	.21	.22	.61			
5	EI dimension	SEA	4	16.65	2	.08	.05	.12	.99	.85	.59	.84
6	EI dimension	OEA	4	7.20	2	.05	.01	.09	1.00	.80	.51	.79
7	EI dimension	UOE	4	18.01	2	.09	.05	.12	.99	.76	.44	.76
8	EI dimension	ROE	4	19.77	2	.09	.06	.13	.99	.79	.49	.80
9	Potency		4	9.53	2	.06	.03	.10	1.00	.81	.53	.81
10	GSE		6	21.06	5	.05	.03	.08	.99	.79	.44	.78
11	Potency and GSE	Two-factor model	10	86.47	26	.05	.04	.06	.99			
12	Potency and GSE	One-factor model	10	1771.27	27	.24	.23	.25	.74			
13	Interdependence		7	102.70	14	.08	.06	.09	.95	.74	.30	.76

Note: [1] EI (Collective emotional intelligence), GSE (Collective general efficacy), Potency, and Interdependence. [2] SEA (Self emotion appraisal), OEA (Other emotion appraisal), UOE (Use of emotion), and ROE (Regulation of emotion).

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Table 2. Means, standard deviations and correlations among the study variables.

Team variables	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Gender[a]	1.53	.29															
2 Average age	1.48	.40	-.18*														
3 Size	4.55	.70	.11	-.09													
4 Sample dummy[b]	1.45	.50	.47**	-.35**	.07												
5 Interdependence	3.68	.30	-.22**	.09	-.07	-.10											
6 EI diversity	.38	.20	.11	-.05	.03	.02	-.17*										
7 Collective emotional intelligence (EI)	3.73	.26	-.04	.14	.03	-.10	.16*	-.22**									
8 Collective generalized self-efficacy (GSE)	3.84	.29	.07	.04	-.04	.03	.06	.01	.39**								
9 Team potency	3.82	.43	-.09	.20**	.13	-.18*	.28**	-.11	.39**	.33**							
10 Team academic performance	4.23	.65	.01	-.01	.19**	-.12	.08	.00	.28**	.27**	.30**						
11 EI minimum	3.32	.40	-.10	.17*	-.04	-.09	.21**	-.67**	.80**	.26**	.32**	.17*					
12 EI maximum	4.12	.31	.06	.10	.10	-.05	.00	.41**	.72**	.33**	.27**	.25**	.28**				
13 EI Regulation of emotion (ROE)	3.74	.37	.25**	-.11	.10	.09	-.06	-.06	.62**	.18*	.17*	.18*	.43**	.50**			
14 EI Self emotion appraisal (SEA)	3.90	.36	.02	.04	.01	.05	.07	-.27**	.75**	.19**	.24**	.07	.68**	.49**	.39**		
15 EI Other emotion appraisal (OEA)	3.63	.39	-.31**	.27**	-.05	-.26**	.26**	-.17*	.69**	.15*	.28**	.22**	.56**	.48**	.11	.47**	
16 EI Use of emotion (UOE)	3.66	.40	-.04	.15*	.04	-.12	.15*	-.10	.64**	.53**	.37**	.28**	.50**	.48**	.20**	.22**	.28**

Notes: N = 104, listwise deletion. [a] Female = 0, Men = 1. [b] One-month intensive cohort = 1, One-semester cohort = 2. *$p < .05$; **$p < .02$; ***$p < .001$

Table 3. Direct and interaction effects of collective emotional intelligence (EI), collective generalized self-efficacy (GSE), and team potency on team academic performance

	Control	Hypothesized relationships					Two-ways interactions		
Model	1	2	3	4	5	6	7	8	9
Gender[a]	.09	.07	.06	.07	.06	.06	.07	.07	.06
Average age	-.04	-.07	-.05	-.08	-.08	-.09	-.09	-.10	-.08
Size	.20**	.18**	.21**	.16*	.18**	.18**	.19**	.16*	.18**
Sample dummy[b]	-.18*	-.16*	-.19*	-.14	-.16*	-.15	-.19*	-.14	-.16
Interdependence	.10	.06	.08	.03	.03	.02	.05	.05	.04
EI diversity		.04				.02	.03	.03	
Collective EI		.29**				.16*	.19*	.21**	
Collective GSE			.28**		.22**	.17*	.22**		.22**
Team Potency				.27**	.20**	.16*		.18*	.19*
Collective EI x Collective GSE							-.13*		
Collective EI x Team potency								-.11	
Collective GSE x Team potency									-.04
F	2.91*	4.59**	5.51**	4.91**	8.54**	5.11**	5.10**	4.70**	5.13**
ΔF above Model 1		8.27**	17.32**	13.93**	12.33**	7.39**	8.37**	6.52**	8.99**
R^2	.07	.14	.15	.13	18	.20	.20	.18	.18

Notes. N = 200. [a] Female = 0, Men = 1. [b] One-month intensive cohort = 1, One-semester cohort = 2. *$p < .05$; **$p < .01$. All variables are standardized.

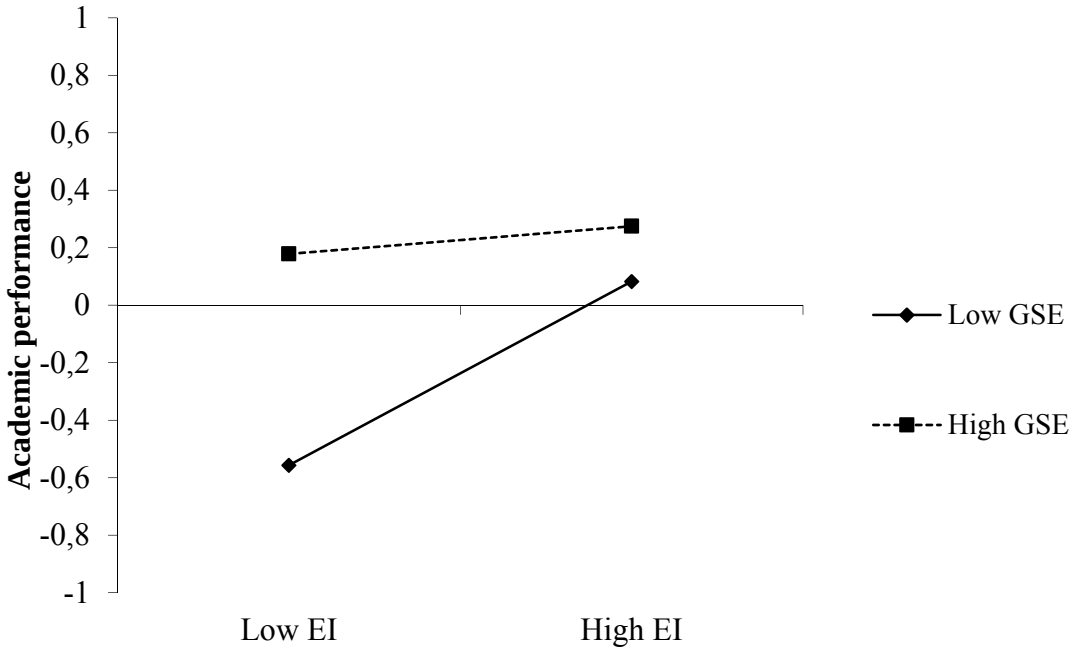

Figure 1. Plot of interaction between collective emotional intelligence (EI), collective generalized self-efficacy (GSE) on team academic performance.

Appendix[1]

Process report

<table>
<tr><td rowspan="2">Grade</td><td colspan="2">Prerequisites</td><td colspan="2">Team Process</td></tr>
<tr><td>Situations</td><td>Theory</td><td>Reflections on key episodes in the team</td><td>Actions
Improve or change behavioral pattern</td></tr>
<tr><td>A
Excellent</td><td rowspan="2">Situations are presented in a way that highlights how individual team members and the whole team have affected the process of the project</td><td>Particularly good application of relevant group concepts and theory</td><td rowspan="2">The team highlights in an excellent manner the development of cooperation through situations that are presented, and reflects in a considered and insightful way about:
• The way individual team members perceive their own and others' approach and behavioral patterns
• How the team communicates and cooperates
• How the diversity of the team influences the cooperation

The team highlights in an excellent manner their learning and teamwork experience through:
• Individual reflections
• Team reflections</td><td>The team implements and evaluates in an excellent manner actions to improve the cooperation</td></tr>
<tr><td>B
Very good</td><td>Some relevant concepts applied

Some group theories integrated</td><td>The team evaluates to some extent the actions taken to improve the cooperation</td></tr>
</table>

Grade	Interdisciplinary	Written report

[1] Guide for Students. Experts i Teamwork. 2015, pp. 15-16. Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

A Excellent	The team has used its disciplinary diversity well: 1. To find a project that suits their combined competence 2. To work on and complete the project	Project work has been carried out in a very good way: • The project exemplifies the village theme • The approach to the project and the project goals are clearly described in the introduction • The methods used and why they are chosen are clearly described • The outcome of the project is clearly presented and discussed • The social relevance of the outcome is very well discussed and suggestions are made as to how the project can be continued
B Very good		