

# Autonomy and Competence in German and American University Students: A Comparative Study Based on Self-Determination Theory

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According to self-determination theory (R. M. Ryan & E. L. Deci, 2000), supports for autonomy and competence are essential for growth and well-being in any learning environment. Educational contexts differ in their relative support for these 2 needs. The authors examined the role of autonomy and competence in 2 German and 2 American university settings, as they were predicted to differ in terms of their relative emphasis on competence versus autonomy. Invariance analyses supported the construct comparability of the measures and demonstrated that German students felt significantly more autonomous and less competent than American students. Perceived pressures and positive informational feedback were modeled as antecedents of autonomy and competence, and well-being was examined as a consequence. The hypothesized model was generally supported across the 4 samples.

According to self-determination theory (SDT), psychological needs are nutrients essential for psychological growth and well-being in every human being (Deci & Ryan, 2000; Ryan & Deci, 2000). Specifically, the theory posits that within any significant life domain, opportunities to experience autonomy, competence, and relatedness (each representing a basic psychological need) are essential in promoting life satisfaction and well-being (Deci & Ryan, 2000). Evidence suggests that people will naturally tend toward contexts, activities, and relationships that support the satisfaction of these needs (Deci & Ryan, 2000; La Guardia, Ryan, Couchman, & Deci, 2000; Sheldon & Elliot, 1999; Vallerand, 1997). Research has even suggested that on any given day, satisfaction of each of these basic needs is a necessary condition for well-being and effective functioning (e.g., Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Ryan, & Reis, 1996). An important aspect of the everyday life of most college students involves completing coursework, being successful in their studies, and working toward a degree. Consequently, feelings of autonomy and competence toward school would seem essential for college students' growth and subjective well-being.

Within North American educational settings, a large number of studies suggested the importance of perceived autonomy, competence, and relatedness for students' subjective well-being, performance, and persistence in school. At every educational level,

students who experience greater need satisfaction appear to be better adjusted in the classroom and in life, demonstrate greater internalization of school-related regulations, exhibit enhanced performance, and report more intrinsic motivation than those who find these needs thwarted in school (Goodenow, 1993; Koestner & McClelland, 1990; Miserando, 1996; Ryan & Deci, 2000, Ryan & Grolnick, 1986; Ryan, Mims, & Koestner 1983; Ryan, Stiller, & Lynch, 1994).

In SDT's framework, the need for autonomy concerns the basic need to experience one's behavior as self-endorsed or volitional (deCharms, 1968; Ryan & Grolnick, 1986). In attribution terms, autonomous behaviors have an internal perceived locus of causality (Ryan & Connell, 1989); they are experienced as emanating from the self (Deci & Ryan, 1985, 2000). The need for competence (Deci & Ryan, 1985; Elliot & Thrash, 2002; Koestner & McClelland, 1990) is the need to experience satisfaction in exercising and extending one's capabilities. Naturally, people seem to seek out challenges that are optimal for their level of development (Harter, 1978; White, 1959). Finally, the need for relatedness concerns feeling connected with significant others.

Perceived need satisfaction is enhanced by social and environmental factors that facilitate the expression of those needs for autonomy, competence, and relatedness. Most of the research on the effects of perceived environmental and social factors in need satisfaction has been conducted with autonomy and not so much with competence. This is in part because SDT postulates that perceived competence will not lead to greater well-being unless the behavior performed is autonomous (i.e., perceived as emanating from one's self or being self-determined; e.g., Ryan et al., 1983). Indeed, it is typically under autonomy-supportive conditions that people's strivings for competence are most fully expressed (Danner & Lonky, 1981). In other words, individuals must not only feel competent to experience greater well-being; they must also feel autonomous in their actions (Fisher, 1978; Ryan,

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1982). Autonomy-supportive contexts are those that provide choice and opportunity for self-direction and a minimal amount of pressured evaluations, imposed goals, and demands. Autonomy-supportive environments also offer greater positive nondemeaning informational feedback and a context in which the other person's perspective is considered (Deci & Ryan, 1985, 2000; Reeve, 1998; Reeve, Bolt, & Cai, 1999; Ryan & Deci, 2000). Autonomy-supportive teachers were found to enhance autonomous motivation and desire for challenge in their students (Deci, Nezlek, & Sheinman, 1981; Flink, Boggiano, & Barrett, 1990; Ryan & Grolnick, 1986), whereas autonomy-supportive parents had more autonomous children, who were in turn better adjusted in school (Grolnick & Ryan, 1989). The importance of an autonomy-supportive social context to enhance feelings of autonomy has been supported at all levels of schooling from elementary education (e.g., Grolnick, Deci, & Ryan, 1997) to college (Black & Deci, 2000; Vallerand & Bissonnette, 1992) to postgraduate education (Williams & Deci, 1996).

Because SDT postulates that autonomy, competence, and relatedness are psychological needs relevant to all humans, rather than cognitive preferences, it becomes important to assess those needs across cultures. Consequently, cross-cultural examinations of autonomy and competence have recently emerged. For example, in Japan, Hayamizu (1997) and Yamauchi and Tanaka (1998) have shown relations between experienced autonomy and competence and student's self-determination and well-being. Chirkov and Ryan (2001) showed that teacher and parent autonomy supports were equally important to well-being and self-determined motivation in Russian and American high school students. In Germany, Wild and Krapp (1995) showed that German children with more autonomy-supportive parents expressed more self-determination toward school, felt more competent, and performed better academically. Cross-culturally, the need for relatedness has not received much attention because it is widely accepted as a basic psychological need relevant to all human beings (Baumeister & Leary, 1995; Ryan, 1993).

The purpose of the present study is to add to this growing body of literature by examining the relevance of the needs for autonomy and competence toward school in German and American samples of undergraduate college students. To do so, we will assess the perceptions of four different groups of college students: two groups of German students and two groups of American students completing their studies in four different universities. The present study is thus embedded in current research examining the relevance of autonomy and competence across cultures as well as the hypothesized relationships among perceived autonomy-supportiveness of the context, psychological needs, and subjective well-being. More specifically, the purpose of the present study is threefold. First, we want to assess mean differences in perceptions of autonomy and competence toward university studies in German and American students. We propose that those differences in need satisfaction will result from cultural differences in the undergraduate college educational systems of those two countries and the opportunities they afford to express autonomy and competence. Consequently, our second goal will be to also propose and test mean level differences in perceived autonomy supportiveness of the educational context and resultant well-being. Finally, we will test a theoretical model of academic motivation, supported by prior research based on SDT, in which the relationships among per-

ceived educational context, the experience of autonomy and competence, and subjective well-being will be examined across the German and the American educational system.

Among the three needs, it is the need for autonomy that has received the most attention (Ryan & Deci, 2000). In cross-cultural investigations, the need for autonomy has most closely been examined because of its controversial nature (e.g., Miller, 1997; Oishi, 2000). In fact, some researchers argue that autonomy is functionally important only in Western, individualistic nations (e.g., Iyengar & Lepper, 1999; Markus & Kitayama, 1991; Miller, 1997; Oishi, 2000). However, in SDT's perspective, *autonomy*, defined as self-endorsement of the reasons for behaving and as experienced volition, is theoretically and operationally differentiated from both independence and individualism (Hmel & Pincus, 2002; Ryan & Lynch, 1989). Defined as volition or self-endorsement, *perceived autonomy* has been found to mean the same thing and affect behaviors and perceptions similarly in collectivistic (e.g., Russian) as well as individualistic (e.g., American) cultures (Chirkov, Ryan, Kim, & Kaplan, 2003).

Within SDT, perceptions of competence have also been examined, but most often in isolation from perceptions of autonomy. One important contribution of the present study for the academic motivation literature is the simultaneous examination of perceptions of autonomy and competence toward university studies, allowing us to explore their combined association with well-being. According to SDT, perceptions of autonomy and competence should closely interact with one another to enhance well-being (Deci & Ryan, 2000). For example, in domains where skills are important for success, such as in school, knowledge and skills acquired in an autonomy-supportive context would most likely foster satisfaction, well-being, and psychological growth (Ryan, 1982). That is, higher levels of perceived competence will not lead to greater well-being unless the behavior is perceived as self-determined (e.g., Ryan et al., 1983).

In the present investigation, the debate surrounding the cross-cultural relevance of autonomy appears somewhat less central because many cultural theorists consider Germany and the United States to be similar in terms of their cultural orientations. For instance, both can similarly be characterized along dimensions of individualism versus collectivism and vertical versus horizontal orientations (Triandis, 1997). Consequently, we would expect German and American students to understand autonomy and competence similarly. However, there is some evidence suggesting that the two countries differ in how undergraduate university students are trained and the extent to which they receive external study guidance (Gellert, 1993; Nenniger, 1989, 1991). Those differences seem meaningful enough to generate differences in perceptions of autonomy and competence toward school. Accordingly, German and American undergraduate university educations are interesting to compare, not because of the cultural backdrops, as much as for the differences in the structure of university education in the two nations. Our analysis of the differences between the German and American systems is informed by a small body of research and thus remains speculative and based in part on our own experience and informal observations. To capture the educational context and related changes in perception of autonomy and competence, we compared students' perceptions of pressure from the educational environment and amount of positive informational feedback. Self-

esteem and life satisfaction were used as indicators of subjective well-being and assessed as possible outcomes of need satisfaction.

### Undergraduate College Education in Germany and the United States

Although elementary and high school education seems similar in Germany and the United States (Gellert, 1993, Stigler & Hiebert, 1998; Triandis, 1997), undergraduate college education appears to offer more opportunity for self-guidance in Germany (Nenniger, 1989, 1991). In what follows, we characterize some of these differences, recognizing that these global descriptions do not capture the significant variation present within each system. However, our purpose is to set the stage descriptively for the predictions that will be tested within our empirical model.

Although both German and American students largely choose their own curricula and are responsible for planning their studies, German students seem to experience fewer constraints and external regulations throughout their studies. For example, although German students are often encouraged to attend lectures, attendance is not required (Gellert, 1993). Voluntary attendance does not appear to be a popular practice in American universities. Almost 50% of the American professors surveyed by Gellert (1993) believed that attending lectures should not be voluntary. Even if attendance is not always monitored in American universities, students may still feel obligated to attend lectures in order to do well on exams, because often a substantial amount of what is evaluated is based on lecture materials not otherwise made available in course readings. In contrast, German undergraduates are typically provided with the required course material in advance so they are free to choose what to learn when and whether they would prefer to learn it on their own or through class lectures. The material is tested in comprehensive oral exams held at the end of a 2- to 3-year period, rather than the frequent testing experienced by American students within each course (Gellert, 1993). On the other hand, American professors surveyed in Gellert's study thought that oral exams were only good to add as a part of the final grade, rather than to use as the only method of evaluating students.

The oral examinations held at the end of the German studies typically focus on conceptual learning as well as students' ability to transfer this knowledge to other areas. Most German professors are also open to the idea of letting students have a say in the development of exams. In contrast, only 16% of American professors liked that idea. In the exam-free period, German students typically attend a certain amount of seminars, in which they obtain grades for doing presentations or papers. Although everyone in class may be encouraged to read the same material, each student is typically only evaluated on the subset of material related to the topic of his or her presentation or paper. After a presentation or an oral exam, students receive individual feedback in which a rationale is provided for the assigned grade (Gellert, 1993). This personalized feedback would be one way through which feelings of autonomy and competence might be enhanced or, if highly negative, thwarted. Indeed, some research suggests that personalized feedback is more conducive to intrinsic motivation than feedback based on grades (Butler & Nisan, 1986). Gellert's (1993) findings suggest that less than 6% of the American professors surveyed thought that students should get individual feedback on grades received on papers and exams. In other words, American

professors believed that the grade assigned was sufficient as a form of feedback. Although tests and evaluations provide competence feedback, according to SDT, feedback will not yield a greater sense of competence if it is embedded in a controlling context rather than an autonomy-supportive one (Ryan et al., 1983).

On the basis of our understanding of the autonomy supportiveness of the educational context, we might expect German students to feel more competent as well as more autonomous than American students. However, empirical evidence suggests that American students generally feel higher levels of achievement motivation, greater perceived competence, and a higher belief in the development of intelligence (Little, Oettingen, Stetsenko, & Baltes, 1995; Nenniger, 1988, 1989, 1991). It is possible that the emphasis of the American culture on the value of competence leads American students to place more importance on this attribute and possibly to inflate their self-perceptions. This would be consistent with previous cross-cultural comparisons in which American participants have tended to rate their competence and skills relatively highly, even controlling for performance outcomes (see Little et al., 1995). Furthermore, infrequent feedback in German schools might lead students to be unsure regarding the effectiveness of their exam preparation or which material they successfully mastered, contributing to lower feelings of competence. In contrast, in American universities, exams or other forms of evaluation are frequent enough to provide information to students on exactly which part of the material they have mastered and on what they still need to focus. However, frequent evaluations are likely to make American students more anxious about school when compared with German students (Nenniger, 1988, 1991). In contrast, German students were found to focus more on the process of learning and be more mastery oriented than their American counterparts (see Nenniger, 1988, 1991; Pintrich, Zusho, Schiefele, & Pekrun, 2001). In addition, Nenniger (1988) found that German students were more likely to self-organize their learning environment and to make use of various study aids and learning strategies, such as active reading. Recent studies also suggest that American students are more oriented toward extrinsic goals and more motivated by external factors, whereas German students find intrinsic goals more important (Schmuck, Kasser, & Ryan, 2000).

These differences in the German and American approaches to undergraduate college education provide an opportunity to test how differential perceived contexts may impact the needs for autonomy and competence and in turn subjective well-being. Because we speculate that within the German system there is much more opportunity to self-organize learning within a context that is more autonomy supportive (e.g., choice about when and in what order to learn class material), we expected German students to feel more autonomously motivated toward their studies than American students. On the basis of prior research, we expected American students to feel more competent than German students. However, we did not expect this difference to be large because we hypothesized that the frequency of the competence-relevant feedback received by American students might be offset by its perceived lower quality relative to the one received by German students. Evidence also suggests that American students may also experience more pressure, which could lead to lower feelings of autonomy and competence.

Overall, we expected German students to feel more self-determined but somewhat less competent toward their studies than

American students. We also expected American students to perceive greater pressure from the educational system but somewhat less positive informational feedback. Overall, we also expected German students to experience greater well-being.

#### Pathway From Perceived Context to Need Satisfaction to Well-Being: Examining Cross-Cultural Similarities

Another important goal of the present study is to examine the relationship among perceived educational context, basic psychological needs, and subjective well-being as they are experienced in educational settings. Regardless of mean differences in perceptions of need satisfaction, autonomy supportiveness of the context, and well-being, the relationships among those constructs should be equivalent across groups. Specifically, we hypothesized that perceived environmental pressure would be negatively related to perceived autonomy and competence, whereas positive informational feedback would be positively related to need satisfaction. Greater perceived autonomy and competence was expected to be associated with greater levels of well-being. The model is depicted in Figure 1. A large body of experimental and field research stemming from SDT has supported various parts of the proposed model (e.g., Chirkov & Ryan, 2001; Deci, 1975; Deci, Eghari, Patrick, & Leone, 1994; Deci & Ryan, 2000; Grolnick & Ryan, 1989; Ryan & Deci, 2000; Vallerand & Reid, 1984).

In the present study, we assessed perceived lack of environmental pressure and perceived positive informational feedback as the subjective components of an autonomy-supportive context. In past research, autonomy-supportive school environments have been associated with higher levels of autonomous motivation and increased competence (Deci et al., 1981; Grolnick & Ryan, 1989; Ryan & Deci, 2000; Ryan & Grolnick, 1986). In addition, optimal challenges and positive feedback provided in an autonomy-supportive context have been found to enhance both competence and autonomy experiences (Deci, Koestner, & Ryan, 1999; Ryan et al., 1983). In terms of consequences, autonomy and competence have been associated with a host of positive outcomes including life satisfaction and self-esteem, which are considered to be central components of subjective well-being (Diener, 2000; Diener & Diener, 1995). In the present study, we used life satisfaction and

self-esteem as indicators of well-being. Those constructs have been used in various cross-cultural investigations to assess well-being in various countries (Chirkov & Ryan, 2001; Ryan et al., 1999). In contrast, controlling forms of motivation have been associated with lower self-esteem and life satisfaction, elevated levels of anxiety, thus lower levels of subjective well-being (e.g., Grolnick & Ryan, 1987, 1989; Miserando, 1996; Ryan & Connell, 1989; Sheldon & Elliot, 1999).

In the hypothesized model, we also examined the simultaneous effects of both perceived autonomy and competence, which allowed us to test their combined association with well-being. According to SDT, competence will not necessarily enhance well-being unless it is accompanied by a sense of self-determination (e.g., Ryan et al., 1983). Especially in domains where a certain amount of knowledge and skills are required to succeed, such as in college studies, competence will be necessary for success, but it will not lead to well-being unless it is being expressed in situations where the need for autonomy is also being met (Danner & Lonky, 1981). Consequently, the model we tested specified a path from autonomy to competence. Thus, some of the relationship between autonomy and well-being will be manifest not only directly but through the effect of autonomy on competence.

#### Summary, Goals, and Hypotheses

The present study is important because it provides a unique opportunity to examine in a natural setting the experience of autonomy and competence in different educational contexts within similar cultural systems. We conducted the present study in two phases using the same methodology. In both Phase 1 and Phase 2, we gathered perceptions of German and American undergraduate university students. We obtained data from students completing their studies at four different universities, which greatly increased the generalizability of our results. We first examined whether German students would indeed perceive their educational environment as more autonomy supportive than American students. We expected German students to experience less pressure from their school environment and to report obtaining greater positive informational feedback and as a result feel more autonomous than American students. However, we did not expect perceived com-

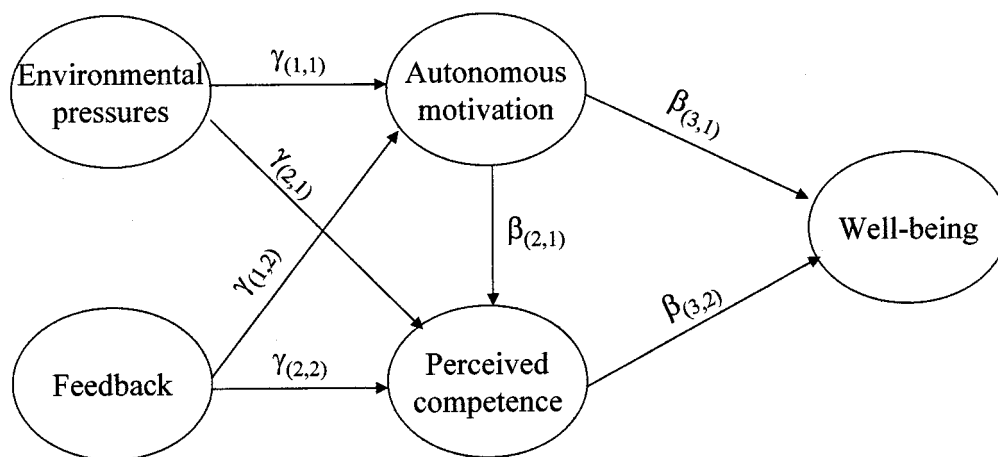


Figure 1. Hypothesized model tested in all four samples.

petence to be higher for German students. Despite the more personalized feedback German students seem to receive, it remains the case that this feedback is infrequent, which might offset its positive effects. On the other hand, the advantage of receiving frequent feedback in the United States might be somewhat offset by its often controlling and impersonal nature. Thus, although we expected American students to feel more competent than German students, we did not expect this effect to be large. We examined the mean differences across Phase 1 and 2 samples simultaneously. This provided a stringent test of the conceptual equivalence of constructs and allowed us to examine mean differences across all groups at once.

We also tested a structural model specifying the relationships among perceived educational context, need satisfaction, and well-being. Regardless of mean differences between Germany and the United States, the relationships among the constructs should be similar across cultures (see Figure 1). That is, provided that the various constructs examined were found to be equivalent or understood similarly across the samples, the process model depicted in Figure 1 should be supported in all groups, thus supporting the generalizability of these motivational processes. We first tested the hypothesized structural model in Phase 1 to establish the fit of the model to the data. We then attempted to replicate this model in Phase 2 in a different sample of German and American students.

## Method

### Participants

College students in four different universities comprised the sample for this study. In total, 1,289 students participated in this study: In Phase 1 of the present study, we recruited 339 undergraduate students from the University of Rochester (U of R) in Rochester, New York (218 women, 116 men, and 5 who did not report gender; age range from 16 to 40 years,  $M = 20$  years), and 156 students from Christian-Albrechts-Universität (CAU) in Kiel, Germany (115 women, 37 men, and 4 who did not provide information on gender; age range from 18 to 50 years,  $M = 24$  years). In Phase 2, we obtained additional data from 415 students from Southwest Missouri State University (SMSU) in Springfield, Missouri (229 women, 137 men, and 49 who did not report gender; age range from 17 to 54 years,  $M = 21$  years), and from 379 students from the University of Hamburg (Uni HH) in Hamburg, Germany (284 women, 84 men, and 11 who did not report gender; age range from 19 to 49 years,  $M = 25$  years). In Phase 1, all students recruited were either majoring or minoring in psychology, whereas in Phase 2, students from a variety of fields participated in the study. At SMSU, 46 students were psychology majors, whereas only 12 were psychology minors. At SMSU, students were majoring in fields such as education, social work, business—finance, marketing, and cell—molecular biology. At Uni HH, 85 students were psychology majors, and the others were majoring in various fields such as education, economics, business—finance, languages (e.g., Japanese, English, Scandinavian), sociology, and history. In addition, 255 students reported psychology as their minors.

### Procedure

Phase 1 of the study was conducted in the fall of 1999 and spring of 2000. Students were recruited in class and either completed the survey measures in class or at home. Phase 2 of the study was conducted in the fall of 2002 and spring of 2003. Students were either recruited in class or through flyers posted outside of large psychology lecture halls requesting students for participation in a social psychology study. All students par-

ticipated in exchange for extra credit. Phase 2 was conducted to provide a cross-validation sample necessary for a test of the replication of Phase 1 results as well as to extend the generalizability of those results by obtaining data from a variety of German and American university students.

The U of R is a small, private institution of approximately 4,400 undergraduate students. It is located in Rochester, New York, a small, northern American city of about 200,000 people. CAU is a public institution of about 19,000 undergraduate students located in Kiel, Germany, a small, northern city with a population of approximately 230,000 people. SMSU is also a public institution of approximately 19,000 undergraduate students, which is located in Springfield, Missouri, a small city in the midwest of approximately 160,000 people. Finally, Uni HH, has a large population of 35,000 undergraduate students and is located in Hamburg, a large northern German city of about 1,800,000 people. None of the schools examined were religious schools. We specifically and purposefully obtained data from students in a variety of university settings, some public and some private institutions, of various sizes, and located in different cities. This diversity in our sample significantly increases the generalizability of our results and helps control for possible differences that could emerge because of the size of the university population studied or the public versus private nature of the institution.

### Measures

The Self-Regulation Questionnaire—Academic (described below) designed to measure students' level of autonomous motivation toward school was translated by Wild and Krapp (1995). Other measures were translated from English to German by A. Nicola Zuehlke and then items were back-translated by a graduate student fluent in English and German. Independent judges then considered the equivalence of the original and back-translated versions of the scales and measures. After discussing any instance of nonequivalence, we did the final editing of the translated versions. In this study, the same measures were used in Phase 1 and 2 and are described next.

*Demographic variables.* Participants were asked to report on their age, gender, major, and grade level. Apart from these four demographics variables, the survey was anonymous.

*Self-Regulation Questionnaire—Academic (SRQ-A; Ryan & Connell, 1989).* This validated scale comprises four subscales and 32 items. In the present study, we used a short 16-item version of this scale designed to assess students' reasons to do homework, participate in class, and try to do well in school. We used two entire subscales taken from the original 32-item scale: reasons for completing homework and reasons for trying to do well in school. We also used some of the items from the other two subscales: reasons for answering questions in class and reasons for doing class work. Students answered each item on a 6-point scale, ranging from 1 (*not at all true*) to 6 (*completely true*). The reasons for engaging in academic work reflected four different forms of regulation differing in their relative autonomy, each assessed with four items. External regulation assesses the extent to which the behavior is regulated on the basis of external pressures and rewards and represents the form of motivation with the lowest level of autonomy (e.g., "Because I'll get in trouble if I don't"). Introjected regulation assesses the extent to which a behavior is regulated out of internal pressures such as feelings of guilt, anxiety, and self-approval (e.g., "Because I will feel bad about myself if I don't do it"). This form of motivation is still not self-determined but represents a higher degree of internalization into the self. Identified regulation is based on the perceived value and worth of school (e.g., "Because it's important to me to do my homework"). Finally, intrinsic motivation is based in the inherent enjoyment of school activities (e.g., "Because I enjoy participating in class"). The internal consistency of the subscales was acceptable, ranging from .78 to .84 across the four samples. The SRQ-A has been widely used and applied to different age levels and cultures, including North America (Grolnick, Ryan, & Deci, 1991; Ryan, 1995; Vallerand, 1997), Germany

(Wild & Krapp, 1995), and Japan (Hayamizu, 1997; Yamauchi & Tanaka, 1998). For the purpose of testing the structural model (SEM), we created four composite indicators, referred to as self-determination indices (SDI).<sup>1</sup> These forms of composite indicators have been widely used in previous research assessing level of autonomy with a Self-Regulation Questionnaire (Deci & Ryan, 1985, 2000), and the validity of this procedure has been documented in details elsewhere (Vallerand, 1997). Specifically, these indices are formed by weighting each item in accord with its underlying level of self-determination (Ryan & Connell, 1989). All four 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. The items reflecting introjected regulation were each given a weight of -1, and the items reflecting external regulation were given a weight of -2. 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:

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

For example, to create the first SDI indicator, the first intrinsic motivation item was given a weight of +2 and was added to the first identified item, which was given a weight of +1. Then the first introjected item was given a weight of -1 and added to the equation. Finally, the first external item was given a weight of -2 and was also added to the equation. The second SDI indicator was created in the same way using the second items of each subscale (Intrinsic, Identified, Introjected, and External). The third and fourth indicators were similarly created.

*Perceived Competence (Pelletier & Vallerand, 1996).* This scale is composed of six items measuring the extent to which one feels competent in the academic domain (e.g., "I feel able to accomplish my schoolwork"). Participants were asked to answer each item on a 6-point scale, ranging from 1 (*not at all true*) to 6 (*completely true*). The internal consistency of the scale was adequate ( $\alpha = .80-.91$  across the samples). Because there were 6 items in this scale, we randomly created three groups or parcels of two items each in order to test the structural model (Byrne, 1998; Kishton & Widaman, 1994).

*Environmental Pressure.* This scale, which was adapted from the Work Climate Scale (Deci, Connell, & Ryan, 1989), consists of eight items designed to measure perceptions of the school atmosphere using the following adjectives: cooperative, tense, relaxed, constrained, pressuring, trusting, demanding, and anxious. Those adjectives were derived from the social and environmental situations assessed by the Work Climate Scale. Participants rated their perception of the school atmosphere using these adjectives on a 6-point scale, ranging from 1 (*not at all true*) to 6 (*completely true*). The internal consistency of the scale ranged from .68 to .81 for all German and American samples. For purpose of testing the structural model, we randomly created three parcels (two parcels with three items and one with two items) and used the average of those items as indicators of the latent variable.

*Perceived Positive Informational Feedback.* This scale, also adapted from the Work Climate Scale (Deci et al., 1989), consists of five items measuring the amount of positive and informational feedback a student experiences in academic contexts (e.g., "My professors often let me know how well they think I am performing"). Students rated the extent to which they agreed with each item on a 6-point scale, ranging from 1 (*not at all true*) to 6 (*completely true*). The internal reliability of the scale ranged from .81 to .85 for all German and American samples. For purpose of testing the SEM model, we randomly created two parcels (one parcel with three items and the other one with two items) and used the average of those items as indicators of the latent variable.

Satisfaction was assessed using the Satisfaction With Life Scale (SLS; Diener, Emmons, Larsen, & Griffin, 1985), a central component of subjective well-being. Students were asked to rate the items on a 6-point scale while considering the duration of their university studies. The cross-cultural equivalence of the SLS has been supported in studies of Russian

and American participants (e.g., Chirkov & Ryan, 2001; Ryan et al., 1999). The internal consistency ranged from .79 to .86 across all four samples. Each item was used as an observed indicator.

*Self-esteem.* The Rosenberg Self-Esteem Scale (11 items) was used to measure perceived levels of self-esteem, another important component of subjective well-being. The items were rated on a 6-point scale, with higher values reflecting higher levels of self-esteem. Students were again asked to rate the items while considering the duration of their university studies. The internal consistency ranged from .88 to .91 across all groups. Because there were 11 items in this scale, we randomly created four parcels (three parcels with three items each and one parcel with two items) and used the average of each parcel as an indicator.<sup>2</sup>

### Data Analytical Strategy

The analysis of the data consisted of two parts: (a) the test of the equivalence of the measurement model and examination of mean differences and (b) the test of the equivalence of the structural model. Although several approaches can be used to test the equivalence of the measurement and structural model (e.g., Byrne & Campbell, 1999; Cheung & Rensvold, 2000; Reise, Widaman, & Pugh, 1993), in this study we used the mean and covariance structure analysis (MACS) developed by Little (1997). This approach has been utilized in many cross-cultural studies to examine construct comparability (e.g., Little, 2000; Little et al., 1995; Grob, Wearing, Little, & Wanner, 1996; Ryan et al., 1999). MACS analyses first allow researchers to simultaneously test and validate the hypothesized factorial structure in each group examined, or, in other words, to test the pattern of indicators-to-construct relations, which include both factor loadings and intercepts (i.e., the measurement model). This is like conducting a confirmatory factor analysis (CFA) for each construct assessed on multiple groups simultaneously. Second, this procedure allows one to evaluate cross-group measurement equivalence by placing between-groups equality constraints on the factor loadings and the intercepts in the measurement model. Continuing with our CFA analogy, this is like constraining all of the factor loadings enabling us to specify those factor loadings as being equivalent across groups. Third, given that the size and direction of the factor loadings are found to be equivalent across groups, these analyses permit the interpretation of differences in latent constructs' means. Comparing latent means is somewhat similar to performing an analysis of variance on raw means, except that in this case it is the means of the latent constructs themselves that are compared. Fourth, it also enables researchers to test central hypotheses concerning cultural similarities and differences in relationships among the latent constructs of interest (i.e., differences in the structural model). Furthermore, this procedure can help attenuate individuals' extreme response style and acquiescent response style that have been found to sometimes occur in cross-cultural measurement research (Little, 1997, 2000). In sum, this cross-validation strategy provides a strong test of whether the hypothesized measurement and structural models specified in one group replicate in another independent sample.

<sup>1</sup> When working in an SEM modeling framework, each latent construct must be assessed and represented by multiple indicators. The number of indicators used to represent the latent constructs is somewhat arbitrary, but a good rule of thumb is to have approximately three indicators, but no more than five (Byrne, 1998). Consequently, the latent constructs examined in this article were represented by sets of 2-4 parcels as observed indicators (i.e., aggregated measured items; Kishton & Widaman, 1994).

<sup>2</sup> In the test of the equivalence of the structural model across groups, the satisfaction and self-esteem scales were used as indicators of well-being (see Figure 1). This was done in order to reduce the number of constructs examined in the SEM model. The description presented in the Method section refers to the manner in which we tested the equivalence of the construct across groups in order to assess mean differences in satisfaction and self-esteem.

*Test of the equivalence of the measurement model.* Formally testing the comparability of various constructs is considered to be a fundamentally important aspect of empirically based cross-cultural or multigroup research (Poortinga, 1989; Vijver & Leung, 1997). Before mean differences could be assessed and interpreted, we needed to establish that the constructs were understood similarly across groups. To assess the construct comparability or measurement equivalence of the variables of interest—namely, perceived autonomy, competence, positive feedback, satisfaction, and self-esteem across the four samples—we used a three-step modeling approach as recommended by Little (1997) and Bollen (1989). In a modeling approach, differences in the fit indices (e.g., comparative fit index [CFI] and root-mean-square error of approximation [RMSEA]) rather than chi-square differences are assessed because change in chi-square is overly sensitive when the sample size is large and a large number of constraints are applied (see also Ryan et al., 1999, and Deci et al., 2001, for applications of this approach). In the present study, we assessed the equivalence of the measurement model for all four samples simultaneously, that is, across Phase 1 and Phase 2 samples. This provided a very stringent test of construct comparability across all four independent groups and allowed us to describe mean differences among constructs concurrently for all of the groups. In Step 1 of a modeling approach, an initial hypothesized measurement model with all factor loadings or measurement coefficients left free to vary is assessed for all four groups simultaneously. This establishes the extent to which the measurement model fit the data adequately in each group. Given that the model fit<sup>3</sup> is found to be adequate (e.g., CFI > .90; incremental fit index [IFI] > .90, and RMSEA < .10), in Step 2, the factor loadings are constrained to be equal in all of the groups tested, and this constrained model is compared with the unconstrained (freely estimated) model assessed in Step 1. If the fit of the constrained measurement model is still good and the change in fit between the constrained and the unconstrained model is found to be less than .05 for most of the fit indices considered, then this indicates the equivalence of the measurement models across samples. In other words, it suggests that the constructs have been understood similarly in different groups. It provides a cross-validation of the measurement model in independent groups. In Step 3, the item intercepts are also constrained to be equal across groups, and the latent means are estimated in all groups except in one group in which the means are fixed to zero. This group becomes the baseline sample against which the other groups are then compared. In the present study, U of R was selected as the baseline group. If the fit of this fully constrained model is found to be adequate and the change in the fit indices when compared with the values in Step 2 is less than .05, then differences in latent means can be interpreted.

According to Little (2000), evidence of construct comparability or equivalence signifies that the constructs examined are defined in the same operational manner in each cultural group, that they are generalizable to each cultural context studied, and that cultural influences have not differentially affected the constructs underlying the measurement parameters. In addition, evidence of measurement equivalence signifies that the between-cultures differences in the latent constructs' means are quantitative in nature and can be meaningfully interpreted and compared.

*Test of the equivalence of the structural (path) model.* Next, we tested hypotheses concerning the equivalence or invariance of the relations between the latent constructs or the equivalence of the structural paths across German and American samples. We first conducted the invariance analyses on the hypothesized model presented in Figure 1 only for Phase 1 samples, that is, U of R and CAU, in order to establish the adequacy of the structural model. Then, we used Phase 2 samples (SMSU and Uni HH) to replicate the structural model tested in Phase 1. For these invariance analyses, we used differences in chi-square to compare models, as suggested by Little (1997), Byrne (1998), and Bollen (1989). To test the equivalence of the strength of the paths in the structural model, we constrained the path coefficients (gammas and betas) to be equal across groups. The chi-square value of this model with the path coefficients constrained was then com-

pared with the chi-square value of the model in which the path coefficients were left free to vary across groups. If as a result of the constraints applied to the model we observe a significant change in chi-square, then the paths are constrained one by one to assess the unique change in chi-square produced by each path and to identify the source of nonequivalence in the structural model. Then, in a stepwise fashion, the path producing the least amount of change in the chi-square value is first constrained followed by the path that leads to the second smallest difference in chi-square and so on, until all paths that produced a nonsignificant change in chi-square when compared with the unconstrained model are included.

## Results

Because of the relatively large number of latent constructs assessed, we tested the invariance of the measurement model for the basic psychological needs, motivational antecedents, and motivational consequences separately. Autonomous regulation and perceived competence were tested together as the basic motivational constructs. Perceived pressure and feedback were tested together as motivational antecedents, whereas life satisfaction and self-esteem were assessed together as motivational consequences.

### *Test of the Equivalence of the Measurement Model: Testing Construct Comparability for Perceived Autonomy and Competence*

To test the measurement invariance of autonomy and competence across the samples, we first estimated a model in which the measurement parameters (factor loadings) in all four groups were simultaneously and freely estimated. These estimated measurement parameters included the factor loadings, error variances, and the covariances among latent constructs. The fit of this initial unconstrained model was good,  $\chi^2(52, N = 1,289) = 162.34, p < .001, IFI = .98, CFI = .98, RMSEA = .08$ , suggesting that the hypothesized measurement model represented a good fit to the data in all four groups. In the second model, we constrained all of the factor loadings to be equal in all four samples. This model assessed the factorial invariance of the measurement model or whether autonomy and competence were understood similarly. The fit of this constrained model was still good, and the difference in fit was minimal,  $\Delta\chi^2(15, N = 1,289) = 25.49, p < .05, \Delta IFI = .01, \Delta CFI = .01, \Delta RMSEA = .00$ . These results indicate that autonomy and competence were comparable in all four samples. The factor loading estimates are presented in Table 1. In the third model, in addition to constraining the factor loadings to be equal,

<sup>3</sup> To assess model fit, we used well-established indices such as the goodness-of-fit index (GFI), RMSEA, IFI, and the CFI (Hoyle & Panter, 1995; Jöreskog & Sörbom, 1996; Hu & Bentler, 1995; Ullman, 1996). Because the chi-square likelihood ratio statistic is extremely sensitive to trivial discrepancies between the observed and hypothesized covariance matrices, it was not used in the decision-making process regarding the adequacy of the measurement model, but is nonetheless presented. The chi-square statistic should be nonsignificant in a well-fitting model. For the GFI, IFI, and CFI indices, values of about .90 or higher are generally considered representative of an acceptable model. For the RMSEA, we considered this index to be a very good fit if it was equal to or smaller than .05 (very small error of approximation), a value of .08 or better was interpreted as a reasonable fit (moderate error of approximation), and an RMSEA greater than .10 was interpreted as indicative of a poor fit.

Table 1  
Parameter Estimates for the Measurement Models for the Two German and the Two American Samples

Observed variable	Factor loadings						Error variance				
	EP	IF	AUT	COMP	SE	GS	U of R	CAU	SMSU	Uni HH	Intercept
EP1	.67						.54	.39	.57	.60	3.98
EP2	.73						.39	.53	.40	.56	3.16
EP3	.67						.46	.58	.52	.63	3.34
IF1		.91					.18	.14	.17	.15	3.38
IF2		.82					.28	.32	.34	.40	3.17
SDI1			.77				.35	.48	.44	.39	1.07
SDI2			.76				.36	.54	.39	.46	-1.35
SDI3			.67				.49	.64	.57	.55	1.51
SDI4			.64				.51	.61	.60	.64	5.02
COMP1				.83			.25	.39	.29	.41	3.80
COMP2				.83			.21	.51	.24	.43	4.32
COMP3				.81			.29	.47	.31	.43	4.49
SE1					.80		.33	.39	.33	.41	4.57
SE2					.85		.25	.22	.24	.35	4.66
SE3					.81		.31	.39	.37	.31	4.68
SE4					.83		.27	.35	.29	.33	4.61
GS1						.74	.37	.41	.47	.51	4.66
GS2						.75	.37	.41	.46	.48	3.75
GS3						.82	.26	.43	.29	.39	3.93
GS4						.62	.56	.65	.60	.65	3.86

Note. Common metric completely standardized. EP = environmental pressure; IF = informational feedback; AUT = autonomy; COMP = perceived competence; SE = self-esteem; GS = general satisfaction; U of R = University of Rochester; CAU = Christian-Albrechts-Universität; SMSU = Southwest Missouri State University; Uni HH = University of Hamburg; SDI = self-determination indices.

we also imposed equality constraints on the intercepts of the measurement model. This fully constrained model was found to be acceptable,  $\chi^2(82, N = 1,289) = 500.98, p < .001, IFI = .91, CFI = .91, RMSEA = .12$ , and the difference in fit with the freely estimated model to be generally acceptable,  $\Delta\chi^2(15, N = 1,289) = 313.15, p < .001, \Delta IFI = .06, \Delta CFI = .06, \Delta RMSEA = .04$ . Because the fit of the model is acceptable and the drop in the fit indices is close to .05, we could then examine and compare the latent means across all four samples of undergraduate students.

The latent mean comparisons for autonomy and competence appear in the first two rows of Table 2. Table 2 also presents the raw means for each constructs because with latent means the means of one sample need to be fixed to zero (U of R). As predicted, the regulatory style of German students at CAU and Uni HH was much more autonomous than that of U of R or SMSU students. In terms of perceived competence, students from CAU were feeling significantly less competent than U of R students, whereas there was a tendency for students from Uni HH to feel the

Table 2  
Latent and Raw Means for the Motivational Constructs, Antecedents, and Consequences Examined

Latent construct	U of R		CAU		SMSU		Uni HH	
	Latent	Raw	Latent	Raw	Latent	Raw	Latent	Raw
Autonomy	0.00	1.25 <sub>a</sub>	4.33***	5.77 <sub>b</sub>	-1.24**	0.12 <sub>c</sub>	4.07***	5.34 <sub>b</sub>
Competence	0.00	4.22 <sub>a</sub>	-0.18*	4.07 <sub>a</sub>	0.23**	4.42 <sub>b</sub>	-0.06	4.15 <sub>a</sub>
Pressure	0.00	3.42 <sub>a</sub>	-0.48**	3.13 <sub>b,c</sub>	-0.44**	2.99 <sub>b</sub>	-0.43**	3.12 <sub>c</sub>
Feedback	0.00	3.26 <sub>a</sub>	0.45**	3.61 <sub>b</sub>	0.26**	3.55 <sub>b</sub>	0.46**	3.60 <sub>b</sub>
Well-being		4.33 <sub>a</sub>		4.38 <sub>a</sub>		4.47 <sub>a,b</sub>		4.60 <sub>b,c</sub>
Satisfaction	0.00	4.03 <sub>a,b</sub>	-0.18	3.86 <sub>a</sub>	0.12	4.15 <sub>b</sub>	-0.16*	3.90 <sub>a</sub>
Self-esteem	0.00	4.63 <sub>a</sub>	0.21**	4.89 <sub>b</sub>	0.14**	4.79 <sub>a,b</sub>	0.64***	5.30 <sub>c</sub>

Note. Latent means are relative to the University of Rochester (U of R), which is set to zero. Raw means with different letter subscripts are significantly different from one another at  $p < .05$  using Tukey  $t$  tests for post hoc comparisons. U of R:  $N = 339$ ; CAU = Christian-Albrechts-Universität ( $N = 156$ ); SMSU = Southwest Missouri State University ( $N = 415$ ); and Uni HH = Universität Hamburg ( $N = 379$ ).  
\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .



same way. Uni HH students felt significantly less competent than SMSU students.

*Test of the Equivalence of the Measurement Model:  
Testing Construct Comparability for Perceived  
Environmental Pressure and Positive Feedback*

The fit of the freely estimated model for the motivational antecedents tested simultaneously in all four groups without the imposition of any equality constraints on the factor loadings was good,  $\chi^2(16, N = 1,289) = 52.64, p < .001, IFI = .98, CFI = .98, RMSEA = .08$ . Again, this indicated that the hypothesized measurement model adequately represented the data in each group. After imposing equality constraints on the factor loadings in all four groups, we found that the fit of the model tested for factorial invariance remained adequate and the difference in fit was minimal,  $\Delta\chi^2(9, N = 1,289) = 28.45, p < .001, \Delta IFI = .01, \Delta CFI = .01, \Delta RMSEA = .00$ . This indicates that perceived environmental pressure and positive feedback are understood in the same manner in the two groups of German and two groups of American students. The parameter estimates for the factor loadings are presented in Table 1. We then constrained the intercepts to be equal across groups and found the fit of this model to be poor,  $\chi^2(34, N = 1,289) = 340.43, p < .001, IFI = .86, CFI = .86, RMSEA = .16$ . In addition, the difference in fit with the freely estimated model was substantial,  $\Delta\chi^2(18, N = 1,289) = 287.79, p < .001, \Delta IFI = .11, \Delta CFI = .11, \Delta RMSEA = .08$ . Several additional analyses revealed that the model with intercepts constrained was satisfactory for the two American samples and CAU considered simultaneously as well as for the two American samples and Uni HH considered simultaneously. Furthermore, this fully constrained model was found to fit well for students from CAU and Uni HH, the two German universities. For those reasons and because the fit of the model with factor loadings invariant was found to be acceptable, suggesting that the constructs of environmental pressures and feedback were understood similarly, we decided to accept the fully constrained model for all four samples and proceed with the comparison of the latent means across all four groups (see Chirkov et al., 2003, for a similar analysis).

The latent and raw mean comparisons for environmental pressure and feedback appear in the third and fourth rows of Table 2. As predicted, students from the two German universities rated the feedback they obtained from professors to be more positive than U of R students and SMSU students. Furthermore, and as predicted, German students at CAU and Uni HH perceived less pressure from their educational environment than U of R students. SMSU students were comparable with CAU and Uni HH students. SMSU is a public university like the two German universities, whereas U of R is the only private university we surveyed. It is possible that the public versus private nature of the universities might in part explain the observed differences in perceived pressure. It seems likely that the amount of pressure experienced in a private university would be greater than in a public university.

*Test of the Equivalence of the Measurement Model:  
Testing Construct Comparability for Perceived  
Satisfaction and Self-Esteem*

Finally, the fit of the model for the motivational consequences tested simultaneously in all four groups without the

imposition of any equality constraints on the parameters was adequate, suggesting a good fit of the measurement model to the data in each group,  $\chi^2(76, N = 1,289) = 499.82, p < .001, IFI = .96, CFI = .96, RMSEA = .13$ . After imposing equality constraints on the factor loadings in all four groups, we found that the fit of the model tested for factorial invariance was still adequate and the difference in fit was minimal,  $\Delta\chi^2(18, N = 1,289) = 31.75, p < .05, \Delta IFI = .00, \Delta CFI = .00, \Delta RMSEA = .00$ . Again, this suggested that the constructs of subjective satisfaction and self-esteem were comparable across all four groups. The parameter estimates are presented in Table 1. We then tested the model with intercepts constrained to be equal across groups and found the fit of this model to be generally acceptable,  $\chi^2(112, N = 1,289) = 741.94, p < .001, IFI = .94, CFI = .94, RMSEA = .13$ , and the difference in fit with the freely estimated model to be acceptable,  $\Delta\chi^2(18, N = 1,289) = 210.37, p < .001, \Delta IFI = .02, \Delta CFI = .02, \Delta RMSEA = .01$ . We could then interpret differences in latent means.

The latent mean comparisons for satisfaction and self-esteem appear in the last two rows of Table 2. Students from the two German universities reported a greater level of self-esteem when compared with U of R students. Students from Uni HH reported the highest level of self-esteem among the samples. With regard to perceived satisfaction during their studies at the university, students from Uni HH reported somewhat lower levels of satisfaction compared with U of R students, although this difference was not significant for CAU students. German students at Uni HH and CAU reported significantly lower levels of satisfaction when compared with SMSU students. Overall, when we combined perceived life satisfaction and self-esteem to examine subjective well-being, we did not find any significant differences between the two countries except that students at Uni HH reported higher subjective well-being than U of R students (see Table 2).

To summarize, after testing the equivalence of the measurement model for the basic needs (autonomy and competence), the motivational antecedents, and the motivational consequences, we were able to conclude that all six latent constructs assessed were comparable across the four samples. We arrived at these conclusions because (a) the test of the latent constructs and models was based on strong theoretical bases, (b) all three measurement models showed generally acceptable fit statistics, and (c) the overall differences in fit among the models with factor loadings constrained (invariant) and the freely estimated models were generally small.

*Ancillary Analyses*

Because naturally German undergraduates are older than American undergraduates, we examined the raw mean differences on the constructs included in the model with age as a covariate. None of the mean differences reported in Table 2 were significantly affected by the inclusion of age. Consistent with previous research (Deci & Ryan, 2000), we found significant gender differences in autonomy and competence such that women felt more autonomous ( $M = 3.12$  vs.  $1.92$ ),  $t(1218) = 4.64, p < .001$ , and less competent than men ( $M = 4.20$  vs.  $4.35$ ),  $t(1218) = 2.86, p < .01$ . Those gender differences are consistent with results of previous studies examining perceived autonomy (Deci & Ryan, 2000). However,

even after controlling for gender differences, we noticed that the pattern of mean differences presented in Table 2 remained unchanged. In addition, in Phase 2, we also collected data on the number of semesters students had been in college and university tuition per semester. There was a significant difference,  $t(780) = 3.56$ ,  $p < .01$ , between semester in college such that German students had been in college longer ( $M = 3.77$  semesters) than American students ( $M = 3.09$  semesters). University tuition was also much more expensive at SMSU ( $M = \$1,630.00$  USD) than at Uni HH ( $M = \$155.00$  USD). We thus examined the raw mean differences between SMSU and Uni HH, with semester in college and tuition as covariates. The mean differences presented in Table 2 remained virtually the same even after controlling for those variables. In Phase 2, we also asked students, on a scale from 1 to 7, to what extent they wanted to get through college quickly so they could earn money, and to what extent they believed the degree they would earn was related to professional opportunities in their field. Although American students wanted to get through college more quickly ( $M = 4.47$ ) than German students ( $M = 3.66$ ),  $t(792) = 6.11$ ,  $p < .01$ , and perceived a greater utility to their degree ( $M = 5.31$ ) compared with German students ( $M = 4.00$ ),  $t(792) = 15.98$ ,  $p < .01$ , those variables did not substantially affect the mean differences presented in Table 2. Thus, age, semesters in college, gender, tuition fees, desire to get through college quickly, and utility of the degree were not included in the structural models tested.

*Test of the Full Structural Equation Model, Phase 1:  
Equivalence of the Structural Model for U of R Versus  
CAU*

Because the measurement parameters (factor loadings) of the latent constructs assessed in the present study were shown to be invariant across samples, we now proceed with the test of the hypotheses pertaining to the equivalence of the structural links among the latent constructs. We first conducted invariance analyses on the structural paths only with the two samples in Phase 1: U of R and CAU. We tested the hypothesized model depicted in Figure 1. For those analyses, satisfaction and self-esteem were modeled as indicators of subjective well-being. As seen in Figure 1, we hypothesized that perceived feedback would be positively associated with autonomy and competence, whereas perceived environmental pressure was expected to be negatively related to autonomy and competence. In turn, we hypothesized that perceived academic competence and autonomous motivation would be positively associated with subjective well-being. We also expected autonomy to be associated indirectly to well-being through its relationship with perceived competence.

The simultaneous test of the hypothesized model, with factor loadings and structural links freely estimated, was first conducted. The model fit was adequate,  $\chi^2(140, N = 495) = 314.82$ ,  $p < .001$ , IFI = .96, CFI = .96, RMSEA = .07. Importantly, the hypothesized model was also found to fit the data adequately in each group: U of R, goodness-of-fit index (GFI) = .92, and CAU, GFI = .90. We then ran another model in which we constrained the structural links (path coefficients: gammas and betas) to be equivalent across the two groups. This represents the specific test of the equality of the relationships among constructs across groups (Bollen, 1989; Byrne, 1994, 1998; Little, 1997). The fit of the

constrained model was also adequate,  $\chi^2(147, N = 495) = 326.47$ ,  $p < .001$ , IFI = .96, CFI = .96, RMSEA = .068, and the change in chi-square was not significant,  $\Delta\chi^2(7, N = 495) = 11.65$ , *ns*. As discussed previously, when evaluating the equivalence of the structural model across groups, experts recommend a statistical approach in which the change in chi-square between the model with the paths freely estimated and the model with the paths constrained to be equal is assessed (Bollen, 1989; Byrne, 1998; Little, 1997). The nonsignificant change in chi-square in the present model suggests that the strength of the regression coefficients were comparable in the American (U of R) and the German (CAU) samples examined in Phase 1. The hypothesized model was replicated in the German sample.

Level of general feedback was positively related to perceived competence ( $\gamma = .23$ ) and autonomous motivation ( $\gamma = .20$ ) in both samples. In contrast, in Germany and the United States, perceived environmental pressure was negatively associated with perceived competence ( $\gamma = -.24$ ) and autonomy ( $\gamma = -.23$ ). In turn, perceived autonomy and competence were both positively related to subjective well-being ( $\beta_s = .25$  and  $.52$ , respectively). Autonomy was also indirectly associated with well-being through its relationship with competence ( $\beta = .21$ ).<sup>4</sup>

*Test of the Full Structural Equation Model, Phase 2:  
Equivalence of the Structural Model for SMSU Versus  
Uni HH*

We again tested the model depicted in Figure 1, expecting the pattern of relationships observed in Phase 1 to replicate in Phase 2. The simultaneous test of the hypothesized model, with factor loadings and structural links freely estimated, was first conducted. The model fit was adequate,  $\chi^2(140, N = 794) = 484.85$ ,  $p < .001$ , IFI = .95, CFI = .94, RMSEA = .079. Importantly, the fit of the model in each group was also adequate: SMSU, GFI = .92, and Uni HH, GFI = .92. We then ran another model in which we constrained the structural links (path coefficients: gammas and betas) to be equivalent across the two groups. The fit of the constrained model was also adequate,  $\chi^2(147, N = 794) = 495.67$ ,  $p < .001$ , IFI = .94, CFI = .94, RMSEA = .08. The change in chi-square between the freely estimated model and the constrained model was not significant,  $\Delta\chi^2(7, N = 794) = 10.82$ , *ns*. This result suggests that the strength of the regression coefficients among the latent constructs examined were parallel in the American (SMSU) and the German (Uni HH) samples examined in Phase 2.

In both cultures, level of general feedback was significantly related to perceived competence ( $\gamma = .13$ ) and autonomous motivation ( $\gamma = .07$ ), although those regression weights appeared weaker than those obtained in Phase 1. Perceived environmental pressure was negatively associated with perceived competence

<sup>4</sup> We also ran two additional multiple regression analyses to test whether perceived educational context would be significantly associated with autonomy and competence after controlling for the effect of age and gender. The regression models included age, gender, feedback, and environmental pressure as predictors of autonomy and competence. In both models, although gender and age were significant predictors, feedback and pressure were also significantly associated with autonomy and competence over and above the effect of gender and age.

Table 3  
*Results of the Structural Analyses Testing the Equivalence of the Structural Model Across the Four Samples*

Model	$\chi^2$	df	RMSEA	CFI	IFI	$\Delta df$	$\Delta\chi^2$
Unconstrained model	799.67	280	.08	.95	.95		
$\beta(2,1)$ constrained	801.18	283	.08	.95	.95	3	1.51
$\gamma(1,1)$ constrained	804.51	286	.07	.95	.95	6	4.84
$\gamma(2,1)$ constrained	808.16	289	.07	.95	.95	9	8.49
$\gamma(2,2)$ constrained	813.53	292	.07	.95	.95	12	13.86
$\beta(3,2)$ constrained	822.67	295	.07	.95	.95	15	23.00
$\gamma(1,2)$ constrained	838.21	298	.08	.95	.95	18	38.54**
All paths constrained	845.85	301	.08	.95	.95	21	46.18**

*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. Numbers in parentheses in the first column are the matrix element of each link tested.  $N = 1,289$  for all  $\chi^2$ s. RMSEA = root-mean-square error of approximation; CFI = comparative fit index; IFI = incremental fit index.

\*\*  $p < .01$ .

( $\gamma = -.34$ ) and autonomy ( $\gamma = -.18$ ). In turn, perceived competence was found to be positively related to well-being ( $\beta = .62$ ), whereas autonomy was not directly related to well-being. However, autonomy was indirectly associated with well-being through its association with competence ( $\beta = .21$ ).<sup>5</sup>

Although, in both phases of the present study, the structural paths tested in the hypothesized model depicted in Figure 1 were found to be invariant across the two groups tested in each phase, there seem to be some differences across the four groups. For example, the direct link between autonomy and well-being was not supported in Phase 2, although the indirect effect was present in all samples. In order to empirically test those observations, we tested the equivalence of the regression paths across all four groups simultaneously.

#### *Test of the Full Structural Equation Model: Equivalence of the Structural Model in All Samples*

We again tested the hypothesized model depicted in Figure 1. The simultaneous test of the hypothesized model, with factor loadings and structural links freely estimated, was first conducted. The model fit was adequate,  $\chi^2(280, N = 1,289) = 799.67, p < .001, IFI = .95, CFI = .95, RMSEA = .08$ . The fit of the model in each group was also adequate: U of R, GFI = .93; CAU, GFI = .91; SMSU, GFI = .92; and Uni HH, GFI = .92. We then ran another model in which we constrained the structural links (path coefficients: gammas and betas) to be equal across all four groups. The fit of the constrained model was adequate,  $\chi^2(301, N = 1,289) = 845.85, p < .001, IFI = .95, CFI = .95, RMSEA = .08$ . However, the change in chi-square between the freely estimated model and the constrained model was significant,  $\Delta\chi^2(21, N = 1,289) = 46.18, p < .001$ . This suggested that the strength of at least one of the regression coefficients was not comparable across the four groups. This is consistent with our observations of the regression coefficients discussed above.

In order to identify the path coefficients that could be considered equivalent across all four groups, we proceeded to examine the unique impact of each hypothesized regression path on the chi-square change in the model. The paths were constrained one at a time, and the chi-square value of the model with only one path

constrained to be equal across groups was compared with the 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 3 presents the results of this stepwise analysis.

The path coefficient from perceived autonomy to perceived competence had the smallest influence on the magnitude of the chi-square, and we first constrained this path to be equal across the four groups. The chi-square change from the unconstrained model was very small,  $\Delta\chi^2(3, N = 1,289) = 1.51, ns$ . The path from perceived environmental pressures to perceived autonomy had the second smallest impact on the fit of the model, and it was constrained next. The difference in chi-square between this model with two path coefficients constrained and the unconstrained model was also nonsignificant,  $\Delta\chi^2(6, N = 1,289) = 4.84, ns$ . We then constrained the path going from perceived environmental pressures to perceived competence to be equal across all groups. The fit of this model with three paths constrained to be equal was not significantly different from the fit of the unconstrained model,  $\Delta\chi^2(9, N = 1,289) = 8.49, ns$ . Then we added to the constrained model the path coefficient between perceived feedback and perceived competence, and this also yielded a nonsignificant change in chi-square,  $\Delta\chi^2(12, N = 1,289) = 13.86, ns$ . We then added a constraint to the path coefficient from perceived competence to well-being, and this led to a nonsignificant change in fit when compared with the unconstrained model,  $\Delta\chi^2(15, N = 1,289) = 23.00, ns$ . However, when we specified a constraint for the path

<sup>5</sup> We ran two more multiple regression models to test the effect of feedback and environmental pressure over and above the effect of number of semesters in college, gender, tuition fees, desire to get through college quickly, and perceived utility of the degree. Although gender, tuition fees, desire to get through college quickly, and perceived utility of the degree were significant predictors of either autonomy or competence, environmental pressure was found to be significantly associated with both autonomy and competence, whereas feedback was significantly associated with competence.

from perceived feedback to perceived autonomy, this led to a significant change in chi-square,  $\Delta\chi^2(18, N = 1,289) = 38.54, p < .01$ . Finally, we added a constraint for the path from perceived autonomy to well-being, and this also yielded a significant change in fit,  $\Delta\chi^2(21, N = 1,289) = 46.18, p < .01$ , relative to the unconstrained model but not when compared with the previously constrained model,  $\Delta\chi^2(3, N = 1,289) = 7.64, ns$ . This indicates that the path from perceived autonomy to well-being did not lead to an additional significant decrease in fit when compared with the previously constrained model. These results suggest that the strength of the relationship among all of the hypothesized constructs were equivalent across the four samples, except for the path coefficients from perceived feedback to autonomy and the path from autonomy to well-being. The nonequivalence identified for those two regression coefficients suggests that the relationships among those constructs are moderated by the sociocultural factors within each sample.

Figure 2 presents the model that was found to best fit the data across the four samples. For the five path coefficients that were found to be equivalent across all of the samples, only the one common path for the four samples is reported. For the two paths that were found to vary across the samples, the path coefficients for each sample are presented. The link between perceived feedback and perceived autonomy appeared most important in the U of R sample. The relationship between autonomy and well-being appeared stronger in the U of R and the CAU samples, even though it was also positive in the other two samples.

## Discussion

The goal of the present study was to examine in a natural setting the relevance of autonomy and competence toward school in different university cultures: two drawn from Germany and two from the United States. First, we assessed mean differences in perceptions of autonomy and competence toward university studies in German and American students. Further, given that we hypothesized that German students would be exposed to less ongoing pressure and allowed more freedom to self-organize their studies (i.e., to perceive their educational context as more autonomy supportive), we expected autonomous motivation toward school to be higher in the two samples of German students. However, we expected German students to feel less competent toward their studies than American students. Although we expected German students to perceive the feedback they receive more positively, it remains the case that this feedback is very infrequent, which might offset the positive effects of this quality feedback. In addition, prior research suggests that American students feel more competent toward their studies than German students (Little et al., 1995; Nenniger, 1988, 1989, 1991).

However, regardless of mean differences in perceived context and motivational variables between German and American students, we hypothesized that the relations among the constructs examined would be invariant across educational contexts. That is, given that the various constructs were found to be understood similarly across the samples, we expected the paths from perceived educational context to autonomy—competence to well-being to be supported in all groups, thus supporting the generalizability of these motivational processes. Specifically, we expected provision of positive informational feedback to foster autonomy and com-

petence toward school, whereas perceived environmental pressure was expected to be negatively associated with need satisfaction in school. In turn, we expected autonomy to be associated with perceived competence and autonomy and competence to be positively related to subjective well-being.

Our findings generally supported these hypotheses. The measures of autonomy and competence as well as the motivational antecedents and consequences were found to be equivalent and thus comparable across cultures. Because we found our measures to be equivalent across all four groups, we could therefore meaningfully test hypotheses concerning the latent mean differences for perceived autonomy and competence as well as for the motivational antecedents and consequences examined in the model. These mean comparisons supported the expected higher level of autonomous motivation toward school in German students relative to American students and a relatively higher level of perceived competence in the American samples. In addition, and as predicted, German students perceived significantly less pressure at school and rated the feedback they received more positively than American students.

In some way, this result might be surprising given the frequency and intensity of performance assessments in American universities. However, feedback as we assessed it reflected not only quantity, but perceived quality of the evaluations. In fact, items such as “My professors often let me know how well they think I am performing” and “My professors never seem to notice when I am doing something well” (reverse scored) represent informational feedback and convey a sense of personal involvement from professors that may be more typical of the way in which the feedback is delivered in German undergraduate university programs. In addition, perceived competence was found to be generally higher in the American samples than in the German samples. This suggests that even if German students perceive the feedback they are receiving to be of a relatively higher quality than American students, it does not necessarily contribute to enhanced feelings of competence, at least relative to American self-perceptions. One interesting possibility is that cultural values for competence may lead American students to emphasize this attribute and possibly to inflate their self-perceptions. This would be consistent with previous cross-cultural comparisons in which American participants have tended to rate their competence and skills relatively highly, even controlling for performance outcomes (see Little et al., 1995). In fact, results of recent studies have shown that Americans are prone to self-enhancement, whereas Germans tend to underestimate their capabilities (Heine & Lehman, 1997; Kitayama, Markus, Matsumoto, & Norasakkunit, 1997).

The recent empirical evidence might also help explain why German students reported slightly lower levels of life satisfaction during the course of their studies compared with American students. However, German students generally reported higher levels of self-esteem than American students. Overall, when we combined perceived life satisfaction and perceived self-esteem to assess subjective well-being, we found that German students did not experience lower levels of subjective well-being compared with American students. In fact, students from Uni HH reported higher levels of subjective well-being compared with U of R students.

Regardless of these mean differences, the proposed associations among motivational antecedents, perceived autonomy and competence, and well-being were found to be generally equivalent across

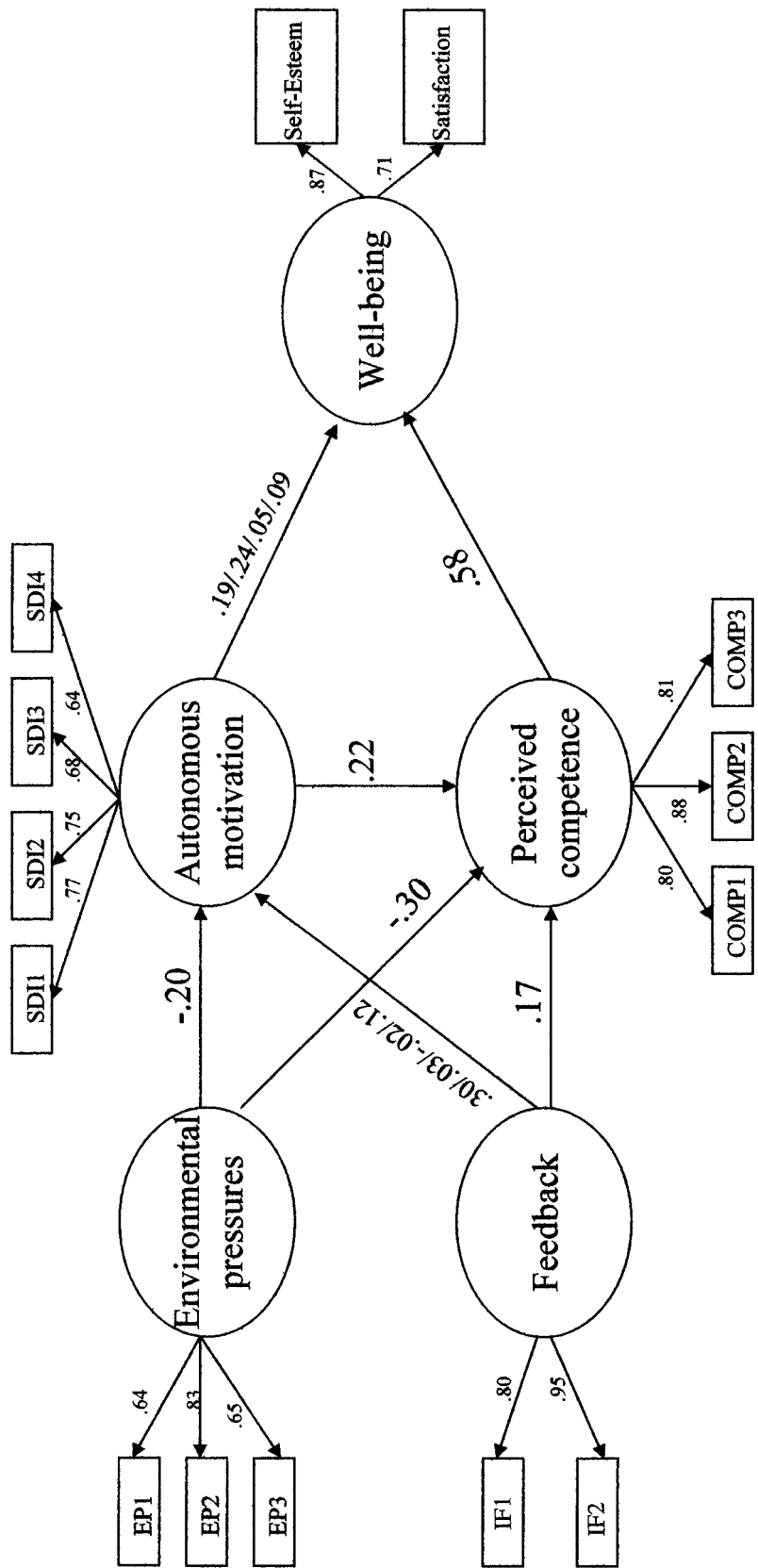


Figure 2. Structural model of academic motivation across all four samples. Only one regression path is presented for the five paths that were found to be equivalent across all four groups. For the nonequivalent regression paths, the regression weights for each group are presented in the following order: University of Rochester, Christian-Albrechts-Universität, Southwest Missouri State University, and University of Hamburg. Model fit:  $\chi^2(295, N = 1,289) = 822.67, p < .001$ , incremental fit index = .95, comparative fit index = .95, root-mean-square error of approximation = .07. SDI = self-determination indices; EP = environmental pressures; IF = informational feedback; COMP = perceived competence.

the groups. In Phase 1 of the present study, the hypothesized model was cross-validated in the German sample. All of the path coefficients in the hypothesized model were supported and found to be equivalent in the U of R and the CAU samples. That is, greater positive informational feedback and lower perceived pressure were positively associated with greater perceived autonomy and competence in both educational contexts. In turn, perceived autonomy and perceived competence were associated with higher levels of subjective well-being in Germany and the United States. In addition, the expected positive association between autonomy and competence was supported in both samples. In Phase 2, we found partial replication for this model. Although the path coefficients were found to be equivalent across the SMSU and the Uni HH samples, some of the hypothesized links were not supported. More specifically, the paths from perceived feedback to autonomy and from autonomy to well-being were not significant. In sum, five out of seven paths were found to be invariants across the four samples. The link between perceived positive feedback and autonomy was not found to be equivalent across samples. This path was found to be relatively stronger in the U of R sample, the only private university setting. In addition, although autonomy was positively associated with well-being in all four samples, this path was found to be relatively stronger in the U of R and CAU samples. There were not a lot of communalities between those two university settings, which we could use to explain this pattern of results. U of R is a small, private American university, whereas CAU is a much larger, public university in Germany. However, the students drawn from U of R and CAU were all psychology majors, which is one similarity that might account for the stronger relationship between autonomy and well-being. In psychology and related fields, students might be more educated about the relationship between autonomy and well-being, thus increasing the strength of that relationship for this group of students. This explanation is speculative, and it remained that the observed variations in the strength of the two nonequivalent path coefficients do not appear to follow any systematic pattern based on hypothesized cultural variations.

Overall, these results are consistent with previous findings and support our hypotheses regarding the relevance and importance of the need for autonomy and competence in school as well as the nature of the educational context that fosters them. Importantly, the indirect path from autonomy to well-being through competence was replicated in Phase 1 and Phase 2. This suggests that perceived autonomy and competence work together to enhance subjective well-being and is consistent with results demonstrating that competence strivings, especially in domains that emphasize skill development such as in school, are most fully expressed under autonomy-supportive conditions (Danner & Lonky, 1981; Ryan et al., 1983).

The generalizability of the present results is strengthened by the fact that four different schools were examined: two German and two American universities, one of which was a private institution. These universities varied in the size of their undergraduate population and the cities in which they were located. Perceptions of students from various academic fields were also surveyed. Thus, the present findings would not appear to be specific to one type of university or a certain population of students or a particular field of study. By choosing to survey students in a variety of universities, we are more confident that the mean differences obtained are the result of the different educational system rather than by-products

of the particularities of the universities included in the sample. Similarly, we are more confident that the similarities observed in the associations among perceived autonomy supportiveness of the educational context, motivational variables, and subjective well-being are the result of underlying similarities in the motivational processes at work in various cultures rather than a pattern of results specific to a certain group of students. Those results support the importance of the need for autonomy and competence in academia across different cultures.

Despite these encouraging findings, the current research has some important limitations worth noting. In the present study, only two cultures were examined: Germany and the United States. Future studies could also investigate the generalizability of those motivational processes in other cultures. In fact, it is clear that there are many structural, cultural, and stylistic variations in educational settings within and between nations that differentially affect need satisfaction, and a test of the effects of these numerous natural variations could contribute to our understanding of autonomous motivation and competence in school, their antecedents, as well as their consequences. Second, although we used a sophisticated procedure to analyze the data and examine our hypotheses, our focus is limited by its reliance on self-report data that is cross-sectional in nature. Additional outcomes, as well as longitudinal studies, would certainly contribute to the present examination of the generalizability of basic psychological needs and especially to more exacting formulations concerning the causality of the implicated processes. Although the relevance of the need for relatedness across cultures has not been questioned, future studies could examine the relationships among autonomy, competence, and relatedness in a school context across cultures.

We also make no claims based on the current data as to the relative efficacy of typical German versus American approaches to university education in terms of attained levels of knowledge or competence or future success within the students' discipline. Rather, our intent was to examine some important psychological variables known to influence school motivation for their comparability and interrelations. The present results thus should not be interpreted in terms of identifying one system as a "better" system, but instead a search for parameters that can be used to improve both. It is true that German students felt more autonomous; however, they were also found to have somewhat lower levels of perceived competence. In contrast, American students seemed to pay the price of frequent, and perhaps more controlling, evaluations by increased feelings of pressure and lower feelings of autonomy. Overall, German and American students reported similar levels of subjective well-being.

The findings of the present study point to the potential importance of the need for autonomy and competence across university cultures and settings. Such results add to a growing body of literature, which suggests that the need for autonomy, competence, and relatedness are cross-culturally salient needs in schools (Ryan & Deci, 2000). Although there may be cultural and institutional variations on how the needs for autonomy and competence are supported, satisfied, and expressed, the importance of experiencing satisfaction of these needs appears to be crucial to the experience of well-being. In our view, an optimal system of education would support both students' volition and competence, and every evaluative system grapples with trade-offs between them. The general model tested in the present study has suggested ways in which

school systems could be more “healthy” by providing more autonomy-supportive contexts, less pressure, and more frequent quality informational feedback.

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Received October 11, 2002

Revision received September 15, 2003

Accepted September 17, 2003 ■

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