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The Effect of Bandwidth Feedback and Questioning on the Performance, Motivation and Autonomy of Age-Group Swimmers

by

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ABSTRACT

The effects of a cognitive coaching intervention (Bandwidth Feedback-Questioning) on the competitive and practice swim times (cTIME and pTIME), technique (TECH), task motivation (TASK), autonomy (AUT), and intrinsic motivation (IM) were determined for age-group swimmers (13 to 17 years) using a repeated measures Pre-Post-Transfer design. It was hypothesized that the Bandwidth Feedback-Questioning (BF-Q) intervention would positively affect TASK and AUT and in turn increase IM. Performance (cTIME and TECH) was also expected to improve as a result of the increased cognitive effort and motivation. Results yielded two significant group interaction effects, one for cTIME and one for TECH. A main effect of Level was reported for TASK, but no other motivational changes in TASK, AUT, or IM were significant. The results are discussed in a context of motor learning, cognitive psychology, goal perspective theory, and questioning / metacognition literature.

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CHAPTER ONE

INTRODUCTION

A critical component of participation in physical activity is motivation (Cox, 1998; Duda, 1996; Tan & Thompson, 1999). Psychologists define motivation as, "... a need or desire that serves to energize behaviour and to direct it toward a goal" (Myers, 1995, p. 397). Therefore, certain goals should emerge that energize people's behaviour to participate in sport. Two such goals are outlined by goal perspective theory (Ames, 1984, 1992; Duda & Nicholls, 1992; Dweck & Leggett, 1988; Nicholls, 1984, 1989). The goal perspective approach is based in social-cognitive theory or the view that people are active participants in perceiving, interpreting, and processing information about their environment (Dweck, 1986). Research has uncovered two primary goal orientations that operate in an achievement environment : task and ego orientations (Ames, 1984, 1992; Duda & Nicholls, 1992; Dweck & Leggett, 1988; Nicholls, 1984, 1989). They are also referred to as learning and performance goals (Dweck, 1986; Dweck & Elliot, 1983 in Roberts & Treasure, 1995), and mastery (Ames, 1984, 1992; Roberts, 1992; Tan & Thompson, 1999) and competitive goals (Roberts, 1992; Tan & Thompson, 1999) respectively. The major research findings of each orientation are summarized in the following table and then discussed.

Table 1.1

Summary of Primary Task and Ego Goal Orientation Characteristics

Theme	Task Orientation	Ego Orientation
Primary foci	Learning, improving, and mastering skills	Demonstrating superior skill level in comparison with others, particularly with reduced effort
Ability	Self-referenced (low comparison with others)	Norm referenced (compared with others)
Success	Viewed as a function of effort	Viewed as a function of innate talent
Positive relationships	Satisfaction and intrinsic motivation	High levels of anxiety (performance worry)
Links	Persistence (especially in the face of difficulty)	Sport drop out (when combined with low task orientation)
Activity preferences	Athletes choose optimally challenging tasks	Athletes choose extreme tasks (either too difficult or too easy)
Effort	High levels (consistent)	Minimized (intermittent)
Inclusion	Allows all athletes to attain a level of personal success	Restricts the number of athletes likely to excel (because success is deemed a function of winning or beating others)

When an athlete is task oriented they are focused on learning, improving, and mastering tasks. Ability is processed according to personal achievement criteria and success is perceived as a function of effort (Dweck, 1986; Newton & Duda, 1999; Nicholls, 1984, 1989). Task orientation is positively related to satisfaction and intrinsic interest in sport (Duda, Chi, Newton, Walling, & Catley, 1995; Hom, Duda, & Miller, 1993; Papaioannou, 1995; Roberts, Treasure, & Kavussanu, 1995; Stephens, 1998; Treasure & Roberts, 1998). An ego oriented athlete is focused on beating others and winning, particularly with reduced effort (Duda, 1993; Papaioannou, 1995; Roberts, Treasure, & Kavussanu, 1995; Treasure & Roberts, 1998) . Ability is processed according to social comparison information and success is viewed as a function of innate talent (Duda, Fox, Biddle, & Armstrong, 1992; Newton & Duda, 1993; White & Duda, 1993). Ego orientation is positively associated with performance 'worry' (Walling, Duda, & Chi, 1993) and boredom (Treasure & Roberts, 1994). Ego oriented individuals are most likely to drop out of sport because their perceived competence is normatively based (Duda, 1993; Jagacinski & Nicholls, 1990; Roberts, Treasure, & Kavussanu, 1997).

Numerous studies have linked task orientation with adaptive motivational patterns such as persistence in the face of difficulty, choice of optimally challenging activities, and a high degree of effort (Martinek & Williams, 1997; Treasure & Roberts, 1994). Competitive, or ego-involving, environments restrict the number of people likely to excel at a given activity. Therefore, adopting an ego perspective can be detrimental to self-confidence, perceived ability, and hope of success if that person is not highly ranked in their sport (Roberts, Treasure, & Kavussanu, 1996; Stephens, 1998).

Longitudinal research in the classroom by Ames (1984, 1989) found that teachers who created a mastery, or task, environment in the classroom, "... enhanced children's involvement in learning as well as their quality of learning" (Roberts & Treasure, 1995, p. 73). However, studies of manipulating the motivational climate in sport have focused on short-term interventions. Only three long term studies were found, two of which were done on aerobic classes (Marsh & Peart, 1988; Lloyd & Fox, 1992 in Ntoumanis & Biddle, 1999) and one which based their interventions on an educational model (Theeboom, De Knop, & Weiss, 1995). Generalizability problems may arise when taking educational programs and directly applying them to sport, or the psychomotor domain.

Decision training (Ota & Vickers, 1996; Vickers, 2000, in press; Vickers & Bales, 1996 a, b, c, 1999, 2000; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999; Vickers, Reeves, Chambers, & Martell, in progress) offers a framework and method for addressing these issues. It argues that the traditional approach to coaching and practice is ineffective because it builds athlete-coach dependency and a lack of cognitive and psychological training. The traditional method includes bottom-up, or part to whole training, high technical emphasis, blocked practice, high quantities of both instantaneous and direct coach feedback, low levels of questioning, or a high degree of coach control, and low levels of athlete cognitive effort. Decision training is grounded in information processing, neuro motor, and cognitive psychology and is focused on increasing athlete cognitive effort, self-direction, and responsibility. Athletes are made aware of the 'underlying features' of their sport so they can analyze, correct, and evaluate their own performances. It has been observed that autonomy and self-awareness gradually increase, although this has not been empirically proven.

Feedback is one of the essential tools that influences these factors. Traditionally, experts advocated high-frequency and high-volume feedback based on Thorndike's propositions (see Schmidt, 1991, p. 244). However, recent research supports other techniques, namely reduced, delayed, and summary feedback given in a bandwidth style (Goodwin & Meeuwsen, 1995; Laver, 1962; Schmidt, 1991; Weeks & Kordus, 1998). Although these techniques improve long term and transfer performance, a problem exists. The delay and reduction of feedback produces an initial decrease in performance. This combined with less perceived attention from the coach may have negative effects on athlete motivation (Hesketh, 1997; Vickers, 1999, 2000, in press).

To combat this perception, Vickers (1999) proposed that athlete-questioning take place during the feedback delay. This would serve four purposes. First, it would increase athlete-coach communication; second, it would prevent the athletes from feeling ignored; third, specific questions about performance would facilitate self awareness and problem solving; and finally, this heightened awareness of self, performance, and cognitive ability would be expected to create a task-involving environment.

There is currently no research on the role of questioning and its relationship to feedback in sport. Studies in nursing, family therapy, psychology, and education cite the importance of asking questions during therapy and learning. The technique has yet to gain empirical support in the sport realm.

Relevant studies in psychology, counseling, and family therapy revolve around questioning as a means to enhance self-reflection in patients. (Dozier, Hicks, Cornille, & Peterson, 1998; Poskiparta, Kettunen, & Liimatainen, 1998). This leads to increased self-regulation and problem solving, similar to the goals of Decision Training.

Contemporary studies in education are built around the construct of metacognition (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Mevarech, 1999). Metacognition, according to Kluwe, is an, "... active, reflective process that is explicitly and exclusively directed at one's own cognitive activity" (1982, in Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995, p. 206). It is an extension of cognition that involves the self-monitoring, self-evaluation, and self-regulation of ongoing tasks (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995). In other words, it is a process by which a person comes to understand a problem and the cognitive processes they are using to solve it. Recall that understanding and solving problems were two aspects of implementing questioning into sport coaching as well as the aims of questioning in therapy.

Metacognition also has the potential to buffer the effects of delayed performance results under delayed, reduced feedback. It is essential that athletes understand why their performance may decline when their coach uses a new feedback style that includes questioning. It is expected that using both problem and process questions will increase both knowledge of performance and metacognitive thinking. This is expected to facilitate the athletes' understanding of Decision Training methods, increase their autonomy in training, and positively affect task involvement. Increased task involvement should produce evidence of adaptive motivational patterns associated with a task goal orientation.

The present study examined the effectiveness of bandwidth feedback - questioning techniques as coaching strategies in competitive youth swimming. Performance (swim times and technique), task motivation, self-regulation (autonomy),

and intrinsic motivation were quantitatively measured using standardized tests in both treatment and control groups. Semi-structured interviews provided qualitative support for the results. Performance and motivational constructs were measured at Pre, Post, and Transfer tests and changes in the variables were assessed over time. The intervention period (Pre – Post tests) was six weeks followed by an eight week transfer period (Post – Transfer tests). The thesis examined the potential of bandwidth feedback – questioning techniques, like the other Decision Training tools, to create long term benefits in athletes' cognitive development and performance. It is possible that in the future, bandwidth feedback – questioning methods may become an important tool for coaching excellence at all levels.

The following chapter will further review relevant literature in achievement motivation, goal perspective theory, motor learning, cognitive psychology and research that supports the use of questioning as a feedback style. Particular emphasis will be placed on the feedback-questioning interaction in the context of autonomous learning, self-regulation, and Decision Training. These topics will be discussed in relation to the proposed study.

CHAPTER TWO

REVIEW OF THE LITERATURE

Goal Perspective Theory of Achievement Motivation

The following definitions will facilitate the understanding of goal perspective theory. Motivation consists of both energizing and directing behaviour toward a goal. (Myers, 1995; Roberts, 1992). Achievement motivation refers to, "... a desire for significant accomplishment, for mastering skills or ideas, for control, and for rapidly attaining a high standard" (Murray, 1938 in Myers, 1995, p. 419). In the last two decades motivation has been studied primarily from a social-cognitive perspective. Ashcraft (1994) quotes the definition of cognition from Neisser's 1967 book Cognitive Psychology as, "... all the processes by which the sensory input is transformed, elaborated, stored, recovered, and used [including] terms as sensation, perception, imagery, retention, recall, problem solving, and thinking..." (p. 12). Therefore, social cognitive theory involves the study of how individuals think, how these thought govern action, affect, and values (Dweck, 1986; Roberts, 1992).

Most recently, social cognitive theorists have focused on goal perspective theory. which describes motivation through two goals regulated by cognitive processes. This approach began with studies in education by Ames & Ames (1984, 1989), Dweck, 1986), and Nicholls (1989). Nicholls tested children from grades 2 through 10 to determine whether they differentiated between skill, luck, effort, and ability. The

relationship between effort and ability formed a foundation of goal perspective theory. In this experiment he showed children a video of two other children working in a classroom. One was focused diligently on the task, while the other was distracted. The diligent worker was given a lower mark than the distracted worker. Responses were judged as to whether children recognized that the distracted student possessed higher ability, and therefore performed better despite lower effort. Based on these results, a developmental pattern emerged. Younger children did not differentiate between effort and ability. They believed higher effort was directly related to higher ability. However, older children and youth did differentiate between the two constructs, and therefore were able to engage in social comparison. (Nicholls, 1989)

These results were consistent across several studies and formed the basis for goal orientations. Task orientation is focused on mastery, improvement and learning new skills. Effort and ability are interchangeable as success is self-referenced (Dweck, 1986; Newton & Duda, 1999; Nicholls, 1984, 1989). Ego orientation is focused on beating others or demonstrating superior ability. This perspective views effort and ability as independent constructs (Duda, 1993; Nicholls, 1989; Papaioannou, 1995; Roberts, Treasure, & Kavussanu, 1995; Treasure & Roberts, 1998).

Duda and Nicholls conducted one of the only studies that directly linked goal orientations in academic and sport settings (Duda & Nicholls, 1992). They trained a teacher to orally administer a questionnaire to 207 high school students (mean age 15.1 years). It included demographic information followed by assessments of goal orientations, beliefs about causes of success, level of interest and satisfaction, and perceived ability in both the classroom and sport. The academic assessments were based

on Nicholls' Motivation Orientation Scales which he developed from his results of classroom motivational constructs. Other measures from Nicholls' work were used to measure beliefs in causes of success, intrinsic satisfaction, and perceived ability. Results of a factor analysis of the data showed that goal perspectives and related beliefs about the world were generalized across the two domains. Method effects could have interfered as the questions were given at the same time and were similar in both areas, although significant differences in perceived ability, boredom, and satisfaction may indicate this was not a problem (Duda & Nicholls, 1992). Satisfaction was strongly related to task orientation in the academic setting, but perceived ability was the major predictor of success in the sports setting. This is a reasonable result considering that competitive sport offers a more public display of ability than the classroom.

Relationship Between Task and Ego Goal Perspectives : Case for Task Involvement

Most recent research has focused on the interaction and relationship between task and ego goal orientations. The outcome of Duda and Nicholls' 1992 experiment was a premonition of future results. In 1994, Fox, Goudas, Biddle, Duda, and Armstrong administered a questionnaire to 231 children (mean age 11.1 years) which measured goal orientations, perceived competence, and enjoyment in sport. The Task and Ego Goal Orientation in Sport Questionnaire (TEOSQ, Duda, 1989, 1992) was used to measure goal orientations. It is a 13-item questionnaire, with seven items loading on the task orientation and six items loading on the ego orientation (Duda, 1992). The psychometric properties of the TEOSQ scales have found to be internally consistent, with alphas

ranging from .81 - .86 on the task orientation factor and .79 - .90 on the ego orientation factor (Duda, 1992). Structural equation modeling has since added support for the internal consistency and construct validity of the TEOSQ as a measure of achievement goal orientation (Li, Harmer, & Acock, 1996; Li, Harmer, Duncan, Duncan, Acock, & Yamamoto, 1998). Pertinent results of this study by Fox and his colleagues (1994) showed that a high task orientation reflected high motivation regardless of a high or low ego orientation.

Roberts and Treasure (1996) conducted a similar and supporting study to establish the orthogonality, or independence, of the two goal perspectives. The Perception of Success Questionnaire (POSQ, Roberts & Balague, 1989, 1991 in Roberts, Treasure, & Kavussanu, 1996) was used to measure goal perspectives, it is similar to the TEOSQ, but contains only 12 items. The task and ego subscales were internally consistent in the study with alphas equaling .80 and .86 respectively. The questionnaires were administered to 333 students (mean age 20.97 years) with exciting results. Out of the four groups, high ego/low task, high ego / high task, low ego / low task, and low ego / high task, both with high task orientations believed effort to be a cause of ability and demonstrated adaptive motivational patterns. This suggests that it is not necessary to quell ego orientation in attempt to raise task involvement. Simply raising task involvement will encourage adaptive motivational patterns despite level of ego involvement (Roberts & Treasure, 1996).

Stephens (1998) also supported the previous findings with a sport specific experiment in soccer. Participants were 212 female players (mean age 11.47 years). The effect of goal orientations and perceived ability on perceived enjoyment and value of

playing soccer were examined. The TEOSQ was used to measure goal orientations. Perceived ability was measured by three items using a 7-point Likert scale. Value was measured using eight questions adapted from the work of Eccles and Eccles and Harold (Stephens, 1998). Three simple questions rated enjoyment. MANOVA results indicated a similar trend to the previous studies. Players who were high in task orientation reported greater enjoyment for soccer, regardless of ego orientation. This result was upheld even though athletes possessed differing levels of perceived competence. In other words, even athletes with low perceived competence who had high task orientations, enjoyed soccer more than their low competence / low task oriented peers. This is congruent with goal perspective research and Nicholls' work in the conceptions of ability (Stephens, 1998). If a person is task oriented they are focused on process and mastery, not on demonstrating high levels of competence in relation to others. Therefore, if task involved, they may have low perceived competence but also hold the view that competence depends on effort, improvement, and practice. Since those variables are within their control and norm referencing is absent, low perceived competency should not have an effect on sport enjoyment.

Treasure and Roberts (1998) also conducted a sport-specific study in basketball with 274 females (mean age 14.01 years) after a week long camp. They used similar measures to their first study, employing the POSQ to measure goal orientations and the 17-item scale adapted from Nicholls to measure beliefs about success in sport. The Perceived Motivational Climate in Sport Questionnaire - 2 (PMCSQ-2), developed by Duda and colleagues (e.g. Seifriz, Duda, & Chi, 1992; Walling, Duda, & Chi, 1993; Newton, 1994) was used to measure the motivational climate. Statistical analysis

supported the relationship between task orientation and climate, namely that a high task environment increased task involvement regardless of individual levels of task orientation.

The studies reviewed suggest that positive motivational outcomes related to a high task orientation may override the negative effects of high ego orientations and low perceived competence. These results are consistent, despite the use of different instruments and goal orientation measures. A study by Roberts and Treasure (1995) administered the TEOSQ as a validity criterion for the POSQ. The task and ego subscales of the POSQ were correlated .71 and .80 with the task and ego subscales of the TEOSQ, respectively. However, there have been no further comparisons between the two instruments. This would be a necessary step in the future to permit generalization of results in goal orientation research.

Another factor affecting generalizability is the samples used in two of the studies. The research by Stephens (1998) and Treasure and Roberts (1998) did not include males and previous studies showed that females are generally higher in task orientation than males (Duda 1989, 1992; Kavussanu & Roberts, 1996; White & Duda, 1994). Still, the results of these studies are strikingly similar. Extensive support for task involving environments is evident. The next section will review studies that have manipulated the motivational environment in attempt to increase task involvement.

Manipulation of Motivational Climate

Long-term Intervention Strategies

Although substantial research supports the promotion of a task orientation and task involving environments there have been few attempts to create such a climate, particularly over the long term (Ntoumanis, 1999).

Ntoumanis (1999) reviewed short and long term climate interventions, measurement instruments in sport and physical education that measure climates, and directions for future research. Of particular importance to the proposed study were the long term intervention studies.

Of the three long-term intervention studies that Ntoumanis reviewed, two of them dealt with manipulation of the environment in fitness classes, not organized sport teams. Only female participants were studied in both cases. The manipulation of both climates involved increasing competitiveness in one situation and decreasing social comparison and normative ability-referencing in the other (Ntoumanis, 1999). The results provided further support for task involving climates, but did not establish any applicable guidelines for future implementation of the strategies used.

Only one other published study was found that used long-term interventions (six weeks) to manipulate the motivational climate. Theeboom, De Knop, and Weiss (1995) based their interventions on TARGET, an educational model that, according to Epstein, defines the motivational climate of a context (1989 in Theeboom, De Knop, & Weiss, 1995; Tan & Thompson, 1999). TARGET is an acronym for the six dimensions of the model that include : Task or design of learning activities, Authority or location of

decision making, Recognition or use of incentives, Grouping or individual/cooperative work, Evaluation or use of feedback, and Time or pace of instruction (Tan & Thompson, 1999, p. 6). The six dimensions were linked to mastery climate characteristics then operationalized to teaching behaviours and strategies to facilitate implementation (Theeboom, De Knop, & Weiss, 1995). A coding instrument to measure the resulting behaviours and use of strategies was used to code videotaped sessions of the class. Participants were 119 children in a summer camp (age range 8 to 12 years) learning wushu, a martial art. Children were exposed to two different teaching methods, one that emphasized a task environment (increased variety of tasks, authority over tasks shared with the learners, use of novel equipment and advanced techniques) and one that adopted a traditional approach (tasks directed by the teacher, progression of drills from basic skills with high repetition and modified equipment). Questionnaires measured enjoyment, perceived competence, and intrinsic motivation. Qualitative interviews were used to supplement the findings and motor skill acquisition was videotaped then assessed by external wushu experts.

Results indicated higher levels of enjoyment in the mastery (or task) program, although no difference in perceived competence emerged between the two groups. Intrinsic motivation was high in both groups, but motor skill acquisition of children in the mastery / task environment was ranked higher than those in the traditional group.

Several concerns emerge in regards to this study, along with some important findings that will facilitate future studies in the field. Nicholls' (1989) in his experiments dealing with differentiating difficulty, luck, ability, and effort found that a majority of children under the age of eleven perceive effort and ability as interchangeable. In other

words, they are naturally task oriented (Nicholls, 1989). The age of the participants in Theeboom et al.'s study may have skewed the results, particularly in the intrinsic motivation and enjoyment categories. This study also neglected to measure goal orientations or perceptions of goal involvement in the lessons. The literature reviewed thus far has shown a strong relationship between perception of motivational climate and variables such as adaptive motivational patterns, intrinsic interest, and enjoyment. The conclusion that TARGET was the primary influence on these variables in the present study may be misguided. Goal orientations and perceptions of the goal climate may have affected levels of enjoyment and intrinsic interest.

Despite these shortcomings, Theeboom et al.'s study presents some important considerations for future research. First, it is the only long-term intervention study that attempted to develop a structured intervention program and a coding system to measure integrity of the intervention. Second, as the authors point out, "... No information is available on the effect of motivational climate on motor skill performance" (Theeboom, De Knap, & Weiss, 1995, p. 310). This study was the first to measure motor performance in the context of a motivational climate. Further research is needed to support the findings that a mastery / task environment affects skill acquisition over the long term. Third, the implementation of TARGET involved six variables. As the authors suggest, future research should test each of the variables in isolation in order to determine which one has the greatest effect on creating a task environment. Finally, the intervention period of three weeks was brief. Longer term intervention and transfer effects merit further study.

Summary : Goal Perspective Theory

Studies in education and sport have established two primary goal perspectives, task and ego orientations. The TEOSQ (Duda, 1989, 1992) demonstrated adequate construct validity and internal consistency for measuring goal orientations in sport. The effects of these goals on variables such as intrinsic motivation, enjoyment in sport, and motivational patterns in sport environments revealed task orientation as a powerful indicator of adaptive patterns, higher levels of enjoyment, and increased intrinsic motivation (Duda, 1992; Fox, Goudas, Biddle, Duda, & Armstrong, 1994; Roberts & Treasure, 1996; Stephens, 1998; Treasure & Roberts, 1998). Results were consistent despite the use of different instruments, sample groups (age, gender), and sports. Support for enhancing task orientation was encouraged by all the authors. The question then turned to methods of manipulating the motivational climate to enhance task involvement and raise task orientation.

There is also a void of research examining long-term intervention strategies that manipulate motivational climate. The one published study in a sport setting used an educational model (TARGET) to create a task oriented environment. Although many limitations were noted, the results did show that a mastery / task environment had positive effects on the motivation, enjoyment, and skill acquisition of participants.

Although sketchy in sections, the reviewed research on goal perspectives, motivational climate, and sport experience do form links that will help guide future research.

Self-regulation and Decision Training (DT)

The reviewed literature established that a task involving environment enhanced adaptive motivational patterns, therefore, recommended coaches are recommended to manipulate the motivational environment to enhance task orientation. Recall that task oriented individuals focus on learning, improving, and mastering tasks (Duda, 1989, 1992; Nicholls, 1989). They use self-referencing techniques to gauge improvement and base success on the outcomes of personal effort (Duda, 1992; Williams, 1994). Task oriented individuals perceive sport as an end in itself (Duda, Chi, Newton, Walley, & Catley, 1995). "Task involvement, by its defining features, means that one is focused on the process (e.g., working hard, meeting the demands of the task).... It is the intrinsic facets rather than the extrinsic dimensions of sport activity which are most pertinent" (Duda, Chi, Newton, Walley, & Catley, 1995, p. 42). Intrinsic factors are controlled by the athletes, allowing them to take responsibility for monitoring and evaluating their learning, improvement, mastery, and success (Martinek & Williams, 1997; Treasure & Roberts, 1994). Increased responsibility means the athlete takes ownership of their participation, effort, accomplishments, skill analysis, and performance, instead of relying on external information, for example, the coach (Duda, 1996).

Considering these relationships, it makes sense to suggest that coaches use strategies to enhance athlete knowledge acquisition, problem-solving (e.g. about skill improvement, error correction, etc.), and cognitive skills. Unfortunately, the traditional instructional model in sport mirrors the opposite (Lee, Swinnen, & Serrien, 1994; Ota & Vickers, 1996; Vickers and Bales, 1996 a, b, c, 1999, 2000, in press; Vickers, Livingston,

Umeris-Bohnert, & Holden, 1999; Vickers, Reeves, Chambers, & Martell, in progress). Coaches increase the dependency of their athletes through constant, instantaneous feedback on perfectly crafted progressions that often stray far from the reality of a competitive situation. This results in reduced cognitive effort by the athletes. Recent research on feedback advocates the delay of feedback and use of knowledge of results (summary feedback) in conjunction with a bandwidth technique, where feedback is reduced as skill improves (Goodwin & Meeuwsen, 1995; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997; Lee, Swinnen, & Serrien, 1994; Schmidt, 1991). However, a noted side effect of decreasing feedback is an increase in athletes who report they feel neglected or ignored.

Decision Training (DT) provides solutions for the coach-athlete dependency and feedback dilemmas. DT is designed to increase cognitive effort, develop cognitive skills, and subsequently increase the responsibility and autonomy of athletes. It contains seven tools : random practice, variable practice, bandwidth feedback, reduced/delayed feedback, questioning to fill the feedback delay, video feedback, and modeling. Random practice involves performing different skills and different classes of skills in a game-like context in random order. Variable practice is similar except only one class of skills is varied. Bandwidth feedback involves giving feedback only when performance is outside preset criteria which are dependent on the level of athlete and knowledge and expectations of the coach. Reduced / delayed feedback allows time between the sport performance and the following communication between coach and athlete, therefore allowing the athlete to process and evaluate their actions. Questioning can be used to fill the feedback delay by allowing the coach to stimulate athlete cognition and analysis

through inquiry. Video feedback involves filming athletes and using the film as feedback for subsequent performance. During modeling, there is a demonstration performed or shown, for example through video or by watching another athlete. Six of the tools have substantial backing in research (Goodwin & Meeuwsen, 1995; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997; Lee, Swinnen, & Serrien, 1994; Schmidt, 1991; Vickers & Bales, 1996 a, b, c; Vickers, 1999, 2000, in press; Livingston, Umeris-Bohnert, & Holden, 1999). However, bandwidth feedback - questioning has not been formally studied in a sport environment in terms of its effect on athlete performance and motivation. One study has been carried out to determine the extent to which experienced coaches will adopt the multiple tools of Decision Training (Vickers, Reeves, Chambers, & Martell, in progress). The study of 13 coaches found they readily adopted bandwidth feedback – questioning methods, but the effect on athlete performance and motivation has not yet been determined.

The following section will review the research related to goal perspective theory and autonomous (self-directed) learning, Decision Training, and feedback. Finally, research pertaining to questioning in other domains will be reviewed.

Goal Perspectives and Autonomy

Limited research has mentioned autonomous, or self-directed learning in relation to goal perspective theory. A study by Duda, Chi, Newton, Walling, and Chatley (1995) proposed a theoretical link between intrinsic motivation and goal perspective theory. They stated that self-determination, or autonomy, is influenced by goal perspectives. The

criteria for task involvement, namely high effort and striving for improvement on past (personal) performance, is primarily under individual control. (Duda, Chi, Newton, Walling, and Chatley,1995).

Goudas, Biddle, and Fox (1994) conducted a study to formally test the relationships between perceived autonomy, perceived competence, goal orientations, and intrinsic motivation in a physical education setting. Participants included a mixed gender group of 84 students, ranging from 12 to 14 years. The physical education class covered two different activities a week, so data was collected separately for each class. Goal orientations were measured using the TEOSQ, perceived competence was determined using two items adapted from Duda and Nicholls (1992), motivational orientations were measured using the Self Regulation Questionnaire (SRQ; Ryan & Connell, 1989) which elicits a measure of self determination or autonomy (Ryan & Connell, 1989). The index is referred to as the Relative Autonomy Index (RAI). Questionnaires were used to administer the instruments.

Results supported the theoretical claims made by Duda, Chi, Newton, Walling, and Chatley (1995). The more self-determined (or autonomous) and task oriented the students were, the more likely they were to report high intrinsic interest. This indicates that enhancing task involvement and autonomy in sport settings will increase intrinsic interest and in turn, "...promote continuing involvement and behavioural interest" (Goudas, Biddle, & Fox, 1994).

However, the study only captured one moment in time and the authors suggested that future research should investigate long-term examination of these constructs. There

may be a problem with conceptual overlap of questionnaire items, as well. The authors did not provide information regarding the validity or reliability of the RAI.

Despite these limitations, results support the logical relationship of autonomy to goal perspective and characteristics of task involvement. Autonomous learning and self-responsibility should be encouraged by coaches (Duda, Chi, Newton, Walling, and Chatley, 1995; Goudas, Biddle, & Fox, 1994).

Cognitive Perspective and Decision Training (DT)

How exactly does a coach increase autonomy and athlete responsibility ? The Decision Training Model (Vickers & Bales, 1996 a, b, c; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999) addresses these questions. It is based in cognitive psychology and motor learning. The following definitions will facilitate a better understanding of the theory behind decision training.

Definitions : Cognition

Cognitive psychology deals with the scientific study of human memory and mental processes, including perception, memory, language use, reasoning, and problem solving (Ashcraft, 1994). It is the study of cognition, defined by Neisser (1967) as, "... all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used [including] terms as sensation, perception, imagery, retention, recall, problem solving, and thinking" (Ashcraft, 1994, p. 12). Metacognition delves one layer

deeper. It refers to, "...learners' awareness and knowledge of their own learning processes, as well as their abilities and tendencies to control those processes during learning" (Derry & Murphy, 1986, p. 9). Cognitive strategies refer to a broader group of intellectual abilities that, "...enables individuals to exercise executive control over how they think in problem-solving situations" (Derry & Murphy, 1986, p. 2). Finally, cognitive skills and motor skills focus on "... what to do ... [and] how to do it" (Schmidt, 1991, p. 8). Success at cognitive skills is determined by intellectual, or mental, processes and decision making. Motor skills concern the quality, or execution, of a movement.

Decision Training (DT)

The seven DT tools are designed to teach, enhance, and refine cognitive-motor strategies. In sport, this refers to athletes' awareness, for example, of technique, tactics, body/physical movement, performance, and similar variables. It also includes processes used to detect and correct errors in these areas.

Traditionally, the coach was responsible for problem solving, or detecting and correcting all athlete errors (Vickers & Bales, 1996 a, b, a; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999). Athletes had little input into training methods and were mentally under challenged. Practices were technically based, focused on performing the motions of skills but excluding tactical and deeper fundamental knowledge of training. Feedback was given immediately, often, "...without any standard of athlete self sufficiency expected" (Vickers & Bales, 1996 a, b, c).

Feedback is a central tenet in coaching and teaching. Two DT tools, bandwidth feedback and video feedback, deal directly with this topic. Questioning is used as a method of filling the feedback delay when augmented, or external information is reduced. The following discussion will review pertinent literature on feedback, relating it to the promotion of self-determined, self-directed (learners) athletes. This in turn will introduce questioning as a logical, viable method of integrating the principles of feedback research and autonomous learning into the goals of DT and goal perspective theory.

Feedback

Recent research in feedback advocates delaying and reducing feedback, particularly as skill increases. Sherwood (1988) was one of the first to test a 'bandwidth' style, or giving feedback only when performance was outside of set criteria. Using a simple motor task, three groups were tested. One received feedback on every trial, whereas the other two were instructed only when their error exceeded +/- 5% and +/- 10% of the goal respectively. The frequency of feedback was inadvertently influenced, as feedback was relatively high early in the practice (many errors) but was reduced as participants increased their skill (Sherwood, 1988; Lee, Swinnen, & Serrien, 1994). Results showed that a larger bandwidth increased the success rate of participants during a transfer test.

Winstein and Schmidt (1990) tested motor skill learning over repeated trials, with transfer tests 10 minutes and 2 days after the experiment. One group received feedback on all the trials, whereas the other group only received feedback on half the trials. The

frequency of feedback was faded for the second group. The 50% group outperformed the 100% group on both retention tests (Winstein & Schmidt, 1990 in Schmidt, 1991).

Goodwin and Meeuwesen (1995) went one step further in their investigation of bandwidth feedback. Subjects were 120 female students (mean age 20.65 years) with no previous golf experience. The motor task measured the accuracy of putting a golf ball 4.57 m over 100 trials with two retention tests, 10 minutes and 48 hours later, respectively. Both transfer conditions involved 20 trials. Participants were randomly assigned to four feedback conditions, BW0% (bandwidth 0%), BW10%, shrinking-BW (reduction of 5% BW every 20 trials with a start value of BW20%), and expanding-BW (an increase of 5% BW every 20 trials with a start value of BW0%). The last condition was a calculated integration of reduced or faded feedback.

Results supported the previous literature as the BW10% and expanding-BW groups performed significantly higher on the retention tasks. Interestingly, shrinking-BW (or increased frequency of feedback) performance deteriorated over 48 hours to the same degree as the BW0%.

The results of these studies provide strong support for reducing, delaying, and using bandwidth feedback strategies. However, there are several limitations to these experiments. First, they all deal with KR or knowledge of results rather than KP or knowledge of performance; second, they all involve augmented or external feedback (i.e. feedback is controlled by the experimenter or 'coach'); and third, they were all conducted in a controlled laboratory setting.

KR is extrinsic feedback that focuses on the outcome of an action in relation to the environmental goal (Schmidt, 1991; Weeks & Kordus, 1998). KP is concerned with

the process and kinematics of a movement (Schmidt, 1991; Weeks & Kordus, 1998). In 'real world' sport environments, KP is more frequent, whereas KR is used more often in laboratory settings (Schmidt, 1991). Limited work has tested whether the KR results also apply to KP feedback situations. A study by Weeks and Kordus (1998) addresses this problem.

34 boys (mean age 12.30 years) attempted to hit a target using a soccer throw-in. None had previous experience with the throw and every participant was shown a model before the start of the study. One group received KP (in the form of a single form cue) every trial, while the other group received KP every five trials, or 33% of the time. One retention and two transfer tests of 5 trials, no KP, followed immediately, 24, and 72 hours after the initial performance. Retention and transfer trials were videotaped and the throw-ins graded by expert judges on the basis of eight form aspects (one point each).

Accuracy scores did not differ between the two groups in the transfer tests. This was expected as the target provided visual feedback on all of the trials. However, correct form was ranked significantly higher in the KP33% group than the KP100% group, even in acquisition (retention ranking). This suggests that reducing the amount of KP may have similar benefits to KR reduction. The authors speculate that, "...infrequent KP assists in developing intrinsic abilities to maintain form in the absence of KP rather than developing dependencies on KP as an external referent" (Weeks & Kordus, 1998, p. 230).

Research on feedback has focused on extrinsic sources while neglecting the, "...active role of the learner" (Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997, p. 270), especially intrinsic motivation. According to these authors, self-regulation

strategies will increase perceived self-control and enhance learning through deeper information processing (1997). Self-regulation was defined as, "...the degree that individuals are metacognitively, motivationally, and behaviourally active participants in their own learning" (Zimmerman, 1994 in Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997, p. 270). The experiment they conducted manipulated feedback type (KR versus KP), feedback frequency (Summary KP versus Self-controlled KP), and control over feedback frequency (Self-controlled KP versus a Yoked group). Video modeling and feedback were also included, the model preceding acquisition and video feedback as part of the KP information. Subjects were 48 university students in physical education classes, equally mixed genders, and all right-handed. The motor skill performed was a left-handed throw in a similar environment to the one used by Weeks and Kordus. A bulls-eye provided 100% KR of accuracy. The subjects were randomly assigned to four groups (a) KR received no kinematic information, (b) summary KP (SUMMARY) received KP after every five trials, (c) self-controlled KP (SELF) received KP only when they requested, and (d) a yoked group (YOKE) that received KP whenever the SELF group requested it.

According to the results, the SELF group learned the skill better and scored better on form and error in the transfer condition. Even more interesting is the large influence that control had over learning and subsequent performance. The SELF group chose KP on only 11.15% of all the acquisition trials. They unknowingly created a faded feedback schedule, as 72% of the total KP results were requested in the first five trial blocks. This feedback fading was not as relevant for the YOKED condition, due to the lack of

personal control (Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997). The KR group did not improve during acquisition and scored the highest on form and error rate.

These results are pertinent for two reasons. Firstly, they emphasize the importance of self-control and autonomy on learning and performance. Secondly, the low scores of the KR group indicate that KP may be more beneficial to learning and skill improvement.

Link to Goal Perspective Theory

Interestingly, this forms a direct link to goal perspective theory. KR is outcome-based, as is an ego goal perspective. KP is process-based, as is a task goal perspective. Theoretically, this indicates that appropriate use of feedback strategies may have the potential to enhance a task environment.

Simply using KP (reduced, delayed, bandwidth) over KR will not automatically create a task environment. Feedback strategies alone will not cognitively engage the learner to the optimal level. As Janelle and his colleagues discovered, the YOKED participants did not perform to the level of the SELF group, despite being exposed to exactly the same feedback frequency (and fading).

The missing link may be self-regulation. According to Zimmerman (1994), self regulation is, "...the degree that individuals are metacognitively, motivationally, and behaviourally active participants in their own learning process" (p.3, in Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997). As the authors state, "Because the learner is actively involved in the learning plan, that individual must assume most of the

responsibility for acquiring proficiency, which leads to higher motivation to perform well" (Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997, p. 277). In other words, the athletes become responsible for much of their own feedback.

However, coaches cannot assume athletes will automatically start thinking about their own improvement when feedback is faded. This is particularly true with young athletes. A simple reduction of feedback may even give them more time to focus on their performance compared to others, or become ego involved. Coaches must constantly monitor athletes' cognitive focus while enhancing and challenging cognitive skills. How do they do this without giving constant feedback. In other words, how do they interact with athletes while reducing direct instruction? The tool of questioning may provide the answer.

Questioning Literature

Vickers suggests that questioning is an alternative problem solving method that can be used in conjunction with bandwidth feedback (Vickers, 1996, 1999, 2000, in press; Vickers & Bales, 1996 a, b, c; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999). The coach becomes a partner with the athlete in determining solutions. The increase in two-way communication gives the coach insight into thought processes of the athlete that underlie a skill (Vickers, in press; Vickers & Bales, 1996 a, b, c). Currently there is no research in sport relating questioning to motor learning, motivational climate, or performance.

However, research in nursing, family therapy, psychology, and education reveals that other domains have long been using questioning as a successful communication and learning tool. Studies in these fields outline the effectiveness of questioning in learning and therapy, describe taxonomies, or levels, of questions, and the effectiveness of these different levels. The following section will review several relevant studies in these fields.

Questioning in Therapy and Nursing

Nursing education cites the importance of questioning as a learning tool (House, Chassie, & Spohn, 1990; Schell, 1998; Wink, 1993). Studies in health counseling have investigated the effectiveness of different questioning strategies nurses use in the field (Dozier, Hicks, Cornille, & Peterson, 1998; Poskiparta, Kettunen, & Liimatainen, 1998). Two relevant studies focused on the relationship between self-determination, or self-regulation, and questioning. There are notable parallels between coaching in sport and nursing in the health and family counseling field. Dozier, Hicks, Cornille, & Peterson (1998) stress the importance of establishing a "therapeutic alliance" between the therapist and the family or individual. According to Catherall, the therapeutic alliance consists of, "...that aspect of the relationship between the therapist system and the patient system that pertains to their capacity to mutually invest in, and collaborate on, the therapy" (1986, in Dozier, Hicks, Cornille, & Peterson, 1998, p. 139). Recall that in Decision Training questioning is hypothesized to procure the same type of relationship between coach and athlete.

The study by Dozier, Hicks, Cornille, and Peterson was designed to link therapeutic techniques (questioning techniques) with the development of a successful therapeutic alliance. Four categories of questions were studied, based on Tomm's Therapeutic Questioning Styles (1988 in Dozier, Hicks, Cornille, & Peterson, 1998). Lineal questions are designed to solve a problem or uncover a cause. They often cause the therapist to adopt a judgmental attitude. Strategic questions have corrective intent, are often confrontational, and indirectly suggest errors that patients have made. Circular questions are exploratory and try to link ideas, people, perceptions, and other areas to form new connections or patterns. Finally, reflexive questions are intended to guide patients in their own problem-solving strategies (Dozier, Hicks, Cornille, & Peterson, 1998). Four videos were made of hypothetical family therapy sessions. Each one used a different questioning strategy. Participants, 40 triads of families, were randomly assigned to watch one of the videos. The Family Therapeutic Alliance Scale (FTAS; Pinsof & Catherall, 1986 in Dozier, Hicks, Cornille, & Peterson, 1998) was given to each participant following the video. It is one of three subscales of the Integrative Psychotherapy Alliance Scale (Pinsof & Catherall, 1986 in Dozier, Hicks, Cornille, & Peterson, 1998) and was designed to measure the degree of alliance between therapists, family members, and individuals. The scale consists of 29- items using a 7-point Likert scale. Data were analyzed using a three-way analysis of variance.

According to the results, circular and reflexive questioning techniques procured higher rankings of perceived alliance from the participants. The authors suggest that type of questioning may be the critical factor in determining level of alliance between the therapist and patient systems.

Several limitations were cited. The use of a video and non-clinical subjects could have skewed the results. Perceptions of the participants may have been different from people in a real therapy situation. Despite the shortcomings, the design allowed for more control over communication in the session by using the same actors in all four scenarios and excluding potentially influential comments that would normally arise in therapeutic conversations. In summary, circular and reflexive questions proved to be the most effective in facilitating perceptions of a close therapeutic alliance.

Think of the sport context for a moment. The coach is similar to a therapist because they bear important knowledge, for example technical, tactical, and other sport-specific information. The coach's role involves imparting this knowledge to athletes, often to remedy incorrect technique or improve tactical errors. This is similar to the role of the therapist in providing interventions that may help clients improve their health. The above study suggests that one of the best methods to impart this information is to involve the patient in their own health, guiding them toward solutions they discover on their own. In other words, they facilitate self-regulation. Recall that self-regulated learners are actively involved metacognitively, motivationally, and behaviourally (Zimmerman, 1994 in Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997) in their own learning. Therefore, it seems reasonable to expect questioning to have positive effects on self-regulation in sport as well as in therapy, since both involve a degree of problem-solving. Also, if certain types of questioning can strengthen the relationship between a therapist and their patient, it would be reasonable to expect similar improvements between coaches and athletes if questioning techniques are adopted.

The second study was a qualitative exploration about types of questions nurses asked patients in order to, "...awaken reflection on their health behaviour in health counseling" (Poskiparta, Kettunen, & Liimatainen, 1998, p. 682). The authors described contemporary trends in health counseling (health behaviour and physical exercise, nutrition, alcohol, and smoking) which advocate patient-centered counseling or emphasizing the personal growth and self-empowerment of individuals. Self-empowerment involves enhancing self-esteem and self-concept, developing social and personal skills, gaining access to new information, and having opportunities to problem solve and make decisions. Health counseling is defined as, "...reciprocal, interactive action in educational processes" (Poskiparta, Kettunen, & Liimatainen, 1998, p. 682). In other words, the aim is to interact with the patient, stimulate self-reflection, then reevaluate and reorganize their activities (Poskiparta, Kettunen, & Liimatainen, 1998). The authors claim that activating the process of reflection is vital to cognitive learning. "Reflection focuses on communication, the latent knowledge base of action, the content of action, and the views of the subjects or their patterns of thought and action" (Poskiparta, Kettunen, & Liimatainen, 1998, p. 682). The aim of encouraging reflection is to raise patients' levels of self-determination and improve their problem-solving skills. These goals are strikingly similar to the goals of Decision Training, where athletes are encouraged to self-regulate and consider their own solutions opposed to relying on the coach for answers.

Since self-reflection is the focus of health counseling, the authors proposed that reflective questioning could be used as a method to stimulate new cognitive and behavioural patterns in patients. The researchers videotaped 38 counseling sessions in a

Finnish hospital. The sessions were coded to determine what types of reflective questions were used, where they occurred in conversations, and how many in total were asked. Overall, nurses did not use a large number of reflective questions. When they did, the results were primarily positive, that is, they increased patients' self-evaluations and self-reflections. The authors suggested that reflective questioning could be new to the health counseling realm, as it is a technique from family therapy and personal relationships. They advocate the use of reflective questioning in the health field with particular emphasis on teaching the necessary communication skills in professional training.

This study, although limited in its examples and vague in the exact coding procedure, is closer to the sport realm in its subject matter. Health behaviours include physical activity and in order to have patients adhere to programs which help improve and optimize health they must understand why those programs are important. When a coach is teaching a skill or a tactic, the player is more likely to learn and use the technique if they understand why they are doing it. As the health reflection counseling model and the Decision Training Model advocate, one of the best ways to improve learning is to put the onus on the learner to help teach themselves. But in order to do this, they must understand what information or skills need to be known, learned, or improved. This understanding develops as a result of self-reflection and self-evaluation. When awareness develops they can start using problem solving to determine solutions. As the previous studies suggested, questioning is an essential tool for guiding self-reflection, self-regulation, and subsequent problem-solving.

Questioning in Education

Questioning has long been recognized as a vital teaching skill. In 1911 Charles DeGarmo wrote, "In the skillful use of the question more than in anything else lies the fine art of teaching; for in such use we have the guide to clear and vivid ideas, the quick spur to imagination, the stimulus to thought, the incentive to action" (in Hunkins, 1976, p. 226). The majority of information on questioning in education relates to Bloom's Taxonomy of Educational Objectives : The Classification of Educational Goals, Handbook 1, Cognitive Domain, more commonly referred to as 'Bloom's Taxonomy' (Morgan & Saxton, 1994). The taxonomy consists of six levels : knowledge (remembering), understanding (comprehending), application (solving), analysis (reasoning), synthesis (creating), and evaluation (judging). As Morgan and Saxton point out, the taxonomy was not intended to provide a structure for planning and asking questions. It is, instead, a method of recognizing different levels of thought that questions (or other knowledge) may ignite. Since Bloom's taxonomy is so prevalent in the questioning literature, it is necessary to introduce it as a knowledge structure. However, the education research in questioning that is reviewed below deals with different questioning strategies to enhance learning. They go beyond the traditional (e.g. Bloom) methods of thinking reflectively about a subject matter or idea, to thinking reflectively about thinking itself. This skill, coined metacognition, will be described further in the following sections and related to the proposed study.

Research Review

King (1994) studied the learning effects of guided cooperative questioning on teaching children how to question and explain. Berardi-Coletta, Buyer, Dominowski, and Rellinger (1995) studied the role of metacognition in problem solving by contrasting problem-focused and process-focused (metacognitive) strategies on training and transfer tasks. Although questioning was not labeled as a variable, the mental focus for each group was initiated through problem and process focused questions respectively.

King (1994) compared two guided questioning strategies and an unguided condition to determine effects on immediate and retained comprehension of a science lesson. Quality and quantity of overt knowledge was also measured by analyzing the tape-recorded discussions. Participants (N = 48) were students in grades four and five, randomly assigned to the three conditions. One group was guided by questions emphasizing a lesson-based approach. Students were to discuss connections between ideas in the material presented that day in class. The second group involved a lesson and experienced based approach. Discussions were again prompted by questions, but they connected the class information to prior knowledge and experience. The control group had no guiding questions, only directions to discuss and ask each other about the lesson. Questions generated by students were coded by differentiating between three levels of questions and knowledge construction. The first level contained factual questions and knowledge restating. The second level involved comprehension questions (understanding) and knowledge assimilation (e.g. definitions, descriptions, paraphrasing).

Finally, the integration level involved connecting ideas, justifying positions, explaining, inferring and linking knowledge and experience.

Both questioning groups retained more of the lesson content than the control group, with the experience-based group ranking the highest. This group used more integration-level knowledge than the other groups. However, at transfer, both question groups were relatively equal, although still above the discussion-only group. Results suggested that questions linking prior knowledge to new knowledge facilitated learning. Questions could be classified according to the level of knowledge integration they target.

Berardi-Coletta, Buyer, Dominowski, and Rellinger (1995) conducted a study in metacognition and problem solving, but it also used two questioning strategies to focus participants on either a problem or process task. Recall that metacognition refers to, "...learners' awareness and knowledge of their own learning processes, as well as their abilities and tendencies to control those processes during learning" (Derry & Murphy, 1986, p. 9). Randomly assigned undergraduate students were assigned to one of three groups, the third being a control. Four experiments required participants to complete different puzzles. The 'coach' asked problem focused questions before each move to one group, process questions to another group, and no questions to the control group. Process questions referred to processes guiding thought, e.g. "How are you deciding which disk to move next ?" (Berardi-Coletta, Buyer, Dominowski, and Rellinger, 1995, p. 207). Transfer tests were administered after each test.

Results supported metacognitive theory in all four experiments. Two basic findings were reinforced in respect to problem solving and solution transfer. First, "...participants do not spontaneously focus on the process by which they attain a problem

solution" (Berardi-Coletta, Buyer, Dominowski, and Rellinger,1995, p. 220). Second, transfer effects are positive if participants do focus on the cognitive process. In all experiments the metacognitive group performed better in the initial and transfer situations. In Experiment 4 metacognitive participants monitored the problem solution and themselves more often, switched from simple to complex strategies, and developed more sophisticated problem representations. Based on these findings the authors suggest that, "... broad based problem solving skills such as "learning how to learn" and self-observation, that is, becoming aware of what one is doing and why, need to be emphasized when problem-solving skills in any domain are trained" (Berardi-Coletta, Buyer, Dominowski, and Rellinger, 1995, p. 222). Problem-solving appears to depend less on the content of one's knowledge base as it does on cognitive processing skills.

One other study further explored the effects of metacognitive training (MCT) on self-directed learning, story comprehension, and self-questioning in kindergarten children (Glaubman, Glauban, & Ofir, 1997). MCT was contrasted with active-processing theory (APT), the more traditional approach where simply asking questions about a subject supposedly increases comprehension. The children were tested before and after the experiment for level of questioning, story comprehension, and level of self directed learning (SDL). A transfer test was administered three months after the experiment (when the students returned from summer vacation) to measure the long-term effects of these methods. Although direct questioning was not specified as a means of instruction, the MCT group was taught to think and inquire at increasingly higher levels of cognition. The continuum of learning was based on King's levels starting at basic understanding of the knowledge (lesson-based) and gradually broadening, deepening and internalizing the

information up to an experience-based level. In the APT condition, students were simply encouraged to ask a large quantity of questions about the material.

Results support those by King and Berardi-Coletta and colleagues. Comprehension, amount of self-directed learning, and level of questioning all increased more in the MCT group than the other two conditions, although the APT method proved superior to the control group. The article concluded with a summary of the relationship MCT has on learning. "...the unique advantage of the MCT method ... lies in its ability to promote self-directed learning and transfer of learning. The MCT training method helped the kindergartners to acquire skills that made them motivated, curious, autonomous, self-directed learners who consciously used critical thinking" (Glaubman, Glaubman, & Ofir, 1997, p. 371).

The relevance of this information to the proposed study is the relationship between knowledge of cognitive strategies, self-directed / autonomous learning and self-management, and transfer of information. In all three studies, questioning played a critical role both as a measure of cognitive processing level and a means by which to teach MCT. Applied to sport, this implies that the level of questioning, not simply the number and frequency of questions, may play a critical role in the speed and degree to which cognitive strategies are learned. As discussed, one of the problems with implementing DT feedback methods is a perception that the coach is neglecting or ignoring athletes (Vickers, 1999, 2000; Vickers & Bales, 1996 a, b, c). Questioning can fill the delay, but it can also help athletes understand why the coach is using such methods (Vickers, 1999; Vickers & Bales, 1996 a, b, c). Results from the Berardi-Coletta et al. study suggest that awareness of how one is processing information is more

relevant than a person's knowledge base. Since feedback in sport is largely focused around solving problems, whether they be technical, tactical, or personal, then gradually increasing an athletes' level of cognitive processing should result in highly effective, transferable problem-solving skills.

Hypothetical Relationships Between Questioning, Self Regulation, and Motivation in Sport

Metacognition is a process of actively reflecting about one's cognitive activity that involves self-monitoring, self-evaluation, and self-regulation of ongoing tasks (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995). Self-reflection is a means to enhance a person's self-determination and problem-solving skills. (Poskiparta, Kettunen, & Liimatainen, 1998). According to the literature, questioning is the means by which these processes are taught and encouraged. This suggests that questions which cause people to analyze, interpret, and evaluate themselves, be it psychologically, cognitively, or physically, will foster higher levels of self-regulation, or autonomy. Using bandwidth feedback – questioning techniques is expected to raise the level of autonomy in athletes.

Recall that a self-regulated person is actively involved in their own learning process in three ways : metacognitively, motivationally, and behaviourally (Zimmerman, 1994 in Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997). If questioning directly influences the degree to which a person is self-regulated, then it will affect their motivation and their behaviours toward learning. In other words, reducing feedback and increasing questioning gives learners more control (regulation) over their knowledge or

skill development. This should translate to higher intrinsic motivation as they take responsibility for their learning (Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997). Bandwidth feedback - questioning methods are expected to raise the intrinsic motivation of athletes.

If reflective questioning during the feedback delay raises an individual's awareness and increases their responsibility for acquiring skills, correcting errors, and creating new techniques, then performance should improve. The behavioral part of being a self-regulated learner describes the visible, physical outcomes of increased cognitive effort. Therefore, bandwidth feedback – questioning methods are expected to improve the performance of athletes in the physical domain.

Questioning creates a unique relationship between coach and athlete. The coach changes from an autocratic leader to a partner. Using reflective questions naturally focuses the athlete on process whether that be cognitive, physical, or affective. The focus on process as opposed to outcome should change the athlete's perception of the training environment. A task-involving climate is characterized by a focus on process versus outcome and personal improvement. Therefore, bandwidth feedback – questioning techniques are expected to increase the perception of a task-involving environment which is closely related to personal goal orientation. Reflective questioning used in the feedback delay will allow athletes to learn more about their technique, think critically about their performance, and communicate this information to the coach. Task oriented individuals focus on learning, improving and mastering skills (Dweck, 1986; Newton & Duda, 1999; Nicholls 1989). Reflective questions naturally facilitate this orientation.

Therefore, bandwidth feedback - questioning methods are expected to raise the task orientation of individual athletes.

Task orientation and task-involving environments have been linked to increased satisfaction, enjoyment, and intrinsic interest in sport. Therefore, if bandwidth feedback – questioning methods increase levels of performance, task motivation / task involvement, autonomy (self-regulation), and intrinsic motivation they would also be expected to facilitate growth, longevity, and optimal experience in sport.

Purpose

There were several reasons for conducting this study. First, there was no research that investigated the effects of bandwidth feedback - questioning techniques as coaching strategies. Since the literature on feedback is relatively conclusive, the next step was to examine methods of enhancing athlete-coach communication when direct instruction is reduced. This study examined the effects of using a bandwidth feedback-questioning (BF-Q) intervention in coaching competitive age-group swimmers.

Second, no formal links had been studied between any of the Decision Training tools and motivation, goal perspectives, or athlete perceptions. The present study measured changes in swimming performance, task motivation, autonomy, and intrinsic motivation as a result of the BF-Q intervention.

Third, little research had examined long-term implementation strategies related to goal perspective theory. Previous studies in this area involved numerous independent variables. The present study examined long term effects (six week intervention with an

eight week transfer period) of a single independent variable (BF-Q intervention) on swimming performance, task motivation, autonomy, and intrinsic motivation.

Hypotheses

The following results were hypothesized for the study. First, the BF-Q intervention was expected to increase athletes' task motivation by focusing swimmers on improvement, personal mastery, and learning. Second, a rise in perceived autonomy (self-regulation) and intrinsic motivation were expected to accompany the increase in task orientation. Third, long-term swimming performance was expected to improve as a result of reflective questioning and the influence of increased cognitive effort and higher self-regulation.

CHAPTER THREE

METHOD

Participants

Five swim clubs in the city of Calgary were invited to take part in the study. Three responded and from these clubs, two groups of youth (ages 13-17) swimmers were randomly assigned to the Bandwidth Feedback-Questioning (BF-Q) condition and two groups to the Control condition. Two skill groups were represented in each condition : High BF-Q, Low BF-Q, High Control and Low Control. The High skilled swimmers represented athletes who were training and competing at the top Alberta Provincial (A) and Junior National levels. The Low skilled swimmers were ranked as Provincial C and B level athletes. A, B, and C time standards are determined each year by Swim Alberta based on national norms for different age groups. Athletes with primarily C times are new to the sport or novice level. Athletes with A times are top Provincial swimmers in their age group and close to achieving Junior National time standards.

A total of 71 youth swimmers were included at the outset of the study, 18 in the High BF-Q, 20 in the Low BF-Q, 15 in the High Control, and 18 in the Low Control. The frequency and duration of all practices were similar across the four groups. A total of seven practices a week for four months were included in the project, with the exception of a one week holiday for all groups at Christmas.

All participants and their parents signed a consent form prior to the intervention.

Participation was voluntary and permission of the club, coach, parents, and swimmers was granted before the study began (see Appendix A).

Procedure

The BF-Q intervention and Pilot study are described first, followed by a synopsis of the experimental design, and finally measurement details for the dependent variables. A description of the instruments and methods used to measure the variables precede details pertaining to the statistical analyses. Finally, details will be provided about supplemental qualitative data analysis.

Pilot Study

Prior to the study, a pilot test was run to validate the integrity of the BF-Q procedures. An external coach from an independent club participated in the week-long test. A 30 minute coaching session was videotaped and coded using the Questioning Coding Sheet which was adapted from the DT Instrument (Vickers, 2000; Vickers, Reeves, Chambers, & Martell, in progress). Measures for Bandwidth Feedback and Questioning were modified for the study (see Appendix B).

A booklet was created by the researcher (Questioning in Coaching : An Overview; see Appendix C) that outlined the theory and practice behind the BF-Q intervention and practical suggestions for reducing feedback and increasing questioning. The booklet was used to conduct a one-hour instructional session with the coach

involving a review and explanation of the booklet, followed by practical examples and a discussion regarding the coach's specific situation. A one-week trial period allowed the coach to apply the theory and practical suggestions. Three sessions were videotaped during this week to provide feedback to the coach on the effectiveness of his BF-Q techniques.

After the week intervention, a final 30 minute session was videotaped as a post test and compared with the pre test. Results indicated a large increase in frequency and quality of questioning and feedback. Data are summarized in Table 3.1.

Table 3.1

Summary of BF-Q Measures for Two 30-minute Pilot Coaching Sessions

	Bandwidth Feedback		Questioning	
	Frequency[a]	Quality[b]	Frequency[c]	Quality[d]
Pre	1.06	3.00	.26	2.80
Post	.56	4.25	.90	4.00

[a]Feedback statements per minute. Lower values are positive. [b]Mean of items on Bandwidth FB : DT Tool 3 on Questioning Coding Sheet (Appendix D). [c]Questions per minute. Higher values are positive. [d]Mean of items on Questioning : DT Tool 4 on Questioning Coding Sheet (Appendix B).

BF-Q Intervention Procedure

Prior to the study, the same procedure used to instruct the Pilot coach was used to instruct the BF-Q coaches, with one addition. After the one-week trial period, the researcher met with each coach in a final feedback session. The feedback session consisted of two parts. A formal component reviewed the coding sheets and provided structured suggestions pertaining to their use of the BF-Q intervention. A less formal component was lead by the coach and consisted of a verbal self-evaluation and discussion regarding their experience testing the BF-Q method.

Maintaining Integrity of the BF-Q Intervention

All coaches (BF-Q and Control) were videotaped and coded by the researcher for levels of BF-Q during two randomly selected practices each week throughout the intervention. This was designed to ensure the coaches would use the BF-Q method throughout the six-week period.

Experimental Design

The study followed a Pre – Post - Transfer design. The dependent variables included a 400m free practice swim time (pTIME), competitive swim times (cTIME), swim technique (TECH), task motivation (TASK), autonomy (AUT), and intrinsic motivation (IM). All dependent variables were measured at the Pre test that occurred the

last week of October, the Post test that took place during the second and third weeks of December, and the Transfer test that was conducted at the end of February. Transfer tests coincided with the end of the short course (25m pool competitions) swim season.

Description and Measurement of the Dependent Variables

pTIMES were measured from a 400 m freestyle event swum in practice and videotaped. cTIMES were acquired from race results provided by the coaches. TECH was ranked by two independent coders using a stroke evaluation form adapted from Haljand (1996) to measure front crawl technique. Several established questionnaires were used to measure TASK, AUT, and IM.

Competitive Swim Performance

Practice Times (pTIMES)

Swimmers were videotaped swimming a 400 m freestyle (front crawl) event in practice at Pre, Post, and Transfer tests. The times were used to measure practice performance in a standard event (400 m freestyle). 400 m freestyle is a minimum qualifying event for Provincial Championships and higher level meets. Swimmers must attain an age-dependent minimum qualifying time (MQT) in 400 freestyle in order to compete at the Provincial championships.

Competition Swim Times (cTIMES)

Swim times for 100 m, 200 m, and 400 m events were collected from meet (competition) results at pre, post and transfer tests for each swimmer in their stroke(s) of specialization. Changes in swim times were determined by calculating the d-scores for each swimmer in each event. A value for overall change in each swimmer's cTIMES was created by summing the d-scores of all three events. There were several reasons for adopting this method. First, including multiple distances provided a more general and overall view of a swimmer's ability. Second, many swimmers specialized in specific strokes, so limiting the choice of times to one stroke would have reduced the number of swimmers in the study. Improvement values (or difference scores) negate stroke speed discrepancies. For example, an athlete may have completed a 100 m fly event in 1 min 15 s at the Pre test and 1 min 10 s at the Post test. Another athlete may have swum a 100 m freestyle event in 1 min 6 s at the Pre test and 1 min 1 s at Post test. The raw times were different, however the d-score values (improvement, in this example) were 5 s for both swimmers.

Technique (TECH)

Swimmers were videotaped swimming a 400 m freestyle event at Pre, Post and Transfer tests. Freestyle was chosen because it is the stroke used most often in training. The 400 m freestyle is a standard event in which all swimmers must attain a certain level before qualifying for standards in other events. The videos were coded for TECH by two

NCCP (National Coaching Certification Program) Level 3 swim coaches who were blind to the details of the study. Criteria for assessing technique were derived from Haljand (1996). The Stroke Evaluation Form (see Appendix D) contained 13 items graded on a 5-point Likert scale. An overall TECH score for each swimmer was calculated as the mean of the 13 items. Changes in TECH were determined through the calculation of d-scores from Pre - Post and Post - Transfer.

Motivational Constructs

Task Motivation (TASK) : The Task and Ego Orientation in Sport Questionnaire

The Task and Ego Orientation in Sport Questionnaire (TEOSQ) was used to measure TASK (see Appendix E). It is a 13-item questionnaire developed by Duda and Nicholls (1989) that measures task and ego orientations respectively. Answers are reported on a 5-point Likert scale. The initial phrase of each item was changed to "I feel most successful in *swimming* when..." to make it specific to the sport.

The construct validity and reliability of the instrument has been supported in studies by Li, Harmer, and Acock (1996) and Li, Harmer, Duncan, Duncan, Acock, and Yamamoto (1998), using structural equation modeling.

TASK Scores

Task orientation (TASK) scores for individual swimmers were obtained by taking the mean of the seven task items (see Appendix E). Difference scores (d-scores) were

calculated using the same method as cTIME and pTIME (subtracting Pre from Post scores, and Post from Transfer scores).

Autonomy (AUT) and Intrinsic Motivation (IM) : The Sport Motivation Scale

AUT and IM were both measured using the Sport Motivation Scale (SMS) (Pelletier, Fortier, Vallerand, Briere, & Blais, 1995) (see Appendix F). The SMS is based on the assumptions of Self Regulation Theory (Deci & Ryan, 1985, 1989) and is a new instrument designed to measure intrinsic and extrinsic motivation in sport. The version used for this study consisted of 28 items categorized into seven subscales and scored on a 7-point Likert scale (see Appendix B). As with the TEOSQ, the items all began with the stem "I *swim* ..." to make it specific to the sport. Three subscales measured different types of IM : IM to know, IM toward accomplishments, and IM to experience stimulation. The extrinsic subscales include external regulation, introjection, and identification. Identified external regulation has been included in more recent versions of the scale, but was not used in this study.

External regulation refers to externally controlled behaviour through threats or rewards. Interrogated regulation involves internal control, but a person acts mainly to avoid negative feelings or to gain rewards. In identified regulation, behaviour is recognized as being useful to personal goals. IM refers to participating for the shear pleasure of doing the activity (Ryan & Connell, 1989 in Goudas, Biddle, & Fox, 1994; Vallerand, 1997). Amotivation is a state of non-motivation where individuals feel no control over their actions and do not perceive any relationship between their actions and

their goals (Pelletier, Fortier, Vallerand, Briere, & Blais, 1995).

According to Deci and Ryan (1985) the different types of motivation form a continuum of self-regulation with IM hypothesized to have the highest level and amotivation the lowest. Support for this self-determination continuum is now prevalent in the literature (see Vallerand, 1997).

Li and Harmer (1996) tested for the simplex structure of the scale using structural equation modeling and confirmed the self-determination continuum across a sample of 857 men and women from various sports. The pattern was also found to be invariant across gender (Li, & Harmer, 1996; Vallerand, & Fortier, in Duda (Ed.), 1998).

Psychometric measurements revealed satisfactory internal consistency indices (mean alpha 0.75) and temporal stability. Although this instrument is relatively new, it holds promising implications for research according to Vallerand and Fortier (in Duda (Ed.), 1998).

AUT and IM Scores

AUT was calculated by weighting each motivational subscale as follows : external regulation (-2), introjected regulation (-1), identified regulation (+1), and intrinsic motivation (+2).[1] Weighted scores were then summed to create an overall

[1] Amotivation was excluded at the recommendation of Dr. L.G. Pelletier in order to maintain an equal number of positive and negative weights. Theoretically, amotivation is defined as a lack of motivation. Since the present study was concerned with the existence of (hypothetical increase in) motivation, amotivation was the most logical construct to omit.

autonomy score. Positive scores represented higher self-determined motivation (i.e. increased degree of AUT) whereas negative scores represented motivation that was non-self-determined (Vallerand, 1997).

IM scores were obtained by calculating the mean scores for each swimmer between all items on the three IM subscales.

D-scores were calculated for IM and AUT scores by subtracting Pre from Post scores and Post from Transfer scores.

Data Analysis

There were four steps followed in the analysis. It was important to determine if the BF-Q intervention occurred as planned. A Group (BF-Q, Control) factorial ANOVA was run on the frequency and the quality of feedback and questioning data to determine if the BF-Q coaches differed from the Control coaches in the amount and quality of feedback and questioning used. Frequency and quality of feedback and questioning data were derived from videotapes of the coaches taken during two randomly selected practices per week throughout the 6-week intervention period. The data were coded by the principal investigator using the categories for frequency and quality shown in Appendix A.

Second, means and standard deviations for 400 m swim times (pTIMES) were reported in absolute time (seconds) for the two groups (BF-Q, Control) and skill levels (High, Low) in order to determine performance in a standard event from Pre – Post and Post – Transfer.

Third, since detecting changes in the dependent variables was central to the purpose of the study, d-scores were determined for the five dependent variables : pTIME / cTIME, TECH, TASK, AUT, and IM. The d-scores for each variable were analyzed, separately, using a Group (BF-Q, Control) x Level (High, Low) x Test (Pre – Post, Post – Transfer) ANOVA's with repeated measures on the last factor. Scheffe contrast of means was used for all post hoc analyses. All data were analyzed using Statview 5.0 (SAS Institute, Inc., 1998). An alpha level of .05 was used for all statistical tests.

Fourth, interviews were conducted with randomly selected swimmers at pre (n = 8), post (n = 7), and transfer (n = 12) for the purpose of supplementing quantitative data. Thirteen primary questions (see Appendix G) guided the interviews and were designed to focus swimmers on particular themes related to the study. Responses were transcribed from video / audiotape then classified by themes according to the original intent of the question and recurring ideas noted in the discussions.

The data were used anecdotally and major themes were summarized in the Qualitative Results section.

CHAPTER FOUR

RESULTS

Of the 71 swimmers enrolled in the four swim groups at the outset of the study, 50 swimmers completed the study, 29 in the BF-Q groups (n = 15 High; n = 14 Low) and 21 in the Control groups (n = 11 High; n = 10 Low). The attrition rate in the BF-Q groups was 23.68 % and in the Control groups was 33.33 %, a non-significant difference. This level of attrition is common in swimming at this level due to swimmers leaving the sport or being promoted to higher level. Of the 23.68 % of BF-Q swimmers who dropped out of the study, 30 % were promoted to higher groups, 10 % were injured, 50 % dropped out of the sport, and 10 % were absent for all test dates. Of the 33.33% of Control swimmers who dropped out of the study, 36.36 % were promoted to higher groups, 18.18% were injured, 36.36 % dropped out of the sport, and 9.09 % were absent for all test dates.

Frequency and Quality of Coaches' Feedback and Questioning

A Group (BF-Q, Control) x Level (High, Low) factorial ANOVA found significant results for frequency of feedback $F(1,20) = 24.28, p < .0001$ and frequency of questioning $F(1, 20) = 27.18, p < .0001$. BF-Q coaches used significantly less feedback and asked significantly more questions than the Control coaches. Significant results were also found for quality of feedback $F(1, 12) = 29.70, p < .0001$ and quality of questioning $F(1, 16) = 19.41, p < .0004$. The BF-Q coaches exhibited higher quality feedback and

questioning techniques than the Control coaches. Table 4.1 summarizes the means and standard deviations for the frequency and quality of feedback and questioning for the BF-Q group (n = 2) and Control group (n = 2) coaches. These results show that the training intervention created different coaching environments in terms of the amount of feedback given and questions asked. The BF-Q coaches asked twice as many questions as they gave feedback statements. In contrast, the Control coaches gave three times as many feedback statements as they asked questions.

Table 4.1

Frequency and quality of feedback and questioning of BF-Q and Control coaches (means with standard deviation in brackets)

	BF - Q Coaches	Control Coaches
Feedback		
Frequency[a]	.56	1.07
	(.20)	(.34)
Quality	4.19	3.17
	(.36)	(.59)
Questioning		
Frequency[b]	1.04	.39
	(.37)	(.24)
Quality	4.32	2.80
	(.51)	(1.05)

[a]Feedback statements per minute. Lower values indicate a positive intervention.

[b]Questions per minute. Higher values indicate a positive intervention.

Swim Performance (Absolute times in practice and competition)

Table 4.2 presents the 400 m freestyle times (pTIME) for the BF-Q groups and Control groups as measured at Pre, Post, and Transfer. These times were compared to the Alberta time standards (seconds) for age and skill level in order to situate the performance of the swimmers in the current study relative to provincial performances. The average "B" level time standard in Alberta for 13 (years) and older swimmers was 325 seconds. This score was derived from the time standards for the age groups 13-14, 15-16, and Senior (17 and older) swimmers in 400 m freestyle. The average "A" level time standard was 291 seconds. Table 4.2 shows that the High Level groups' performance was consistent with "A" standards and the Low Level groups' performance was consistent with "B" standards.

Table 4.2 also shows that at the outset of the study (Pre), the mean of the High Control group was faster than the High BF-Q group and was still faster at the end of the study (Transfer). Note, however, that the gap between the two narrowed considerably by the end of the study (Transfer). Mean times for the Low BF-Q group were more equivalent to those of the Low Control at outset of the study (Pre) but by the end of the study (Transfer) the Low BF-Q group was considerably faster than the Low Control.

Consideration was given to analyzing the data using Analysis of Covariance (ANCOVA), however, this approach was not selected due to the differences in skill level at the outset of the study. D-scores, or difference scores were therefore determined from Pre – Post and Post – Transfer for all dependent variables and used throughout.

Table 4.2

pTIMES (seconds) at Pre, Post, and Transfer tests for the BF-Q (High, Low) and Control (High, Low) groups (Means with standard deviations in brackets)

	BF – Q Groups		Control Groups	
	High	Low	High	Low
Pre	320.22	361.22	302.25	363.86
	(12.22)	(29.55)	(14.50)	(26.85)
Post	311.00	349.44	299.50	355.57
	(15.95)	(34.46)	(15.60)	(25.72)
Transfer	307.30	343.78	302.62	350.14
	(11.95)	(32.23)	(20.40)	(18.77)

Competitive Swim Time Performance (cTIME)

Table 4.3 presents the cTIME d-scores (seconds) from Pre - Post and Post - Transfer for the BF-Q and Control groups. Negative values indicate that the swimmer improved during the test period, while positive values indicate a lack of improvement. All groups improved from Pre - Post except the Low BF-Q swimmers, although from Post – Transfer the Low BF-Q swimmers improved the most. The High BF-Q group showed the greatest cumulative cTIME improvement across Pre - Post and Post - Transfer periods.

Table 4.3

cTIME d-scores (seconds) from Pre-Post and Post-Transfer (Means, with standards deviations in brackets)

	BF –Q Groups		Control Groups	
	High	Low	High	Low
Pre-Post	-18.54	4.05	-15.81	-15.47
	(6.93)	(8.55)	(10.01)	(12.57)
Post-Transfer	-3.22	-17.00	-.86	-5.00
	(6.77)	(12.03)	(6.06)	(7.25)

A Group (BF-Q, Control) x Level (High, Low) x Test (Pre – Post, Post – Transfer) ANOVA with repeated measures on the last factor found a significant difference in D-scores for Test $F(1, 46) = 5.28, p < .03$. The swimmers improved their cTIMES from Pre - Post and Post - Transfer, as shown in Figure 4.1. A post-hoc Scheffe analysis indicated that the improvement in d-scores from Pre - Post was significantly greater than from Post - Transfer.

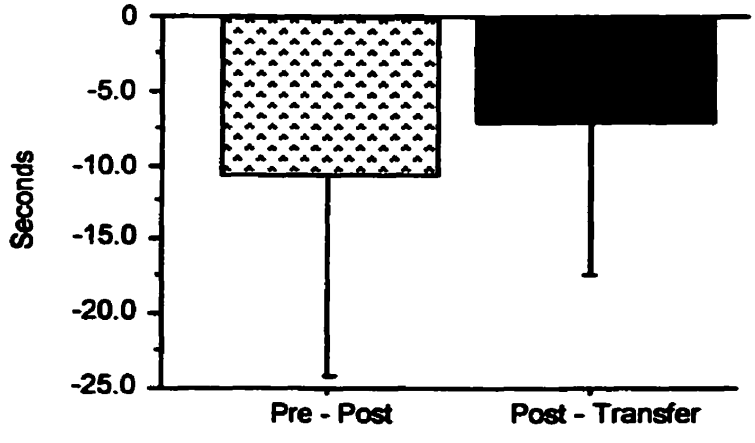

Figure 4.1. Overall cTIME improvements from Pre - Post and Post - Transfer.

There were no significant main effects for Level, meaning each group improved equally. However, the two way interaction of Group x Level was significant $F(1, 46) = 4.90, p < .03$ as shown in Figure 4.2. The results show that the BF-Q intervention affected the swimmers differently, according to whether they were High skilled or Low skilled. The greatest improvement in swim cTIME was achieved by the High BF-Q group, followed by the Low Control, High Control, and the Low BF-Q groups. Post hoc contrast of means indicated the High BF-Q group improved significantly more $F(1, 1) = 5.71, p < .02$ than the Low BF-Q group. There were no other significant contrasts between groups.

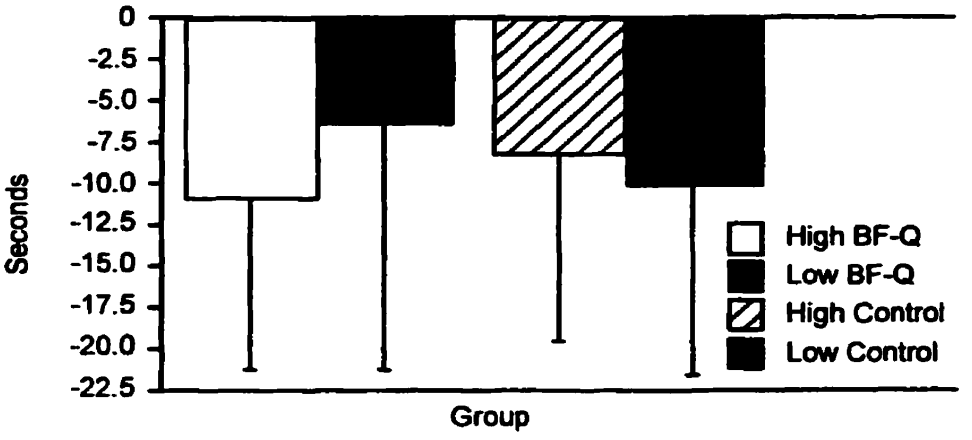

Figure 4.2. cTIME improvements (seconds) with standard deviations for the BF-Q (High, Low) and Control (High, Low) groups.

The two-way interaction of Test x Group was significant $F(1, 46) = 13.19, p < .0007$ as shown in Figure 4.3. The BF-Q groups improved 7.64 seconds from Pre - Post and 9.87 seconds from Post - Transfer. The Control groups improved by 15.65 seconds from Pre - Post and 2.83 seconds from Post - Transfer.

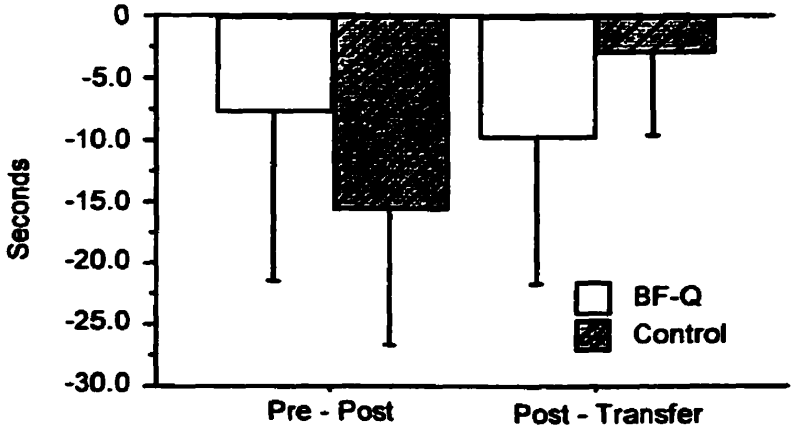

Figure 4.3. cTIME improvements (seconds) with standard deviations for the BF-Q and Control groups from Pre - Post and Post - Transfer.

There was a significant two-way interaction of Test x Level $F(1, 46) = 22.68, p < .0001$ as shown in Figure 4.4. The High skilled groups improved their swim cTIMES from Pre - Post by 17.39 seconds and by 6.46 seconds from Post - Transfer. The Low skilled groups showed an opposite profile; they improved their cTIMES from Pre – Post by 4.08 seconds, and 12.00 seconds from Post - Transfer.

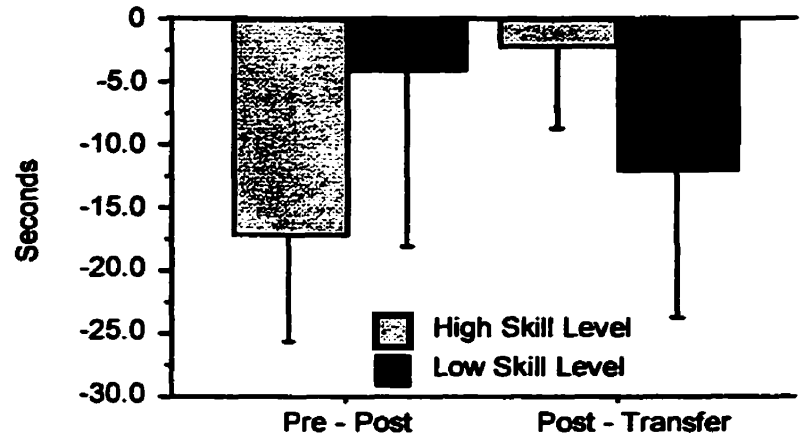

Figure 4.4. cTIME improvements (seconds) with standard deviations for the High and Low skilled groups from Pre - Post and Post - Transfer.

The three-way interaction of Test x Group x Level was significant $F(1, 46) = 13.82, p < .0005$ as shown in Figure 4.5. The Low BF-Q group did not improve their cTIMES from Pre - Post, while the High BF-Q and both Control made their greatest gains at this time. From Post - Transfer, the Low BF-Q group showed the greatest improvement of all the groups, decreasing their swim cTIMES by an average of 17.00 seconds. Post hoc contrast of means indicated that from Pre - Post the Low BF-Q group significantly increased their cTIMES compared to the High BF-Q $F(1,1) = 33.04, p < .0001$; the High Control $F(1,1) = 21.72, p < .0001$; and the Low Control $F(1,1) = 19.86, p < .0001$. From Post – Transfer the Low BF-Q showed significantly greater improvement than the High BF-Q group $F(1,1) = 12.30, p < .001$; the High Control $F(1,1) = 14.35, p < .0004$; and the Low Control $F(1,1) = 7.51, p < .0087$. There were no other significant contrasts between the groups.

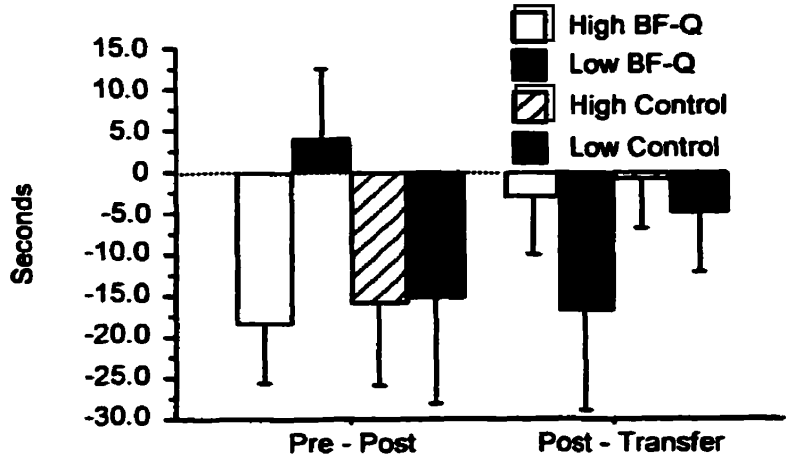

Figure 4.5. cTIME changes (seconds) with standard deviations for the BF-Q (High, Low) and Control (High, Low) groups from Pre - Post and Post - Transfer.

Practice Swim Time (pTIME) Performance (D-scores)

Table 4.4 presents the d-scores (seconds) for the 400 m freestyle performed by each group in practice from Pre - Post and Post - Transfer. Means are listed with standard deviations in brackets.

Table 4.4

pTIME d-scores (seconds) for the BF-Q (High, Low) and Control (High, Low) groups from Pre - Post and Post - Transfer (Means, with standard deviations in brackets)

	BF –Q Groups		Control Groups	
	High	Low	High	Low
Pre-Post	-9.20	-11.78	-2.75	-8.29
	(9.15)	(22.92)	(6.65)	(3.45)
Post-Transfer	-3.70	-5.67	3.13	-5.43
	(13.41)	(8.32)	(10.37)	(12.37)

A Group (BF-Q, Control) x Level (High, Low) x Test (Pre - Post, Post - Transfer) ANOVA on the pTIME d-scores with repeated measures on the last factor, found no significant differences between groups.

Swim Technique (TECH)

Inter-observer agreement

Each swimmer's technique was evaluated by two independent coders who were certified Level 3 NCCP (National Coaches' Certification Program) and expert coaches in swimming. And Observer (1, 2) x Test (Pre - Post, Post - Transfer) ANOVA with repeated measures on the last factor on the TECH d-scores found no significant differences $F(1, 33) = .01, p < .92$ between coders' means scores, as shown in Figure 4.6.

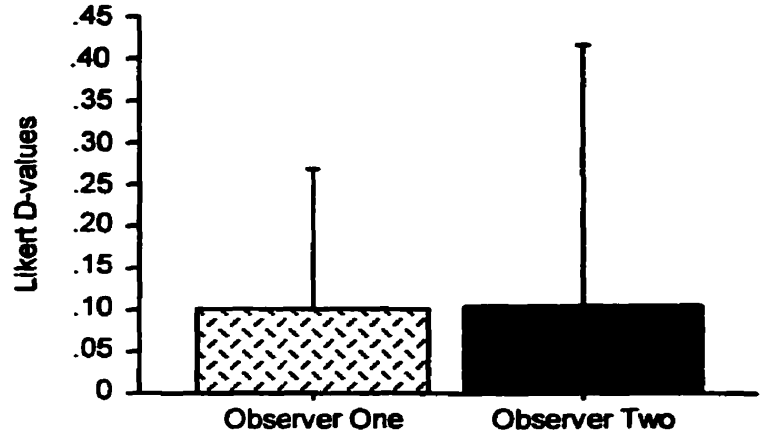

Figure 4.6. Overall differences in observer TECH rankings (Likert d-score means) with standard deviations.

Improvement in Swim TECH

Table 4.5 lists the means and standard deviations for swim TECH for the BF-Q groups (High, Low) and the Control groups (High, Low) at Pre, Post, and Transfer tests and the d-scores for each group during Pre – Post and Post – Transfer periods. Although all groups improved their TECH during the study, the TECH scores were still below the median 5-point Likert score of 3.0, with the exception of the High Control at Post and Transfer tests. The swim TECH scores represented a mean of 13 items on the Stroke Evaluation Form (see Appendix C). The Low BF-Q group was assigned the lowest TECH ranking at Pre, Post, and Transfer tests, in contrast to the High Control swimmers who ranked the highest.

Table 4.5

TECH raw scores for the BF-Q (High, Low) and Control (High, Low) groups at Pre, Post, and Transfer tests with d-scores during Pre – Post and Post – Transfer (Means, with standard deviations in brackets)

	BF – Q Groups		Control Groups	
	High	Low	High	Low
Pre	2.79	2.19	2.99	2.61
	(.29)	(.42)	(.21)	(.18)
Post	2.85	2.47	3.14	2.75
	(.31)	(.13)	(.21)	(.20)
Transfer	2.91	2.54	3.16	2.86
	(.28)	(.11)	(.29)	(.25)
Pre-Post	.05	.27	.15	.10
	(.12)	(.39)	(.11)	(.09)
Post-Transfer	.07	.04	.02	.14
	(.17)	(.14)	(.15)	(.16)

A Group (BF-Q, Control) x Level (High, Low) x Test (Pre – Post, Post – Transfer) ANOVA on the TECH scores with repeated measures on the last factor, found no significant differences due to Group, Level, or Test. The three-way interaction of Test x Group x Level was significant $F(1, 30) = 5.33, p < .03$ as shown in Figure 4.7. Table 4.5 also presents the means and standard deviations for the TECH d-scores (5-point Likert means). The Low BF-Q and Low Control groups improved their technique more

than the High Level groups. This result was not unexpected as the Low skilled swimmers had room for more improvement than the High skilled swimmers. The greatest improvement in swim TECH was found for the Low BF-Q group from Pre - Post. Contrast of means analyses yielded a significant difference $F(1, 1) = 6.96, p < .01$ between the High BF-Q and Low BF-Q groups from Pre – Post. The Low BF-Q group showed the most improvement in TECH, while the High BF-Q showed the least improvement. No other significant contrasts were found.

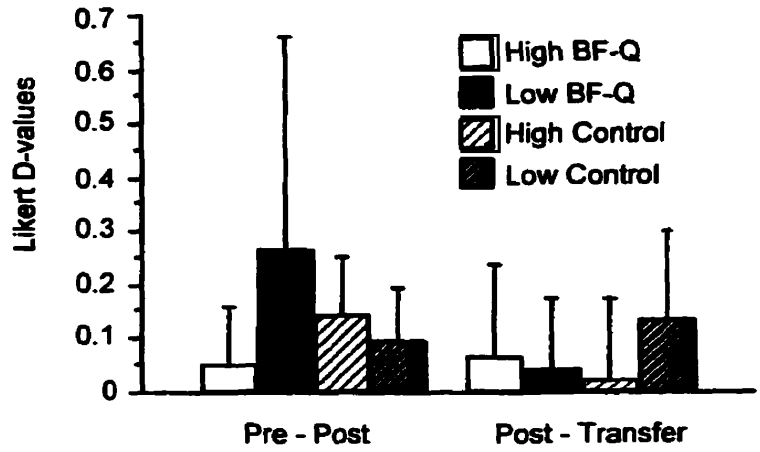

Figure 4.7. TECH improvements (5-point Likert means) with standard deviations for the BF-Q (High, Low) and Control (High, Low) groups from Pre - Post and Post - Transfer.

Motivational Constructs

Table 4.6 presents the means and standard deviations for task motivation (TASK), intrinsic motivation (IM), and autonomy (AUT) with d-scores from Pre - Post and Post - Transfer periods. TASK means represent responses on a 5-point Likert scale and IM means represent responses on a 7-point Likert scale. AUT means are weighted scores on

a continuum of self-regulation or AUT. Positive values indicate high levels of self-regulation (AUT) while negative values reflect low levels. TASK means were high across the study for both the BF-Q and Control groups. IM means were close to the median (4.0) of the 7-point Likert scale. All AUT means were positive values, indicating higher levels of perceived self-regulation by the swimmers.

Table 4.6

TASK, AUT, and IM raw scores for the BF-Q (High, Low) and Control (High, Low) groups at Pre, Post, and Transfer tests with d-scores from Pre - Post and Post - Transfer (Means, with standard deviations in brackets)

	BF – Q Groups		Control Groups	
	High	Low	High	Low
TASK				
Pre	3.91	4.10	4.18	4.10
	(.71)	(.45)	(.44)	(.43)
Post	4.02	3.79	4.24	3.86
	(.56)	(.94)	(.57)	(.57)
Transfer	3.83	3.62	4.23	3.86
	(.84)	(.83)	(.52)	(.60)
Pre - Post	.12	-.32	.07	-.24
	(.49)	(.88)	(.72)	(.69)
Post - Transfer	-.12	-.16	-.01	0.00
	(.60)	(.84)	(.63)	(.64)

Table 4.6 cont.

	BF – Q Groups		Control Groups	
	High	Low	High	Low
AUT				
Pre	2.74	1.29	4.10	3.40
	(2.82)	(3.30)	(3.57)	(1.68)
Post	1.51	1.12	3.16	1.88
	(3.74)	(3.23)	(2.13)	(2.01)
Transfer	1.68	1.21	2.86	2.59
	(3.64)	(3.82)	(2.53)	(3.11)
Pre - Post	-1.23	-.17	-.94	-1.53
	(2.77)	(3.72)	(2.25)	(3.05)
Post - Transfer	.17	.09	-.30	.72
	(2.06)	(3.42)	(2.54)	(2.71)
IM				
Pre	4.83	4.35	5.33	4.40
	(.98)	(1.13)	(.72)	(.76)
Post	4.39	4.23	5.06	4.43
	(1.18)	(1.36)	(.95)	(1.10)
Transfer	4.38	4.30	5.43	4.10
	(.96)	(1.55)	(.81)	(1.10)
Pre - Post	-.44	-.12	-.28	.03
	(.43)	(.70)	(.63)	(1.10)
Post - Transfer	-.01	.07	.37	-.34
	(.25)	(1.67)	(1.01)	(1.49)

Task Motivation (TASK)

A Group (BF-Q, Control) x Level (High, Low) x Test (Pre – Post, Post – Transfer) ANOVA on the TASK scores with repeated measures on the last factor, found a significant difference for Level $F(1, 46) = 4.34$, $p < .04$ as shown in Figure 4.8. The Low skilled groups showed a significant decline in TASK motivation compared to the High skilled groups. There were no other significant main effects or interaction effects found.

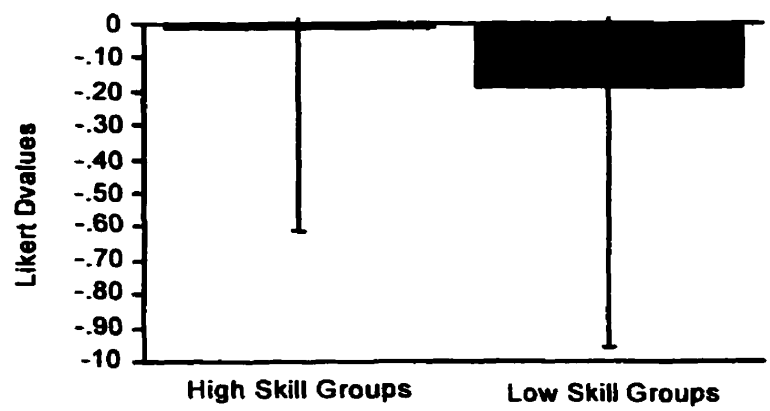

Figure 4.8. Combined TASK d-scores for the High and Low skill groups with standard deviations.

Autonomy (AUT)

The AUT scores were analyzed using a similar ANOVA procedure as TASK motivation. There were no significant main effects of interaction effects for change in AUT.

Intrinsic Motivation (IM)

The IM scores were analyzed using a similar ANOVA procedure as for TASK motivation. There were no significant main effects or interaction effects for change in IM.

In summary, only one significant effect was found for the motivational constructs. Both High level groups increased TASK motivation from Pre - Post, whereas the Low skilled groups decreased. Although most of the motivational constructs did not change significantly over the study, the raw scores at Pre, Post, and Transfer indicate above-average values. This indicates the motivation (TASK, AUT, and IM) remained relatively high from Pre - Post and Post - Transfer.

Summary of Quantitative Results

Significant differences were found for cTIME, TECH, and TASK. The Low BF-Q group did not improve their cTIME from Pre - Post but improved their cTIME significantly more than the High BF-Q and both Control groups from Post - Transfer. The opposite occurred for TECH, where the Low BF-Q group made significantly greater gains in TECH from Pre - Post than the High BF-Q and both Control groups. Both Low skilled groups (BF-Q and Control) showed a significantly greater decline in TASK across the study than the High skilled groups. No significant differences were found for pTIME, IM, or AUT. The next section provides a synopsis of qualitative results from athlete interviews.

Qualitative Results

Interviews were conducted at Pre, Post, and Transfer periods and involved questions related to the dependent variables. General themes are reported according to the intent of the questions.

Perception of Questioning Used by the Coaches

Swimmers were asked to reflect on any perceived changes in coaching methods that occurred during and after the intervention. Following the general comments, swimmers were asked specifically if the coach had asked them more questions.

Responses from the BF-Q swimmers were varied. The Low BF-Q swimmers noticed a greater change in their coach's behavior than the High BF-Q swimmers. As one athlete in the Low BF-Q group mused, "...at the beginning of the year they really didn't know how to interact ... like, it was another style of coaching. He's become better at doing what he does. He asks us a lot of questions about our strokes because he wants us to figure it out instead of him telling us all the time. So it's like, 'why don't you try this and not this, and why don't you try this...'." Another swimmer noted, "When we started he made up the workouts, we did them, and we went home. Now he lets us have more input." Not all swimmers detected a change in the Low BF-Q coach's methods, as one athlete mentioned, "no, no change... he probably 'cranks' me more on stroke technique but that's about it."

No changes were noted in the methods employed by the High BF-Q coach, although responses suggested that questioning methods were already being used prior to the intervention. When asked if there were any changes in the amount of feedback or questioning one swimmer in the High BF-Q group stated that, "He gave us feedback on our meets – but he always does that. He asked us stuff like he usually asks." A second athlete supported this, commenting that questioning was utilized at meets, but not in practices. According to another athlete, the coach always asked how they were doing and corrected their strokes. "Sometimes he'll get me to try something and ask me how it felt. Other things – well – everyone knows there are certain things you just have to change... so then he'll just tell us."

Athletes in the Control groups did not notice any change in their coaches' behaviors, or in the quantity of questions asked. The High Control coach employed a more direct method as one swimmer stated, "...he just tells us what we need to improve; we don't really spend time figuring it out." The Low Control coach used some questioning, but, "not a lot" (Low Control swimmer).

Motivations Related to Swimming

Athletes were asked what motivated them to come and train in the pool. Four recurring themes included enjoyment of the sport, desire for success or accomplishment, fitness, and social interaction. When asked to define what they meant by 'fun', one swimmer put it like this, "...friends, and improving, and just having something to say you're good at" (High Control swimmer). Achievement motivations were frequently

related to time standards and goals that athletes were striving to accomplish such as best times in certain events. All except one athlete cited "friends" as a primary reason for their dedication to swimming.

A related question probed likes and dislikes about the sport. Athletes reported competence and positive affect (related to achievement), swim meets, travel, and friends as favourite aspects of swimming. Many swimmers mentioned practices as a general dislike, in particular the timing, quantity, and difficulty of workouts. However, there was some irony in these responses as one High BF-Q swimmer stated, "...it's not that I don't like them, it's just that they're hard to do". The commitment required was also cited as a negative part of the sport.

Athlete Input

Several questions focused on the details of autonomy and self-regulation that athletes preferred. They were asked if they had input into their training and whether they preferred more input or "just to be told what to do by the coach" (Interviewer). Most athletes stated they had some input, primarily related to meet events and certain technical elements in practice. The majority of athletes also expressed a preference for more input from the coach. They felt the coach had more expertise and knowledge, therefore was better suited to give feedback and advice. At one extreme, a Low BF-Q athlete stated, "Other coaches will ask you what you're doing wrong and they won't tell you what you need to work on for, like, five minutes while you're discussing it ... and that doesn't really help much with something."

Coaching Styles

The question "in your opinion, what makes a good and a bad coach", produced an array of interesting responses. The majority of athletes cited knowledge as a critical aspect of coaching effectiveness. According to the swimmers, it was extremely important that a coach "just knows what he's doing" (Low Control swimmer). Other popular characteristics of "good coaches" included a sense of humor, respect for swimmers, and fair and equitable behavior. Effective coaches were perceived as being able to push athletes, provide challenging workouts, but also to have fun. As one swimmer stated succinctly, "I would like a coach who supports their swimmers and tells them what they're doing wrong and tries to push them but in a positive way" (High Control swimmer).

Several responses touched on theory and methodology of teaching, long term athlete development, and experience-related coaching methods. One athlete mused in detail on learning styles. "...everyone learns in different ways. Like some people hate being told that they're doing something wrong, and they don't like it... and they don't care anymore. And other people, when they hear something like that, they want to do better. So they [the coaches] have to adapt to that sort of thing. I don't know if it's possible to do this – but find out how each kid learns and likes to be pushed – and doesn't like to be pushed – and do it that way" (High BF-Q swimmer).

An older (17 years) athlete in the Low Control group reflected on athlete input in a coaching context. "And you want your swimmers to have a say in what they're doing.

Especially at the age I'm at now. We're old enough to say 'yeah, that's working', or 'that's not.' But it depends on how long you've been swimming. Like, if I started when I was 14 [years] then I don't think I'd be, 'I know what I want to do!'"

Another swimmer discussed coaching methods in relation to long term planning and commitment. "Their coaching style has changed [over several years]. We have definitely picked up the intensity of the workouts. But, it's more focused on the people who they [the coach] think will succeed. You know it's a good thing for me ! Because I'm a person who succeeds so I get a lot of the attention – but for some people it's not so good ... and it's really hard for me to say if that's good or bad. Part of me says "don't put the effort in if they're not going to give the effort back", and then part of me says, "well, they're here so you might as well give them a bit of attention" (High BF-Q swimmer).

One of the most prevalent characteristics of a bad coach related directly to the attention debate discussed by the above athlete. According to the majority of swimmers, a bad coach was someone who "played favorites" (Low Control swimmer), or favored certain (e.g. faster) swimmers over others.

Apathy, disinterest (in athletes), and autocratic behavior were also admonished by swimmers. One Low BF-Q athlete stated, "...a bad coach is someone who always undermines you and always tells you how bad you are at this and how bad you are at that .... and just gives you the workout and doesn't care whether you're doing the right technique or the wrong technique – they just tell you what's wrong and 'fix it yourself.'"

Many athletes also expressed dislike for incompetent coaches. They wanted someone who could give challenging workouts and produce results (e.g. fast times)

without "wasting time" (High BF-Q swimmer). Although swimmers begrudged some of the difficult aspects of training, they also expressed the desire for a coach who could train, challenge, and push them to new heights – or their goals – in the sport.

Knowledge of Swimming

In order to probe perceived cognitive levels of swimming knowledge, athletes were asked "how much they felt they knew about the sport" (Interviewer). Most of the swimmers felt they knew "a little bit" (High Control swimmer) but not a lot, and certainly not as much as the coach. Two primary knowledge areas surfaced, distinguished by the level of athlete. Swimmers in the High skilled groups felt they knew more about training methods, for example tapering, training cycles, and periodization. Swimmers in the Low skilled groups perceived greater knowledge of stroke techniques.

In general, swimmers felt they would learn more as they became more experienced, but did not express high levels of confidence in their present knowledge of the sport.

Changing the Swim World

The last question probed swimmers' global view of the swim milieu. They were asked whether they would change anything related to swimming (e.g. meets, clubs). Some athletes were content with the present system. One athlete enthusiastically requested, "I'd have gills !" (Low BF-Q swimmer). Others mentioned details pertaining

to practices such as changing the time (no morning practices) and reducing the frequency of workouts. One unique idea related time standards to swimming experience. "I think I might make the times for B's a little slower for people who weren't swimming for as long. Like, the times would be harder for someone swimming for five years than someone swimming for two years" (Low BF-Q swimmer).

Many responses related to meets. Several swimmers wished meets were shorter. Another athlete wished there was a 2000 m event , or more equitable distance swims, for example, "...a 1500 m for girls" (Low Control swimmer). Psychological effects of meets were also mentioned. "I would try and key down the stress a bit – like at meets when you are trying to swim your best and everything goes down the drain because there's so much pressure" (High Control swimmer).

The other major area of change related to social aspects of clubs and swim groups: One swimmer in the High BF-Q group said, "I would change the way most clubs worked. Some clubs the older swimmers don't even know the younger swimmers. I would have more inter-club unity. Most of the kids all do their own thing and they only know each other because they wear the same colours. Maybe a relay night so you would get to know some of the younger swimmers...."

An athlete in the High BF-Q group put it this way, "I would like everyone's attitude to be good for the whole day. And everyone working hard but being positive too."

Summary

Perceived differences in coaching styles from Pre – Post and Post – Transfer were only reported by the Low BF-Q swimmers. Improved communication with the coach, and increased athlete-input were two dominant changes noted. Swimmers in all groups stated that training was increasing in difficulty through the coach "making them work harder" (Low Control swimmer).

Generally, the athletes seemed highly motivated by achievement (e.g. reaching time standards, accomplishing goals, swimming best times) and social aspects of the sport such as friends, travel with the team, and coach-athlete relationships. Equitable, knowledgeable, friendly coaches were perceived as being the best leaders, while coaches who demonstrated apathy, autocratic behavior, and favoritism were perceived as "bad" instructors. The majority of athletes preferred the coach to give them feedback and instruction, primarily because they felt the coach knew more and had earned the right to impart the knowledge gained through their own athletic experience.

Although athletes mentioned hard workouts and difficult training periods as partially negative, they conceded in other statements, that these are required to reach goals and achieve better swim times. Responses hinted that athletes tend to rely on coaches to provide this extra challenge or motivation to get through the "trials" in order to reap the rewards.

Finally, athletes appeared to be generally content with the current swim world. No glaring dislikes were evident, and most preferences were individual to the swimmers.

CHAPTER FIVE

DISCUSSION

This study measured changes in competitive youth swimmers' performance (pTIME, cTIME, TECH) and motivation (TASK, AUT, and IM) due to a bandwidth feedback-questioning (BF-Q) coaching intervention. The study took place over a three-month period during the short-course (25 m pool competitions) winter swim season. Both quantitative and qualitative methods were employed in a Pre – Post - Transfer design to obtain a more complete synopsis of the BF-Q intervention effects. To date, no studies had specifically examined Bandwidth-Feedback Questioning methods in coaching, or the relation between cognitive (e.g. feedback and questioning) coaching methods and psychological constructs (e.g. perceived levels of task orientation, intrinsic motivation, and autonomy). The results of this study offer interesting insights into the effects and use of BF-Q methods in the coaching arena.

The principle findings showed a significantly different effect of the BF-Q intervention due to the Level of swimmers. The Low BF-Q group significantly improved their technique (TECH) more than the High BF-Q group from Pre - Post, but did not improve their competitive swim times (cTIME). However, from Post - Transfer, the Low BF-Q group significantly improved cTIME as compared to the High BF-Q and both Control groups. The High BF-Q group improved the most overall in cumulative cTIME across the entire study. The only significant motivational change was a larger drop in task motivation (TASK) for the Low skilled swimmers (BF-Q and Control) as compared

to the High skilled swimmers. These results are now discussed in more detail as they relate to current research in motor learning, cognitive psychology, and questioning / metacognitive literature.

Bandwidth Feedback-Questioning (BF-Q) and Performance

The significant cTIME results suggest the BF-Q intervention affected the Low BF-Q group differently than the High BF-Q and Control groups. All groups except the Low BF-Q swimmers showed marked improvement in cTIMES from Pre - Post. However, the negative improvement in cTIME performance for the Low BF-Q group coincided with large TECH gains compared to the High BF-Q and Control groups. From Post - Transfer, the opposite result occurred, as the Low BF-Q group showed dramatic improvement in cTIME. Considering the intent of the BF-Q intervention was to elicit intrinsic feedback through cognitive effort, it is logical to assume the large TECH improvements were influenced by some degree of cognitive and motor restructuring. This assumption is supported by research in motor learning. Recall the study conducted by Weeks and Kordus (1998) on the effects of varying KP (knowledge of performance) feedback related to soccer throw-in form (technique). The reduced feedback group not only scored better at transfer, but also had superior form scores immediately following the trials. In the present study, a similar trend occurred as the Low BF-Q group showed large TECH improvements Pre - Post.

The study by Janelle, Barba, Frehlich, Tennant, and Cauraugh (1997) also supported the present results, in particular the relationship between TECH and cTIMES.

The researchers examined the effects of self-controlled feedback (KP) and varying feedback schedules on form and accuracy of a left-handed throw. The self-controlled feedback group (SELF) had superior form scores immediately following the trial period (acquisition) and at transfer. In comparison to the other groups in the study, the SELF group did not differ on accuracy and consistency of the throws at acquisition. However, at transfer, the SELF group scored highest on both accuracy and consistency.

These results paralleled the present study. The Low BF-Q group showed the largest improvements in TECH from Pre - Post, but these TECH gains did not manifest themselves in competitive performance until the Post - Transfer period. Also interesting to note is that no significant differences were found between the groups in pTIME improvement during the Pre - Post and Post - Transfer periods. According to emerging motor learning theories, reliance on feedback and extrinsic information would negate group differences between the BF-Q groups and the Control groups during early practice (Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997; Lee, Serrien, & Swinnen, 1994; Salmoni, Schmidt, & Walter, 1984; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999). However, in the long term transfer situation where the feedback was not readily available and the skills were performed out of context (i.e. in a race situation the BF-Q groups would demonstrate superior performance). This prediction proved true for the Low BF-Q group, but not for the High BF-Q group. Plausible reasons for this are now discussed.

Feedback and Questioning Variations

In the study by Janelle, Barba, Frehlich, Tennant, and Cauraugh (1997) the group that improved the least during the acquisition and transfer was given KR (knowledge of results) feedback compared to the other groups who received KP (knowledge of performance) feedback. KR provides information related to "how well the performer reached the performance goal", whereas KP describes "feedback directed toward the actual kinematics used during the performance of the skill" (Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997, p. 270).

According to the athletes in the present study, the High BF-Q group may have received more feedback in the form of KR than KP. This information included both extrinsic feedback from the coach, and intrinsic feedback from the athletes elicited through questioning. One athlete stated that the coach did ask them questions and give feedback, but usually after meets and in relation to competition performance and results. Athletes in this group also stated they knew more about training cycles and meet preparation / strategy than other aspects of swimming. In contrast, the Low BF-Q group listed technical information as their knowledge forte. This suggests that the type, not simply the quantity, of BF-Q may play a critical role in its overall effectiveness as coaching method. Research in feedback and questioning supports this claim (Dozier, Hicks, Cornille, and Peterson, 1998; Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997; Poskiparta, Kettunen, & Liimatainen; Weeks & Kordus, 1998) as Sacheva (1996) stated, "The types of questions and the manner in which questions are asked have a direct impact on the effectiveness of the questioning" (p. 17). For example, in counseling,

Tomm (1987) described different types of questions (e.g. lineal versus reflexive) that were used to focus patients on certain topics, ideas, or reflections. It is plausible that the questions asked in the present study affected the results based on the goals and foci of the coaches and swimmers.

Swimming Level

It is logical to assume that the aforementioned goals and foci would be different based on the Level of the swimmers. For example, high skilled athletes would be expected to have more refined technical ability than low skilled athletes, and therefore be more focused on competitive performance. Likewise, novice athletes and their coaches would be expected to concentrate energies toward improving technique before focusing on competition. This also may have accounted for differences in results between the High and Low BF-Q groups. Whereas the High BF-Q group demonstrated consistent improvement in cTIME across the Pre - Post and Post - Transfer periods, the Low BF-Q group's cTIMES were not affected until the TECH changes were evident. Support for this assumption was derived from the observations of coaches during the intervention period. The Low BF-Q coach taught more TECH in the observed workouts. Even during more intense sets, the questions and feedback revolved around technical points. The High BF-Q coach used more summary feedback and pre-questioning during observed workouts, but maintained a focus on training intensity and competitive performance goals during the swim sets.

Perception of Coaching Methods

Another possible explanation for the difference between High and Low BF-Q results relates to athlete perceptions of the coaching environment. As mentioned, each coach focused on different aspects of training and competition. Both attempted to use BF-Q to emphasize these areas. However, according to interviews, the athletes in the High BF-Q group noticed no change in their coach's behaviour related to feedback and questioning. In contrast, the Low BF-Q athletes perceived a number of differences in their coach's techniques. Swimmers in the High BF-Q group stated that their coach already used questioning techniques, "like, he directs you a little, but he'll ask you stuff...." In this case, transfer effects would have been negligible because athletes were already accustomed to the techniques.

An interesting result of the study hypothetically supports this argument. The High BF-Q group exceeded the other groups in cumulative cTIME improvement across the Pre - Post and Post - Transfer periods. The absence of an initial performance plateau or decrement, as hypothesized by motor learning studies, could have been affected by the existing presence of BF-Q techniques.

Performance Conclusions

The results suggested that the BF-Q intervention had significantly different effects on the High and Low BF-Q groups. The Low BF-Q group experienced a large improvement in TECH from Pre - Post that was reflected in cTIMES from Post -

Transfer. The High BF-Q swimmers improved their cTIMES substantially and their TECH consistently across both periods. Diverse BF-Q strategies and foci for the higher and lower levels of athletes may have contributed to these differences. The intensity of the BF-Q intervention (i.e. athlete perception of BF-Q methods) is another factor that could have influenced the results. According to this study, it appears that BF-Q has a more dramatic effect on the progress and improvement of novice swimmers.

Motivational Constructs

There was no evidence that the BF-Q techniques affected TASK motivation, autonomy (AUT), or intrinsic motivation (IM) as originally hypothesized. The only significant result for motivational changes was a greater decrease in overall TASK motivation for both the Low BF-Q and Low Control groups as compared to the High BF-Q and High Control groups. Although there were no significant changes in AUT and IM, the results are theoretically meaningful and will be discussed within a context of motor learning research, goal perspective theory, and questioning / metacognitive literature.

Decrease in TASK Motivation

Both low skilled groups (BF-Q and Control) decreased significantly more than the high skilled groups over the course of the study, although it is interesting to note that all four groups decreased in overall TASK motivation. Seasonal trends are the most logical

explanation for both these results, as one coach remarked, "Of course motivation decreases; everyone starts the season out all excited" (High Control coach).

The winter swim 'year' consists of two smaller seasons : short course 25 m pool meets (September to February) and long course 50 m pool events (March to July). The groups in the present study traveled to major competitions at the end of November (at post test) and in February or early March (at transfer). By definition, TASK motivation involves a focus on improvement, mastery, and learning (Duda, 1993, 1998). The beginning of the season should have facilitated high TASK motivation as athletes regained fitness and focused on TECH. However, as competition assumed top priority, TASK motivation may have diminished and no longer dominated swimmers' foci. As Swain and Harwood (1996) stated, a goal " 'orientation' means only a 'proneness to a type of involvement. It does not guarantee that 'state of involvement' in a particular situation" (p. 112). Decreased TASK motivation most logically accrued as a result of increased competition which is inherently norm-referent, and performance oriented (Duda, 1998; Swain & Harwood, 1996). This would be particularly true for lower skilled swimmers who demand more TECH work early in the season than higher skilled athletes. One athlete mentioned at the post test, "He's making it harder for us. At the beginning of the year it was easier and now it's getting more difficult" (Low Control swimmer). A larger discrepancy between mastery and competitive situations would naturally occur for lower skilled swimmers throughout the season.

Higher skilled swimmers train more consistently throughout the year toward competitive goals, therefore it would be expected to see more consistent TASK levels.

As one swimmer emphasized, "If you are in the top squad of your club you are there for a reason. You are there for swimming – that is what you DO" (High BF-Q swimmer).

The significant decrease in TASK motivation for the lower skilled groups can be logically explained by seasonal variables. Still, the decrease in TASK contradicted the hypothesis that BF-Q would facilitate increased TASK in conjunction with higher perceived AUT and IM. Several explanations for these results are now presented.

TASK Motivation Ceiling Effect and the TEOSQ

Initial TASK motivation levels may have limited the effect of the BF-Q intervention. All groups were high in TASK motivation at the outset of the study, the lowest mean being 3.91 out of 5.00. Quite simply, the athletes may not have increased their TASK motivation levels far beyond the Pre test scores, particularly with the 5-point Likert scale of the TEOSQ.

Recent research outlines several concerns regarding the sensitivity of the TEOSQ, goal orientation categorization (Kudar, Weinberg, and Barak, 1997) and the definition of the different goal orientations (Berlant & Weiss, 1997; Swain & Harwood, 1996). The apparent ceiling effect of TASK in this study may support these observations. It is possible the TEOSQ was not sensitive or extensive enough to adequately measure TASK. Also, the TEOSQ is a general instrument that can be applied to any sport and it may be worthwhile to consider sport-specific items that would describe TASK motivation (Swain & Harwood, 1996).

TASK, IM, and AUT : Metacognition and Questioning

No significant changes (except TASK motivation as discussed above) were reported for the motivational constructs during the course of the study. The hypotheses predicted several motivational consequences of using BF-Q techniques, namely increased TASK motivation, AUT (self-regulation) and IM through a medium of self-reflection, problem-solving, and metacognitive awareness. Since BF-Q methods were employed by the coaches, why were there no observed changes in TASK, AUT or IM ?

Recall the comment made by Sacheva (1996) that, "The types of questions and the manner in which questions are asked have a direct impact on the effectiveness of the questioning" (p. 17). The literature specifies that reflexive or reflective questioning be used in order to stimulate metacognition, problem-solving, self-awareness, and subsequent autonomy of thought (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Dominowski, 1998; Dozier, Hicks, Cornille, & Peterson, 1998; Poskiparta, Kettunen, & Liimatainen, 1998; Tomm, 1987). This level of questioning probes beyond basic knowledge to the processes that discover, retain, and synthesize that knowledge. For example, in place of asking "Where does your hand enter in freestyle ?" a coach would inquire, "How are you thinking about your hand entry in freestyle ?"

Critical to this explanation is the differentiation between cognition (knowing) and metacognition (knowing about knowing) (Hacker, 1998; Flavell, 1971). The coaches used questions that targeted athlete cognition – for example, what they knew about stroke technique, what strategies they used to swim faster in races, and why they were required to swim certain sets. The questions appeared to increase cognitive effort as evidenced by

performance improvement. However, it could be argued that in order to establish a link between psychological (e.g. motivational) constructs and cognition, "metacognitive effort" is required. Lee, Swinnen, and Serrien (1994) made a similar claim when they stated, "...the instructor is faced with roles of both assisting the learner with the skill and educating the learner about learning" (p. 341).

Why is this metacognitive knowledge so important in linking cognition to motivation ? The answer relates directly to the positive effects of cognitive strategies on motor performance. Using cognitive strategies (e.g. BF-Q) improves long-term retention, performance and transfer of skills (Halpern, 1998; Hesketh, 1997; Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997; Lee, Swinnen, & Serrien, 1994; Schmidt, 1991; Vickers, Livingston, Umeris-Bohnert, & Holden,1999; Weeks & Kordus, 1998). However, a paradox exists. Although long-term improvement is facilitated by cognitive methods, short-term performance is slowed and may even digress. As Hesketh (1997) stated, "...cognitive factors that are known to be effective in facilitating transfer are effortful, and unless handled carefully, may have unintended motivational consequences" (p. 317-318). In other words, if coaches use cognitive methods without informing athletes of the long-term benefits, athletes may lose the desire to strive for mastery and improvement (TASK), experience helplessness and loss of self-regulation over their progress (AUT), and cease to enjoy their sport (IM). Metacognitive strategies teach awareness of cognitive processes – including learning processes – so athletes can understand, prepare for, and take control over their own cognitive development. "The development of expertise is any area requires deliberate, effortful, and intense cognitive work. Learners need to understand and be prepared for the effortful nature of ... thinking

so they do not abandon the process too soon, believing that thinking should have been easier or accomplished more quickly" (Halpern, 1998, p. 452). In the present study, there was no evidence that extensive reflective / reflexive questioning occurred, therefore it is not surprising that TASK, AUT, and IM did not increase.

Motivational Conclusions

The only significant motivational result was a larger decrease in overall TASK for the low skilled groups compared to the high skilled groups. The BF-Q intervention did not appear to influence TASK motivation, IM, or AUT. The type of questioning used by the coaches is the most plausible reason why the motivational constructs were not affected. Questions focused on concrete areas of swimming such as stroke improvement, race evaluation, and training cycles, not on the processes of self-reflection or knowledge of cognitive processes. According to the literature, these are critical processes for higher level thinking and awareness which should ultimately affect the motivational variables (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Dominowski, 1998; Dozier, Hicks, Cornille, & Peterson, 1998; Glaubman, Glauban, & Ofir, 1997; Hesketh, 1997; Poskiparta, Kettunen, & Liimatainen, 1998; Tomm, 1987).

Decision Training (DT) Related to Competitive Swim Performance and Motivation

The results supported Decision Training (DT) in respect to significant performance changes in swim cTIME and technique (TECH) for the BF-Q groups.

However, the expected significant increases in motivational constructs (i.e. TASK motivation, AUT, and IM) predicted by DT were not apparent. The following discusses these results in a context of DT.

Competitive Swim Time (cTIME) and DT

DT was designed to foster improved performance, higher cognitive effort, greater athlete motivation, and athlete autonomy in transfer situations (Vickers, 1999, 2000; Vickers & Bales, 1996 a, b, c; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999; Vickers, Reeves, Chambers, & Martell, in progress). Competitive swim times (cTIME) for the Low BF-Q athletes did not improve from Pre - Post but improved significantly from Post - Transfer as predicted by DT. Vickers et al. (1999) described this, "...sustained depression in performance during early acquisition, which ranged from 3 to 6 weeks..." (p. 364). According to DT, this reversal occurred because of the increased cognitive effort required in practices. The demand of increased cognitive effort from the athletes would cause a plateau or decrement in performance in the short term that would rebound over the long term. The significant improvement in cTIME from Post – Transfer for the Low BF-Q group supported this claim. Although the High BF-G group improved the most out of all the groups, the swimmers did not demonstrate the pattern of improvement predicted by DT. However, evidence discussed from the interviews suggested that the High BF-Q coach used some DT (BF-Q) techniques prior to the study, therefore negating their full effects during the study.

Cognitive Effort, TASK Motivation, AUT, IM, and DT

It is important to note that no formal tests were run that measured the cognitive effort of athletes during the study. This was due to the absence of cognitive effort tests developed for motor activity settings. Therefore, beyond what was reported in the qualitative interviews, no measures were available for this dimension of DT.

DT also predicted increases in athlete AUT, TASK, and IM but these hypotheses was not supported. Indeed, TASK declined for all groups over the course of the study, and significantly more for the Low skilled groups than the High skilled groups. This may have been affected by ceiling effects of athlete TASK motivation, restrictions of the instruments used to measure TASK, AUT, and IM, and the inherent nature of the swim season. Swimmers started the season with higher levels of motivation, particularly TASK, but decreased as the season focused more on competition and racing. The swim year began in September, but competition was not emphasized until December (Post tests). The short course (25 m pool races) season peaked at the end of February (Transfer tests) with Provincial and National championships. A drop in TASK motivation, AUT, and IM in conjunction with increased competition has been supported by research in swimming (Pelletier, Fortier, Vallerand, & Briere in Vallerand & Rousseau, 2001; Petherick & Weigand in Duda & Hall, 2001) and other sports (Vallerand, & Rousseau, 2001; Vallerand, Gauvin, & Halliwell, 1986).

The BF-Q intervention (DT method) required higher levels of cognitive effort, as discussed in the literature. Interviews indirectly supported this claim, as athletes expressed general dislike of having to think for themselves in practice. The process was

effortful and some athletes may have resisted the encouragement for increased autonomy (AUT) or TASK motivation (Halpern, 1998; Hesketh, 1997; Vickers, 1999, 2000, in press; Vickers & Bales, 1996 a, b,c). Interviews suggested this was true for many swimmers in the study, as one athlete poignantly stated, "I would rather the coach tell me so then I don't have to think" (High Control swimmer). Athletes in all groups were consistent in their desire for coach-dominated instruction. However, the primary reason for this appeared to be a lack of perceived knowledge of the sport. Most athletes conceded that when they reached higher levels of swimming they would "definitely want more input because I will know what works for me and what doesn't" (Low BF-Q swimmer). One of the major goals of DT is that athletes become more responsible for their own development. But the reluctance of some to accept this challenge has been widely observed in coaches' reports of using DT in other sports (Vickers, 2000, in press; Vickers & Bales, 1996 a, b, c). The main reason for requiring higher levels of autonomy (self-regulation) is that all athletes have to compete alone and make critical decisions without their coaches.

DT coaching methods encourage greater athlete cognitive effort with the intention of increasing knowledge of the sport and raising AUT, TASK motivation, and intrinsic motivation (IM), over time (Vickers, 1999, 2000; Vickers & Bales, 1996 a, b, c; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999). It is possible that the present study measured the increase in cognitive effort as demonstrated by cTIME improvement, but was not of sufficient length to measure subsequent motivational changes.

Conclusions

The current study endeavored to establish a relationship between BF-Q coaching techniques and several performance and motivational variables. The BF-Q intervention affected the High and Low BF-Q groups differently, with the Low BF-Q swimmers indicating improvement that supported current motor learning research (Janelle, Barba, Frehlich, Tennant, and Cauraugh, 1997; Lee, Serrien, & Swinnen, 1994; Salmoni, Schmidt, & Walter, 1984; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999). TECH improved during the Pre - Post period at the expense of competitive performance. The opposite occurred during the Post - Transfer period when cTIMES for the Low BF-Q group improved dramatically. The High BF-Q group improved their cTIMES the most overall. Possible explanations for group differences included diverse questions and foci of the coaches and level of swimmers; perception (or lack thereof) of changes in coaching behaviour; and the preexistence of questioning techniques by the High BF-Q coach.

The only significant result related to motivational variables was a significantly larger decrease in TASK for the Low skilled groups than the High skilled groups. This was explained by seasonal variables, primarily a changing focus as the competition approached.

Just as the type of BF-Q employed may have affected performance patterns, the same was true for motivational results. There is a strong theoretical link between cognition and motivation or psychological variables, however it was not upheld in the present study. According to recent literature, metacognition - and more specifically self-reflection and reflexivity of thought - may be the missing link between the cognition and

motivation (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Dominowski, 1998; Dozier, Hicks, Cornille, & Peterson, 1998; Glaubman, Glauban, & Ofir, 1997; Hesketh, 1997; Poskiparta, Kettunen, & Liimatainen, 1998; Tomm, 1987). Since the BF-Q techniques observed by the coaches did not stimulate this level of thinking and reflection, then it was no surprise that TASK motivation, AUT, and IM did not increase.

Decision Training (DT) supported the results in respect to performance (cTIME and TECH) improvements for the BF-Q groups and increased athlete cognitive effort. Since the BF-Q intervention significantly affected long-term competitive swim performance (cTIME) for the BF-Q groups, it is possible that subsequent motivational changes simply required a greater period of time to take effect. It is also possible that the effortful nature of cognitive skills and the increasing competitive focus of the swim season prevented significant changes in TASK motivation, autonomy (AUT), and intrinsic motivation (IM). Evidence from interviews suggested this may have been particularly relevant to the youth age group. Athletes did not want more autonomy or self-responsibility at the time of the study, but they agreed this would change as they achieved higher levels in swimming and acquired more in-depth knowledge of the sport. The results concurred with the research that predicted long term versus short term benefits of using DT methods (Vickers, 1999, 2000; Vickers & Bales, 1996 a, b, c; Vickers, Livingston, Umeris-Bohnert, & Holden, 1999).

This study was the first to directly examine questioning methods and in particular the interplay between bandwidth feedback and inquiry. Recent research in coaching expertise supports the use of questioning methods in coaching. In a study by Abraham (1997), "...the most controversial finding ... was that expert coaches would question

more and instruct less than non-expert coaches" (in Abraham & Collins, 1998, p. 66). Claxton (1988) found a similar result when studying novice versus elite tennis coaches and mused that, "Questioning has been discussed as a valid teaching strategy in many texts, but its value in coaching may have not yet been realized. More study needs to be made of questioning as a valuable coaching strategy" (p. 308). The present study embarked on this work. Implications of current motor learning research suggest that questioning methods are ideally paired with bandwidth feedback techniques. The results of this study validated that BF-Q methods do have potential to improve performance. However, this is only the beginning of an unlimited area of research. In the next chapter, limitations of the present study and suggestions for future research will be detailed.

CHAPTER SIX

LIMITATIONS AND FUTURE DIRECTIONS

Questioning, and in particular BF-Q coaching methods have not previously been investigated in sport. Due to the groundbreaking nature of this study, there are a myriad of research directions possible. Limitations of the present study are discussed first, supplemented with suggestions for improvements in future studies. Following the limitations are more elaborate suggestions for research directions in questioning and coaching.

Limitations

Sample Size

All efforts were made to include a maximum number of swimmers within the constraints of existing swim groups and age criteria. However, the number of variables measured and the emergence of two distinct swim levels substantially decreased the sample size. In future, it would be beneficial to increase the cross section of participants (e.g. include more clubs and groups) or run the study in a longitudinal format, repeating the tests over a period of months or years with the same athletes.

The repeated measures and larger cross section would help reduce the effects of seasonal interruptions, as well. It would be advised that future studies adopting a Pre - Post - Transfer design ensure strategic planning of test periods. Although this was

assumed for the present study, starting earlier in the season would have been beneficial. The Post and Transfer tests conflicted with holidays and meets – two precursors to absenteeism.

Attrition Rate

Another limitation of this study was the high overall-average attrition rate (28 %). Swimmers who dropped out of the club, who were absent for all test dates, or who moved to other groups were not represented in the results. Therefore, the swimmers who were included in the study may represent the most dedicated athletes. This could have affected the measurements of motivation and performance. Studying coaching interventions that are effective on highly motivated athletes will not contribute to knowledge about methods that can be employed to keep less motivated athletes in sport. It may be worthwhile in the future, to track those participants who drop out of the study as well as those who remain in the groups.

Nature of the Sport

The complexity of swimming presented several challenges that should be considered in other research. cTIMES were measured using a compilation of strokes that best represented swimmers' strengths. However, this rendered the comparison of raw times impossible. Limiting the measurement to one stroke would severely restrict sample

size because of specialization effects. Swimmers often start the season off with a large repertoire of races but quickly reduce those to a small number of "best" events.

In the present study 400 free was used for TECH and pTIMES. However, the other standard event required by higher level meets is 200 IM (all strokes) and may be a better choice for use in future studies as it provides a more rounded view of swim ability. Also, TECH should include all strokes, but involve less intricate TECH points on the evaluation form.

One further sport-specific issue is worth mentioning. Swimmers spend the majority of their time training in the water. This creates a natural delay of feedback because coaches cannot provide immediate information to athletes who are submerged or swimming in the middle of the pool. Bandwidth feedback, therefore, may occur naturally in the swimming environment, thus dampening the strength of it's effectiveness in the intervention.

It is suggested that future studies examine questioning and BF-Q methods in other sports, particularly where measurement options are less complex and there is not a high degree of "natural" Decision Training (i.e. bandwidth feedback) that occurs.

Length of the Study

Two issues related to the length of the study deserve mention. First, the intervention period may have been too brief to affect motivational changes in athletes. Decision Training techniques usually require four to six weeks to take effect (Vickers, 1999, 2000). However, it seems logical to propose this time period may be extended in a

field setting where the intervention is only one of a large number of variables affecting athletes during training and racing. In future, long term studies involving cognitive methods may consider implementing an extended intervention period, particularly if the study takes place in a field setting.

The second issue relates to the time allotted for coaches to learn and adopt the new coaching methods. Considering the effects of a cognitive intervention require four to six weeks to take effect, it is doubtful that the teaching techniques involved can be adopted more quickly. It is recommended that in future, the training of the coaches also take place over an extended period with increased opportunity for practical application of the theory.

Random Assignment of Groups

In the present study, groups were randomly assigned to the BF-Q and Control groups. This method may not be appropriate for complex studies involving established sport clubs. It is recommended that researchers assign groups to experimental conditions following pretests that establish variable baselines. Variability and standard deviations of motivational and performance variables, gender differences, and other factors may cause random assignment to be a serious limitation.

Gender Effects

Gender is another variable that should be considered when assigning groups. The literature supports gender differences for TASK and IM (Duda, 1998; Duda & Hall, 2001; Newton & Duda, 1993; Stephens, 1998) therefore the ratio of males and females in experimental groups merits consideration to ensure accurate results.

Ensuring maximal parallels between experimental and control groups will strengthen the validity of results. This is especially true when studying sports with pre existing groups.

Experimental Design

Three topics related to the experimental design deserve mention. Although these areas did not severely limit the study, improving their use may facilitate more accurate results in the future.

Bandwidth feedback and questioning were linked in this study. Therefore, it is not possible to state conclusively if it was the absence of direct feedback or the increase in questioning that created the observed effects. To determine this, four groups could be included in future studies : a Bandwidth Feedback only group, a Questioning only group, a Bandwidth feedback and Questioning group, and a Control group.

The Pre – Post – Transfer design of the present study allowed for the determination of transfer effects. It may be worthwhile including an extended transfer test in future studies, as modeled by other motor learning research (Schmidt, 1992;

Vickers, 1999; Weeks & Kordus, 1998). This would allow for a more complete investigation of possible transfer effects.

The present study also used qualitative methods (interviews) to supplement the quantitative results. Pertinent information related to athlete perceptions, coach interpretations, and athlete-coach relationships was gleaned from the interviews. It is highly recommended that more rigorous qualitative methods supplement future studies. This is particularly important when dealing with motivational concepts that have been touted as 'ill defined', for example goal orientations (Berland & Weiss, 1997; Graham & Golan, 1991; Pintrich, 2000; Swain & Harwood, 1996). The sole use of questionnaires to measure these concepts may fail to provide a complete synopsis of the intervention effects.

Limitation Synopsis

The present study possessed a number of limiting factors related to the number of participants, measurements of experimental variables, and experimental design. However, these are all areas that can be improved upon in future research. Some limitations are unavoidable when conducting research in a new area. Major recommendations for reducing the limitations of the present study include studying BF-Q interventions in diverse sports, increasing sample size or adopting longitudinal experimental designs, and maximizing the use and rigor of qualitative methods.

Pertinent directions for future research are now discussed.

Future Directions

In light of the results from the present study, several primary research directions deserve consideration.

Future studies should be more sensitive to the type of BF-Q techniques – not only the quantity of feedback and questioning. In particular, the literature strongly supports the use of more reflexive / reflective methods for establishing links between cognition and motivation (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Dominowski, 1998; Dozier, Hicks, Cornille, & Peterson, 1998; Poskiparta, Kettunen, & Liimatainen, 1998; Tomm, 1987). It is recommended that specific instructional guidelines accompany the study of these BW-Q types. For example, questioning or "inquiry" methods are used in outdoor education (Hammerman & Priest, 1989; Hammerman, Hammerman, & Hammerman, 1994), counseling (Dozier, Hicks, Cornille, & Peterson, 1998; Poskiparta, Kettunen, & Liimatainen, 1998; Tomm, 1987), metacognition / cognitive science and education (Dominowski, 1998; Graeser, Pearson, & Huber, 1993) and medical / dental education Knight, Guensel, & Feil, 1997; Sacheva, 1996). Despite the extensive use of these methods, there is little empirical research that has studied the effectiveness of different questioning methods. Examination of different types and processes of BF-Q techniques in a sport context is warranted, based on the implications from existing literature and the results of the present study.

Goal perspective theorists also note that more long-term studies are needed that manipulate motivational climate and goal orientations (Duda, 1992, 1996; Ntoumanis & Biddle, 1999). Considering the strong theoretical links between cognitive methods and

the current definition of goal orientations, continuing research that investigates relationships between these constructs would be recommended. It is also suggested that in the future, researchers consider other variables linked to goal perspective theory and motivation in general such as perceived competence, anxiety / competitive stress, intrinsic and extrinsic motivations, and social-cognitive facilitation (Duda, 1996, 1998; Heyman & Dweck, 1992; Pensgaard & Roberts, 2000; Vallerand, 1996; Vallerand, Gauvin, & Halliwell, 1986). Social facilitation, for example, is particularly important in the study of kids / youth sport (Duda, 1993, 1998; Roberts, 1993; Swain & Harwood, 1996; Vallerand, 1997).

In light of the current results another direction for future research would be to link other Decision Training tools with BF-Q and study the motivational consequences. For example, BF-Q methods coupled with video feedback or modeling may enhance the effectiveness of the techniques (e.g. Vickers, Livingston, Umeris-Bohnert, & Holden, 1999).

DT emphasizes the increased stimulation of athlete cognitive effort, however there are currently no instruments to measure cognitive effort in sport or physical activity settingings. In order to establish quantitative relationships between cognitive effort and performance, motivation, and coach-athlete relationships it is suggested that an instrument be developed that measures cognitive effort in sport.

The final recommendation returns to the nature and type of questioning. There are a number of questioning taxonomies in education, Bloom's being the most pervasive and well-known system (Glaubman, Glaubman, & Ofir, 1997; Sacheva, 1996). However, anecdotal evidence from observing coaches and interviewing athletes suggests that sport

may necessitate the development of specific measurements for questions related to motor skills, training, and physical development. As discussed, there are categories of technical, tactical, and personal questions specifically related to swimming that emerged among the different coaches in the study. In order to effectively study the impact of questioning in a sport environment, a 'sport questioning taxonomy' may need to be developed.

Future Directions : Conclusions

The research possibilities are infinite in new areas of study. However, results of the present study suggest the above topics merit study based on their potential to build a solid foundation from which to base questioning and BF-Q literature upon in sport. In light of the theoretical links and current results, the type of questioning and 'process of inquiry' used to elicit specific performance and motivational results should be studied in more depth. Also, employing longer interventions may yield more significant links between cognitive coaching methods and goal orientations, intrinsic / extrinsic motivations, and self regulation. Finally, it would be worthwhile to develop a taxonomy of question types and methods that are sport specific. This may aid in streamlining future study in this new area. As mentioned by Abraham (1997) and Claxton (1988), questioning methods are used in coaching, and used by some of the most effective coaches. Considering that questioning has been touted, "the single most important teaching method" (Thomas, 2000) future development of questioning taxonomies / methods and combinations with other Decision Training or cognitive methods (e.g.

feedback variations, modeling, hard-first instruction) may lead to substantial advances in systems of coaching and training in sport.

According to this study, Bandwidth Feedback-Questioning methods have the potential to positively affect athlete performance in sport. In the future, we must strive to develop optimal methods for using these strategies in order to tap the motivational and social areas of youth sport.

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APPENDIX A

UC
THE UNIVERSITY OF
CALGARY
Faculty of Kinesiology

Dear Parent / Guardian,

The following information pertains to a research study being conducted by a Masters Degree Candidate from the University of Calgary, with adolescent athletes from your son / daughter's swim club. Participation in the study is entirely voluntary. If, after reading the following information, your son / daughter would like to participate in the study and you support their participation, please read and sign the two enclosed consent forms. One of the copies of the consent should be retained by yourself for future reference. The other copy should be given to your son / daughter's swim coach who will pass it on to the researcher.

The study will look at the performance and motivational effects of using questioning as a coaching method to assist in giving athletes feedback. Changes in swimming performance and motivation will be measured using questionnaires, video, and interviews. All data will remain confidential and anonymous. Two groups will experience questioning feedback while two groups will act as controls with no change in coaching method. Research design consideration requires the swimmers not be aware of the group they are in. The groups will be randomly assigned to a condition.

This is a new area in sport research as questioning has never been studied before in the sport realm ! For more specific information pertaining to the study, see the enclosed participant informed consent form. However, if you have any other questions, please, do not hesitate to contact the researcher, Kristine Chambers at 210-4744 or Dr. Joan Vickers are 220-3420.

Sincerely,

Kristine Chambers

Masters Degree Candidate / Researcher
E-mail : klchambe@ucalgary.ca

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CALGARY
Faculty of Kinesiology

Participant Informed Consent

Questioning in Coaching : Increasing Autonomy, Motivation, and Coach-athlete Communication

INVESTIGATORS : Kristine Chambers, Dr. Joan Vickers

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

PURPOSE

The purpose of this study is to examine the effects of "questioning" as a coaching technique in competitive swimming. Theoretically, if coaches ask athletes questions about their performance, their thought processes, and their training, the athletes may perceive more control (or self regulation) over their athletic development. Higher perceived control, or autonomy, may in turn raise an athlete's motivation and enjoyment of the sport. This chain of events may also (positively) affect an athlete's performance.

This study builds on research that advocates reducing direct feedback (and encouraging self-feedback skills) from the coach as athletes become more skilled in their sport. Guiding athletes in their own problem solving, error correction, and self-feedback skills raises their level of knowledge about the sport. Questioning techniques are widely used in education, counseling, and psychology but have never been studied in sport. Therefore, another purpose of the study is to evaluate whether questioning techniques from other disciplines will be as effective in the sport realm.

MEASUREMENTS AND PROCEDURES

This study involves four coaches of adolescent competitive swim groups. All coaches will be videotaped in a regular coaching session prior to the start of the project. Following the taping, all athletes will fill out several questionnaires that measure motivation and level of control that the athletes feel they experience in swimming. Several athletes will also be interviewed about the above topics in order for the researcher to gain further insight not offered by the questionnaires. Swimming times will be recorded as performance measures. Swimmers will also be videotaped to evaluate stroke technique.

Two coaches will then be involved in a training session that will teach them questioning techniques. The other two coaches will be used as controls (or comparisons) and not learn questioning. Following the training, the two coaches will try and use the techniques for six weeks of training, during which the researcher will video tape random practices. The control group coaches will coach as normal for six weeks, and also be videotaped at random training sessions.

At the end of the six weeks all athletes will again fill out the questionnaires and be interviewed. Finally, two weeks after this last testing session there will be a "transfer test". This will involve one last videotaped session of the coach at a swim meet and final performance measures of the athletes (times and video of technique). The purpose of a transfer test is to measure whether questioning had any long term effects on the coaches and athletes.

PARTICIPATION DETAILS

Participants will receive six weeks of training with a focus on freestyle technique by certified swim club coaches. Instruction may involve coaching using questioning as a method of giving feedback or it may involve traditional coaching. The final session will conclude with a swim meet in which all swimmers are invited to take part. During a pre-test prior to the study, a post-test after six weeks, and after the swim meet, participants will be timed in 400 Free, fill out two questionnaires, and be videotaped in order to evaluate stroke technique. The videos will be viewed only by the research team and at no time will participants be identified by name. A random selection of athletes will also be interviewed (four from each group) at these three different times.

During random practices throughout the study, the coaches will be videotaped. These videos will focus only on the coach and be viewed only by the research team in order to analyze the questions being asked.

All athletes and coaches will be told about the study beforehand and will have access to the final report when it is complete. The athletes will not be told whether they are in the control or experimental groups until the end of the eight weeks. If any of the coaches or athletes require additional information or wish to withdraw from the study they may do so at any time.

RISKS

There are no additional risks to participants, other than those normally associated with swimming. All participants will receive quality coaching and providing they follow the directions given by the coach and lifeguards, the inherent risks associated with swimming will be kept at a minimum.

BENEFITS

All swimmers may experience improvement in swimming ability . On completion of the study, all swimmers will be told the exact details of the research and each club will receive a copy of the finished report once the analyses are complete and written up. The club will have the opportunity to obtain the stroke technique videos for use in video feedback, at no cost except copying charges. The clubs will also have access to the booklets used to teach questioning if they are interested in using it in their program.

CONFIDENTIALITY

Participant information and data collected in this experiment are confidential. All information in questionnaires and interviews will remain anonymous and none shall be released without your written consent. The information, however, may be used for statistical analysis for scientific purposes with your right to privacy retained.

The videotapes and interviews will be viewed and listened to only by the research team. Any information the researcher decides to write in the final report will be sent to the athletes first to confirm interpretation and meaning. Any information an athlete wishes to be excluded from the report will be honoured. All athletes, coaches, and parents will have access to the final report.

FREEDOM OF CONSENT

In the event that you suffer injury as a result of participating in this research no compensation will be provided to you by the University of Calgary, the Faculty of Kinesiology, or the researchers. You still have all your legal rights. Nothing said here about treatment or compensation in any way alters your right to recover damages.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time without jeopardizing your participation in further research or your participation in the swim club. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact :

Kristine Chambers 210-4744 (H)
Dr. Joan Vickers 220-3420

If you have questions concerning your rights as possible participants in this research, please contact the Office of the Office of Medical Bioethics, Faculty of Medicine, University of Calgary, at 220-7990.

Participant's Signature	Date
Parent / Guardian's Signature	Date
Investigator's Signature	Date
Witness' Signature	Date

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APPENDIX B

Questioning Coding Sheet

Name of Coach

Club

Date

Description of Practice

DATA FEEDBACK		Total
Individual Corrective		
Group Corrective		
Individual Positive		
Group Positive		
Negative		
TOTAL FB		
FB statements / minute		

DATA QUESTIONING				Total
To individual				
To group				
Answered (athlete)				
Asked by athletes				
TOTAL QUESTIONS (asked by coach)				
Questions / Minute				

NOTES ...

NOTES ...

BANDWIDTH FB : DT Tool 3	n/a	1	2	3	4	5
Reduced Frequency						
Delayed						
Summary						
Bandwidth						
Fading						

QUESTIONING : DT Tool 4	n/a	1	2	3	4	5
Frequent						
Challenging / Probing						
Reflective / Reflexive						
Appropriate						
Athlete Engaged						

APPENDIX C

Questioning in Coaching ...an overview...

by Kristine Chambers
MSc Candidate, University of Calgary

INTRODUCING QUESTIONING

When was the last time you asked a question ? Most likely sometime in the last few hours.

Questioning is...

...one of the more common elements of communication. It is used to inquire, to discover, to interrogate, to accuse, to praise, to sympathize, to probe.

However, the "art of questioning" is more complicated than a "how're ya doin' today". In this booklet, questioning will be introduced as a "tool of coaching". It is already used extensively in education, counseling, psychology, nursing, and medicine, among other areas.

You no doubt recall a time when, happily daydreaming in class, the teacher woke you up with a poignant "...so what do YOU think about what we just discussed ????"

"In the skillful use of the question more than in anything else lies the fine art of teaching; for in its use we have the guide to clear and vivid ideas, the quick spur to imagination, the stimulus to thought, the incentive to action."

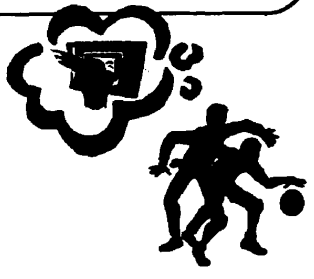
Charles DeGarmo, 1911 (Hunkins, 1976, p. 226)

Think about it. Coaches are teachers. Generally, we think of coaches as "physical" trainers, responsible for imparting motor skills and techniques upon their athletes. Sometimes we forget the huge role that psychological and cognitive processes play in sport - in the learning of skills, the performing of those skills, and the transfer of skills to different situations (training, competition, etc.)

Current trends are starting to place more emphasis on the psychological and cognitive areas of sport. Questioning, in the context of this project, deals more with the cognitive realm.

Cognition is ...

- ..."*the scientific study of how we use perception, attention, memory, problem solving, and decision making in our daily lives.*" (Vickers, 2000)
- ...or...*how we think about the world that we see, hear, feel, and experience.*
- ...and *how we decide our reactions and actions to our environment.*
- ...in sport...*perceiving performance variables (strengths, weaknesses), competition strategies, decision making, techniques, etc.*



COACHING METHODS : PAST AND PRESENT

Behavioural training (BT) is ...

...the *traditional method of coaching that emphasizes the physical dimensions of performance.* BT uses high levels of feedback, easy to hard progressions, high level of coach control, and low athlete involvement in decision making / error detection and correction / performance details. (Vickers, 2000)

Since BT produces immediate improvements in performance it appeared to be the best approach. However ... recent research shows that athletes who are trained using BT methods are unable to maintain a high level of performance in the long term. Skills learned in a BT environment are not performed successfully in transfer situations. In other words performance falls sharply over time and in novel environments (e.g. competitions).

Why does this happen ? Recent research suggests that lack of cognitive training may be part of the answer. In light of this, a new method of coaching has evolved called Decision Training (DT) (Vickers, 2000).

DECISION TRAINING : THE TOOLBOX

Decision Training (DT) is ...

"...a method of coaching aimed at developing self-aware, responsible, autonomous, informed athletes who are able to make critical decisions and perform under pressure with the maximum flexibility and consistency in performance." (Vickers, 2000).

Questioning is one of seven tools contained in the "DT Toolbox". A brief explanation of DT is necessary to understand the exact role of questioning in coaching.

In contrast to BT (behavioural training), DT emphasizes lower levels of (reduced) feedback, hard first instruction, increased coach-athlete communication, joint (athlete-coach) decision making, and increased athlete involvement in error detection and correction, performance and training.

Great teachers don't teach. They help students learn. Students teach themselves.
Jacob Neusner (Thompson, 1995, p. 69)

When using DT, initial progress is slower than seen with BT. However, over the long term, DT produces larger overall performance gains that are highly transferable with (e.g. to novel environments such as competitions).

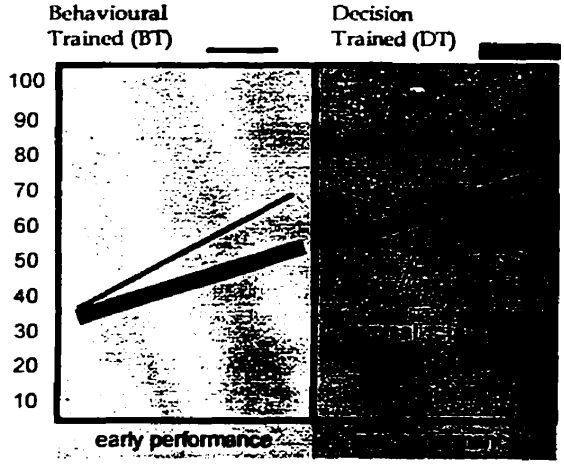


Figure 1. Recent research shows a reversal in long term performance when BT is used. The opposite is true when DT is used. Progress is slower at first, but greater as training progresses. (Vickers, 2000, p. 11)

THE ROLE OF QUESTIONING

Questioning is closely related to the DT Tool called Bandwidth Feedback. This tool advocates reducing and delaying feedback in a bandwidth style.

A bandwidth is...

"...a zone of "acceptable performance" as set by the coach." (Vickers,2000, in press). When an athlete performs outside the bandwidth, feedback (FB) is given. If they perform within the limits, no feedback is given.

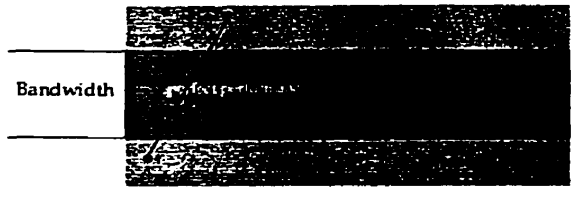


Figure 2. Example of a bandwidth. Feedback is given only when performance falls outside of the bandwidth.

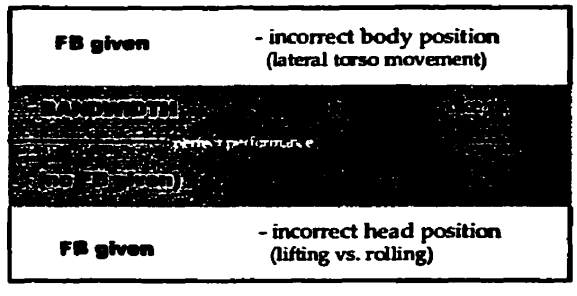


Figure 3. Example of a theoretical bandwidth for freestyle during a technical workout focusing on streamlining (novice level).

The purpose of using bandwidth FB is to gradually increase the awareness of the athlete (think critically about their performance) rather than becoming dependent on the coach.

But will athletes automatically start analyzing performance variables simply by "not receiving FB" ? No... research shows they actually feel neglected by the coach as communication is decreased. Questioning can remedy this problem.

Questioning fills the "FB delay". Coaches can use questions to probe athletes' understanding of their sport and increase their problem solving abilities.

FROM QUESTIONING TO MOTIVATION

If a coach reduces feedback and increases questioning then athletes will be required to take more responsibility for their performance and improvement (e.g. through recognizing strengths and weaknesses, creating their own strategies, and related tasks).

If athletes are suddenly required to devote extra attention to problem solving (as opposed to simply applying feedback from the coach) their focus shifts. They are forced to concentrate on the PROCESS of their training to a greater degree. This causes a concurrent shift in goal structures... and goals are a key tenant of motivation.

Motivation involves...

"... energizing and directing behaviour toward a goal." (Myers, 1995; Roberts, 1992). There are different types of motivation. Achievement motivation is particularly relevant in sport.

Achievement motivation is ...

*"...a desire for significant **achievement**, for **mastering new skills** or ideas, for **control**, and for ... attaining a high standard."* (Murray, 1938 in Myers, 1995, p. 419).

Sport is an "achievement-based environment". In other words, achieving goals is paramount - whether they be focussed on performance, technique, skill, or other elements of the sport. Research has uncovered two primary "goal orientations" that operate in an achievement environment. Below are the primary characteristics of each goal orientation.

Task Goal Orientation	Ego Goal Orientation
• focus on learning, improving and mastering skills	• focus on performing better than others (particularly with reduced effort)
• ability is self-referenced (not compared to others)	• ability is norm-referenced (compared to others)
• related to high levels of satisfaction and intrinsic motivation	• related to high levels of anxiety - performance worry
• is linked with persistence (especially in the face of difficulty)	• linked with sport drop out (when combined with low task orientation)
• athletes are highly self-regulated (autonomous/ responsible)	• limits # of athletes likely to excel (i.e. only one can win)

PUTTING THE PUZZLE TOGETHER

Task and ego orientations are NOT opposites. Someone can be high in both, low in both, or have varying degrees of both. Here is the clincher. Task orientation has positive effects on motivation, performance, longevity in sport, and enjoyment of sport REGARDLESS of ego orientation. So, athletes could be high in ego orientation but as long as they are ALSO HIGH IN TASK ORIENTATION the same benefits will be recognized. This has important implications for coaches.

Task orientation is the key. If coaches use methods that increase the task orientation of their athletes, then the positive benefits of this goal structure should emerge.

Here is how the puzzle fits together.

Puzzle Piece #1
Encouraging athletes to be *task oriented* translates to more *focus on improvement, mastery, and learning.*

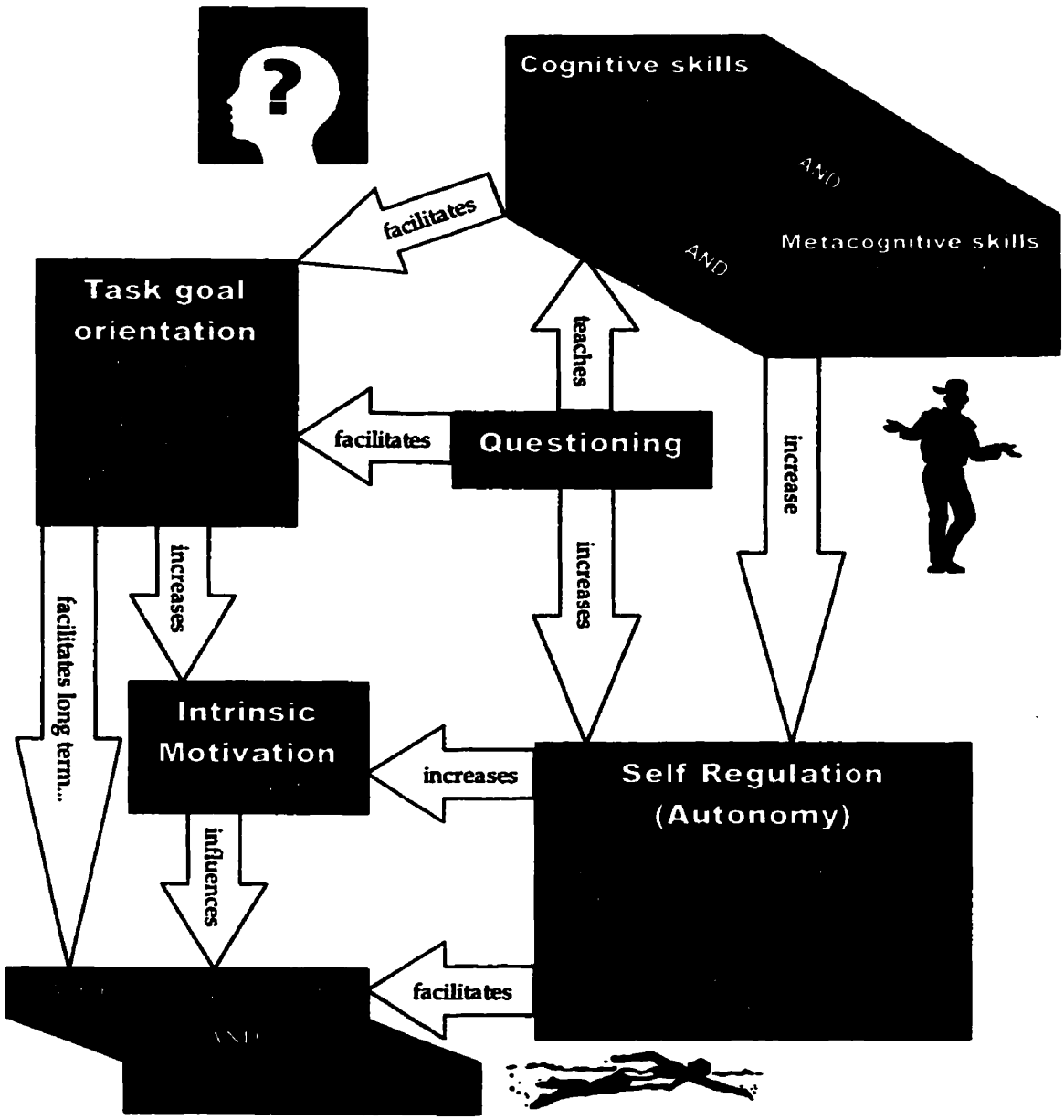
Puzzle Piece #2
If an athlete is focused on the above goals they take more responsibility (assume more control/autonomy) over their development in sport. Athletes who are autonomous or *self-regulated* have been shown to *enjoy* their *sport more* (intrinsic motivation).

Puzzle Piece #3
If athletes *enjoy* their *sport more*, and are *focused on improvement, optimal challenge, and learning* (which can be infinite) then it seems natural to assume they will remain *motivated, stay in sport* longer, and *improve performance.*

Puzzle Piece #4
Focusing on the elements of *task orientation requires cognitive abilities* such as *perception, problem solving,* and *decision making* ... the foundations of DT and questioning. Therefore, using questioning to increase the task orientation of athletes should result in increased enjoyment of sport, improved performance, higher levels of personal responsibility (I.e. the ability to make their own decisions and solve problems), and self awareness.

"Athletics are like everything else. I've never seen a great athlete burn out on their sport because they truly love what they're doing. People who get burned out on what they're doing are probably doing it for the wrong reasons."
Steve Hamilton (Hetzel, 1996, p. 34)

THE QUESTIONING PUZZLE



TYPES OF QUESTIONS

"What do you think you're doing coming in late ? Why weren't you on time today ? Better have a good reason for it."

"Can you think of a strategy to use so you get your time after every interval ? "

"Where is your arm at the end of your pull ? What do you think is going to happen if you push the water that way ?"

"What are you THINKING ? Didn't you listen to the instructions ?"

As you can tell from the hypothetical statements above, questioning is not a simple process. Questions themselves can be positive, negative, direct, indirect, probing, or grouped according to level, intent, and responses they evoke. Research in counseling and psychology has investigated different types of questions and their effect on communication, problem solving, and self-regulation. Reflexive questioning has emerged as the most effective method for "mobilizing problem solving resources". (Tomm, 1988, p. 9)

Reflexive questions are...

... driven by a facilitative intent ... that is, they *help learners mobilize their own problem solving resources* (reflection, creativity, self-awareness, evaluation, hypothesis forming, and so on).

Example.
You are introducing a set (5x100) that links drill (streamline side kick, switch every 6) and swim (free). The object is for the swimmers to incorporate what they work on in the drill into the swim.
Set : 100drill - 25swim/75drill - 50 drill/50 swim etc.

Instead of explaining the objectives and telling the swimmers what they need to work on, questioning can be used to have swimmers "discover" the goals of the set.

Some reflexive questions that may be used in this situation are ....

"What do you think is the purpose of this drill ?"
"Can you think of any strategy you can use to remember the purpose while you're swimming ?"
"Why do you think it is important to work on streamlining ?"
"What are some cues you can use in order to think about the drill when you swim ?"

THINKING ABOUT THINKING

Reflexive questioning stimulates metacognitive processes.

Metacognition is ...

"thinking about thinking", or "cognition about cognition", or processes individuals use to monitor and control their learning and understanding.

Research shows that people who are aware of how they think, learn, understand, and problem solve are better able to access information and use it in new situations.

How does this apply to coaching ?

How many times have you been sitting at a swim meet watching an athlete who has been performing perfect technique in practice ... and it "goes to pieces" in competition ? Or, how many times do you have to remind swimmers to "get their times" during a set, or look at the clock, or pay attention to their technique ?

Athletes may "cease to think" when they are not challenged to do so. This often results in a spiral of "not thinking" that leads to increased coach "reminders" and coach frustration.

Questioning gives swimmers control over some of their evaluation and analysis. This reduces the amount of work for the coach. It also requires swimmers to think without demanding them to think. (I.e. The difference between telling a swimmer they need to focus on streamlining and asking them why streamlining is important and how they can focus on it.)

In summary, reflexive questioning evokes...

- ✓ metacognitive processes (self-monitoring, self-evaluation, and self-regulation or change)
- ✓ discovery
- ✓ higher level thinking (why...what if....etc.)
- ✓ summarizing, checking, and predicting
- ✓ problem solving

Reflexive questioning does NOT...

- ✗ demand right answers (or even imply there are any)
- ✗ suggest the coach knows everything
- ✗ accuse athletes of "not knowing" something
- ✗ imply the athletes is "dumb" or ignorant

QUESTIONING SUMMARY

Effective questioning may be used to arouse curiosity, stimulate interest in the topic, clarify concepts, emphasize key points, enhance problem-solving ability, and encourage students [or athletes] to think at higher cognitive levels. Questioning helps motivate students [or athletes] to search for new information and can be utilized to ascertain the levels of students' [or athletes'] abilities."

(Sachdeva, 1996)

Questioning is an amazing tool for coaching. It has the power to influence swimmers' performance, motivation, autonomy, enjoyment of the sport (intrinsic motivation), and communication with the coach, among others.

However, questioning is not as simple as it appears. There is no list of "the right questions to ask" or a prescription for "asking this question if this happens". It is a context-specific method that must be adapted to suit the philosophy and style of the coach who is using it.

Along with the benefits, there are also some problems that may arise when a coach is first introducing questioning.

1. *Time.* If athletes have entered the zone of "non-thinking" it will take time for them to set the cognitive wheels in motion. Their answers may be insufficient, or simply not there ! This requires a great deal of patience on the part of coach to persevere and refrain from "answering for the athletes".

2. *Time.* Asking a question, waiting for a response, modifying that response or probing further takes a lot longer than simply giving feedback. This is especially noticeable when a coach first starts using questioning because they face a combination of the above two problems - or time x 2 ! (Note : this does improve exponentially once swimmers and coaches become comfortable with the method.)

3. *Timing.* Swimming poses an interesting challenge for questioning because of the environment (i.e. athletes spend 70-80% of their time with their faces / ears underwater !). Obviously there are more and less appropriate times to engage in in-depth questioning. A coach must use their discretion in this area - perhaps having a "learning session" before going in the water, and using summary feedback (i.e. after the set and/or practice).

4. *Delayed Results.* Methods that encourage cognitive effort are part of Decision Training. As mentioned before, results are slow to appear in this type of training. In fact, usually there is a DROP in performance (as athletes adjust to the new level of thinking) before it rises. Coaches must be aware of this and not assume the technique is failing. It will succeed over time (4-6 weeks).

5. *Initial Effort.* Questioning requires the coach to use a different approach when instructing. Suddenly they are not solely "in charge" of providing feedback to their athletes, or communicating every detail of a workout. Suddenly they must extract this information from their athletes. Initially this requires a lot of hard thinking ! One must be constantly checking, evaluating, monitoring, and adapting. For example, tone of voice is as important as what question you are asking. Consider the following....

A swimmer complains they "aren't going anywhere" in the water. The coach asks...
"What do you think is holding you back?"

Put the emphasis on "you", soften the end of the sentence and you are asking for the swimmers' opinion. However, if you put the emphasis on "think" with an exaggerated hand motion you seem to be accusing the athlete of not knowing the answer themselves.

Questioning is both an art and a science. If used appropriately it can create a unique and amazing environment. It reduces the responsibility of the coach by placing some of that responsibility on the athletes. Through problem solving and discovery athletes become more engaged in their training. They grow more aware of the sport and more aware of why they are swimming, how they process information, use thinking skills, and transfer these to swimming performance. Probably one of the most important aspects of engaging the athletes is making them feel "good about themselves" as they "discover" swimming through questions and answers. They may enjoy sport more, reach a higher level, and remain lifelong participants.

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APPENDIX D

Stroke Evaluation Form

Swimmer # : _____

* 1 = unskilled (beginner)
  3 = average ability
  5 = highly skilled (expert)

PRETEST

ARM PULL & RECOVERY					
• High shoulder position at the beginning of pull	1	2	3	4	5
• High elbow during catch phase	1	2	3	4	5
• Soft kick or crossover kick pattern (during pull)	1	2	3	4	5
• At midpull, arm is vertical with elbow and hand at shoulder line	1	2	3	4	5
ARM PUSH & RECOVERY PHASE					
• Arms accelerate through push phase	1	2	3	4	5
• Recovering arm enters at the middle of the stroke	1	2	3	4	5
• Elbow exits the water first on recovery	1	2	3	4	5
• Hands "stick" in the water (no slipping)	1	2	3	4	5
OVERALL					
• Body position is flat and high	1	2	3	4	5
• 1-3 leg kicks during one arm cycle (timing)	1	2	3	4	5
• Moves forward during stroke (as much as possible)	1	2	3	4	5
• Timing of breathing (inhale with recovery & pull)	1	2	3	4	5
• Stroke length (longer is better)	1	2	3	4	5

POST TEST

ARM PULL & RECOVERY					
• High shoulder position at the beginning of pull	1	2	3	4	5
• High elbow during catch phase	1	2	3	4	5
• Soft kick or crossover kick pattern (during pull)	1	2	3	4	5
• At midpull, arm is vertical with elbow and hand at shoulder line	1	2	3	4	5
ARM PUSH & RECOVERY PHASE					
• Arms accelerate through push phase	1	2	3	4	5
• Recovering arm enters at the middle of the stroke	1	2	3	4	5
• Elbow exits the water first on recovery	1	2	3	4	5
• Hands "stick" in the water (no slipping)	1	2	3	4	5
OVERALL					
• Body position is flat and high	1	2	3	4	5
• 1-3 leg kicks during one arm cycle (timing)	1	2	3	4	5
• Moves forward during stroke (as much as possible)	1	2	3	4	5
• Timing of breathing (inhale with recovery & pull)	1	2	3	4	5
• Stroke length (longer is better)	1	2	3	4	5

TRANSFER

ARM PULL & RECOVERY					
• High shoulder position at the beginning of pull	1	2	3	4	5
• High elbow during catch phase	1	2	3	4	5
• Soft kick or crossover kick pattern (during pull)	1	2	3	4	5
• At midpull, arm is vertical with elbow and hand at shoulder line	1	2	3	4	5
ARM PUSH & RECOVERY PHASE					
• Arms accelerate through push phase	1	2	3	4	5
• Recovering arm enters at the middle of the stroke	1	2	3	4	5
• Elbow exits the water first on recovery	1	2	3	4	5
• Hands "stick" in the water (no slipping)	1	2	3	4	5
OVERALL					
• Body position is flat and high	1	2	3	4	5
• 1-3 leg kicks during one arm cycle (timing)	1	2	3	4	5
• Moves forward during stroke (as much as possible)	1	2	3	4	5
• Timing of breathing (inhale with recovery & pull)	1	2	3	4	5
• Stroke length (longer is better)	1	2	3	4	5

Comments :

_____

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APPENDIX E

Items contained in the Task and Ego Orientation in Sport Subscales (Duda, 1993)

Task Orientation

"I feel most successful in "swimming" when . . ."

...I learn a new skill and it makes me want to practice more.

...I learn something that is fun to do.

...I learn a new skill by trying hard.

... I work really hard.

...Something I learn makes me want to go and practice more.

...A skill I learn really feels right.

...I do my very best.

Ego Orientation

"I feel most successful in "swimming" when . . ."

...I'm the only one who can do the play or skill.

...I can do better than my friends.

...The others can't do as well as me.

...Others mess up and I don't.

...I score the most points / goals, etc.

...I'm the best.

Answers are scored on a 5-point Likert scale with number one labeled "Never", number three labeled "sometimes", and number five labeled "always".

APPENDIX F

Items on The Sport Motivation Scale

(Pelletier, Fortier, Tuson, Briere, & Blais, 1995)

Why Do You Practice Your Sport ? (i.e. Swimming)

Using the scale below, please indicate to what extent each of the following items corresponds to one of the reasons for which you are presently practicing your sport.

1. For the pleasure I feel in living exciting experiences.
2. For the pleasure it gives me to know more about the sport that I practice.
3. I used to have good reasons for doing sports, but now I am asking myself if I should continue doing it.
4. For the pleasure of discovering new training techniques.
5. I don't know anymore; I have the impression that I am incapable of succeeding at this sport.
6. Because it allows me to be well regarded by people I know.
7. Because, in my opinion, it is one of the best ways to meet people.
8. Because I feel a lot of personal satisfaction while mastering certain difficult training techniques.
9. Because it is absolutely necessary to do sports if one wants to be in shape.
10. For the prestige of being an athlete.
11. Because it is one of the best ways I have chosen to develop other aspects of myself.
12. For the pleasure of I feel while improving some of my weak points.
13. For the excitement I feel when I am really involved in activity.

14. Because I must do sports to feel good about myself.
15. For the satisfaction I experience while I am perfecting my abilities.
16. Because people around me think it is important to be in shape.
17. Because it is a good way to learn lots of things which could be useful to me in other areas of my life.
18. For the intense emotions I that I feel while I am doing a sport that I like.
19. It is not clear to me anymore; I don't think my place is in sport.
20. For the pleasure that I feel while executing certain difficult movements.
21. Because I would feel bad if I was not taking time to do it.
22. To show others how good I am at my sport.
23. For the pleasure I feel while learning training techniques that I have never tried before.
24. Because it is one of the best ways to maintain good relationships with my friends.
25. Because I like the feeling of being immersed in the activity.
26. Because I must do sports regularly.
27. For the pleasure of discovering new performance strategies.
28. I often ask myself; I can't seem to achieve my goals that I set for myself.

Responses are answered on a 7-point Likert scale with numbers one and two under the label of "does not correspond at all", numbers three, four, and five under the label of "corresponds moderately", and numbers six and seven under the label of "corresponds exactly".

APPENDIX G

Interview Questions

1. State your name, age, the number of years you have been involved in competitive swimming, and your level.

2. What motivates you to train in the pool ?

3. What aspects of swimming do you enjoy the most ? Why ?

4. Is there anything you do not enjoy about swimming ? Why ?

5. Do you have any input into your own training, like correcting your strokes or monitoring your performance ?

6. Would you like to have some input or do you prefer to be told what to do by a coach ?

7. Do you know a lot about swimming, like stroke techniques, methods of training, and that sort of thing ? If not, would you like to learn more ? If so, how do you use that knowledge when you swim ?

8. Do you ever compare yourself with others - e.g. speed, technique, performance, etc. ? If so, do you do it often ?

9. In a typical practice, what do you think about most often when you swim ?

10. Do you ever ask the coach about swimming ? If so, what kinds of things do you ask about ? If not, why ?

11. Describe your idea of "the perfect race".

12. What do you think makes a really good coach? What do you feel makes a bad coach ?

13. If you could change some things about swimming what would they be and why ?

*14. Have you noticed any changes in "Name"'s coaching style over the past few months ?

*15. Does your coach ask you more questions or ask you about more 'things' that they did at the start of the season ?

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* Questions 14 and 15 were asked at Post and Transfer tests only.

Questions 2 through 4 and 13 targeted all the dependent variables. Questions 5, 6, 10, and 12 targeted autonomy, with 12 including an element (the coach) of motivational climate. Questions 7, 8, 9, and 11 were designed to stimulate goal orientation discourse. Question 11 offered insight into all the variables, but was targeted toward performance and goal orientations. The questions were worded informally, in some instances, to make them more palatable to the adolescent age group.

At Post and Transfer tests, the questions were modified to inquire about changes in the athletes perceptions. For example, a supplement to question one was, "Has anything changed about what motivates you to train in the pool, or come to swimming everyday ?"