Getting Satisfaction from Interpersonal Interactions in Small Groups:  
A Model Based on Self-Determination Theory

The main purpose of the present study is to explore conditions for active participation in, and getting satisfaction from, small group interactions. Especially, this paper focuses on interpersonal communication among college students in cooperative learning groups. Relying on the theoretical framework of self-determination theory, we propose that participation in interpersonal interactions would be enhanced by three basic psychological needs: competence (perceived communication competence), autonomy (perceived autonomy in small group contexts), and relatedness (willingness to establish and maintain interpersonal relationships with their group members). It was also assumed that these three basic psychological needs, which would be influenced by perceived environmental pressures, would affect degrees of active oral interactions among students, which, in turn, would determine degrees of class satisfaction. Using structural equation modeling, we tested the hypothesized causal links among the variables to modify the original model and produce a finalized model. For cross-validation, then, we tested the finalized model with an independent sample, to confirm the equivalence of the measurement and the structural paths across the samples.
Getting Satisfaction from Interpersonal Interactions in Small Groups: A Model Based on Self-Determination Theory

The main purpose of the present study is to explore conditions for spontaneous participation in, and getting satisfaction from, small group interactions. Especially, this paper focuses on interpersonal interactions among college students in cooperative learning groups consisting of four people. The basic assumption is that interpersonal interactions in cooperative groups would be associated not only with academic motivation but also with relational and communicative motivation.

Cooperative learning has been found effective with college and graduate students as well as younger children. Felder and Brent (1996, p. 43) concluded that cooperative learning enhanced college students’ "motivation to learn, retention of knowledge, depth of understanding, and appreciation of the subject being taught." And Hancock (2004) found a significant association between higher peer orientation—a student's preference to work on tasks with other students—and stronger motivation to learn with cooperative learning strategies among graduate students.

Enough evidence seems to have been accumulated that cooperative learning enhances students' learning. Little, however, is known about what would motivate students' active participation in cooperative learning activities. Most studies have considered cooperative learning only as an enhancer of motivation (Lepper and Henderlong, 2000, pp. 292-294). Few studies, if any, have raised such question as: What would motivate students to actively engage in cooperative learning activities?

Despite the evidence that cooperative learning enhances academic achievement, many students are still apprehensive about cooperative techniques in their classes (McCroskey & Richmond, 1990). Student-to-student interactions would not start automatically (Phipps, Phipps, Kask, & Higgins, 2001). Besides academic motivation, extrinsic motivation and efforts are necessary for cooperative learning, because cooperative learning involves "cooperation" as well as "learning."

While investigating internalization of perceived locus of causality, Ryan and Connell (1989) tested their hypotheses in two domains: academic achievement domain and prosocial behavior domain. Because these two domains are "fairly independent realms of inquiry" and "represent areas where we have sought to explore the issue of autonomy as it interfaces with other basic psychological needs—namely, those for competence and relatedness" (p. 751). Cooperative learning, which requires spontaneous interpersonal interactions among students, combines these "two fairly
independent realms of inquiry” and would also demand autonomy, competence, and relatedness. So far, however, most studies on cooperative learning have exclusively focused on the “academic achievement domain.” The purpose of the present study is to call for attention to the “prosocial behavior domain,” or interpersonal interaction aspect, of cooperative learning.

Relying on the theoretical framework of self-determination theory (Deci & Ryan, 1985; Deci & Ryan, 2000; Ryan & Deci, 2000), we propose that students’ interpersonal communication in cooperative learning would be enhanced by three basic psychological needs underpinning self-determined motivation: competence (perceived communication competence), autonomy (perceived autonomy in small group contexts), and relatedness (feeling comfortable with maintaining relationships with their group members). Furthermore, we assume that these three basic psychological needs, which would be influenced by perceived environmental pressures, would affect degrees of active oral interactions among students, which, in turn, would determine degrees of class satisfaction.

**Conditions for effective cooperative learning**

We, following Johnson, Johnson, and Holubec (1994, p. 1), define cooperative learning as “the instructional use of small groups so that students work together to maximize their own and each other’s learning.” Cooperative learning sessions are “externally and regularly imposed interpersonal communication settings,” where students are supposed to be engaged in intensive small group discussions for a semester. And Hancock (2004, p. 159) defined cooperative learning as "students working in mixed-ability groups on clearly defined tasks with the expectation that they will be rewarded on the basis of group success."

Johnson, Johnson, and Smith (1991) identified five basic elements that are necessary for effective use of cooperative learning method: positive interdependence, individual accountability, face-to-face promotive interaction, social skills training, and group processing. These elements are all closely related to interaction among students.

Reviewing numerous studies on cooperative learning, Cohen (1994) pointed out that positive outcomes could be actually obtained only under certain conditions. One of the most important elements for successful cooperative learning, Cohen (1994) argues, is interaction among students. The key feature distinguishing collaborative learning from individual and competitive learning is social interaction, manifested by verbal communication behavior (Klein & Huynh, 1999). Indeed, the interaction in cooperative learning mostly takes the form of oral communication among students.
Bunch of studies have found positive effects of oral interactions in cooperative learning. Barnes and Todd (1977) and Sharan (1980) reported that students who spoke or explained benefit more than those who just listened. Johnson, Johnson, Roy and Zaidman (1985) showed that "vocalizing" was more strongly related to achievements than "listening." As Bargh and Schul (1980) have suggested, cooperative learning enhances achievements by providing students with pseudo-teacher experiences. And this "teaching" or "explaining" allows a student "to see the issue from new perspectives, enabling him or her to see previously unthought of new relationships between the discrete elements" (Bargh & Schul, 1980, p. 595). Examining four studies on oral interaction and learning, Webb (1983) also concluded that "giving elaborate explanations" was "consistently and positively" related to academic achievement, whereas giving simple terminal answers was not. And other studies also demonstrated that elaborate explanations could be the most consistent and positive predictor of achievement (Webb, 1991; Swing & Peterson, 1982).

Since the positive effects of oral interaction were demonstrated, scholars of cooperative learning have investigated under what conditions students are willing to actively participate in interpersonal interactions. So far, scholars have identified various conditions that encourage and stimulate interaction. We may categorize the conditions as following. (1) Group task: A single task that can be done by one person would not stimulate interaction. Tasks should be genuine "group task," which requires resources (information, knowledge, materials, skills, etc.) that no single individual possesses so that no single individual is likely to solve the problem or accomplish the task objectives (Cohen & Arechevala-Vargas, 1987). In this "reciprocal interdependence" arrangement, each student must exchange resources with others before the task can be completed (Cohen, 1994).

(2) Ill-structured problems: The nature of the work assigned to the groups should be "ill-structured" problems which do not have one right answer, or nonroutine problems, for which there are no standard recipes or procedures. Cooperative learning can be effective, when groups manage the process of solving "ill-structured" problems with "explicit talk" (Cohen, 1994, p. 6).

(3) Heterogeneous group composition: Academically heterogeneous groups ensure more interactions among students than homogeneous groups, because high-achieving students would have more chances to give explanations to low-achieving students (Hooper and Hannafin, 1988; Swing and Peterson, 1982).

(4) Goal and resource interdependence: Positive goal interdependence and resource interdependence can also encourage interaction (Johnson, Johnson, & Stanne, 1990).
But Cohen (1994) warns that (a) the interaction should be stimulated by task arrangements and (b) goal and resource interdependence are not sufficient conditions for activating group participation.

(5) Reward interdependence: Students are stimulated to participate and to help one another when they are rewarded as a group, while each student is individually accountable for his or her learning (Slavin, 1983).

From the standpoint of motivation study, however, these conditions above are generally associated with extrinsic motivation only—getting group tasks done, solving ill-structured problems, helping one another to get a better grade, receiving group rewards, and so on. These conditions would hardly foster intrinsic motivation toward interaction with group members.

In some cases, interaction may even be scripted with specific conversational strategies that students practice before attempting the group task (Spurlin, Dansereau, Larson, & Brooks, 1984). But the "scripted and imposed interaction" would not motivate genuine interaction. On the contrary, many studies on motivation suggest that such imposition would diminish any intrinsic motivation toward interaction. Successful and effective cooperative learning can be achieved through spontaneous interaction from the participants. We assume that some people are more intrinsically motivated toward social interaction; and they would more enjoy and get satisfied from interaction itself; for them, interaction is not a means to get other rewards, but a reward itself. And the purpose of the present study is to examine causes and effects of intrinsic motivation toward interpersonal interaction based on the self-determination theory.

**Interaction and communication orientation**

Oral interactions in cooperative learning mean interpersonal communication behaviors. Many experiments have demonstrated that individuals have different levels and patterns of interpersonal communication orientation, including communication anxiety, interpersonal communication competence, communication efficacy, social skills, relational competence, communication apprehension, and relational maintenance. Individual differences in communication behaviors, we propose, would affect motivation of interaction in cooperative learning. In other words, those who are more open and willing to maintain interpersonal relationships, less communicatively apprehensive, more comfortable with having conversations with strangers, and more communicatively competent, would more actively participate in interaction.

Interpersonal communication scholars have found that some people perceive themselves as more communicatively competent (Spitzberg & Hecht, 1984; Spitzberg &
Cupach, 1984 Spitzberg & Cupach, 1989; Wiemann, 1977), less apprehensive (McCroskey, 1978; McCroskey, 1993; McCroskey & Beatty, 1998), cognitively and behaviorally more adaptive or more involved in conversational interactions (Cegala, 1981; Duran, 1983), and more willing to talk (Burgoon, 1976; Burgoon & Hale, 1983).

The predisposition for active oral communication or "speaking out" would be different for each and every individual (McCroskey, 1970, 1977, 1984, 1992; McCroskey et al., 1989; McCroskey & Richmond, 1990). Communication scholars have developed many constructs for communication predispositions. For example, communication apprehension (McCroskey, 1970, 1977, 1984, 1989) is "an individual’s level of fear or anxiety associated with real or anticipated communication with another person or persons" (1977, p. 78). And self-perceived communication competence is defined as "individual’s confidence about his or her own oral interaction skill" (McCroskey & Richmond, 1990). Since the choice of getting involved in communication is a cognitive matter, perception of competence (of which one usually is aware) is more important than actual competence (of which one may be unaware). In other words, self-perceived communication competence is perceived (Dembo & McAuliffe, 1987) or relative (Webb & Kenderski, 1984) communication ability that encourages (or discourages) people to engage in interpersonal communication. Willingness to communicate is a volitional choice about oral interaction, which is cognitively processed (McCroskey & Richmond, 1985; 1990). Willingness to communicate, which can explain diverse talking behaviors, is understood as a personality construct. (McCroskey & Richmond, 1985; 1990).

Consider a typical cooperative learning session in a college class. At the beginning of the semester, students are assigned to small groups where they meet their group members, often, for the first time. Before starting discussion on any topics or working together on a group task, students must “meet” one another—greeting, introducing oneself, shaking hands, and starting casual conversations; in other words, before starting a “group” project, students must form a “group”; before starting "cooperation," students must work on interpersonal relationships, which require certain types of efforts and skills. We propose that those efforts and skills for relationship building and maintenance would require motivation, quite distinctive from academic motivation. We may call it motivation of interaction, or social motivation.

**Frequencies of interaction—academic status or communication orientation?**

Studies investigating interactions among cooperative learning groups have reached the conclusion that academic status influences frequencies of oral interactions: students with low academic status interact less frequently and have less influence than students
with high academic status (Hoffman, 1973; Rosenholtz, 1985; Tammivaara, 1982).

Academic status, however, is a perception. Students with higher academic status are those who are perceived as relatively higher achievers by peer students (Webb & Kenderski 1984; Dembo & McAuliffe 1987). As such, differences in academic status are virtually non-exist in a large college class where students meet their class mates for the first time. Furthermore, students of prestige universities are quite homogeneous in terms of academic abilities, as they passed through highly selective admission processes. Especially in a college classroom situation, therefore, communication orientation would have a stronger impact on the amount of oral interactions in cooperative groups rather than academic status.

Moreover, communication scholars have found that communication orientation, such as communication apprehension, influences academic achievement. Interestingly enough, it was found that communication apprehension has a direct relation with cognitive performance and various academic achievements such as overall grade point average, standardized achievement scores, and grades earned in small classes in junior high and college (Bourhis & Allen, 1992; McCroskey, Butterfield & Payne, 1989). This is because, communication scholars argue, communication apprehension produces social isolation, disintegration and helplessness (McCroskey & Sheahan, 1978; Daly & Stafford, 1984). Education scholars (Johnson, Johnson, Roy and Zaidman, 1985; Webb, 1991; Swing & Peterson, 1982) also suggest, implicitly or explicitly, that giving explanation enhance academic achievement, not vice versa. Thus, we should raise the following question: What would encourage (or discourage) students to engage in oral interactions in cooperative learning such as giving elaborate explanations?

Self-determination theory and A Model of Small Group Interactions and Satisfaction

Self-determination theory (Deci & Ryan, 1985; Deci & Ryan, 2000; Ryan & Deci, 2000) postulates human beings have three basic psychological needs underpinning self-determined motivation: autonomy (the belief that one is the origin and regulator of his or her actions), competence (the belief that one can efficaciously interact with the environment), and relatedness (the seeking and development of secure and connected relationships with others in one’s social context). Specifically, the theory posits that within any significant life domain, opportunities to experience autonomy, competence, and relatedness are essential in promoting life satisfaction and well-being (Deci & Ryan, 2000; Levesque, Zuehlke, Stanek, & Ryan, 2004).

Deci and Ryan (1985, p. 37) defined self-determination as "a quality of human
functioning that involves the experience of choice, in other words, the experience of an
internal perceived locus of causality...[S]elf determination is the capacity to choose and
to have those choices, rather than reinforcement contingencies, drives, or any other
forces or pressures, be the determinants of one's actions.... The psychological hallmark
of self-determination is flexibility in managing the interaction of oneself and the
environment.” Deci and Ryan (1985, p. 58) contended that perceived competence and
intrinsic motivation were closely related.

Interestingly, Deci and Ryan (1985) suggested the cognitive evaluation theory,
which conceptualized how interpersonal communication affected intrinsic motivation:
“Controlling interpersonal communication” (experienced by recipients as "pressure to
think, feel, or behave in specified ways) would decrease intrinsic motivation (Deci &
Ryan, 1985, p. 95), while “informational interpersonal communication” (experienced by
recipients as allowing "choice" and providing "information that is useful for a person in
his or her attempts to interact effectively with the environment") would increase
intrinsic motivation (Deci & Ryan, 1985, p. 96). As such, Deci and Ryan conceptualized
interpersonal communication as an "event" or a "feedback" that might influence
intrinsic motivation for certain behaviors.

Generally, in self-determination theory, interpersonal communication has been
considered as a contextual element that might affect self-determined motivation. We,
however, are interested in intrinsic motivation for interpersonal communication per se.
Deci and Ryan (1985) saw interpersonal communication as a facilitator (or an inhibitor)
for intrinsic motivation for some human behaviors. But the present study attempts to
identify facilitators that motivate interpersonal communication. In other words, the
present study examines how individual differences in communication competence,
perceived autonomy, and seeking relatedness are associated with students' active
participations (oral interactions) in cooperative learning and class satisfaction. The
assumption is that motivation for cooperative learning would be enhanced by
perceived competence in interpersonal communication, perceived autonomy in
cooperative learning groups, and one's willingness to establish and maintain
interpersonal relationships with the group members.

Applying the perspectives of the self-determination theory to interpersonal
interactions, we hypothesized that students with greater perceived autonomy,
perceived competence, and willingness to establish interpersonal relationships, within
the cooperative learning groups, would more actively participate in the oral
interactions, which, in turn, would result in greater class satisfaction.
Class satisfaction

As cooperative learning is a learner-centered model, it is necessary to monitor students’ experience such as student class satisfaction along with academic achievements. Few studies, however, have examined the impact of cooperative learning on class satisfaction. We propose that students who participate more actively in cooperative learning activities would get greater class satisfaction.

According to the self-determination theory, perceptions of autonomy and competence should closely interact with one another to enhance the sense of well-being (Deci & Ryan, 2000). So far, however, studies based on the self-determination theory have paid little attention to effects of relatedness on the sense of well-being. In this study, we will examine how relatedness as well as autonomy and competence enhance the sense of well-being in classroom, or class satisfaction.

Social factors: Perceived pressure in classroom

At the same time, we also assumed that perceived environmental pressure would affect the levels of autonomy, competence and relatedness in cooperative learning. Self-determination theory assumes that social contexts may satisfy or thwart the needs for autonomy, competence, and relatedness. According to Deci and Ryan (1985), autonomy-supportive environments, as opposed to controlling situations, are assumed to facilitate self-determination motivation. Autonomy-supportive environments refer to situations in which individuals regard themselves as the origin of their behavior; and controlling situations refer to events in which individuals perceive themselves as pawns to external forces such as rewards or punishments (DeCharms, 1968).

Our assumption is that perceived classroom climate would influence the three psychological needs for cooperative learning. In other words, if students perceive that they are forced to participate in cooperative learning activities, they would perceive lower level of autonomy, competence, and relatedness in small group activities.

The proposed model

Integrating our hypotheses, we may construct a sequential model as following: perceived classroom climate (social pressure) \( \rightarrow \) the three psychological mediators (autonomy, competence, and relatedness) \( \rightarrow \) interpersonal interactions in cooperative learning groups \( \rightarrow \) class satisfaction. The model is depicted in Figure 1. Using structural equation modeling, we tested the hypothesized causal links among the variables to modify the original model and produce a finalized model. For cross-validation, then, we tested the finalized model with an independent sample, to confirm
the equivalence of the measurement and the structural paths across the samples.

<<Figure 1 about here>>

Method

Participants

Participants were 337 undergraduate students, enrolled in a large introductory-level course of *Space astronomy and exploration*, at one of the top-ranked private universities in a metropolitan city. In Phase 1 of the present study, 174 students were recruited (85 female and 89 male students; 110 freshmen, 36 sophomores, 12 juniors, and 16 seniors). In Phase 2, 163 students participated (81 female and 82 male students; 94 freshmen, 49 sophomores, 11 juniors, and 9 seniors).

Procedure

Phase 1 of the study was conducted in the spring of 2003. Students participated in nine cooperative learning sessions (3 hours each) during 16 week of the semester. Students’ perceived classroom climate, autonomy, competence and relatedness regarding cooperative learning were measured at the beginning of the semester, that is, before the first cooperative learning session. Students’ interaction behaviors and class satisfaction were assessed after the ninth cooperative learning session, that is, at the end of the semester. In each cooperative learning session, we applied a modified version of Student Teams Achievement Divisions (STAD) model suggested by Slavin (1978, 1995). Most of the cooperative learning groups consisted of four students, unless there were drop-outs.

In a typical session, the instructor started the class with lecture or instructional presentation (for 30 to 50 minutes), and provided students with learning materials. Following the presentation, the instructor set a group task to students. Students were guided to study on his/her own for about 10 minutes, and then to perform peer-instructions and discussion with their group members. At the end of each cooperative learning session, the instructor asked several groups to present their discussion results, and prompted other students to comment. Finally, the instructor wrapped up the class with review and summary presentation.

Phase 2 was conducted in the fall of 2003 to obtain a cross-validation sample necessary for a test of the replication of Phase 1. The instructor, course materials, and the procedures of cooperative learning sessions were identical with Phase 1. The final
model derived from the post hoc analyses on the data from Phase 1 was tested on the data from Phase 2. In other words, the sample from Phase 1 served as the calibration sample on which the initially hypothesized model was tested, and on which any post hoc analyses were conducted in the process of attaining a well-fitting model. Once the final model was determined, the validity of its structure was tested based on the sample from Phase 2, or the validation sample. (Byrne, 2001, pp. 248-249).

**Measures**

*Perceived classroom climate: Social pressure in cooperative learning class*

This 5-item scale, adapted from the work climate scale (Deci, Connell, & Ryan, 1989) and environmental pressure scale (Levesque et al., 2004), was modified to measure the perceived classroom pressure especially for cooperative learning using the following adjectives: tense and nervous, comfortable, liking (enjoying), calm and relaxed. Example items are “Engaging in a small group discussion makes me tense and nervous because of its impact on my grade,” “I am participating in cooperative learning because that’s what I am supposed to do,” and “I am participating in group work unless other group members would get mad at me.” Participants were asked to answer each item on a 5-point scale, ranging from 1 (not at all true) to 5 (completely true). The internal consistency of the scale was adequate (Chronbach’s alpha= .81 and .87, for sample 1 and sample 2, respectively). For the purpose of testing the structural model, we randomly created two parcels (one parcel with 3 items and the other with 2 items) and used the average of those items indicators of the latent variable.

*Perceived autonomy for small group interaction*

To measure perceived autonomy in cooperative learning situation, we adopted and modified the Self-Regulation Questionnaire, originally developed by Ryan and Connell (1989). Ryan and Connell created three reason categories differentiated along a continuum of autonomy (intrinsic, identified, introjected, and external) and created the inventory which consists of four subscales and 32 items. In the present study, we selected nine items from the intrinsic, identified and introjected reason categories and modified the items to fit with cooperative learning situations.

These items include intrinsic motivation (e.g., “I participate in group discussion because I like it.”), identified motivation (e.g., “I participate in group discussion because it is important to me.”) and introjected motivation (e.g., “I participate in group discussion because I feel bad about myself if I don’t.”). Responses were responded on a 7-point Likert scale measured by 1 (strongly disagree) to 7 (strongly agree).
Following Levesque, Zuehlke, Stanek, and Ryan (2004), we created three composite indicators, referred to self-determination indices (SDI). These form of composite indicators have been widely used in previous research assessing level of autonomy with a Self-Regulation Questionnaire (Deci & Ryan, 2000). Specifically, these indices are formed by weighting each item in accord with its underlying level autonomy. All three intrinsic items were given a weight of +2 because they are the most self-determined, followed by the items representing identified regulation, which were all given a weight of +1, and the items reflecting introjected regulation were each given a weight of -1. Then, one item representing each of the forms of motivation was included in a composite. These composite indices (SDI) were computed in the following way:

$$SDI= (2 \times \text{Intrinsic}) + (\text{Identified}) - (\text{Introjected}).$$

**Self-perceived communication competence scales**

To measure perceived communication competence in oral interactions, we employed a modified version of the Self-Perceived Communication Competence Scale (SPCC) developed by McCroskey (1988; 1990). The SPCC scale was created to measure the operationalization of subjects’ self-perceptions of their communication competence. The SPCC scale consists of 12 items with a potential range of 0 (completely incompetent) to 100 (competent). We selected the items reflecting communication contexts relevant to cooperative learning activities (talking in small groups and talking in dyads) and two types of receivers (acquaintances and friends). The internal consistency of the scale was adequate (Chronbach’s alpha= .91 and .92, for sample 1 and sample 2, respectively).

This scale has high face validity since it includes asking students to directive estimate their own communication competence across a variety of contexts. Examples items include: “Present a talk to a small group of acquaintance,” and “Talk to your friend you like.” In order to test the structural model, we randomly created three parcels (4 items each) and used the average of those items indicators of the latent variable (Byrne, 1998; Kishton & Widaman, 1994).

**Perceived relatedness**

In the self-determination theory’s framework, the need for relatedness can be defined as “feeling of connected with significant others (Levesque et al., 2004, p. 68),” or “the seeking and development of secure and connected relationships with others in one’s social context (Deci & Ryan, 1985, 1991).” We define perceived relatedness as
willingness to build and maintain relationship with others in cooperative learning groups.

As self-determination theory contends that autonomy and competence have the most powerful influences on intrinsic motivation, relatedness has been considered less central to intrinsic motivation (Deci & Ryan, 2000; Levesque et al., 2004; Standage, Duda, & Ntoumanis, 2003). As for intrinsic motivation for interpersonal interactions, however, perceived relatedness, or willingness to maintain and develop relationships, would have stronger influences than in the case of academic motivation.

Studies on interpersonal relationships have shown that relationships are not self-sustaining—relational maintenance behaviors are necessary to sustain relationships (Dainton & Aylor, 2002). Duck (1986) argued that maintenance involved the use of carefully selected strategies as well as everyday, routine interaction. Dainton and Stafford (1993) contended that relational maintenance strategies were intentional and consciously enacted. Canary and Stafford (2001) define relational maintenance behaviors as “actions and activities used to sustain desired relational qualities” (p. 134).

In the present study, relatedness was assessed using the inventory of relational maintenance strategies created by Canary and Stafford (1992). The relational maintenance scale, originally developed to measure relational maintenance strategies in romantic relationships, was modified to assess willingness to initiate and develop interpersonal relationships with other group members. The internal consistency of the scale was adequate (Chronbach’s alpha = .90 and .88, for sample 1 and sample 2, respectively). Because there were 8 items in the scale, we randomly created two parcels of three items and one parcel of two items to test the structural model.

**Participation in small group interactions**

The amount of participation in oral interactions was measured by the modified version of the post-interaction expectancy scale, originally developed by Dobos (1996). Examples are: “I worked as a team with the group members,” and “I talked much more frequently while engaged in group activities than usual.” Participants were asked to answer each item on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The internal consistency of the scale was adequate (Chronbach’s alpha= .82 and .84, for sample 1 and sample 2, respectively). Because there were four items in the scale, we randomly created two parcels of two items.

**Class Satisfaction**

Degrees of class satisfaction were measured by the modified version of pre and post
interaction expectancy scale, originally developed by Dobos (1996). The four items were: "I am generally satisfied with the class," "I could learn the subject better through small group activities," "I like my group members," and "I am generally satisfied with cooperative learning activities." The internal consistency of the scale was adequate (Chronbach’s alpha = .88 and .87, for sample 1 and sample 2, respectively). Out of the four items, two parcels of two items were randomly created.

**Data analysis**

All SEM analyses in the present study were performed using Version 5.0 of the statistical program AMOS (Arbuckle, 2003). SEM, including confirmatory factory analysis and path modeling, assumes multivariate normality (Ullman, 2001). Using Mardia’s multivariate kurtosis coefficient, we evaluated the multivariate normality of the data for the SEM analyses. The data for the structural model were nonnormal in distribution (Marida’s multivariate coefficient = 39.32 and 39.78, for sample 1 and sample 2, respectively). Thus, we used the maximum-likelihood estimation and applied the boot strapping approach, which does not require a distributional assumption. For each SEM analysis, 500 bootstrap replication samples were drawn with replacement from the data set.

**Results**

The first hypothesized model

The correlation coefficient matrices among the item parcels for the two samples were presented in Table 1. An inspection of the bivariate correlations among the variables suggest that the three psychological needs variables—autonomy, competence and relatedness—are all closely associated with one another. And relatedness is also significantly associated with class satisfaction.

<<Table 1 about here>>

The hypothesized model, depicted in Figure 1, was tested with the sample 1 through SEM using the maximum-likelihood method. To assess model fit, we used well established indices such as IFI, CFI, and RMSEA (Ullman, 2001). Because the chi-square likelihood ratio statistics is extremely sensitive to trivial discrepancies between the observed and hypothesized covariance matrices, it is not enough to determine the
adequacy of the models. The chi-square statistic should be nonsignificant in a well-fitting model. For the IFI and CFI indices, values of about .90 or higher are generally considered representative of an acceptable model. For the RMSEA, equal to or smaller than .05 is considered as a very good fit, a value of .08 or smaller interpreted as a reasonable fit, and greater than .10 as indicative of a poor fit. Results showed the initially hypothesized structure moderately fit to the data with the sample 1, $\chi^2(83, \text{ } N=174) = 224.25, p<.001$, IFI = .91, CFI = .93, RMSEA = .10.

The finalized model
To modify the model, modification indices were examined, which suggest that the paths between perceived pressure and competence be removed from the model, as it was nonsignificant. Many additional paths and correlations of error terms were suggested by the modification indices. Among them, however, only theoretically acceptable paths were added; correlations of error terms were not added, because it was difficult to theoretically justify. As a result, paths from autonomy to competence, from autonomy to relatedness, and from relatedness to satisfaction were added.

This is a reasonable modification of the original model, because self-determination theory emphasizes the primacy of autonomy as an enhancer of intrinsic motivation. Without perceived autonomy, students would perceive lower levels of communication competence and lower levels of willingness to initiate and maintain interpersonal relationships with the group members. And it is also theoretically acceptable that, among the three psychological needs, only relatedness is directly connected to class satisfaction, because satisfaction from cooperative learning activities would be dependent on friendly and intimate relationships with other group members. The finalized model, represented in Figure 2, fit to the data much better than the initially hypothesized model: $\chi^2(81, \text{ } N=174) = 149.91, p<.001$, IFI = .95, CFI = .96, RMSEA = .07.

Test of the finalized model with a validation sample
We produced a finalized model through post hoc model fitting. There have been, however, rigorous debates regarding the pros and cons of post hoc model fitting. Although some scholars have severely criticized the practice (Cliff, 1983; Cudeck & Browne, 1983), others have argues that as long as the researcher is fully cognizant of the exploratory nature of his or her analyses, the process can be substantively meaningful because practical as well as statistical significance can be taken into
account (Tanaka & Huba, 1984).

One approach to addressing problems associated with post hoc model fitting is to employ a cross-validation strategy whereby the final model derived from the post hoc analyses is tested on a second independent sample. As such, Sample A serves as the calibration sample on which the initially hypothesized model is tested, and on which any post hoc analyses are conducted in the process of attaining a well-fitting model. Once this final model is determined, the validity of its structure can then be tested based on Sample B, the validation sample (Byrne, 2001). To test the invariance of the model fit across the two samples, we first tested the equivalence of the measurement model, and then tested the equivalence of the structural (paths) model.

Test of the equivalence of the measurement model

To test the measurement invariance across the samples, we first estimated a model in which the measurement parameters (factor loadings) in all samples were simultaneously and freely estimated. These estimated measurement parameters included the factor loadings and error variances, and the covariances among latent constructs. The fit of this initial unconstrained model was good, \( \chi^2(162, N=337) = 281.28, p<.001, \text{IFI} = .96, \text{CFI} = .97, \text{RMSEA} = .05 \), suggesting that the hypothesized measurement model represented a good fit to the data in with the two groups.

In the second model, we constrained all of the factor loadings to be equal between the two samples. This model assessed the factorial invariance of the measurement model. The fit of this constrained model was still good, and the difference in fit was minimal, \( \Delta \chi^2(9, N=337) = 6.04, p = .74, \Delta \text{IFI} = .00, \Delta \text{CFI} = 00, \Delta \text{RMSEA} = .00 \).

In the third model, in addition to constraining the factor loadings to be equal, we also impose equality constraints on the intercepts of the measurement model. This fully constrained model was found to be still good, \( \chi^2(201, N=337) = 360.80, p<.001, \text{IFI} = .95, \text{CFI} = .96, \text{RMSEA} = .05 \), and the difference in fit with the freely estimated model to be also minimal, \( \Delta \chi^2(39, N=337) = 79.52, p = <.001, \Delta \text{IFI} = .00, \Delta \text{CFI} = 01, \Delta \text{RMSEA} = .00 \). These results suggest that the measurement parameters of the latent constructs were invariant across the samples. In other words, the latent constructs in the final model are valid not only for the sample 1, but also for the sample 2.

Test of the equivalence of the structural model

Then, we conducted invariance analyses on the structural paths with the two samples. The simultaneous test of the finalized model, with factor loadings and structural links freely estimated, was first conducted. The model fit was adequate,
We then ran another model in which we constrained the structural links (path coefficients) to be equal across the two groups. The fit of the constrained model was adequate, $\chi^2(170, N=337) = 298.71$, $p<.001$, IFI = .96, CFI = .96, RMSEA = .05. However, the change in chi-square between the freely estimated model and the constrained model was marginally significant, $\Delta \chi^2(10, N=337) = 26.02$, $p <.01$, $\Delta$IFI = .00, $\Delta$CFI = .00, $\Delta$RMSEA = .00. This suggested that the strength of at least one of the regression coefficient was not comparable across the two samples.

In order to identify the path coefficients that could be considered equivalent across the groups, we examined the unique impact of each hypothesized regression path on the chi-square change in the model. The paths in the finalized model were constrained one at a time, and the chi-square value of the model with only one path constrained to be equal across the samples was compared with chi-square value of the unconstrained model. Then, in a stepwise fashion, all of the paths that were not found to affect the model fit significantly were constrained to be equal across the samples, and at each step, the fit of those increasingly more constrained models was compared with the unconstrained (baseline) model. Table 2 presents the results of this stepwise analysis.

The path coefficient from interaction to satisfaction (path 1), first constrained across the samples, had rather small influence on the magnitude of the chi-square. The chi-square change from the unconstrained model was very small, $\Delta \chi^2(1, N=337) = .28$, $p = .60$. As a next step, path from relatedness to interaction (path 2) was constrained. The difference in chi-square between this model with two path coefficients constrained and the unconstrained model was also nonsignificant, $\Delta \chi^2(2, N=337) = .28$, $p = .47$. And the path from perceived social pressure to autonomy (path 3) was added as the third constrained paths. The fit of this model with three paths constrained to be equal was not significantly different from the fit of the unconstrained model, $\Delta \chi^2(3, N=337) = 3.03$, $p = .39$. We then additionally constrained the paths from perceived social pressure to communication competence (path 4), and then from perceived social pressure to relatedness (path 5), one by one, but no significant changes were found: $\Delta \chi^2(4, N=337) = 6.50$, $p = .17$, and $\Delta \chi^2(5, N=337) = 7.48$, $p = .19$, respectively.

However, when we specified a constraint for the path from competence to interaction (path 6), this lead to a significant change in chi-square, $\Delta \chi^2(6, N=337) = 14.44$, $p = .03$. Additionally constraining the path from autonomy to interaction (path 7)
did not make a significant change, $\Delta \chi^2(7, N=337) = 14.78, p = .04$. But the additional constraint on the path from autonomy to competence (path 8) yielded a significant change in fit, $\Delta \chi^2(8, N=337) = 22.57, p = .00$. Adding constraints on the paths from autonomy to related (path 9), and from relatedness to satisfaction (path 10), did not change the model fit significantly: $\Delta \chi^2(9, N=337) = 22.57, p = .01$, and $\Delta \chi^2(10, N=337) = 26.02, p = .00$, respectively.

These results suggest that the strength of the relationship among all of the hypothesized constructs were equivalent across the samples, except for the path coefficients from autonomy to competence, and from competence to interaction. The nonequivalence identified for those two regression coefficients suggests that the relationships among those constructs are moderated by the differences between the two samples.

**Discussion**

The present study attempts to identify conditions that may encourage students to actively participate in small group interactions, especially within the contexts of cooperative learning in college classes. Many studies on cooperative learning have demonstrated that learning together is an effective teaching technique. But few studies have raised such question as what would motivate students’ oral interactions? Based on the self-determination theory, we postulated that students’ sense of autonomy, competence, and relatedness in the contexts of cooperative learning would intrinsically motivate students to more actively participate in small group interactions. In other words, our assumption is that those who perceive they have communication competence, autonomy in their groups, and willingness to maintain relationship with other members would actively and spontaneously participate in oral interactions of cooperative learning, and as a result, would more satisfy with the CL and the class.

Initially we suggested a sequential model of perceived classroom climate (social pressure) $\rightarrow$ the three psychological mediators (autonomy, competence, and relatedness) $\rightarrow$ interpersonal interactions in cooperative learning groups $\rightarrow$ class satisfaction. Employing a series of structural equation model analyses, we modified the structural model deleting and adding paths to make the model fit better to the data (sample 1), within the theoretical consideration of the significance of regression paths within the model.
Our data generally supported the initially hypothesized model (Figure 1) and fit better with the finalized model (Figure 2). The final model suggest the followings: Those who felt higher levels of social pressure perceived lower levels of the two psychological mediators regarding the cooperative learning activities: autonomy and relatedness. This means that self-perceived communication competence is less influenced by social pressure.

Perceived autonomy, communication competence, and willingness to establish interpersonal relations showed positive impacts on the amount of interpersonal interactions within the cooperative learning group activities. And higher levels of interactions resulted in greater satisfaction of the class and the cooperative learning activities. Among the three psychological need variables, only relatedness showed a significant direct impact on class satisfaction. The results suggest that the amount of relationship maintenance behaviors in cooperative learning sessions may enhance class satisfaction more directly rather than indirectly, that is, via the amount of interactions.

To validate the finalized model, we tested the model with an independent sample. For sample 2, we collected the data from the identical course taught by the identical instructor, just in the following semester. A series of equivalence tests of measurement model and structural model between the two samples generally showed that the model produced with the sample 1 also fit well with the sample 2. There were only differences with the two path coefficients out of ten: from autonomy to communication competence, and from competence to interaction. We may speculate that even the slight difference in student body could affect especially the relationship among communication competence, autonomy, and interaction.

References


PISA (2003b). Learners for Life: Student Approaches to Learning, Paris: OECD.


Tanaka, J. S., & Huba, G. J. (1984). Confirmatory hierarchical factor analyses of


Table 1

Correlation Coefficients among the Item Parcels

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<th>SDI_3</th>
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<th>COMP_2</th>
<th>COMP_3</th>
<th>RM_1</th>
<th>RM_2</th>
<th>RM_3</th>
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<th>PART_2</th>
<th>SAT_1</th>
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Note. Above diagonal is sample 1 (N = 174), and below diagonal is sample 2 (N = 163). PSP_CL = perceived social pressure in cooperative learning; SDI = self-determination indices; COM = perceived communication competence; RM = relational maintenance behaviors; PART = participation in group interactions; SAT = class satisfaction. *p>.05, **p>.01
Table 2  
Results of the Structural Analyses Testing the Equivalence of the Structural Model across the Two Samples

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<th>Model</th>
<th>χ²</th>
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Note. All models are compared with the unconstrained model, which serves as the baseline model for the invariance analyses evaluating the equivalence of the structural model. N = 337 for all χ². RMSEA = root-mean-square error of approximation; CFI = comparative fit index; IFI = incremental fit index. * p < .05, ** p < .01
Figure 1: Hypothesized Model
Figure 2: Finalized Model
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