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Autonomy Support and Need Satisfaction in the Motivation and Well-Being of Gymnasts

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This study examined the effects of young athletes' perceptions of support from coaches and parents on their need satisfaction, motivation, and well-being. Using the framework of self-determination theory (Ryan & Deci, 2000b), a 4-week diary study of 33 female gymnasts from the northeastern U.S. was conducted that examined (a) the relations of perceived parent and coach supports to the athlete's enduring and daily motivation and need satisfaction and (b) how daily motivation and psychological need satisfaction during practice affects athletes' well-being. Results obtained using hierarchical linear modeling (HLM) revealed that, as predicted, daily motivation predicted pre-practice well-being, and that changes in well-being from pre- to post-practice varied systematically with the need satisfaction experienced during practice. Discussion highlights the importance of adult supports for adolescent sport participants to ensure need satisfaction, and the advantages of diary methodologies in sport research.

As children and teenagers' participation in organized sports has grown, so has awareness of the benefits and hazards associated with it (Martens, 1978; Fox & Biddle, 1988; Whitehead & Corbin, 1997). Although psychological and physical benefits can derive from participation in competitive sport (Frederick & Ryan, 1995; Mandigo & Holt, 2000), for many children and teens, it can also lead to damaged self-esteem and mood disturbances, particularly when youths experience performance pressure from close adults (Brustad, 1988; Davis, 1997; Ommundsen & Vaglum, 1991; Pugh, Wolff, DeFrancesco, Gilley, & Heitman, 2000; Reeve & Deci, 1996). For these reasons, the influence of coaches and parents on children and teen sport participants' experiences is an issue of utmost importance in sport psychology.

Not surprisingly, there is considerable research on the interaction of parents and coaches with sport participants. For example, parental pressure predicted decreased enjoyment of bas-

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ketball (Brustad, 1988), and parental and coach positive emotional involvement predicted the enjoyment of soccer (Ommundsen & Vaglum, 1991). Also, having an autocratic coach who provided little feedback decreased intrinsic motivation in Division I college athletes (Amorose & Horn, 2000, 2001), and in swimmers (Black & Weiss, 1992). The present study examined the impact of athletes' perceptions of coaches and parents, and training climate, on sport motivation and well-being. We used self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000b) to formulate hypotheses about how parents' and coaches' interaction styles influence athletes' motivation and well-being.

The Motivation of Gymnasts

Gymnastics is a challenging skill-based sport that requires long hours of practice to attain proficiency, and rigorous training to attain the needed strength and endurance. Accordingly, gymnasts face many challenges, such as intense training, competition, and the maintenance of a physique that is difficult to maintain during adolescence (Davis, 1997; Douillard, 1994). Because of its rigor, and because training starts at an early age, both coaches and parents are typically strongly involved in a gymnast's development, and play critical roles in shaping the athlete's sport-related experience and self-concept. Adults' expectations and pressures can lead young athletes to experience stress, pain, and self-disparagement, just as support and encouragement can lead to joy, a sense of challenge, and enhanced self-esteem (Goudas, Biddle, Fox, & Underwood, 1995; Krane, Greenleaf, & Snow, 1997).

SDT (Ryan & Deci, 2000a) is relevant to this issue as it predicts how adult pressure can lead athletes to adopt a motivational style that is more controlling, whereas adult autonomy support can foster more self-determined and intrinsic forms of motivation (Frederick & Ryan, 1995; Ryan & Connell, 1989). Furthermore, a core aspect of SDT is the proposition that different forms of motivation range on a continuum of self-determination that have been shown to differentially affect performance and well-being (Ryan & Deci, 2000a).

The Continuum of Motivational Styles

SDT specifies that people can be motivated for different reasons that can be modeled as lying along a continuum of autonomy. The least autonomous form of motivation is labeled *external regulation*, and occurs when a person performs activities either to obtain rewards, or to avoid punishments or sanctions. Another form of motivation is *introjection*, which concerns performance motivated by self-esteem related contingencies. An introjected athlete feels prideful and self-aggrandizing when performing well, and self-disparaging or guilty when doing poorly. A still more autonomous form of motivation is described as *identified motivation*, when the person experiences an activity as personally valuable or important to the self, such as exercising to maintain one's health. Finally, some activities are *intrinsically motivated*, a highly autonomous form of motivation in which an activity is engaged because of its inherent satisfactions such as for the fun, interest, or the challenge it offers. These four types of motivation have been studied in many domains of activity including education, religion, work, health care, and sport (see Ryan & Deci, 2000b, for reviews). In each of these domains, the four types have been shown to fall along a continuum of autonomy that has been validated both in children and adults (Ryan & Connell, 1989; Vallerand, 1997), with external regulation being the most controlled form of motivation, and intrinsic motivation the most autonomous.

Numerous studies have indicated that the more autonomous the person's motivation, the greater his or her persistence, performance, and well-being (Deci & Ryan, 2000). The relative autonomy of motivation has been found to relate to quality of experience and sport attitudes (Pelletier et al., 1995), and with readiness to initiate exercise and enjoyment (Markland, 1999;

Mullan & Markland, 1997). Goudas, Biddle, and Fox (1994) showed that children in physical education (PE) classes with more autonomous motivational styles expressed more interest in physical activities and less ego involvement (Seifriz, Duda, & Chi, 1992). Goudas, Biddle, and Underwood (1995) also showed that undergraduate PE students in a gymnastics course who experienced greater autonomy in class were more likely to evidence intrinsic interest and report intentions to persist. These and other studies (e.g., Vallerand & Losier, 1999) suggest the applicability of SDT to sport and exercise. In the present study we measured each of these motivational styles and related them to the motivational climate created by parents and coaches, and to gymnasts' well-being.

The Motivational Climate

SDT proposes that pressure and control have negative effects on one's adopted motivational style because they thwart the satisfaction of the basic psychological needs for autonomy, competence, and relatedness. These needs are either fulfilled or thwarted through interactions with key people in a given context, and we label the quality of these interactions the motivational climate. A motivational climate will foster autonomous motivation to the extent that it supports satisfaction of these three psychological needs. To foster autonomous motivation, the person(s) who have the power to influence others (e.g., coaches, parents) should be both involved and autonomy supportive (Grolnick, Deci, & Ryan, 1997). Involvement concerns the extent to which adults care for and devote resources to the children (e.g., accompanying them to practice or meets, speaking with the coaches or with the parents, asking the child about what is going on within the activity). Autonomy support concerns the extent to which adults enable and encourage initiative and choice in the athlete, and share in his/her perspective when solving problems or offering advice (Reeve, 1998; Ryan, 1993). The opposite of autonomy support is control, as when coaches or parents are more directive, authoritarian, and pressuring. Thus, involvement is the extent to which an adult partakes in a child's activity, whereas autonomy support qualifies this involvement in terms of the degree to which the adult controls the child's activity, or supports the child's initiative.

According to SDT, involvement typically has positive effects, particularly when combined with autonomy-support (Grolnick, Ryan, & Deci, 1991). This means that a controllingly involved coach or parent will likely foster externally regulated or introjected motivation in an athlete. By contrast, an autonomy-supportive coach or parent will likely foster identified regulation and intrinsic motivation (e.g., Chirkov & Ryan, 2001; Grolnick & Ryan, 1989; Ryan & Grolnick, 1986). In two recent longitudinal studies, the motivational orientation and supportiveness of parents and coaches fostered autonomous motivation in adolescents and in competitive swimmers, which in turn increased their persistence in sports (Fortier, 2000; Pelletier, Fortier, Vallerand, & Brière, 2001). Sarrazin, Vallerand, Guillet, Pelletier, and Curry (2002) also found that task-involving climates (contrasted with ego-involving climates) promoted need satisfaction and negatively predicted drop-out in a 21-month longitudinal study of adolescent handballers. Accordingly, we predicted that our young gymnasts would be more autonomously motivated to the extent that they experienced parents and coaches as positively involved and autonomy-supportive rather than controlling. This hypothesis was tested both in terms of individual differences in perceptions, and in terms of daily training experiences.

Effects of Climate and Motivation on Well-Being

SDT proposes that autonomous self-regulation leads to increased well-being. We define well-being as psychological functioning characterized by positive experiences and an integrated sense of self within the domain of action (Ryan & Deci, 2001). As such, our choice of indicators reflects this definition of well-being, in that they focus on stability of one's self-

concept, feeling an inner energy and spirit (vitality), and being proactive and approach-oriented (PANAS). SDT posits that the fulfillment of the basic psychological needs for autonomy, competence, and relatedness is necessary for well-being to be attained and maintained. When any of these psychological needs is frustrated or blocked, ill being and impoverished engagement is the predicted result. Consistent with this view, Sheldon, Ryan, and Reis (1996) and Reis, Sheldon, Gable, Roscoe, and Ryan (2000) found that both general well-being and day-to-day fluctuations in well-being were directly associated with perceived psychological need satisfaction. In the current study, we tested how variations in experiences of autonomy, competence, and relatedness in gymnastics affected changes in well-being from before to after a practice.

We used indices of well-being that we suggest are impacted by the sport experience. One is the athlete's *mood*, which we assessed using a widely used measure of positive and negative affect developed by Watson, Clark, and Tellegen (1988). Engaging in physical activities has been associated with increased PA but not NA, both within- and between-persons (Clark & Watson, 1988; Watson, 1988). VanLanduyt, Ekkekakis, Panteleimon, Hall, and Petruzzello (2000) found mood improvement for some exerciser participants, and mood deterioration in others.

Another focus is *subjective vitality* (Ryan & Frederick, 1997), or the experience of feeling energetic and alive. Vitality has been shown to positively relate to need fulfillment, and to covary with physical states such as pain and common physical ailments such as colds, flu, and headaches (Ryan & Frederick, 1997). Also, autonomous motivation and need satisfaction have been shown to engender more vitality (Nix, Ryan, Manly, & Deci, 1999; Reis et al., 2000).

A third important aspect of well-being concerns *self-esteem*. Recent research on self-esteem suggests that having stable self-esteem is at least as important as having a high level of self-esteem (Kernis, Cornell, Sun, Berry, & Harlow, 1993). Level and stability have independent effects on positive outcomes, even though they tend to be moderately correlated (Kernis et al., 1993). Consistent with SDT's view that autonomous motivation is associated with more stable self-esteem (Deci & Ryan, 1995), Kernis, Paradise, Whitaker, Wheatman, and Goldman (2000) found that people with more stable self-esteem were more likely to pursue goals for autonomous (identified and intrinsic) relative to controlled (introjected and external) reasons. They also experienced more interest and less tension. Also, children with unstable self-esteem were shown to be less intrinsically motivated (Waschull & Kernis, 1996), and to perceive their father as more controlling and critical (Kernis, Brown, & Brody, 2000).

Based on these studies, we expected that gymnasts with higher autonomous motivation and need satisfaction would have higher and more stable self-esteem, PA, and vitality, and lower and more stable NA. We also expected that perceptions of parents' and coaches' autonomy support would influence level and stability of self-esteem, PA, NA, and vitality similarly.

Overview of Study

To date, research on sport motivation has mainly used cross-sectional designs that focus on individual differences. However, the ongoing experience of practicing a sport varies from day to day or from practice to practice. On some days, one can feel more confident, energetic, and inspired, whereas on others, one may feel tired, impatient, and insecure. Diary studies (Reis & Gable, 2000) allow one to examine factors that influence this fluctuation. In the present study, we recorded day-to-day motivation to attend practice, experiences of need satisfaction, and well-being. We asked gymnasts to complete short forms before and after each of their practices, for a total of 15 practices that spanned a period of 4 weeks. The data are thus structured across two levels, the first being daily fluctuations of psychological constructs that are nested within gymnasts, who may differ at a second level in terms of experienced support and motivation.

Person-level hypotheses: At the between-person level, analyses were conducted to examine relations between self-reports obtained in the initial questionnaire and aggregated data from the daily reports. Perceptions of autonomy support and involvement from coaches and parents were expected to be related to the adoption of more autonomous forms of motivation and to reports of need satisfaction. Autonomous motivation and need satisfaction, in turn, were expected to have positive effects on PA, self-esteem and vitality, and negative effects on NA.

Practice-level hypotheses: We asked gymnasts to report before each practice why they came to their practice that day and to report on their well-being. After each practice, we asked them to report on how their needs for autonomy, competence, and relatedness had been satisfied during the practice, and to report on their well-being again. It was expected that incoming motivation would relate to well-being before and after practice, but that need satisfaction during practice would predict of changes in well-being from before to after each practice. We also tested for cross-level interactions, such as the effects of individual differences in overall motivation on the relation between daily motivation and daily need satisfaction with fluctuations in well-being.

METHOD

Participants

Forty-five female gymnasts between the ages of 7 to 18 (M = 13 years, SD = 2.35) from a northeastern U.S. competition team agreed (with parents' consent) to participate in a diary study on their motivation for gymnastics. The gymnasts were coded on their ability level using a 5 to 9 scale from the classification system of the United States Association of Gymnastics, with level 9 being the highest ability level. The median ability level was 6. The number of years that the gymnasts had been practicing ranged from 1 to 11, with a median of 6, and they reported practicing for an average of 7 hours a week.

Procedure

All 45 gymnasts completed the initial questionnaire, and 33 completed the diary forms before and after each practice, for a total of 15 practices that spanned 4 weeks during the non-competing period of the season. Because the club moved to a new location between the administration of the initial questionnaire and the diary study, the remaining 12 gymnasts stopped training at this club and did not complete the diary part. The median number of diaries completed per participant was 13, with a range from 4 to 15. This number of observations is considered to yield moderate power (Kreft & De Leeuw, 1998) and is similar to many other published studies in terms of the ratio of people and days to number of variables studied (e.g, Gable, Reis, & Elliot, 2000; Reis et al., 2000; Sheldon, Ryan, & Reis, 1996). The questionnaires and diaries were administered by trained research assistants who brought completed forms to the laboratory immediately after each collection. All measures were scaled from 1 to 5 to ensure the young gymnasts would use the full scale and wording on some of the items was simplified.

The Initial Questionnaire

The initial survey was given 1 month prior to the start of the diary study in two group administrations. Gymnasts reported their age, level, years practicing gymnastics, and the number of hours and sessions practiced per week. They also completed the following measures:

Self-regulation for gymnastics. This scale assessed five different motivational regulations for engaging in sport/leisure activities, based on the model set forth by Ryan and Connell (1989) and elaborated in the sport domain by Pelletier et al. (1995). It consisted of 15 statements that answered the question "Why do you practice gymnastics?" that participants rated using a 1 (*completely agree*) to 5 (*completely disagree*) Likert-type scale. Three items assessed intrinsic motivation (e.g., "For the pleasure I feel when I practice gymnastics"; α = .73), 3 assessed identified regulation (e.g., "It is a good way to get exercise"; α = .63), 3 assessed introjected regulation (e.g., "I would feel guilty if I didn't come to practice"; α = .53), 3 assessed external regulation (e.g., "I like to win ribbons and trophies at meets"; α = .66), and 3 assessed amotivation (e.g., "I'm not sure why I still practice gymnastics, I don't seem to be going anywhere with it"; α = .88). Although some of these reliabilities appear to be low, they were calculated with only 3 items, which lowers estimates of reliability. Moreover, these reliabilities are similar to the ones obtained in other research using both children (e.g., Ryan & Connell, 1989; α's ranged from .62–.82), and adolescents (e.g., Vallerand, Fortier, & Guay, 1997; α's ranged from .72–.87). For some analyses, subscale items were averaged to form an index of relative autonomy, computed from the following formula (Grolnick & Ryan, 1987): 2 (intrinsic motivation) + (identification) – (introjection) – 2 (external regulation).

Children's perception of parents scale. This scale was adapted from Grolnick et al. (1991) and measured children's perceptions of parental autonomy support (6 items, e.g., "My parents let me choose what to do when it comes to gymnastics"; α = .69) and involvement (7 items, e.g., "My parents don't do as much as they could to support me in gymnastics" [reversed] α = .80), on a 1 to 5 Likert-type scale. The scale was also modified to measure perceptions of the coaches' autonomy support (α = .79) and involvement (α = .83) by replacing the term "parents" with "coaches." Parent autonomy support and involvement were correlated at .57, and coach autonomy support and involvement were correlated at .79.

Attendance. The number of attended practices out of a possible 15 was computed for each gymnast and used as an indicator of behavioral engagement in gymnastics.

Measures in the Diary Study

Before each practice, gymnasts completed a short form on which they were asked to respond to items in terms of how they felt at this moment, and contained the following scales:

Motivation for gymnastics. Six items were adapted from the initial questionnaire to measure gymnasts' reasons for coming to practice, rated on a 1 to 5 scale. Answers included 2 external regulation items ("Because I don't want others to get upset with me for not being here" and "Because I have to be here"), 2 introjection items ("Because I would feel guilty if I didn't come to practice" and "Because I am hoping to show off my skills today"), 1 identification item ("Because I think it's important to practice to maintain and improve my skills"), and 1 intrinsic motivation item ("Because I feel like I really want to do gymnastics"). A daily motivation index was calculated using the same formula used in the initial questionnaire.

Positive and negative affect schedule (PANAS). This scale contained 10 items measuring positive affect (e.g., excited; α = .91) and 10 items measuring negative affect (e.g., distressed; α = .91) rated on a 1 (*Not at all*) to 5 (*Extremely*) Likert-type scale (Watson et al., 1988). Subscale items were averaged to form daily PA and NA scores. The PANAS has been used and validated with children samples (Melvin & Molloy, 2000; Wilson & Gullone, 1999).

Self-esteem. This 10-item scale assessed the gymnasts' attitudes towards themselves (e.g., "I feel that I have a number of good qualities"; $\alpha = .88$; Rosenberg, 1965), using a 1 (*Strongly disagree*) to 5 (*Strongly agree*) Likert-type scale. Item scores were averaged to form daily self-esteem scores.

Subjective vitality scale. Four items from this 7-item scale (e.g., "I feel alive and vital"; $\alpha = .87$) were used to assess the gymnasts' daily subjective feelings of vitality on a 1 (*Not at all*) to 5 (*Extremely*) Likert-type scale (Ryan & Frederick, 1997). Items were averaged to form daily vitality scores.

After each practice, participants completed a second form containing once again the PANAS, self-esteem, and subjective vitality scales. They also completed the following scale:

Need satisfaction scale. This scale assessed the extent to which gymnasts felt that their needs for autonomy (7 items, e.g., "My coaches helped me choose my own direction during practice"; $\alpha = .87$), competence (2 items, e.g., "I was good at gymnastics"; $r = .39$), and relatedness (3 items, e.g., "I felt like I was part of the team"; $\alpha = .89$) were satisfied during their practice, using a 1 (*Completely disagree*) to 5 (*Completely agree*) Likert-type scale. Subscale items were averaged to form daily autonomy, competence, and relatedness scores. They were highly correlated at .51, .57, and .83, as they have been in other studies (e.g., Deci et al., 2001).

RESULTS

Person-Level Analyses

At this level of analysis, we were interested in examining relations between perceived autonomy support with the different motivational styles and need satisfaction, and between motivational styles and need satisfaction with well-being outcomes. For this purpose we aggregated the diary data across all sessions for each gymnast on each variable (before and after practice data separately), and also computed the average variation on each post-practice well-being variable over the 4-week period of the study by taking the standard deviation of the daily scores for each gymnast (Kernis et al., 1993).

Table 1 presents motivation means for the initial questionnaire and the averaged daily reports. Gymnasts scored highest on identification, followed by intrinsic motivation and by introjection in the initial questionnaire. They scored highest on intrinsic motivation, followed by identification and introjection in the daily self-reports. Correlations between the initial and daily measures ranged from .22 to .50, indicating that situational motivation (i.e., practice level) is somewhat related to contextual motivation, but may also be affected by situational influences, as postulated in Vallerand's (1997) hierarchical model of motivation.

Correlations between age and motivation revealed that older gymnasts reported being less introjected in the initial questionnaire, $r = -.33$, $p < .05$, and reported being more identified on a daily basis than younger gymnasts, $r = .44$, $p < .01$. Age was unrelated to attendance level. Identified gymnasts also practiced more times per week, $r = .32$, $p < .05$. Despite these relations, age and ability level did not moderate the results reported below, and are not further discussed.

Correlations were computed between parent and coach autonomy support and involvement with initial and daily motivation scores (see Table 1). These revealed that perceived parent autonomy support was positively related to identified (initial and daily) and intrinsic motiva-

Table 1
Means and Standard Deviations (*SD*) of Initial/Daily Motivation Variables and Daily Need Satisfaction, and Their Correlations with Perceptions of Parents and Coaches from the Initial Questionnaire (*n* = 45/33).

	Mean (*SD*)	Parent autonomy support	Parent involvement	Coach autonomy support	Coach involvement
Amotivation	1.80 (.99) / 1.71 (.97)	–.15 /–.30+	–.28+ / –.13	–.34* / .03	–.42** / .07
External regulation	1.80 (.96) / 2.21 (1.15)	–.01 / –.26	.37** / –.21	.19 / .08	.21 / .17
Introjection	3.18 (.88) / 2.65 (1.07)	–.07 / –.29+	.26+ / –.05	.04 / .02	.06 / .06
Identification	4.53 (.63) / 4.23 (.88)	.27+ / .38*	.21 / .18	.37** / .33+	.49*** / .32
Intrinsic motivation	3.93 (.73) / 4.44 (.52)	.31* / .13	.31* / .04	.20 / –.11	.34* / –.08
R. A. I.	5.62 (2.61) / 6.03 (3.22)	.26+ / .43**	–.14 / .23	.05 / –.01	.14 / –.08
Autonomy	3.83 (1.03)	.23	.37*	.54***	.60***
Competence	3.73 (.57)	.06	.04	.33+	.37*
Relatedness	4.08 (.92)	.37*	.35*	.42**	.50**

Note: R. A. I. = Relative autonomy index. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

tion (initial) motivation, while coach autonomy support was associated with higher identified motivation. Involvement was only related to initial motivation measures. Perceived parent involvement was positively related both to autonomous and controlled forms of motivation, whereas perceived coach involvement was positively related to identified and intrinsic motivation and negatively related to amotivation. It is also worth noting that perceived parent involvement was positively related to the number of times gymnasts practiced during the week, $r = .41$, $p < .01$, as was coach autonomy support, $r = .29$, $p < .05$.

Table 1 also displays the correlations between perceived parent and coach autonomy support and involvement with need satisfaction during practices. Expectably, parent autonomy support and involvement were not strongly related to need satisfaction during practice, but coach autonomy support and involvement were. Thus, coaches may possibly have greater influence on gymnasts' practice motivation and well-being than parents. Parent involvement was perceived as relatively less autonomy supportive than the involvement of coaches, as indicated in (a) the correlation between parent autonomy support and involvement of .57, which is not as strong as the correlation of .79 between coach autonomy support and involvement; (b) its similar correlations of parent with both controlled and autonomous forms of motivation; and (c) its low correlation with satisfaction of the need for autonomy. This could mean that at least some of the parents in our sample were perceived as involved in a pressuring way, whereas coaches were perceived as involved in an autonomy supportive way.

Table 2 presents correlations between the motivational styles measured in the initial and daily questionnaires and the averaged daily ratings of well-being. Overall, these correlations reveal a pattern where positive well-being outcomes were more positively correlated with autonomous motivational styles, and more negatively correlated with controlling motivational styles, whereas the opposite pattern was true for negative well-being outcomes.

Specifically, intrinsic motivation was positively related with average pre- and post-practice PA, whereas controlled forms of motivation (introjected and external) and amotivation were positively related to average pre- and post-practice NA. In light of the ample evidence for separate affective systems for PA and NA, these results are interesting. It appears that PA is associated with more autonomous forms of motivation, whereas NA is associated with more controlled forms of motivation. Instability of PA tended to be positively correlated with external regulation from the initial questionnaire, and amotivation from the diaries. In contrast, instability of NA was only negatively correlated with intrinsic motivation from the diaries.

Mean vitality ratings were positively related to intrinsic motivation and negatively to external regulation and amotivation. Instability of vitality was positively associated with external regulation from the initial questionnaire, and with amotivation from the diaries.

Means for self-esteem pre- and post-practice were negatively associated with controlling motivational styles both from the initial questionnaire and from the diaries, and were positively associated with intrinsic motivation from the diaries. In contrast, unstable self-esteem was positively associated with introjection and external regulation from the initial questionnaire, and amotivation from the diaries. This supports Deci and Ryan's (1995) hypotheses that being motivated in a controlling manner is associated with more unstable self-esteem.

Finally, number of attended practices did not correlate with motivation from the initial questionnaire, but was positively correlated with daily intrinsic motivation, $r = .37$, $p < .05$.

To prospectively examine the influence of daily motivation on change in daily well-being, we conducted partial correlations between aggregates of daily motivation and aggregates of well-being variables measured post-practice, controlling for aggregates of well-being variables measured pre-practice. Even though these analyses do not meet all criteria for causality, they can give an indication of the likelihood that motivational styles affected patterns of change in well-being during practice. Very few correlations were significant. Intrinsic motivation was

Table 2
Correlations between Initial/Daily Motivation and the Means and Variability of Daily Outcomes (*n* = 33)

	Amotivation	External regulation	Introjected regulation	Identified regulation	Intrinsic motivation	R. A. I.
Mean PA B. P.	–.28 / –.29+	–.04 / –.09	.01 / .06	.09 / .40*	.35* / .68***	.29+ / .36*
Mean PA A. P.	–.21 / –.34*	–.22 / –.13	.01 / .16	.05 / .21	.32+ / .54**	.41* / .26
SD PA A. P.	.00 / .33*	.36* / .15	–.15 / –.03	.03 / –.02	–.22 / –.06	–.34+ / –.11
Mean NA B. P.	.38* / .62***	.40* / .33*	.44** / .38*	.11 / –.04	.09 / –.32+	–.41* / –.45*
Mean NA A. P.	.20 / .24	.45** / .31+	.20 / .19	.18 / .07	–.01 / –.39*	–.36* / .37*
SD NA A. P.	.27 / .23	.14 / .09	.26 / .17	.11 / –.02	.08 / –.34*	–.12 / –.22
Mean vitality B. P.	–.51** / –.41*	–.18 / –.22	–.13 / –.05	–.15 / .02	.13 / .67***	.30+ / .37*
Mean vitality A. P.	–.45** / –.49**	–.41* / –.32	–.16 / –.08	–.13 / –.06	.18 / .51***	.49** / .38*
SD vitality A. P.	.19 / .35*	.50** / .26	.24 / .19	–.05 / –.15	–.21 / –.12	–.58*** / –.31+
Mean self-esteem B. P.	–.54** / –.48**	–.11 / –.24	–.35* / –.17	–.09 / .13	.05 / .64***	.29+ / .45**
Mean self-esteem A. P.	–.56** / –.55**	–.22 / –.28+	–.42* / –.20	–.08 / .19	.10 / .63***	.42* / .49**
SD self-esteem A. P.	–.01 / .36*	.37* / .17	.30+ / .12	–.18 / –.27+	–.24 / –.17	–.54*** / –.28+

Note: R. A. I. = Relative Autonomy Index, B. P. = Before Practice, A. P. = After Practice, *SD* = Standard Deviation. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

negatively correlated with post-practice NA, $pr = -.34$, $p < .05$, and amotivation was negatively correlated with post-practice self-esteem, $pr = -.35$, $p < .05$. We repeated these analyses correlating well-being variables with parent and coach autonomy support and involvement, and with aggregates of need satisfaction during practice. None of the correlations were significant.

Practice-Level Analyses

Having examined the between-persons findings, some questions arise. Even though we know that levels of affect, vitality, and esteem averaged across days were related to average levels of motivation coming into the practice, between-persons analyses tell us nothing of whether they fluctuated together during practices. Because it is also not appropriate to conduct regression analyses on aggregated data with so few cases, nor is it appropriate to conduct regression analyses using the daily measures as cases because they are non-independent observations, we carried out a series of hierarchical linear models to examine the links between need satisfaction, motivation, and well-being at the daily level.

Using hierarchical linear modeling (HLM; Bryk & Raudenbush, 1992) with maximum likelihood estimation, we analyzed if daily well-being varied as a function of daily experiences of motivation and need satisfaction. HLM treats person-level effects as random by using regressions at two levels simultaneously to calculate error terms. A significant random effect indicates that the individual intercepts and slopes are not homogeneous, and that some individual difference variable may be able to explain the fluctuation in slopes across people. To test this, we examine cross-level interactions, or the influence of between-subject effects (e.g., perceived coach autonomy support) on, for example, within-subject slopes between need satisfaction and well-being. Practice-level well-being was estimated using the following equation:

$$WB_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij} \quad (1)$$

where β_0 refers to person (j)'s well-being during an average practice; β_1 represents a maximum likelihood estimate of person (j)'s slope estimating well-being from daily motivation and need satisfaction variables; X_{ij} represents the motivation or need satisfaction value on each day (i) for each person (j); and e_{ij} is residual error. Person-level effects were estimated using the following equations:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}W_j + u_{0j} \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}W_j + u_{1j} \quad (3)$$

where γ_{00} refers to the sample's mean well-being across practices; γ_{01} represents the average variation in well-being means derived from a variable measured at the trait level, such as perceived coach involvement; γ_{10} represents the average well-being slope across the sample estimated from daily motivation or need satisfaction [1]; γ_{11} represents the average variation of the well-being slopes estimated from a variable measured at the trait level, such as perceived parental autonomy support; W_j represents the value of a trait measured in the initial questionnaire for person (j); and u_{0j} and u_{1j} represent the average error. When the random effect (i.e., "u") was significant, thus indicating heterogeneous slopes or intercepts across gymnasts, moderator variables, like perceived parent autonomy support, were added into the second level equations to examine if they could explain the variance. Note that when we estimated the effects of need satisfaction on well-being after practice, controlling for well-being before practice, the parameters γ_{10} and γ_{11} indicate pre-practice well-being intercepts and slopes, while new parameters

are added for predictor variables' intercepts (γ_{20}) and slopes (γ_{21}).

Our analyses were done using HLM 5 (Raudenbush, Bryk, Cheong, & Congdon, 2000) with the predictors centered around their respective person-level mean in order to observe how unit changes in the predictors were related to changes in outcomes for each individual. First, we tested whether incoming motivation would relate to well-being measured before practice. Analyses were done by regressing the outcome variables measured before each practice separately on each motivational style and relative autonomous motivation. Results, presented in Table 3, indicate that unit increases in relative autonomous motivation marginally led to a .04 unit increase in PA, and significantly led to a .04 unit decrease in NA, a .05 unit increase in vitality, and a .04 increase in daily self-esteem. Most of the estimated intercepts and the slopes were heterogeneous (i.e., u_0 and u_1 were significant), but none of the variables assessed in the initial questionnaire significantly moderated these effects. Analyses with intrinsic and identified motivation as predictors also yielded significant results. Unit increases in intrinsic motivation led to a .26 increase in PA, a .10 decrease in NA, a .34 increase in vitality, and a .13 increase in self-esteem. Unit increases in identified motivation in turn led to .18 increases in PA and vitality, and a marginally significant .09 increase in self-esteem. Again, most of the estimated intercepts and slopes were heterogeneous, but none of the measures in the initial questionnaire could explain the variability. The other motivational styles were not related to changes in well-being, meaning that, overall, autonomous motivational styles were shown to positively relate to well-being on a daily basis, and it appears that intrinsic motivation was a better predictor than identification.[1]

Next, analyses were conducted to examine whether incoming motivation would relate to changes in well-being outcomes from before to after practice. Pre-practice levels of well-being were entered into the equation to control for initial level when predicting post-practice well-being. These analyses all yielded non-significant results. Since incoming motivation did not influence changes in well-being, something during practice might have affected changes in well-being. So we conducted analyses to examine the effects of need satisfaction during the practice on changes pre- to post-practice. Each of the needs was entered in separate equations to avoid multicollinearity problems because they were highly correlated with one another, and results are presented in Table 3. Increases in daily need satisfaction predicted increases in PA, vitality, and self-esteem, whereas NA was in no way influenced by daily need satisfaction. More specifically, unit increases in perceived autonomy support from coaches predicted a .11 unit increase in PA, a .25 unit increase in vitality, and a .12 unit increase in self-esteem. Unit increases in feelings of competence predicted a .24 unit increase in PA, a .24 increase in vitality, and a .11 increase in self-esteem. Finally, unit increases in relatedness to peers predicted a .19 unit increase in PA, a .34 unit increase in vitality, and a .18 unit increase in self-esteem.

All of the intercepts and slopes were again heterogeneous, but moderating effects were only found for change in self-esteem. Coach involvement as rated by the gymnasts in the initial questionnaire moderated the slope between pre-practice and post-practice self-esteem (i.e., variations in $\beta_{1,}$ or γ_{11}), and this effect was homogeneous across gymnasts; the self-esteem slope was flatter for gymnasts who reported high coach involvement (1 standard deviation above the

1. Additional analyses were conducted on each well-being measure, one set entering both intrinsic and identified motivation as predictors (r = .21), and a second set entering intrinsic and extrinsic motivation (r = –.18). In the first set, intrinsic motivation yielded a bigger effect than identification for PA, self-esteem, and vitality, while neither significantly predicted NA. In the second set, intrinsic motivation yielded a bigger effect than extrinsic motivation for PA, self-esteem, and vitality, while neither significantly predicted NA.

Table 3
Unstandardized (group centered) Results from the HLM Analyses on Well-being Before Practice and Change in Well-being *(n* = 33)

	Positive affect	Negative affect	Vitality	Self-esteem
Intercept γ_{00}	4.02***	1.82***	4.07***	4.19***
R. A. I. Slope γ_{10}	.04+	–.04**	.05*	.04**
Intrinsic motivation γ_{10}	.26***	–.10*	.34***	.13**
Identified regulation γ_{10}	.18**	–.03	.18**	.09+
Intercept γ_{00}	3.80***	1.71***	3.82***	4.15***
Autonomy γ_{10} [a]	.15**	–.15*	.11*	.18**
γ_{20}	.11*	–.04	.25**	.12*
Competence γ_{10}	.14**	–.14*	.14**	.20***
γ_{20}	.24***	–.04	.24***	.11**
Relatedness γ_{10}	.16**	–.14*	.12*	.18**
γ_{20}	.19**	–.05	.34***	.18***

Note: R. A. I. = Relative Autonomy Index. [a] γ_{10} = Slope of outcome before practice, γ_{20} = Slope of need satisfaction after practice. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

grand mean) than for gymnasts who reported lower coach involvement (1 standard deviation below the grand mean). However, coach involvement did not influence the relation between need satisfaction and self-esteem (i.e., γ_{21} was *ns*). Specifically, when need for autonomy was entered, self-esteem changed by .21 points across the sample, and coach involvement had an effect of $\gamma_{11} = –.17$, $p < .05$, which means that for gymnasts who reported lower coach involvement, self-esteem changed by .38 points compared to .04 for gymnasts who reported higher coach involvement. When need for competence was entered, self-esteem changed on average by .22 points, and coach involvement had an effect of $\gamma_{11} = –.14$, $p < .05$, which means that for gymnasts who reported lower coach involvement, self-esteem changed by .36 points compared to .08 for gymnasts who reported higher coach involvement. When need for relatedness was entered, average change in self-esteem was .20, and coach involvement had an effect of $\gamma_{11} = –.17$, $p < .05$, which means that for gymnasts who reported lower coach involvement, self-esteem changed by .37 points compared to .03 points for gymnasts who reported higher coach involvement.

DISCUSSION

The goal of this study was to examine the effects of perceived parent and coach autonomy support on the motivation and well-being of gymnasts. Self-determination theory (Deci & Ryan, 1985, 2000) proposes that the satisfaction of the needs for autonomy, competence, and relatedness is essential to sustained and healthy motivation, and that these needs are most likely to be fulfilled under contexts that support people's need for autonomy. Young gymnasts participated in a questionnaire study, and a subset of them participated in a diary study examining perceptions of their parents' and coaches' autonomy support, their motivation, need satisfaction, and well-being. Diary studies have the advantage of gathering data at a time close to when people experience targeted events and are therefore less subject to memory biases. Having multiple records of a person's experiences also has the advantage of increas-

ing greatly the power of statistical analyses, although one needs to control for person-related and time-related sources of variance. HLM can handle these issues by allowing to simultaneously test within-person and between-persons effects. Disadvantages of this technique include the increased time and operating costs, and the difficulty of getting long-term commitment from research participants.

The results of this study nicely demonstrate the value of this methodology. When aggregating daily-level data, we found that perceptions of parent and coach autonomy support and involvement influenced the quality of the gymnasts' motivation. The more autonomy supportive and involved parents and coaches were perceived to be by the gymnasts, the more autonomously motivated the gymnasts were. We were also interested in the question of whether daily motivation and need satisfaction would influence changes in well-being during practice. Partial correlations between well-being variables and aggregates of daily motivation and need satisfaction revealed no significant patterns of influence. Thus, the conclusions one would draw from such between-persons analyses on aggregated data would be that incoming motivation and need satisfaction during practice do not have a strong influence on changes in well-being.

However, using HLM made it possible to examine the day-to-day influence of such variables on changes in well-being during practice. In the present study, it allowed us to find that incoming motivation only influenced well-being reported before practice, but that need satisfaction during practice had an overriding effect on change in well-being from before to after the practice. Perceived parent and coach autonomy support and involvement measured in the initial questionnaire had no moderating effects on such relations. Only in one case did we find that coach involvement (which was perceived as fairly non-controlling as attested by its high correlation with autonomy support) influenced the extent to which self-esteem fluctuated during the course of a practice. Gymnasts who perceived that coaches were highly involved in their training had more stable self-esteem than those who perceived coaches as uninvolved.

Person-level analyses revealed that perceived parent and coach autonomy support had an influence on the gymnasts' adoption of more autonomous forms of motivation. Interestingly, parent involvement also increased the likelihood of adopting more controlled forms of motivation, whereas coach involvement did not. It appeared that coaches' involvement was perceived by the athletes as being less pressuring than the athletes' own parents' involvement. However, these results were not replicated when analyses were done at the daily level. Perceived parent and coach involvement and autonomy support did not moderate the effects of daily need satisfaction on improvements in well-being. Only in the case of self-esteem did we find that coach involvement had a positive effect on the stability of gymnasts' self-esteem.

Our results mainly focused on examining the effects of perceived autonomy support and need satisfaction on athletes' well-being. One additional result showed that parent involvement and autonomy support, and autonomous motivation, had effects on attendance to practice. This result offers interesting support to previous research that has shown that autonomous regulation not only influences the quality of one's experience of sport participation, but also behavioral involvement (Pelletier et al., 2001; Sarrazin et al., 2002).

On the theoretical side, the results of this study support self-determination theory's proposal that autonomy support serves to satisfy psychological needs that are necessary for sustained autonomous motivation. We found this effect at two levels. First, perceived parent and coach autonomy support was associated with more autonomous motivation toward gymnastics. Second, daily need satisfaction during practice led to increased well-being. Studies have found similar results in other domains, such as education (Vallerand et al., 1997), organizations (Deci et al., 2001), and behavioral health (Turner, Irwin, Tschann, & Millstein, 1993).

The present study was limited by some design factors. First, our participants were children and adolescent females. The age range was wide, which raises the issue of whether age would

moderate the effects reported above, but we found no such effects. Butler (1989) similarly reported that children as young as first graders easily lose their intrinsic motivation in competitive contexts. Although we can not speculate about the generalizability of our results to different age groups and to male athletes, we must note that the literature reviewed herein includes many studies that used children and adults of all ages, of both genders, of different ability levels, and in different sports, with congruent findings. Moreover, research on the role of gender in sports reveals that gender does not have a unilateral effect on motivation; the effect is sport and context specific (Gill, 1999). Nonetheless, future studies would need to replicate the present results in older populations, with male athletes, and with larger samples.

Second, the measure of need satisfaction led to problems of multicollinearity that precluded teasing apart each need's contribution to explaining the variance in each outcome variable. Although it is possible to separate the effects of the needs in more controlled settings (e.g., Goudas, Biddle, & Underwood, 1995; Oppenheimer, Stet, & Versteeg, 1986) and to look at the individual effects of each need (e.g., Deci, Hodges, Pierson, & Tomassone, 1992; Gagné, Senécal, & Koestner, 1997), they tend to function in unison in natural settings (e.g., Baard, Deci, & Ryan, 2000; Deci et al., 2001; Gagné, 2003). Future studies may focus more on the individual contributions of each of these needs.

Third, we assessed gymnasts' *perceptions* of their parents' and coaches' autonomy support. Future studies should obtain reports from multiple sources to help establish construct validation. It would also be useful to manipulate coaching styles in future studies, something that has been done in other domains. For example, Williams, Gagné, Ryan, and Deci (2002) trained physicians to be autonomy supportive with patients and found that patients became more autonomously motivated to abstain from smoking. Similarly, Deci, Connell, and Ryan (1989) trained managers to be more autonomy supportive with employees and found that employees in turn became more satisfied at work and more trustful of the organization. Thus, an intervention study could be designed to train coaches to be autonomy supportive toward their athletes and then look at effects on motivation, well-being, and performance. Related to this issue is the question of pressures experienced by the coaches to have high performing athletes. Pelletier, Séguin-Lévesque, and Legault (2002) found that school teachers who experience pressure to comply with a curriculum and live up to performance standards become less autonomy supportive with students. Examination of the context for coaches may thus contribute to our understanding of how and why coaches adopt autonomy-supportive or controlling styles.

The implications of this study to the training of young athletes are clear. The way training is carried out has an influence on the well-being of athletes, and perhaps on their participation. Training contexts where coaches support the autonomy of athletes by listening to their concerns and affording them some choice, where athletes feel well connected to teammates, and where they receive some positive competence feedback, are likely to help athletes experience sustained positive emotions, be more energized, and have higher and more stable self-esteem. Using an autonomy supportive style to coach athletes may have direct benefits on how the athlete feels in terms of competence and autonomy, but also this style may influence the climate of the training environment, including how athletes interact with one another. That is, athletes may feel not only that they are talented and can make informed choices, but that they are also part of a cohesive group of like-minded people. We also suggest that when athletes train for autonomous reasons and when their needs are supported by parents and coaches during training, they might train in a manner that will decrease the risk for injury and burnout. Longitudinal studies could allow the testing of this hypothesis. In the meantime, the present diary study supports the importance of providing supports for athletes' psychological needs as an integral part of training, and offers an interestingly rich set of new ideas that can be further explored through research.

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