The impact of training in groups on individual athletic performance: Possible mediation of group cohesion.

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It seems appropriate (to me anyhow) that a Thesis that examines group cohesion and performance should recognise the assistance of others in getting the big T completed. So here goes! The list of those contained below is not an exhaustive list, rather it contains those that most obviously helped me.

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☺

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Abstract.

Previous literature has shown that there is a positive relationship between cohesion and performance in team-based sports. The reported research extends this relationship in two ways. First the relationship between cohesion and performance was investigated in training groups of two individually-oriented sports (running and cycling). Second, individual performance in a group, with reference to cohesion, was compared to individual performance alone. Two independent studies assessed the relationship between task and social cohesion, as measured by the Group Environment Questionnaire, and performance. Study One related cohesion to athletic performance of 132 runners in a half-marathon running race. Study Two examined the relationship between cohesion and training effectiveness, as measured by recorded heart rate, amongst 17 road cyclists. These studies found that (a) social cohesion was not significantly related to performance; (b) task cohesion was positively correlated to performance, but only in Study Two; and (c) individual training is associated with significantly higher athletic performance than training in groups with low task cohesion, but is no better than training in a high task cohesion group. These results are discussed with reference to previous cohesion and exercise physiology literature, leading to conclusions being made at both a theoretical and an applied level.

1. Introduction.

1.1. Cohesion and sport.

The manner in which individuals perform a task when in small groups compared to when alone has been of interest since Triplett (1898) demonstrated that cyclists riding together ride faster than cyclists riding alone. One factor that has been advanced to explain the performance in a small group is the construct of cohesion. The present research sets out to explore the relationship of cohesion and performance within individual athletic sports. Previously cohesion has been studied in the sports psychology literature by examining the cohesion-performance relationship within sports teams (e.g. basketball). More recent literature (e.g. Carron, Widmeyer & Brawley, 1988; Spink & Carron, 1993) have extended the research into the link between cohesion and performance to include more individualistic sports (e.g. fitness classes). This study aims to extend the research one step further by looking at cohesion and performance within the training groups of individual athletes. Although these athletes compete as individuals, they often train with others; therefore, task performance may be dependant upon the quality of the training completed with others If so, the degree of the cohesiveness of the training group may be related to effectiveness of the training.

The aforementioned extensions of the cohesion research are dealt with in this chapter, by firstly defining what cohesion is, and how it can be measured. Then the relationship between cohesion and performance is examined, with regard to social and task cohesion, as well as the level of task interdependence that a sport has. Finally, conclusions are made as to the circumstances in which cohesion and performance are related. Conclusions about how cohesion and performance could be associated with reference to the training groups of endurance runners and road cyclists.

1.2. Defining and measuring cohesion.

It is far easier to illustrate what cohesion is than to actually define it. Cohesion is often colloquially described as that sense of 'us' or 'we-ness' that binds a group together (Mudrack, 1989b). *Prima facie* the impact that cohesion has is easy to illustrate. Little searching is required before a group, such as a sports team, is found that exudes a sense of 'us'. However, formal definitions of cohesion tend to be more problematic. Initially much of the cohesion research tried to define and operationalise a single concept of cohesion. Such research can be referred to as being an illustration of an unitary model of cohesion. More recently, there has been a recognition that cohesion is most likely to be multidimensional in nature. This section reviews the issues of what cohesion is, and how it could be measured with reference to these models of cohesion.

1.2.1. Unitary models of cohesion.

A unitary model of cohesion is a theoretical model that attempts to show that there is one underlying process that explains group cohesion (Hogg, 1992). It is recognised that there may be different motives as to why a group is cohesive (Spink, 1990b), but it is argued that the outcome of the existence of group cohesion is of greater importance than exactly what caused the cohesion in the first instance (Piper, Marrache, Lacroix, Richardsen and Jones, 1983). For example, Schacter (1951) stated that "whether cohesiveness is based on friendship, the valance of the activity mediated by the group, or group prestige, the consequences of increasing group cohesiveness are identical" (p.192).

Early unitary definitions of cohesion used the metaphor of an atom to describe cohesion (Mudrack, 1989b; Hogg 1987, 1992). This metaphor describes the individual members of the group as the atoms, and the cohesion acting upon these individuals as the interatomic forces. Festinger, Schacter and Back (1950) provided the definitive 'atom-based' definition of cohesion: "the total field of forces which act on members to remain in the group" (p.164). Included in these forces were interpersonal liking and group task attraction. Although this definition remains highly influential, and has helped shape how cohesion has been measured (Cota, Evans, Dion, Kilik & Longman, 1995), it has also been subject to much criticism, based upon three issues. Firstly, it was thought that operationalising a total field of forces was impossible (Mudrack, 1989b), due to the overly general nature of the definition (Carron, 1980). Some researchers have unsuccessfully attempted to operationalise a field of forces as a measure of cohesion. For example, Hagstrom and Selvin (1965) separated the components that comprise the field of forces, namely interpersonal attraction and group task attraction, and Gross (1957 in Cota *et al.*, 1995) attempted to operationalise the 'total field of forces' by using these specific components of cohesion suggested by Festinger *et al.* (1950). Neither approach led to a successful operationalisation of a field of forces (Cota *et al.*, 1995).

The next common criticism of the Festinger *et al.* (1950) definition of cohesion is that the definition focuses upon the individual at the expense of the group. In this respect Gross and Martin (1952a) argued that it would be better to view cohesion as "the resistance of a group to disruptive forces" (p.553). They felt that this was a better definition because it addressed what kept groups together, whereas the Festinger model focuses only upon the individual, and how the group impacts upon them (Carron, 1980). Consequently, the Gross and Martin (1952a) definition of cohesion has proved to be of limited value. Firstly, it has proved impossible to operationalise 'disruptive forces'. Herein lies one of the biggest difficulties in measuring cohesion. Cohesion is the property of the group, and thus should be measured at the level of the group and not the level of the individual (Mudrack, 1989a). Thus operationalising cohesion as disruptive forces would be one way of more accurately assessing cohesion at the level of the group. However, there are still no measures that assess the cohesion of the group *per se*, rather cohesion is almost universally measured by utilising aggregates of individual reports of cohesion, such as attraction-to-group (ATG) measures (*Ibid*, 1989a). A further limitation of the Gross and Martin definition of cohesion is that recent research has indicated that measurement of cohesion should include measurement at both the group and the individual level (Carron, Widmeyer & Brawley, 1985; Cota *et al.*, 1995; Mudrack, 1989a, 1989b). The need to distinguish between the group and the individual is addressed soon.

Finally, Festinger *et al.* (1950) have been criticised for only operationlising the 'field of forces' by solely assessing interpersonal attraction. This is not a criticism of their definition of cohesion *per se*, rather a criticism of the methodology that they used to measure it. Attraction appears to have been operationalised as the measure of cohesion by researchers such as Festinger *et al.* (1950) because of the "apparent futility of measuring, weighting, and combining all the factors that attract members to a group" (Carron *et al.*, 1985, p.245). The futility of operationalising a field of forces is reflected in a subtle shift of the definition of cohesion by Festinger (1950), when he redefined cohesion to be "the resultant of all forces acting on members to remain in the group" (p.274). This led to cohesion being conceptualised as the sum or average of forces acting upon individuals to stay in a group (Mudrack, 1989a). Hogg (1992) noted that this led to cohesion often being operationalised in terms of attraction. Cartwright (1968) reviewed this cohesion measured as attraction research, and concluded that there were five general methods by which cohesion had been assessed as attraction (also see Lott & Lott, 1965).

Studies that have investigated the degree of *interpersonal attraction amongst members* have done so on the assumption that a group will be more cohesive the more group members like each other (e.g. Festinger *et al.,* 1950; but see review by Lott & Lott, 1965). The *evaluation of a group as a whole* refers to a the degree of attraction that an individual has to the group as a whole, as opposed to the individual members of the group (e.g. Bovard, 1951). The degree of *closeness or identification with a group* shows the strength of member identification or personal involvement with the group (e.g. Converse & Campbell, 1968). Schacter (1951) measured the *expressed desire to remain in the group* amongst members of 'clubs', that were formed for the experiment. Questions that assessed this desire to remain in the group were asked of participants (e.g. Do you want to remain a member of this group?). Finally, attraction has often been measured in the past by means of a *composite index* of some or all of the methods already described. These composite indexes have been used extensively in the study of cohesion in sport (e.g. Ball & Carron, 1976; Carron & Ball, 1977; Landers & Luschen, 1974; Martens & Peterson, 1971; Melnick & Chemers, 1974; Peterson & Martens, 1972; Williams & Hacker, 1982).

The assumption that attraction and cohesion were the same thing has been severely criticised because it is an incomplete representation of the construct. Mudrack (1989a) noted that whilst this approach to cohesion measurement is easy to define, it is a poor representation of cohesion as it focuses entirely on individuals to the exclusion of the group, thus ignoring one of the major considerations of small group analysis, namely the need to distinguish between the individual and the group. Likewise, Carron (1980) highlighted the fact that operationlising cohesion as attraction underrepresents the concept because there are other factors beyond simple attraction to other group members which may also play a role in an individual staying in a group. Escovar and Sim (1974) stated that some of these factors could include task forces (e.g. group goals), personal forces (e.g. personal rewards associated with group membership) and normative forces (e.g. societal or pragmatic reasons for staying in the group).

There are a few other common criticisms of treating attraction as synonymous with cohesion. Firstly, operationalising cohesion as attraction fails to consider cohesion in situations of negative affect (Hogg, 1992). In other words, group members may not like each other, yet the group can be maintained (Carron, 1980), as demonstrated by ingroup bias (Hogg, 1987), and the group still being able to unite attain goals (e.g. Lenk, 1969). A related issue refers to the formation of groups. Escovar and Sim (1974) stated that attraction is not a pre-requisite in group formation. There are many other reasons as to why a group might be formed. For example, Sherif and Sherif (1953) showed that two groups of boys, who were fiercely competitive against each another, worked together in order to solve common problems. Finally, Carron and Chelladurai (1979, in Carron 1980) observed that if attraction is the sole basis for cohesion, then in larger groups cliques could form, detracting from the overall group cohesion levels.

It is therefore possible to conclude that none of the methods that have attempted to measure cohesion as a unitary construct have adequately represented the construct. To summarise, these methods that have treated cohesion as unidimensional have suffered problems either in terms of difficulties associated with operationalising the model of cohesion that has been proposed (e.g. field of forces), or in that the representation of cohesion appears to be incomplete (e.g. interpersonal attraction). In addition, it is difficult to compare the findings, as these studies have operationalised cohesion in a variety of different manners. Moreover, Carron *et al.* (1985) questioned the methodological soundness of many of these studies, when they noted that:

> "Most of these measures were devised by the researcher and were rarely if ever subjected to psychometric analyses to establish their reliability and validity" (p.246).

Furthermore, Zaccaro and McCoy (1988) suggested that unitary models of cohesion "obscure and obfuscate" (p.848) the relationship between the component forces of cohesion that act upon group membership and maintenance. In any case, multidimensional models of cohesion appear to be more consistent with what is known about the structure of cohesion (Cota *et al.*, 1995). Thus it seems more logical to attempt to define and measure cohesion by describing it in terms of a multidimensional construct.

1.2.2. Multidimensional models of cohesion.

Multidimensional models of cohesion propose that cohesion consists of two or more independent dimensions. Theorists (e.g. Hackman, 1976) have argued that cohesion should be viewed from a multidimensional perspective, due to the differing consequences for individual productivity, group performance, and norm development for the different dimensions of cohesion. There are, however, no firm conclusions as to the number of separate dimensions that represent cohesion. For example, Peterson and Martens (1972) identified three different dimensions, Yukelson, Weinberg and Jackson (1984) identified four dimensions, and Gruber and Gray (1981) concluded that cohesion consisted of six independent dimensions. More commonly, however, it has been recognised that there are two key dimensions that help explain the nature of group cohesion, namely *task* cohesion and *social* cohesion. The rest of this section attempts to demonstrate that cohesion can best be described in terms of both the task-social dimension and the individual-group dimension, which has previously been alluded to.

There is much literature that has suggested that group cohesion should be conceived of in terms of both task related processes and socially related processes (e.g. Anderson, 1975; Carron & Chelladurai, 1981; Hagstrom & Selvin, 1965; Zaccaro & McCoy, 1988). Such a distinction is congruent both with the more general group dynamics literature, which is concerned with the locomotion and cohesion of groups (Lewin, 1935), and earlier conceptualisations of how cohesion should be measured (e.g. Festinger *et al.*, 1950). Mikalachki (1969) proposed that the task related processes of cohesion were the degree to which a group works together in order to achieve their goals. Group membership is perceived as mediating the attainment of task-related personal goals (Festinger *et al.,* 1950). Socially related cohesion reflects the degree of intramember liking (Cox, 1990), and pertains to a group focusing upon maintaining harmonious social relations (Hogg, 1992). It may not be possible for a group to simultaneously be both task and socially oriented, as focusing upon attaining one inhibits achievement of the other (Carron & Chelladurai, 1981).

The other commonly identified dimension of cohesion is the distinction between the group and the individual. Shaw (1974) nicely summarised the need for such a distinction, when he described a group as being different than the sum of the needs of the individual due to individuals behaving differently in a group situation because of different stimuli. Likewise, it has often been acknowledged in the cohesion literature that there should be a distinction between the group and the individual. For example, Van Bergan and Koekebakker (1959) distinguished between these two concepts when they defined ATG as "the interaction of motives working on the individual to stay in the group" and cohesion as "the degree of unification of the group field". Evans and Jarvis (1980) also agree that there should be a distinction between interpersonal attraction and cohesion. They noted that the measure of cohesion seemed to be a measure of closeness or bonding or similarity. Thus measurement of cohesion would best be accomplished by a measure of variability that noted differences in individual member bonding etc. compared to the group mean. On the other hand, the degree of interpersonal attraction is the summation of the feelings of individual members. Logically this is best assessed by a measure of central tendency. Hence, from a conceptual viewpoint, there is a need to account for differences between the group and the individual.

It has also been suggested that there is a third dimension of cohesion, which has been labelled a *normative force* (Cota *et al.*, 1995). A normative force can be conceived of as a dimension that maximises intergroup differences and minimises intragroup differences (Hogg, 1992). Carron (1980) suggested that normative forces are particularly important for defining cohesion within sporting groups, which this research focuses upon. For example, Carron and Chelladurai (1979) suggested that normative forces were instrumental in keeping athletes in a team due to strong restraining forces which prevent the athlete from leaving the team (e.g. transfer rules, geographical location, social stigma associated with quitting). Others, however, have questioned whether normative forces should be considered as a separate dimension of cohesion. Hogg (1992) noted that is difficult to assess whether normative forces are a separate dimension of cohesion because the manner in which these forces work psychologically has not been explored. Moreover, Mullen and Copper (1994) failed to find that any normative force was a separate, independent predictor of cohesion, in a meta-analysis of cohesion literature.

Thus it can be concluded that the differences between social cohesion and task cohesion and the need to distinguish between the group and the individual are the two major defining dimensions of cohesion[1]. Research that combined the task-social

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[1] Some (e.g. Cota *et al.*, 1995) have argued that cohesion should be defined in terms of general dimensions and situation specific (e.g. sport specific) dimensions. However, conceiving of cohesion in such a manner can be criticised for resorting to reductionism in order to satisfactorily explain the cohesion construct (e.g. Hogg, 1992).

and group-individual distinctions that define cohesion was carried out by Carron *et al.*, (1985), in a manner positively relevant to the current sports-based research. They developed an instrument to measure cohesion in sports teams, named the Group Environment Questionnaire (GEQ). Ostrow (1990) noted that the purpose of the GEQ is to:

> "assess the task and social aspects of an individual's perceptions of a sport group as a totality and the individual's attraction to the group, as they relate to the development and maintenance of group cohesion" (p.125).

The GEQ consists of four subscales. These subscales assess both an individual's perception of a group as a totality (group integration), and their personal attraction to that group (attraction to group). On both of these issues an individual can be focused on either the task or social aspects of the group (Carron *et al.,* 1985). The subscales are labelled *attraction to the group - task (ATG-T); attraction to the group - social (ATG-S); group integration -task (GI-T);* and *group integration - social (GI-S).* Although it has just been recognised that cohesion should be measured in a manner that accounts for the distinction between the needs of the individual and the group, the present study considers only the task-social distinction. Whilst recent studies of group cohesion have often assessed cohesion at both the level of the group and the individual, much of the earlier (attraction-based) cohesion research assessed cohesion only at the individual level thus making it difficult to compare research. Therefore, the two subscales of ATG-T and GI-T were combined, to provide a measure of task cohesion. Likewise, the measure of social cohesion is provided by combining ATG-S and GI-S.

Compared to earlier attempts to measure cohesion, the GEQ appears to provide a comprehensive representation of the cohesion construct. For example, Hogg (1992) observed that the GEQ is superior to other sports-based cohesion questionnaires, due to the rigorous nature of its design and the high intra scale reliability, and Cota *et al.* (1995, p.576) noted that:

> "The most impressive finding is that GEQ subscale scores have separate and meaningful patterns of correlations with variables that are important to group functioning and performance, such as adherence to group meetings and attributions for group failure."

The *raison d'etre* of research that has attempted to measure cohesion, such as the research of Carron *et al.* (1985), appears to be a desire to be able to relate cohesion to performance. There is often an intuitive link between cohesion and performance in small groups, which is understandable given that the construct of cohesion is a construct used to explain group functioning. This relationship between these variables are examined in the following section.

1.3. Cohesion and performance.

Performance has been cited as a consequence of cohesion by various reviewers of the cohesion literature (e.g. Lott & Lott, 1965; Carron, 1980; Hogg, 1992). An intuitive link exists between cohesion and task performance, as it is easy to conceive that higher levels of cohesion would be associated with better task performance (e.g. Zander, 1974). This intuitive link between cohesion and performance is also reflected in the cohesion literature. For example, Mudrack (1989a) observed that some researchers (e.g. Straub, 1975) have attempted to show that cohesion is the *sine qua non* of task performance. However, there is no straightfoward linear relationship between cohesion and performance (Carron & Chelladurai, 1981). Indeed, findings from the cohesion-performance relationship are so equivocal that some reviewers (e.g. Stogdill, 1972) have observed that the two are not positively related (but see Mudrack, 1989b). However, recent reviews and research point to cohesion and performance being related, but only in certain circumstances.

Some previous researchers have proposed that the cohesion and performance relationship can be explained if the multidimensional nature of cohesion is taken into account (e.g. Zaccaro & McCoy, 1988), because task and social cohesion have differing emphases in terms of goal focus, and thus should have differing consequences for task performance (e.g. McGrath, 1962). Others have proposed that accounting for the degree of intramember interdependence helps explain previous inconsistencies in the cohesion-performance literature (e.g. Landers & Luschen, 1974), because only those sports with the highest needs for intramember coordination (e.g. basketball) require cohesion to aid (sic) task performance (Carron & Chelladurai, 1981). A better way of accounting for previous inconsistencies in the cohesion-performance relationship than individually applying either of the above approaches is to simultaneously consider both the multidimensionality of cohesion and the degree of task interdependence, as will be demonstrated. The remainder of this section reviews previous attempts to explain the cohesion-performance relationship, looking firstly at explanations based upon the (multi)dimensionality of cohesion, then the degree of task interdependence. Then these two differing explanations of how cohesion and performance are related will be linked, thereby accounting for the equivocal nature of previous findings. Congruent with the nature of the current research, this will be done with reference only to previous sports psychology research[2].

1.3.1. Social cohesion and performance.

As previously pointed out, it has been assumed by some researchers that cohesion is the *sine qua non* for successful task performance (Mudrack, 1989a). Thus, much of the early sports based cohesion research, like early general cohesion literature, attempted to show that the level of social cohesion was a cause of performance. This type of methodology led to equivocal findings, and thus the usefulness of measuring the social cohesion-performance link has been questioned by researchers that wish to examine the manner by which cohesion causes increased task performance (sic). In addition, research that has addressed aspects of the social cohesion-performance

[2] The relationship between cohesion and performance can also be addressed in non-sporting contexts in a similar manner, as outlined by Cota *et al.* (1995). Such research is not considered here, however, as it is not directly relevant to the aims of the research.

relationship have assessed social cohesion by a wide variety of measures that have been used interchangeably not only with each other, but also with cohesion *per se* (Carron *et al.*, 1985), thus further complicating comparisons between research.

Some studies show that there is an inverse link between the degree of social cohesion and task performance. For example, Grace (1954) found measures of intramember cooperativeness to be inversely related to team success in high school basketball teams. Likewise, McGrath (1962) also found higher levels of interpersonal attraction to be associated with poorer performance amongst three man rifle teams, as did Landers and Luschen (1974) in a study of bowling teams. Similarly, in a celebrated study of the cohesion-performance issue, Lenk (1969) found that low levels of social cohesion were associated with high levels of performance. He observed the performances of the German national eights rowing team. There were notable tensions within the group due to compatibility problems between members from different clubs, and disagreements about the type of training the team was doing. This almost led to the destruction of the team on several occasions. Quite clearly the rowers that Lenk studied were not friendly with each other. It is an intuitively appealing idea to think that such conflict would prohibit effective task functioning. The opposite was true in this case:

> "The performance did increase and paralleled the sharpness of the conflict during the two years in which the eight existed... The team became unbeaten Olympic champions" (Lenk, 1969, p.395).

However, other researchers have found a positive link between measures of social cohesion and performance. Klein and Christiansen (1969) found a positive relationship between interpersonal liking of teammates and performance success in a study of intercollegiate basketball teams, as did Fiedler (1954). Also, Landers, Wilkinson, Hatfield and Barber (1982) found that a midseason measure of friendship predicted late season performance amongst participants of a basketball league.

It is possible to account for many of the inconsistencies in the social cohesion-performance research if the nature of the task, and specifically the degree of task interdependence involved, is taken into account. Research that has attempted to account for inconsistencies in the social cohesion-performance research using this method will be discussed shortly (e.g. Landers & Luschen, 1974). First, however, the task cohesion-performance relationship will be considered as discrepancies in this research have also been accounted for with regards to the degree of task interdependence. For now, it can be observed that others have suggested that the contradictory nature of the social cohesion-performance research has indicated that social cohesion is not consistently related to performance (Mudrack, 1989b; Cox, 1990). Thus they have concluded that task cohesion should be the sole measure of cohesion as it better ties measurement of cohesion with actual group behaviour and performance.

1.3.2. Task cohesion and performance.

Task based cohesion in sport exists in situations where a team unites around certain performance related goals, with the task normally being the reason that the team was formed (Cox, 1990). In competitive sport the usual goal for a team is to win (Hogg, 1992). Thus, it follows that there should be a relationship between sporting performance and the degree to which a team unites around their goal of winning. Most studies that have looked at the task cohesion-performance relationship show a positive relationship, but there is also research which does not show such a relationship.

Most researchers that have measured the task cohesion-performance relationship have noted a positive relationship. Moreover this finding has been replicated in a number of different sports. For example, Carron, Widmeyer and Brawley (1988), Carron and Spink (1993) and Spink and Carron (1993) amongst exercise class participants; Kim and Sugiyama (1992) amongst school athletic teams; and Widmeyer and Williams (1991) and Williams and Widmeyer (1991) amongst members of golf teams, have all noted that task cohesion, as assessed by the GEQ, and performance are positively related.

Some studies, however, have failed to show a positive relationship between task cohesion and sporting performance. For example, Carron, Widmeyer and Brawley (1988) measured group member adherence, amongst summer recreation sport league (soccer, slowpitch, baseball, basketball and softball) participants, and found no significant relationship between task cohesion and performance. Indeed, social cohesion was a better indicator of member adherence. It is debateable, however, as to whether summer recreation sports should be considered in the same manner as competitive sport, which is task-achievement oriented in nature. For example, Mudrack (1989b) noted that various studies (e.g. Schacter, Ellerston, McBride & Gregory, 1951; Mikalachki, 1969) have indicated that task cohesion appears to be related to performance "only after interacting with a group's orientation towards productivity" (p.774). For example, a group may not have a performance orientation, as opposed to a socially-oriented focus (e.g. McGrath, 1962). It would be patently inaccurate to suggest that all members of all such 'social' league sports have a task achievement orientation (Singer, 1986), as opposed to a socially oriented achievement motivation.

A study conducted by Everett, Smith and Williams (1992), using collegiate swimmers as subjects, was another that failed to find a positive relationship between task cohesion and performance. Some researchers have attempted to explain such findings by considering the nature of the task when interpreting the results of [task] cohesion-performance research (e.g. Landers & Luschen, 1974; Carron & Chelladurai, 1981).

1.3.3. Task interdependence and cohesion in sport.

In their review of early cohesion research, Lott and Lott (1965) noted that specific demands of the task (e.g. job specifications) may diminish the interpersonal attraction-performance relationship. An explanation as to how these task demands may alter the cohesion-performance relationship in sports based research was proposed by Landers and Luschen (1974). The limitation with their explanation was that it treated cohesion as an unitary construct. Carron and Chelladurai (1981) later expanded this explanation, taking into account the multidimensional nature of cohesion. The degree to which these proposals accounted for the inconsistent nature of previous cohesion research is reviewed in the rest of this section.

Landers and Luschen (1974) suggested that the rate of interaction amongst group members is the distinguishing factor between those studies that show a cohesion-performance relationship, and those that do not. They argued that a sport that has a high rate of intramember interaction (e.g. basketball) will likely show a cohesion-performance link, whereas a sport that has a lower interaction rate (e.g. bowling) will not. The interaction rate is a function of the manner by which the individual group members efforts are pooled. *Interacting* groups, such as basketball teams, require the input of each group member in order to achieve a successful performance (*Ibid*, 1974), and as such are highly interdependant (Carron, 1980). On the other hand, the performance of a *coacting* group (e.g. bowling) is determined by simple summation of the efforts of each of the individual group members (Landers & Luschen, 1974). These groups do not require high interdependence between members to perform successfully.

Equivocal support exists for the proposals put forth by Landers and Luschen (1974). Many studies that have examined the cohesion-performance relationship in sports with high task interdependence levels have noted a significant relationship (e.g. ; Ball & Carron, 1976; Fiedler, 1954; Klein & Christiansen, 1969; Landers, Wilkinson, Hatfield & Barber, 1982; Martens & Peterson, 1971; Williams & Hacker, 1982). Further support for the proposals of Landers and Luschen (1974) are those studies that did not note a significant cohesion-performance relationship in the sports that were low in task cohesion levels (e.g. Everett *et al.*, 1988; Landers & Luschen, 1974; Lenk, 1969; McGrath, 1962). However, other studies do not provide support for the argument that the cohesion-performance relationship will only be observed in those sports that are high in task cohesion levels. Melnick and Chemers (1974), and Grace (1954) noted that cohesion and performance were not positively related in separate studies that used basketball teams, a sport that is high in task interdependence levels. Likewise, other studies have noted that cohesion and performance are positively related in sports (e.g. golf) that are low in task interdependence levels (e.g. Carron *et al.*, 1988; Carron & Spink, 1993; Kim & Sugiyama, 1992; Spink & Carron, 1993; Widmeyer & Williams, 1991). Thus it is possible to conclude that the degree of task interdependence of a sport is not the sole delineating factor in distinguishing those studies that show a positive cohesion-performance relationship from those that do not.

It appears that the multidimensional nature of cohesion also needs to be considered. For example, Carron and Chelladurai (1981) expanded upon the ideas of Landers and Luschen, as well as the work of Thompson (1967) and Ball (1973), when they suggested that the cohesion-performance question should be considered with regards to two principle issues. Specifically, they proposed that research into the cohesion-performance issue should take into account the multidimensional nature of cohesion and the task interdependence level of the sport in question, as earlier suggested by Landers and Luschen (1974).

As opposed to a dichotomous distinction between interactive and coactive style sports, Carron and Chelladurai (1981) postulated that sports can be classified as having one of four increasing levels of task interdependence (task independence, coactive dependence, reactive-proactive dependence, and interactive dependence). They stated that "cohesiveness is a prerequisite for team success" (p.38) only for those sports with the highest intramember interdependence levels, namely interactive dependence (e.g. basketball). It was felt that the reason for this was that intramember coordinative procedures are of critical importance in determining the task performance of interactively dependant sports. Comparatively, "the level of cohesiveness present among group members is irrelevant" (*Ibid*, 1981, p.38) for the performance of those sports with lesser degrees of task interdependence, due to a lower need for intramember coordinative procedures in order to perform successfully. Moreover, they suggested that the cohesion-performance relationship would only apply for task cohesion, and not for social cohesion. Specifically, it was suggested that "interpersonal attraction is largely immaterial for successful performance" (Carron & Chelladurai, 1981, p.36). This is because social cohesion aids in accruing social rewards, but does not relate to performance (Carron, 1980).

Empirical evidence fails to support the ideas of Carron and Chelladurai (1981). Firstly, previous studies show that there is a positive relationship between social cohesion and performance, provided task interdependence is accounted for. Previous research shows that social cohesion is positively related to performance in those studies that have used sports with high degrees of task interdependence (e.g. Klein & Christiansen, 1969; Fiedler, 1954; Landers *et al.*, 1982), but negatively related to performance in sports with low degrees of task interdependence (e.g. Grace, 1954; Landers & Luschen, 1974; Lenk, 1969; McGrath, 1962). This implies that for the present research social cohesion is not likely to be an important factor when considering task performance, as this research examines the cohesion-performance relationship using sports with low degrees of task interdependence (e.g. running and cycling).

Studies that have considered the task cohesion-performance issue also fail to provide empirical support for Carron and Chelladurai's proposals of a positive cohesion-performance relationship applying only to highly interdependent sports. In particular, there have been many studies that have shown that task cohesion is positively related to performance in sports that are low in task interdependence levels. Such studies include those that found a task cohesion-performance link amongst members of fitness classes (e.g. Carron *et al.*, 1988; Carron & Spink, 1993; Spink & Carron, 1993), golf teams (e.g. Williams & Widmeyer, 1991; Widmeyer & Williams, 1991), and athletic teams (e.g. Kim & Sugiyama, 1992). Admittedly, firmer conclusions cannot be made about the interaction between task cohesion and task interdependence levels, as there is little literature available that directly addressed the task cohesion-performance issue using sports that were high in terms task interdependence. One study, by Carron *et al.* (1988), found an inverse task cohesion-performance relationship amongst sports with higher degrees of task interdependence. As pointed out earlier, this study used social league sports, and it is questionable whether social league sports should be considered in the same manner as competitive sports due to a greater focus upon socially oriented goals (Singer, 1986), which we have seem to inhibit the achievement of task oriented goals (e.g. McGrath, 1962). However, it seems that low interdependence levels do not preclude there being a task cohesion-performance interaction.

Thus, there is little empirical evidence that concurs with Carron and Chelladurai's (1981) proposal that only task cohesion relates to performance and only in interactively dependant sports. Furthermore, it appears that the manner in which they proposed that cohesion and task interdependence were related to sporting performance was erroneous. Mullen and Copper (1994) observed that the implicit assumption behind the argument that the task cohesion-performance relationship would only be observed in those sports with the highest levels of coordination and interdependence seems to be that suboptimal performance in such sports (e.g. hockey) is the result of inadequate intramember coordination. This assumption appears to be mistaken, as based upon the results of their meta-analysis of the cohesion-performance relationship, Mullen and Copper concluded that task cohesion is not improved through enhancing the smooth operation of a group. Of course, this is not implying that enhancing coordination will be of no use in aiding performance. Rather, the impact of cohesion upon sporting performance does not seem to be simply a function of having smoother operation of group coordination of interaction (*Ibid*, 1994).

Hogg (1992) suggested reasons that explain why the task interdependence level *per se* does not alter the task cohesion-performance relationship. Hogg is of the opinion that it is "patently inaccurate" (1992, p.145) to theorise that a positive task cohesion-performance relationship will only occur in those sports that are interactively dependant, as other non-interactive teams (e.g. swimming teams) can all logically be highly task cohesive. As just demonstrated, task cohesion does not simply involve individuals coordinating effectively to perform successfully, as suggested by Carron and Chelladurai (1981). Instead, it appears that task cohesion stems from a intramember goal commonality (see Deutsch, 1949; Hogg, 1992).

Thus, it is proposed that task cohesion can occur when group members have the same goals (e.g. Carron, 1982). For example, members of a swimming relay team can be task cohesive if they all share the same objective of winning a relay race (Hogg, 1992). This theory is compatible with existing literature, which has shown that the task cohesion-performance relationship does not occur exclusively in those sports with high task interdependence, but can also be observed amongst sports with low degrees of task interdependence (e.g. Carron & Spink, 1993; Kim & Sugiyama, 1992; Williams & Widmeyer, 1991). It is therefore logical to extend the cohesion-performance relationship one step further. If commonality of goals can lead to task cohesion, it follows that the task cohesion-performance relationship should also apply to the training groups of athletes.

In the present research, the sports studied were long-distance running and road cycling, which are both individualistic in nature during competition. During training, however, many of these athletes train in groups, and it is predicted that the degree of task cohesion of individual athletes in these groups is associated with higher athletic performance. Dissimilarities between individual and team-based sports arise if the nature of task cohesion is considered with reference to competition. Members of team based sports compete together, focused upon a common goal, whereas an individual athlete may even end up competing against their training partners in order to achieve individual goals[3]. This distinction between previous research and the current research could potentially ameliorate any task cohesion-performance relationship. However, as will be demonstrated in the next section, the degree to which athletic training can be considered effective influences the potential competitive performance. Therefore, as task cohesion should be a factor which is associated with superior training, and training is associated with higher performance, it follows that there could be a task cohesion-performance relationship with reference to training groups of runners and cyclists.

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[3] It is also possible that each member of a cycling or running training group could have a 'do-your-best' goal, which would mean that in competition training group partners would not have to compete against each other. Hodge (1994) recommended such a focus upon attaining such personal goals in competition in order to reach maximal individual performance. However, the reality of sports competition is that there is an overwhelming focus upon interpersonal comparison, thus leading to interpersonal competition.

1.4. Group training and individual training.

Despite the implicit assumption behind cohesion research that the whole is greater than the sum of its individual parts (Cox, 1990), previous research has not examined whether individual performance of members of the group is superior to individual efforts *per se*. One obvious reason why this has not occurred is that many of the sports that have been used during cohesion-performance research are team based (e.g. basketball). This makes it difficult to compare performance achieved alone with individual performance within a group, as most team-based sports cannot be performed alone. The sports used in this research, however, do not require the assistance of others to perform the task as they are performed in an individualistic manner. Furthermore it is possible to draw some predictions about the likely nature of individual athletic performance resulting from performing the task alone or in a group situation, based on findings of some related research.

Firstly, there is a body of literature that has indicated that individual performance in a group situation is likely to be higher than a purely individual effort, at least in some circumstances. Triplett (1898) first noted that an individual's task performance is higher when completing the task in the presence of others than when completing the task alone. He observed that cyclists rode 39.55 seconds per mile faster when paced against others than when paced against time. The observation that individual performance is higher in the group situation due to the 'mere presence' (Shaw, 1981) of others was later termed the *social facilitation* effect (e.g. Allport, 1920). Recent research has replicated this effect (e.g. Sorrentino and Sheppard, 1978; Williams, Nida, Baca and Latane, 1989).

However, other research has demonstrated that the presence of others can lead to *social inhibition*, a performance decrement associated with a perceived overly high level of self-attention (see Mullen & Baumeister, 1987). Zajonc (1965) accounted for the contradictory nature of the social facilitation and the social inhibition literature, when he noted that the presence of others, both co-actors and audience (Mullen &

Baumeister, 1987), is associated with increased arousal levels. For simple or well-learned tasks this arousal facilitates task performance, but for complex or poorly learned tasks the increased arousal associated with the presence of others is associated with social inhibition (also see Griffith, Fichman and Moreland, 1989; Paulus, 1983). As the present research assesses performance using the sports of running or cycling, both of which involve the repetition of a well-learnt biomechanical process, it would be expected that the presence of others would be associated with increased performance by these athletes.

Whilst the social facilitation research has demonstrated that individual performance within a group is higher than when alone for tasks such as training for running or cycling, it does not specify the manner in which task cohesion is related to the performance of the individual in the group. One study has directly compared the task performance of individuals and the performance of individuals in groups with reference to the degree of task cohesion in the group. Everett *et al.* (1992) looked at cohesion and performance in a study that used a group of collegiate swimmers by grouping the swimmers into relay teams. This study showed that task cohesion was negatively and significantly related to social loafing, or low task performance.

It may be problematic to accept this finding as a general rule as it applied to females only, whereas males showed no significant difference between task cohesion and task performance. Moreover, the finding only applied to females if their performance was identifiable in the relay situation. The contradictory nature of these findings may be a function of the experimental design of the study, which involved the creation of *ad-hoc* relay teams. Mullen and Copper (1994) noted that the task cohesion-performance relationship is much weaker if the group is *ad-hoc*, than if the group is a real group. Nonetheless, it is not possible to make firm conclusions about the performance resulting from competing either in a group or as an individual based solely upon the equivocal results of the Everett *et al.* (1992) study.

However, other research provides collaborating evidence for the possibility that task cohesion is associated with the higher individual task performance when performing a task in a group compared to performing a task alone. Carron and Spink (1993) and Spink and Carron (1993) examined the cohesion-performance relationship amongst members of fitness classes after implementation of a team-building exercise. They noted that both the task performance of experimental group members was superior to control group members and task cohesion levels were higher amongst experimental group members than control group members. Therefore, it has been shown that task cohesion is linked with superior individual athletic performance in a sport that, like running and cycling, has low task interdependence levels. It should be noted, however, that the measure of performance for both the control group and the experimental group was assessed in a group situation. Thus, unlike the current research, individual performance was not compared with performance in a group. Nonetheless, if this conclusion is combined with the findings both of Everett *et al* (1992) and social facilitation literature, it seems likely that individual task performance would be lower than the performance of an individual within a group, and that the task performance in the group is associated with task cohesion.

Having just concluded that it appears that task cohesion is related to superior athletic performance arising from completing a task in a group, it is necessary to add a caveat for the present research. As pointed out earlier, this research examines the cohesion-performance relationship in the training groups of the individual sports of running and cycling. For these sports, whilst a members of a group may gain performance benefits associated with cohesiveness when they train together, it may be at physiological cost. In this respect the exercise physiology literature contradicts the conclusions of the cohesion literature as the exercise physiology literature has shown that task performance in individual endurance sports may best be achieved by training alone.

Athletic training for endurance based sports primarily utilises the aerobic energy system. This is the energy system that the body uses when training is completed at intensity levels that enable the primary source of fuel for the body, adenosine triphosphate, to be produced through a chemical process combining oxygen with either carbohydrates or fats (Gollnick, 1988). Training of the aerobic energy system leads to increased cardiorespiratory levels (Hagan, Smith & Gettman, 1981), increased capacity by the muscle fibers to generate adenosine triphosphate[4] (Wilmore & Costill, 1994), and is associated with increased athletic performance (Hagan *et al.*, 1981; Krebs, Zinkgraf & Virgilio, 1986). However, there are individual differences at the rate at which this adaptation takes place.

Rushall and Pyke (1990) suggested that there are underlying principles of training, adherence to which will give the greatest physiological benefit to the individual athlete. One of these principles, the principle of individuality, suggests that the optimal level of training is unique to each individual athlete (e.g. Bowerman, 1974; Wells & Pate, 1988). This is because each individual can tolerate a different amount of training and because it takes individuals differing periods of time to recover from any given training load (Ackland & Reid, 1994). In particular, it appears that the level of intensity of exercise is a critical factor in determining the degree of individual training effectiveness (Maughan, 1994). Training at non-optimal training intensities does not lead to the same increases in fitness levels as does training at optimal training intensity levels. For example, Burke and Franks (1975) observed that low intensity training (65% of maximum heart rate) does not lead to significant increases in cardiorespiratory fitness compared to a control group that did not train. Higher intensity training (75% or 85% maximum heart rate) led to significant increases in fitness compared to both control subjects and those that trained at low intensities (see also Fox, Bartels, Billings, Mathews, Bason & Webb, 1973; Sharkey & Holleman, 1967; Wenger & Bell, 1986). Unless athletes train only with others of very similar fitness levels, they are not going to be experiencing optimal training benefits when training in a group. Therefore it may be best for the performance of athletes to train alone.

Thus it can be seen that the cohesion literature and the exercise physiology literature are antagonistic in the manner that they present methods associated with high task performance. One of the goals of this research is to assess the relationship between

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[4] Improved ability by the body to supply adenosine triphosphate is a function of increased slow-twitch muscle fibre size; increased number of capillaries, increased muscle myoglobin content; increased number and size of muscle mitochondria leading to more efficient oxidative metabolism; and increased muscle triglyceride and muscle glycogen levels (Wilmore & Costill, 1994).

performance and training in either a group or individual situation, so as to find out which is associated with the highest task performance. Although it is an intuitively appealing idea to think that individual performance may be improved by training in a group, there is no direct evidence to support such a claim. Therefore, it appears that exercise physiology principles have greater influence in determining the effectiveness of training in individual endurance based sports than does cohesion.

1.5. The present research.

This research examines two aspects of the relationship between cohesion and sports performance, both of which are an extension over a prototypical sports-based cohesion study. Firstly, it is proposed that a positive task cohesion-performance relationship can be observed in the training groups of athletes, based upon an extension of existing cohesion literature which has shown that task cohesion and performance can be positively related in those sports with low intramember interdependence. Secondly, athletic performance arising from training either alone or in a group is compared, with reference as to the manner in which task cohesion is related to performance in the group.

Two studies were conducted addressing these issues. The first study related group cohesion of training groups of runners to a measure of athletic performance in a half-marathon. The second study looked at the relationship between group cohesion and individual athletic performance amongst the training groups of competitive road cyclists.

2. Study One.

2.1. Introduction.

Study One examines the cohesion-performance relationship with reference to the training groups of long distance runners. Previously, performance of a group or team in competition has been related to measures of cohesion. As long-distance running is an individual sport, it is not possible to measure the performance of the group in competition. However, one of the underlying assumptions of cohesion research is that group cohesiveness can be associated with greater performance than the summation of individual member input (Cox, 1990), due to the group environment enabling access to an increased number of resources (e.g. abilities, opinions) compared to an individual (Shaw, 1981). Thus, it could be expected that cohesion of a training group could also be associated with increased individual athletic performance, because of the increased resources that a training group could provide to an individual to help achieve higher levels of performance.

Two major issues are addressed in this study, both pertaining to the measurement of cohesion in training groups of runners. Firstly, the relationship between both task cohesion and social cohesion, and performance is addressed. We have already seen that sports with low degrees of task interdependence, such as in the training groups of long-distance runners, typically show that task cohesion and performance are positively related (e.g. Carron & Spink, 1993; Kim & Sugiyama, 1992; Widmeyer & Williams, 1991), whereas social cohesion and performance typically are not positively related (e.g. Landers & Luschen, 1974; Lenk, 1969; McGrath, 1962).

The other issue that is addressed is how the performance of runners who train in groups compares to the performance of runners who train alone. It has just been demonstrated that cohesion could be associated with increased athletic performance in a group setting, arising from increased resources available to the training group.

Thus, it could be expected that training in a group would lead to higher levels of performance than training alone. However, no research has shown that individual performance in a group, positively related to task cohesion, is superior to individual performance. Some related research has indicated that such a finding would be likely. For example, social facilitation research has noted that simple, well-learned tasks, performed in the presence of co-actors, are performed to a higher level within a group than when the same task is performed alone (e.g. Griffith *et al.*, 1989; Paulus, 1983). Taken in conjunction with cohesion research that has found a positive task cohesion-performance relationship in sports with low intramember interdependence (e.g. Carron & Spink, 1993; Spink & Carron, 1993), it is logical to conceive that task cohesion and performance are related in group training in a manner that leads to superior performance than could be achieved alone.

However, exercise physiology literature has indicated that the highest performance levels for individual aerobic sports, like long-distance running, are achieved by training alone. It has been noted that athletic training enhances athletic performance (e.g. Hagan *et al.*, 1981), and that the optimal amount and intensity of training that should be completed is unique to each individual athlete (e.g. Wells & Pate, 1988). Moreover, it has also been noted that non-optimal training intensities are associated with lower athletic performance (e.g. Burke & Franks, 1975). Thus, because training alone creates maximum opportunity to train in a physiologically optimal manner, the exercise physiology literature has shown that individual training is likely to lead to the highest task performance. Therefore, because cohesion literature has not previously shown that performance in a group, positively related to task cohesion, is superior to individual performance, it is expected that this research will show that individual training leads to better race performance than group training, congruent with exercise physiology principles.

2.1.1. Research hypotheses.

Hypothesis One:

There will be a positive relationship between task cohesion scores from the Group Environment Questionnaire (GEQ) and athletic performance for those runners who train with others. i.e. the higher the task cohesion scores, the better the runners will have performance relative to their predicted time.

Hypothesis Two:

There will be a non-direct relationship between social cohesion scores from the Group Environment Questionnaire (GEQ) and athletic performance for those runners who train with others. i.e. social cohesion scores will not be consistently related to race performance.

Hypothesis Three:

Those runners who trained alone will perform better (compared to their predicted times) than both those runners who trained in groups, irrespective of the level of task cohesion of the training group.

2.2. Method.

2.2.1. Participants.

A total of 188 runners who completed the 1995 Christchurch City half-marathon were approached to participate in the study. All those approached had completed the race in a time faster than the median time (1hr 44mins 50secs) and lived in the city of Christchurch. 90 runners filled out and returned questionnaires. This group consisted of 82 males, and 8 females. Ages ranged from 16 years to 68 years, with an average

age of 36.5 years. 38 of these runners were registered with one of the Christchurch athletic clubs. The remaining 52 runners were not affiliated to any club. A further 42 runners did not fill out questionnaires, as they trained exclusively alone, but allowed their times to be used in the study as a comparison group. This group consisted of 38 males and 4 females, with ages ranging from 20 to 53 years. The average age was 35.2 years.

2.2.2. Materials.

The measure of cohesion used was the Group Environment Questionnaire (Carron, et. al., 1985) (see appendices). The GEQ was designed to measure cohesion in sports teams. For this study, minor modifications were made to the questionnaire so that the questions referred to training groups rather than competing teams. Other researchers (e.g. Carron & Spink, 1993) have found that such minor alterations to the GEQ do little to alter the internal consistency of the questionnaire. Participants were asked to consider those people they normally trained with when they were training for the 1995 Christchurch half-marathon. They were then required to rate 17 statements on a nine-point Likert scale (1 = "low agreement"; 9 = "high agreement"). Examples of the questions contained in the GEQ include: *"Our training group is united in trying to reach our goals for performance*"; and "*I am not going to miss the members of the training group when the season ends*". The GEQ consists of four separate sub-scales (attraction to the group - task (ATG-T), attraction to the group - social (ATG-S), group integration - task (GI-T), and group integration - social (GI-S)). As already outlined in the introduction, the subscales of ATG-T (questions 5, 9 & 17) and GI-T (questions 3, 7, 11, 14 & 16) were combined to provide a measure of Task cohesion. Social cohesion was assessed by combining the ATG-S (questions 1, 4, 8, 12 & 15) and GI-S (questions 2, 6, 10 & 13) sub-scales from the GEQ.

2.2.3. Procedure.

A list of those who finished the 1995 Christchurch City half-marathon was obtained from race organisers. Potential subjects (n=188) were identified from the list as those Christchurch residents who finished in the top half of the field. Although it is a generalisation, it was reasoned that 'better' runners were more likely to be more committed, and that because of this, these runners should be better able to answer the questionnaire about their training partners. Also, it was thought that these runners would be more likely to accurately predict their race time. These runners were contacted by telephone. It was explained that the study was part of a Masters Thesis investigating the impact of group training in sport. Those that were interested were asked if they trained with others (a pre-requisite to fill out the GEQ). 146 people indicated that they did train with others and were asked if they would complete a short questionnaire (the GEQ). The questionnaire was posted to these subjects with a return envelope and contact phone numbers for those with queries or concerns. A further 42 people said they would be happy to participate, but trained exclusively alone. These runners were told that they would be unable to complete the questionnaire, but were asked if their times (predicted and race times) could nonetheless be included in the analysis.

2.3. Results and Discussion.

2.3.1. Performance measure.

An index of performance was calculated for each runner by calculating the percentage of predicted time (PT) that in had taken each runner to complete the race[5]. (RT). (average RT/PT = 102.1%, min = 85.2%, max = 115.6%)

2.3.2. Cohesion.

Questions were scored to provide separate measures of Task cohesion (average score = 5.914, min = 3.533, max = 9.0) and Social cohesion (average score = 6.087, min = 2.35, max = 9.0).

2.3.3. The relationship between cohesion and performance.

Social and task cohesion scores were correlated with the performance measure using a Pearson product-moment correlation. Social cohesion (r=.029) was significantly related to the performance measure, thus concurring with previous research that has noted that social cohesion and performance are not positively related in sports that have low degrees of task interdependence (e.g. Lenk, 1969; McGrath, 1962).

However, the finding that task cohesion was not significantly related to performance (r=.125) differs from previous research that looks at the task cohesion-performance relationship in low task interdependence sports (e.g. Carron & Spink, 1993;

[5] As a whole, this index unfairly shows slower than predicted race times. This is partly because the weather during the 1995 Christchurch half-marathon was both very cold and wet. This tends to have deleterious effect upon athletic performance. It is an unavoidable survival mechanism that in cold weather the body concentrates on keeping the core temperature normal at the expense of body extremities (McArdle, Katch & Katch, 1991). Thus, blood supply to extremities, such as the legs, is lower, and consequently so too is the amount of oxygen that leg muscles can receive. This lowers the maximum output and hence speed possible.

Widmeyer & Williams, 1991). One reason why task cohesion was not related to performance in this study, unlike other similar studies, may be due to the performance measure used. Previously the performance measure taken has been a direct measure of the desired outcome of the task being performed by the group. For example, Everett *et al.* (1992) used time taken to complete a swimming relay as the measure of performance for a swimming team. The difference between findings of previous research and the current study in terms of the task cohesion-performance relationship could pertain to the fact that previous research has generally examined the relationship amongst competitive sporting groups. Usually the *raison d'etre* of such groups is competing to win, whereas the same can not necessarily be said of the training groups of runners who participated in this study.

Here it is proposed that task cohesion in training is associated with more effective training, which in turn is associated with more effective race performance. However, it may be that the link between task cohesion levels in training and actual race performance is not direct enough for there to be a significant task cohesion-race performance relationship. Task cohesion may have a significant impact upon training effectiveness, and training effectiveness is associated with more effective race performances, but it could be that task cohesion is not necessarily positively related to task performance.

Other research has noted that there has to be a positive link between the two variables being measured in order for a significant relationship to be observed. For example, amongst literature that looks at the link between attitudes and behaviour, Ajzen and Fishbein (1977) observed that when the measured attitude is general and the behaviour is very specific, there is not a close correspondence between actions and words. However, if both the attitude and the behaviour measured are specific, attitudes then appear to predict behaviour. Olson and Zanna (1981, in Myers, 1990) demonstrated this when they showed that an expressed interest in health and fitness was not predictive of exercise, whereas an expressed interest in jogging was associated with that person doing jogging.

Therefore, it is proposed that task cohesion was not significantly related to race performance in this study as the measure of cohesion was not positively linked to performance. Rather, it appears that task cohesion could be linked with the task performance of the training group amongst which the cohesion exists. This issue is addressed in Study Two.

2.3.4. Solo training vs. group training.

In order to test hypothesis three, for both task and social cohesion, high and low cohesion groups were created. High cohesion groups consisted of the runners who had scored in the top third of cohesion scores, and low cohesion groups consisted of those runners who scored in the bottom third of cohesion scores. For task and social cohesion separately, a single factor (training condition: high cohesion/low cohesion/alone) between-subjects analysis of variance (ANOVA) was conducted on an index of performance. This revealed significant findings for task cohesion $F(2,100)=3.597$, $p<.05$, but not for social cohesion. Figure 2.1 illustrates the differences between the performance levels of the three groups. Post-hoc tests (Fisher PLSD) reveal there to be significant differences between the performance of those that trained only by themselves (race time 100.3% predicted) and those that trained in groups that were low in task cohesion levels (race time 103.5% predicted). There was no significant difference in performance between those that trained in groups that were high in task cohesion (race time 101.8% predicted) and either solo trainers or those from low task cohesion groups.

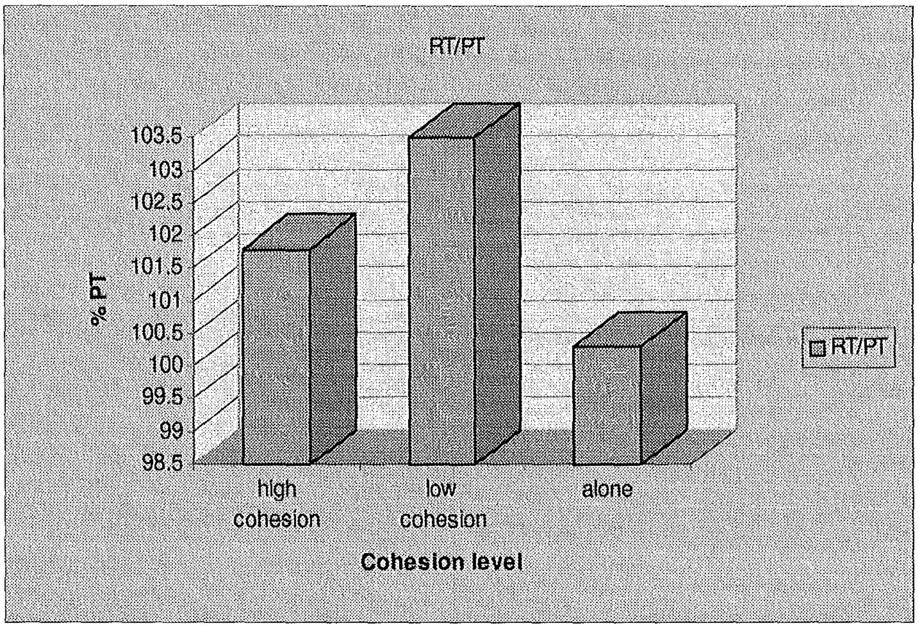

Figure 2.1: Comparison of degree of task cohesion present in training group and measure of individual athletic performance.

These results do not support the prediction made by hypothesis three, which proposed that runners who trained alone would perform better than the runners who trained in groups. It was thought that individual training would be more effective than training in a group, irrespective of the cohesion level of the training group, due to the exercise physiology literature (e.g. Rushall & Pyke, 1990) showing that each individual has a different optimal level of training, which is most likely to be attained by training alone rather than with others.

However, the results of this study provide a potential resolution to the contradictory nature of the cohesion and exercise physiology literature with regards to conclusions about the type of training that will most likely lead to the highest performance levels. The results from this study indicate that training in a group with high task cohesion levels results in similar performance levels to training alone. It is only when runners train in groups that are low in task cohesion levels that performance is significantly lower than training alone. Further discussion of this finding, and implications arising from it, are covered in the main discussion section.

3. Study Two.

3.1. Introduction.

Study Two examines the relationship between training performance and cohesion in a group of road cyclists. It has already been established that task-based cohesion is related to performance in sports that are low in task interdependence levels, such as road cycling. Typically the cohesion-performance issue has been addressed by examining the performance in a set task or competitive event. Study One varied from this norm by examining the relationship between cohesion of a training group and performance, based upon the notion that it is the degree of effectiveness of the training that determines the performance. This produced equivocal findings. One of the potential limitations of the methodology of Study One is that it was assumed that the goals of the training group and the goals of training for effective race performance were the same. Thus, Study Two looks at the relationship between a measure of a training performance goal, training effectiveness, and cohesion. The following is an explanation of how this training effectiveness can be measured.

3.1.1. Training effectiveness.

As indicated earlier, for each individual there is a theoretical optimum level of training that they should do, expressed both in intensity and duration of training (Bowerman, 1974). To do too little work whilst training means that a full benefit is not gained. On the other hand, to do more than the 'perfect' amount can lead to being overtrained, a state of permanent non-recovery potentially leading to injuries, illnesses and performance decrements (Wells & Pate, 1988). The major issue in ensuring that maximal physiological adaptation takes place appears to be intensity of the training, as opposed to training duration (Maughan, 1994).

One way of assessing training effectiveness is to take a physiological measure of 'work' during training, such as heart rate[6]. Although guidelines exist with regards to what constitutes 'effective' training when heart rate is used to measure intensity, it is somewhat difficult to define exactly at what heart rate everyone should be training. Quite simply, there are large individual differences in ability to tolerate a given training load (Rushall & Pyke, 1990). Moreover, there are wide discrepancies as to how hard people are exercising at exactly the same heart rate[7]. Therefore, it is more accurate to refer to training intensity as a percentage of maximum heart rate, as this measure allows the heart rate recordings of each individual cyclist to be compared against their own baseline measure, namely maximum heart rate.

Some exercise physiology reviewers have stated that training in excess of 60% maximum heart rate (MHR) is high enough to create a positive training effect upon the aerobic (with oxygen) energy system (e.g. Ackland & Reid, 1994; Edwards, 1993). This is the primary energy system used in all exercise greater than two minutes duration (Tabotta, 1996). Others (e.g. Wells & Pate, 1988) believe that all training for aerobic events should be done at a higher intensity, such as in excess of 65-70% MHR. For the purposes of this study the more cautious figure (60% MHR) will be used. Certainly, this positive training benefit is gained until the body can no longer exercise aerobically and starts to use the anaerobic energy system, the so-called anaerobic threshold. The anaerobic threshold has been defined as:

> "the point above which the metabolic processes of the body can no longer provide a continuous supply of adenosine triphosphate to the contractile complex of the active muscle fibers" (Wells & Pate, 1988, p.360).

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6 From a physiological standpoint, it is not entirely accurate to use heart rate as a measure of 'work'. Heart rate is a (very good) correlate of work, especially in predominantly aerobic based sports such as road cycling. However, heart rate does not precisely reflect differences in the intensity of work being done. Factors including illness, fatigue and adrenaline can all alter the clarity of the relationship between heart rate and training intensity (Dishman & Landy, 1988). Only a device that directly measures power output (e.g. SRM Power cranks) can give an exact measure of work at all times. However, such devices are rare even in the field of sports science. Thus, for reasons of practicality, heart rate is the measure of work.

7 Exercise intensity at a given pulse rate is determined by the maximum pulse. For example, an individual exercising at a heart rate of 170bpm, is exercising very hard indeed if their maximum pulse is only 175bpm. For another individual, with a maximum pulse of say 200bpm, attaining a pulse of 170bpm would be done with a good deal less stress. Therefore, at best, pulse rate per se is a within subject measure of exercise intensity.

Above this point, a lack of oxygen supply to the body prevents effective metabolic processing. Ackland and Reid (1994) believe that this happens at some point above 85% of maximum heart rate (MHR) in trained athletes. Thereafter, the anaerobic (without oxygen) energy system is utilised.

Training that uses the anaerobic energy system (i.e. over 85% MHR) is termed ineffective training for this study. This is because the benefits to road cyclists doing training that utilises this system are not clear cut. Whilst training at anaerobic levels can increase race speed, there are also negative consequences with such training, mainly associated with overtraining. For example, both Wells and Pate (1988) and Edwards (1993) warn about the danger of overtraining that arises from doing anaerobic training. Moreover, Tabotta (1996) noted that anaerobic training is a component that is normally incorporated into training two to three months before a targeted competition (e.g. National championships). This study was conducted over the winter (noncompetitive) season, meaning that anaerobic training should not have been a part of the training of cyclists at the time that they participated in the study.

Thus, comparisons between group and individual training sessions can be made on the basis of the effectiveness of the training. Training between 60% and 85% of maximum heart rate was considered effective training. Training that occurs below this zone can be considered to be undertraining, while training above this zone can be considered to be overtraining. Using recorded heart rate monitors, the percentage of time that each cyclist spent in each of these three training effectiveness levels will be observed.

3.1.2. Heart Rate Monitors (HRMs).

The HRM, simply, is a device which provides a constant readout of heart rate. The advantage in using such a device is that athletes then know how hard they are training. This information can help the individual athlete ensure that they are training at correct intensities. However, this knowledge potentially creates a bias for this study, as those cyclists who have some understanding of exercise physiology may have altered their training intensity levels as a consequence of using the HRM, and thus have been able to have seen precisely how hard they were training. For example, Griffith (1993), Aiello and Svec (1993), and Aiello and Kolb (1995) have all noted that electronic monitoring of behaviour was associated with altered task performance in computer data entry tasks. Such a problem would likely affect the results of the alone training condition, where the cyclists have total volition over their training intensity level. Having acknowledged that a bias could exist here, it should be noted that the likelihood of much alteration of normal training is not likely to be high. Many of the cyclists studied have their own HRMs anyway, so the information provided would not be novel.

3.1.3. Training effectiveness and cohesion.

So far it has been argued that the correct type of training for sports like road cycling will have a greater impact upon competition performance than incorrect training. It has also been noted, in chapter one, that there is a relationship between cohesion and performance, the association of which primarily arises during training. Therefore, what has been proposed is that the degree to which training can be considered to be effective provides a measure of performance, which can be compared with cohesion ratings pertaining to the training groups to which the cyclists belong.

There is a general trend in the cohesion literature for researchers to look to show a positive relationship between cohesion and performance. Here, too, it is expected that there should be corresponding levels of cohesion and extent to which training can be considered to be effective. So high levels of cohesion should be associated with effective training (60-85% MHR) because this leads to the best task performance, but should not be associated with either under training (under 60% MHR) or over training (over 85% MHR) as such training is less likely to lead to effective task performance. This relationship between training effectiveness and cohesion should apply for task cohesion, but not for social cohesion. As has already been demonstrated, task cohesion measures are often positively related to effective task performance whereas social cohesion measures are not. It is expected that there will be a task cohesion-performance relationship in this study, unlike Study One, because both the measure of performance and the measure of cohesion pertain to the training group.

Finally, it is expected that individual training will be more effective than group-based training. Although Study One indicated that training in high task cohesion groups was associated with similar performance levels as individual training, it is expected that this finding will not be replicated in this study, due to the biomechanical considerations associated with training with others when cycling. Specifically, the most obvious difference between cycling alone and cycling with a group of others is to do with aerodynamics. Wind resistance increases as a square of the bicycle speed, so that at speeds over 40 kph over 90% of the total retarding force on the bike is caused by wind resistance (Kyle, 1994). Thus, at the same speed, group training is far less taxing than solo training because by riding in a manner that provides shelter from the wind for those behind (drafting) it is possible to ride up to 39% more efficiently (Palmer, Hawley, Dennis and Noakes, 1994). Caru, Mauri, Knippel and Carnelli (1987) observed that this drafting effect caused a drop in heart rate from an average of 162bpm to an average of 145bpm, approximately a 10% drop, amongst track cyclists riding at 30 kph (a typical training pace) one rider behind another. The effect on heart rate that drafting causes will be even larger in this study as the cyclists studied trained with an average of five other riders at a time. Elsewhere, it has been shown that increased drafting effect is associated with less physiological effort to attain any given speed. For example, drafting behind a special pace vehicle that removed 100% of air resistance, John Howard rode a bicycle at a speed of 245.077 kph (Kyle, 1994). Therefore, it can be expected that the nature of this drafting effect would result in less effective training in groups.

3.1.4. Research hypotheses.

Hypothesis One:

Group training will be more effective than individual training.

Hypothesis Two:

There will be a positive relationship between task cohesion and performance, but there will not be a positive relationship between performance and social cohesion.

Hypothesis Three:

There will be a positive relationship between the degree of task cohesion and the amount of effective group training.

Hypothesis Four:

There will be a negative relationship between the degree of task cohesion and the amount of ineffective (both under and over training) group training.

3.2. Method.

3.2.1. Participants.

17 road cyclists from the three Christchurch based cycling clubs (Halswell-Avon Cycling Club, Hornby Cycling Club, and Papanui Cycling Club) volunteered to take part in the study. The group consisted of 16 males and 1 female. Ages ranged from 15 to 31 years, with an average age of 20.5 years.

3.2.2. Materials.

Two instruments were used. Each subject had to fill in a modified version of the Group Environment Questionnaire as in Study One. In addition, subjects had to wear a Heart Rate Monitor during training.

The Group Environment Questionnaire.

As in Study One, a modified version of the GEQ was again used to measure cohesion (see appendices). Again, as New Zealand amateur cycling is largely done as an individual sport, the questions referred to training 'groups' as opposed to 'teams' of athletes. The procedure for completion of the GEQ was exactly the same as in Study One, yielding a cohesion score for both task and social cohesion.

Heart Rate Monitors.

The HRM model used in this study was the Polar Sports Tester. This model HRM is capable of storing the athlete's heart rate, as well as simply displaying it. This function allows heart rate information to be recorded and later analysed. In this study heart rate was sampled and recorded once every 60 seconds during training rides.

3.2.3. Procedure.

Subjects were recruited by personal approach. They were informed that the study was looking at differences between training alone and training in a group. As an incentive, analysis of the effectiveness of their own training was promised. Upon agreeing to participate, subjects were asked to wear the HRM twice when training alone, and twice when training with others. It was stressed to participants that these recordings should happen as a part of their normal training. Consequently, each subject was allocated two weeks in which to complete the four rides.[8]

Subjects were given a demonstration of how to operate the HRM, and were also given a set of instructions which they could refer to. They were asked to ensure that the HRM was set to record their heart rate every 60 seconds. At the same time, subjects were given the questionnaire to complete. After completion of the four rides[9], subjects were given a summary of their training effectiveness. At the same time the full purpose of the study was explained.

3.3. Results.

3.3.1. Training effectiveness.

Once subjects had completed their monitored training, the data was downloaded to an IBM compatible computer using a Polar interface device and software. This gave, for each person, a list of heart-rate, for each 60 seconds of each training ride. An example of training in both the alone and group conditions, for one subject, is displayed graphically in Figure 3.2. Note the differences in the percentage of time that this subject spends training in each of the three training effectiveness levels (under, effective, over) as a function of training condition (alone or group).

[8] Although two weeks were allocated, the average time to completion was four weeks, mainly due to a combination of poor weather, and widespread illness.
[9] Not all subjects completed two rides in each condition. Failure to correctly follow the set-up procedure for the HRM resulted in a number of rides not having any data recorded.

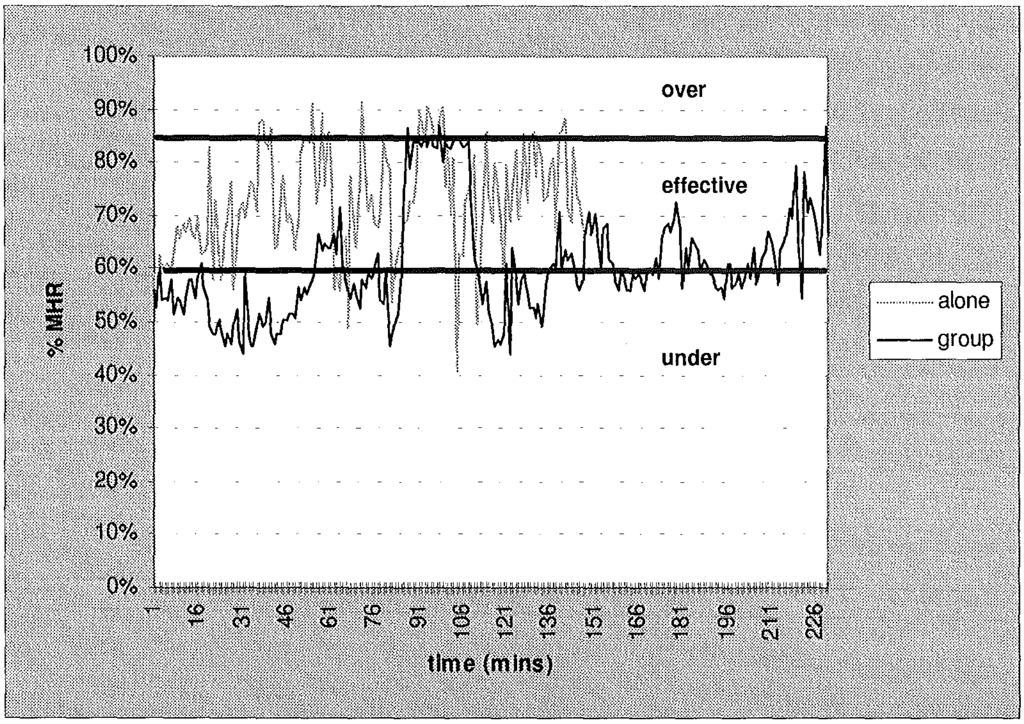

Figure 3.1. Linechart demonstrating differences in training intensities of an individual and a group training session for one subject.

Then, for each subject, a theoretical maximum heart rate was calculated, using the age-adjusted method (220bpm - subject's age)[10]. From this, it was possible to calculate the pulse that corresponded to training at 60% and 85% MHR. The percentage of time that the subject spent below (under training), in (effective training), and above (over training) these target zone limits were then calculated. Once the data was converted into a percentage form, individual rides in both conditions (group and alone) were averaged[11], giving the average percentage of time that had been spent training at the three training intensity levels (under/effective/over) for both training conditions. Mean figures for this data are presented in Table 3.1. The data from the alone training condition was then compared with the data from the group training condition by means of a 2 (training

[10] Tabotta (1996) noted that, in the absence of a maximum heart rate test, the 220-age formula serves as a suitable method of working out the maximum heart rate of a cyclist.

[11] In the case of only one ride being recorded per training condition, there was no need to average the rides. Rather, the remaining ride for that condition was accepted.

condition: alone/group) × 3 (training intensity: under 60% MHR/60-85% MHR/over 85% MHR) repeated measures ANOVA. This revealed only a main effect of intensity level. $F(2,32)=120.044, p<.0001$.

	Training effectiveness		
	under	**effective**	**over**
Alone	4.664	86.415	8.922
Group	7.518	78.714	13.768

Table 3.1: Percentage of time spent in each training effectiveness level as a function of training condition.

Although, as a whole, there were no differences between the two training conditions, to test Hypothesis One, a contrast between alone and group conditions for the effective training condition. This revealed only a marginally significant difference between the alone and group training condition (p=.08).

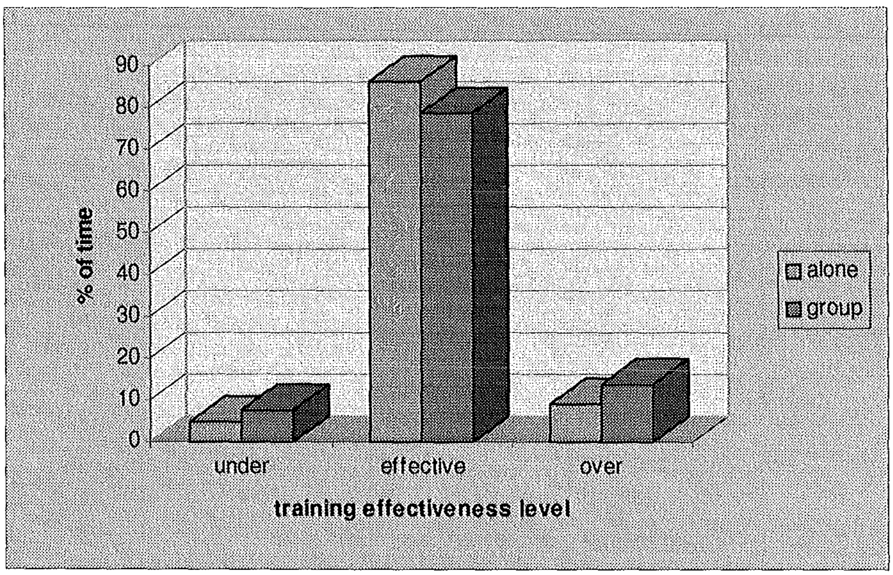

Figure 3.2: Frequency distribution of training intensity expressed as the average percentage of time spent at each intensity level

3.3.2. The Group Environment Questionnaire.

The GEQ was used to measure cohesion levels of the cyclists. It consists of four sub-scales. As in Study One, the subscales of ATG-T and GI-T were averaged to give a measure of task cohesion (average score = 5.657, min.= 2.5, max.= 8.4), and ATG-S and GI-S were averaged to give a measure of social cohesion (average score = 5.934, min.= 4.075, max.=7.1). The measures of task and social cohesion were then correlated with the training effectiveness data for the group training conditions.

	Training effectiveness		
	under	**effective**	**over**
Social	-.309	-.112	.347
Task	-.596*	.115	.193

*p<.01 (one-tailed)

Table 3.2: Table of correlations between cohesion scores and training effectiveness level for group training condition.

As can be seen in Table 3.2, no clear relationship between task cohesion and training effectiveness existed. This provides partial support for Hypothesis Two, in that social cohesion is not associated with performance, consistent with previous research (e.g. McGrath, 1962; Landers & Luschen, 1974). The only significant correlation between task cohesion and training effectiveness level is at the under effectiveness training intensity level ($p<.01$). This provides partial support of Hypothesis Four, which expected that both under and over training would be inversely associated with task cohesion. However, no support was found for Hypothesis Three, which suggested that task cohesion would be positively associated with training at effective training intensity levels.

3.4. Discussion.

The purpose of this study was to examine the cohesion-performance relationship within training groups of road cyclists. This was done on the assumption that the quality of training helps determine competitive performance. Specifically, it was proposed that cohesion would be a factor in determining the degree of effectiveness of training. The findings offer partial support of the hypotheses which addressed this issue.

As expected, social cohesion was not significantly related to training effectiveness, as can be seen in Table 3.2. This finding is congruent with previous sports psychology literature that has examined the social cohesion-performance relationship in those sports, like road cycling, that have low degrees of task interdependence (e.g. Lenk, 1969). Reasons why social cohesion and performance are not positively related are discussed in the next chapter.

Conversely, the findings of this study did not concur with previous research as regards the task cohesion-performance relationship. Such research has shown that task cohesion and performance are positively related in sports with low task interdependence levels (e.g. Kim & Sugiyama, 1992), even if the sports, such as fitness classes, have a non-competitive task-orientation (e.g. Carron & Spink, 1993). For this study, as observed above, task cohesion and performance were only positively related for one of three training intensity levels, thus only partially replicating the findings of previous research.

However, it could be that task cohesion and performance were related in this study, but the relationship was not assessed in the correct manner. The measure of the effectiveness of training for this study was assessed by establishing what was an effective training intensity (60-85% MHR). Training that was completed at a lower intensity than this was termed under training, and training completed at a higher intensity was termed over training. It follows that training at the effective intensity level should be associated with task cohesion, as training at effective levels is associated with high task performance levels, as is task cohesion. With the benefit of hindsight, this method of assessing performance may not have been the best that could have been used. Rather, it may have been better to have assessed performance in a manner that recognised the cyclists that participated in the study did not necessarily view effective training occurring at the same intensity levels as was defined by this study.

Training at the under training intensity level was significantly and negatively related to task cohesion. This means, as expected, task cohesion was positively related to cyclists not training at an intensity level which creates negligible training benefits to the aerobic energy system. It is widely recognised that training at under training intensities can be considered to be inefficient (e.g. Rushall, 1996). Potentially, the degree to which this inefficient training is avoided would have provided a better measure of task performance, as it seems that this is how the cyclists determined training effectiveness. Specifically, members of training groups who reported high task cohesion levels did significantly less training at the under training levels than those who were low in task cohesion.

Moreover, there are two reasons for thinking that the cyclists studied did not view training in excess of 85% MHR as overtraining. Firstly, declaring that training in excess of 85% MHR is overtraining may have been too harsh a criteria. Tabotta (1996) noted that the anaerobic threshold of a cyclist typically is between 85% and 92% MHR. In the interests of conservatism, the lower figure was chosen for this study. However, it is likely that this figure is too low for some subjects, especially given that some were international representatives, thus meaning an increased probability of an anaerobic threshold in excess of 85% MHR due to superior fitness levels (e.g. Ackland & Reid, 1994). It is also likely that decreeing training in excess of 85% MHR to be overtraining was too stringent considering that MHR was determined using the age-adjusted method, which in some cases led to a theoretical MHR for the cyclist some 10-15 bpm (approximately 5%-7.5%) lower than they reported that they believed was their MHR. These issues could have been avoided if both the maximum heart rate and the anaerobic threshold had been tested for each cyclist, but such physiological testing was beyond the means of this study.

In any case, it appears that the cyclists studied did not necessarily view anaerobic training as overtraining. It was reasoned earlier that the cyclists should not have been training at the overtraining intensity level due to the fact that the study was conducted during the noncompetitive season (winter). It should be conceded, however, that this reasoning is based solely upon commonly accepted training principles (e.g. Ackland & Reid, 1994; Tabotta, 1996). This certainly does not preclude the possibility that some cyclists might achieve their highest potential by doing some anaerobic training year-round, a possibility that could occur due to individual differences in coping with training (e.g. Rushall & Pyke, 1990). As opposed to trying to delineate whether anaerobic training was beneficial, and if so, how much should have been conducted, it would have been far easier to have a definition of performance that simply recognises that training at some low intensity levels does not create enough training stimulus, and therefore can be considered to be wasted time spent training. Such a definition of performance indicates that there is a positive task cohesion-performance relationship amongst the cyclists used in the current study.

The other issue that was addressed by this study was whether more effective training was completed in the alone training condition or in the group training condition. It was found that marginally more effective training was completed when training alone, a trend that remains even if the above criticisms of the definition of effective training is accounted for (refer Table 3.1.). This finding is to be expected because demands of the task of riding in a group, namely drafting effects, mean that it is physiologically less efficient to train in a group (e.g. Caru *et al.*, 1987; Kyle, 1994). It is not possible, however, to draw a firm conclusion about the manner in which task cohesion is related to individual performance in the group situation, as the sample size (17) was too small to be able to divide into high and low task cohesion groups. The implications of both the findings of this study and Study One with regards to comparisons between individual training with individual performance in a group are discussed in further detail in the next chapter.

4. General Discussion.

This study extended research into the cohesion-performance relationship by examining the relationship amongst the training groups of the individual sports of running and road cycling, unlike many previous studies which have studied only team based sports (e.g. basketball). Congruent with previous literature that had examined the cohesion-performance relationship in sports with low levels of task interdependence, it was found that social cohesion is not positively related to performance. Conversely, it was concluded that task cohesion was related to performance, but in a more restricted manner than had been noted in the past. The other extension of this study was to examine the sporting performances of athletes who trained in groups compared to those athletes who did not train in groups. No significant performance differences were found between those athletes that trained alone and those that trained in highly task cohesive groups, but it was found that training in groups with degrees of task cohesion is associated with significantly lower performance levels than can be achieved by training alone. The differences between group and individual training are discussed in some depth soon. Firstly, however, the findings of this research about the manner in which social and task cohesion relate to performance are addressed.

4.1. Social cohesion and performance.

Previous sports based cohesion literature which addressed the social cohesion-performance issue using sports that require low levels of intramember interdependence have noted that social cohesion is not positively related to sporting performance (e.g. Lenk, 1969; McGarth, 1962). Both Study One and Study Two also found that social cohesion is not positively related to performance. In Study One a within-subjects measure of performance (race time/predicted time) was found to be unrelated to social cohesion for competitors of a half-marathon running race. Likewise, Study Two noted that social cohesion was not related to effective training amongst road cyclists.

The reason why social cohesion is not positively associated with task performance appears to arise from affiliative motives being incompatible with performance motives (Carron & Chelladurai, 1981). Socially based cohesion refers to cohesion based on the degree of interpersonal attraction of group members. This means a group that is socially cohesive can be described as focused upon attaining social rewards based upon intramember attraction. Carron and Chelladurai (1981) proposed that such social cohesion necessarily inhibits task performance attainment, as the collective group energy is not fully focused upon task attainment. As noted earlier, research that has addressed this relationship between social cohesion and performance has been divided in terms of findings. Some research has concluded that social cohesion and performance are inversely related (e.g. McGrath, 1962), yet others have noted that social cohesion and performance are positively related (e.g. Williams & Hacker, 1982). Here it has been pointed out that many of these inconsistent findings can be accounted for if the degree of task interdependence is considered. Typically, those sports that have low degrees of task interdependence levels do not show a positive social cohesion-performance relationship, whereas those sports with high degrees of task interdependence typically do show this relationship. However, the underlying reason why some sports show a social cohesion-performance relationship and others do not appears to be linked to the direction of causality of the relationship.

Carron and Chelladurai (1981) observed that although social cohesion was not required in order for there to be successful task performance, this did not preclude social cohesion developing in a group. Empirical research exists for this claim, as it has been noted that performance has resulted in social cohesion (e.g. Carron & Ball, 1977; Landers *et al.*, 1982). Moreover, Mullen and Copper (1994) concluded that successful task performance causes social cohesion, but not vice versa. Therefore, it follows that it would have been unlikely for social cohesion and performance to have been positively related for this research, as both Study One and Study Two involved measures of performance that were a consequence, as opposed to an antecedent, of any social cohesion.

4.2. Task cohesion and performance.

Previous sports psychology studies have predominantly found that there is a positive relationship between task cohesion and performance (e.g. Kim & Sugiyama, 1992; Williams & Widmeyer, 1991). The studies carried out for this research have also noted this task cohesion-performance relationship. However, it appears that the relationship between task cohesion and performance of training groups only exists in limited conditions. Study One indicated that there was not a positive relationship between task cohesion of the training groups of endurance runners and their performance in a half-marathon. Conversely, Study Two did demonstrate a task-cohesion-performance relationship, in showing that greater levels of task cohesion were associated with not training at the inefficient under-training intensity level. Ostensibly, the results found about the task cohesion-performance relationship in Study and Study Two, taken as a whole, could be interpreted as showing a neutral or nonexistent relationship. However, if the issue of how task cohesion was measured is taken into consideration, it appears that there is a limited positive task cohesion-performance relationship in training groups of runners and cyclists.

It was hypothesised that the task cohesion-performance relationship was not observed in Study One because the measure of performance was not specific to the task(s) which were the *raison d'etre* for the group. Research in other areas of social psychology, such as literature examining the link between attitudes and behaviour, have shown that a relationship between the two factors is most likely to exist when they at the same level of specificity (Ajzen & Fishbein, 1977).

If a lack of specificity of measurement is the cause of a task cohesion-performance relationship not being observed in Study One, it would imply that this research did show a limited task cohesion-performance relationship. However, even ignoring the results found in Study One, there is still only limited support for a task cohesion-performance relationship. Study Two hypothesised that task cohesion would be positively associated with training at the effective training level (60%-85% MHR), but this relationship was not observed. Rather, the sole link noted between task cohesion and performance in Study Two was when task cohesion was associated with not training at the under training intensity level (under 60% MHR). One explanation for finding only a limited task cohesion-performance relationship, as outlined in the discussion of Study Two, is that the measurement of effective training operationalised was inappropriate.

The definition of what constitutes effective training for Study Two, and thus effective task performance, was based upon guidelines in the exercise physiology literature. However these are general guidelines only, and individual differences in ability to cope with training workload should have been accounted for (e.g. Rushall & Pyke, 1990; Tabotta, 1996). As already mentioned, it seems unlikely that the cyclists who participated were all in agreement that effective training occurs at the intensities that this study outlines (60%-85% MHR). Specifically, many cyclists believe it important to train at intensities in excess of 85% MHR (Wells & Pate, 1988). Instead, it seems likely that cyclists view ineffective training as training completed at low intensities, as this training does not lead to increased levels of fitness (e.g. Ackland & Reid, 1994), and thus can be viewed as inefficient (Rushall, 1996). A better representation of the impact of task cohesion on performance may have been to assess the extent that task cohesive groups avoided ineffective training.

It can be concluded that there is some evidence of a task cohesion-performance relationship existing within the training groups of runners and cyclists. Future research could clarify the nature of this relationship if more attention is paid to the goals of the group, as suggested by Hogg (1992). This point is dealt with further in the section that deals with implications for further research. Now, the focus turns to research that compared individual athletic performance to individual performance within a group, with reference to the task cohesion level of the group.

4.3. Alone training vs. Group training.

The sports cohesion literature has generally shown that higher levels of task cohesion are associated with higher performance levels (e.g. Carron & Spink, 1993; Carron *et al.*, 1988; Widmeyer & Williams, 1991). A logical extension of this research is to examine the task performance of an individual training alone compared with the performance levels of an individual training in a group environment, while taking into account the degree of task cohesiveness of the group. It could be expected that this type of research would show performance in a task cohesive group, at least, to be superior to an individual effort, based upon the implications of other previous task cohesion-performance literature (e.g. Carron *et al.*, 1988; Everett *et al.*, 1992). However, this relationship was not found when the performance achieved by runners and cyclists training alone was compared to the performance achieved from group-based training. As outlined in the introduction, the likely reason for this relationship not being evident is that the exercise physiology literature promotes the need for individual training, so as to gain optimal training benefits. The following section compares the antagonistic nature of these two bodies of literature with regards to the current research.

As stated earlier, previous cohesion research has not directly compared individual performance with the performance of an individual within a group. Some studies (e.g. Carron *et al.*, 1988; Carron & Spink, 1993; Spink & Carron, 1993) have noted that task cohesion is associated with higher individual performance amongst members of fitness classes. Other studies have observed that individual performance is superior when in a group than when alone (e.g. Sorrentino & Sheppard, 1979; Williams *et al.*, 1989). However, studies have not been completed that have compared performance in a group, as a function of the degree of group task cohesion, to individual performance. Nonetheless, research points to high levels of group task cohesion being associated with higher individual task performance levels in a group than an individual would attain.

Conversely, the exercise physiology literature indicates that the highest performance levels for running and cycling are likely to be achieved by training alone. Rushall and Pyke (1990) suggested that training should be specific to the individual. Maughan (1994) concluded that exercise intensity was the critical factor in determining individual training effectiveness for individual aerobic-based sports (e.g. Burke & Franks, 1975; Fox *et al.*, 1973; Wenger & Bell, 1986). Thus, it follows that training for sports like running and cycling should predominantly be completed alone so as to allow maximum opportunity to train in a physiologically correct manner.

The findings of this research provide equivocal support as regards both the cohesion literature and the exercise physiology literature. Study One observed that runners who trained alone ran significantly faster times in a half-marathon running race than those runners who trained in groups with low degrees of task cohesion and Study Two showed that marginally more effective training was done alone than in a group, thereby supporting principles outlined in exercise physiology literature. However, the results of this research have also shown that cohesion and performance are positively related, albeit in a limited manner. Study Two showed that not training at the under training intensity level (under 60% MHR) was associated with higher task performance when training in a group. Thus it can be seen that this research has found supporting evidence of both cohesion and exercise physiology literature.

Findings in the current research raise the possibility that cohesion and exercise physiology literature do not need to be viewed as antagonistic. Study One found that the alone training condition was associated with higher performance levels than those who trained in low cohesion groups, but no difference was noted between the alone condition and training in high task cohesion groups. One interpretation of this finding is that cohesion and exercise physiology literature are actually compatible in terms of the training that they have associated with effective task performance.

Specifically, incorporating the results of the present research, both the cohesion and exercise physiology literature imply that athletes should not train in groups with low task cohesion, as these groups are associated with lower task performance comparative to either high task cohesion groups or to those who train alone. Looked at another way, high performance levels can be attained either through training alone, so as to train in a physiologically optimal manner, or by training in groups that are high in task cohesion.

If this finding can be replicated, two implications could be made as a consequence. Firstly, it implies that cohesion is not the *sine qua non* of successful sporting performance, at least with regards to sports with low task interdependence. This finding has been noted elsewhere in cohesion literature by Mullen and Copper (1994) in a meta-analysis of cohesion-performance literature. While concluding that sports groups demonstrated the strongest cohesion-performance effects of all, because they real groups in the environment whose members often self-select membership, they noted that primarily performance causes task performance as opposed to task cohesion causing performance. Thus, considering exercise physiology literature also, it appears that neither social nor task cohesion is a pre-requisite for sporting performance in sports like running and cycling.

Nonetheless, the results have also demonstrated that task cohesion can be related to sporting performance. Some (e.g. Buys, 1978) have questioned the usefulness of the small group. In finding that training groups of runners with high task cohesion exhibited performance as good as those that trained alone, it can be argued that the group-based training for cyclist and runners is one method that they can achieve high sporting performance. Moreover, in some other respects, training in high task cohesion groups is better than individual training. For example, training in a group also fulfils social needs, in terms of interpersonal attraction (e.g. McGrath, 1962), and affiliation needs, as measured by attraction to group membership (Shaw 1981). In addition, task performance in a group has been shown to be associated with higher levels of individual motivation, measured as adherence (e.g. Dishman & Landy, 1988) and goal achievement (e.g. Weingart & Weldon, 1991, in Hinsz, 1995), than performing a task alone. Furthermore, it possible to clarify the nature of the task cohesion-performance relationship by accounting for task related variables (Lott & Lott, 1965), as outlined in the next section.

4.4. Limitations and suggestions.

There appear to be a number of issues which could be addressed by future research, which would enable more precise conclusions to be made about the nature of the task cohesion-performance relationship. This section outlines what these issues are, and how future research might address them.

The most contentious conclusion made by this research is that task cohesion is positively related to performance. To reiterate, only Study Two showed a positive task cohesion-performance relationship, as noted at the under training intensity level. It was proposed that the absence of this relationship in Study One was because cohesion and performance were not assessed at the same level of specificity. Obviously this explanation can easily be criticised, as there is no research to support it. Nonetheless, it follows logically that sporting performance is related to the quality of training conducted (e.g. Ackland & Reid, 1994), and that the quality of group training is related to the degree of task cohesion of the group, as shown in Study Two. However, the relationship between training group task cohesiveness and individual sporting performance may be too abstract for a significant relationship to be demonstrated, because of the large number of variables that comprise a successful sporting performance. This point is of particular relevance here, as cohesion is a psychological construct, which Dishman & Landy (1988) noted are not as strongly associated with sporting performance as physiological variables. The validity of this proposal could be addressed by future research which measured the relationship between both task cohesion and performance in a training group, with reference both to the training performance goals that the group sets and with reference to an actual measure of sporting performance (e.g. win-loss ratio).

A related issue, which could also be considered by future research, is the manner by which the task cohesion-performance relationship should be measured. Ultimately, measurement of performance should be with reference to absolute performance, as sports psychology researchers should look to find psychological variables linked with optimal sporting performance when the research pertains to competitive sport. Nonetheless, the findings of Study Two imply that closer attention should be to the performance goals of the training group when assessing the performance of a group. Study Two outlined one method of determining the degree of effective training, as measured by heart rate. As already acknowledged, the method used was based upon commonly accepted training guidelines (e.g. Ackland & Reid, 1994), but this does mean that it was the only correct method of training. Rather, there may be many effective methods of athletic training, none of which are necessarily superior to others. Instead of conceptualising the correct training programme, it would have been better, but far more complex, to consider the ability of the individual athlete to cope with level of training stimulus (Rushall & Pyke, 1990). Measurement of training effectiveness should attempt to assess the degree to which optimal training level is being attained. A way that future research could incorporate measures of individual adaptation to training is through use of psychological questionnaires. For example, Ravizza (1993) noted that performance of athletes can be enhanced through increased self-awareness, developed through a variety of methods that include psychometric assessment of levels of variables such as arousal levels.

Furthermore, it was assumed that the goals of the training group were performance oriented, which may not necessarily always represent the goals of the members of the training group. Even within competitive sport, a number of athletes do not have a primary focus on task productivity. For example, in a study of 700 NCAA division one college athletes, Weinberg, Burton, Yukelson and Weigand (1993) noted that 19% of athletes thought that fun and enjoyment was the most important goal in sport. Likewise, Siegal and Newhof (1984) concluded that concepts related to personal satisfaction then mastery of opponents were the concepts that were viewed most positively in terms of exercise participation amongst competitive basketballers, irrespective of player ability. It may be necessary to qualify the extent of the task cohesion-performance relationship to those athletes whose training groups are achievement oriented. Hogg (1992) noted it has been shown that task cohesion is only associated with performance, if performance was an internalised norm for the group (e.g. Schermerhorn, Hunt & Osborn, 1988).

Another consideration which could be addressed is the issue of the duration over the cohesion-performance relationship is examined. Some previous studies (e.g. Landers *et al*, 1982) have taken measurements of cohesion and performance across a sporting season, and then inter-related the two variables. Conversely, this research measured both the performance and the measure of cohesion at one time only. This is a potential weakness of this study, as Weinberg (1994) called for more studies in the field of sports psychology to be carried out over longer periods, such as a sporting season, so as to increase the validity. If the task cohesion-performance relationship was to be considered over a longer duration, such as a sporting season, it is likely that a more accurate representation of performance arising from training either alone with others would be found. In particular, conducting research over a longer time frame is more likely to lead to results that demonstrate whether task performance is mainly due to completing physiological optimal training, as can be done when training alone, or whether task performance is more to do with factors associated with task cohesion within a group, such as task adherence (Dishman & Landy, 1988) and greater goal achievement (Weingart & Weldon, 1991).

Finally, the task cohesion-performance relationship would also probably be clarified if further methodological considerations were accounted for. Conclusions about Study Two especially were hampered by too small a sample size, meaning that it was not possible to divide the sample into high and low cohesion groups, thus restricting the degree to which findings can generalised (Dishman & Landy, 1988). Also, the size of the training group should be accounted for. Previous research has suggested that task cohesion is likely to be higher the smaller the team. For example, Widmeyer, Brawley and Carron (1990) noted that task cohesion was higher in 3 person basketball teams, than 6 person or 9 person teams. However, the present research did not relate task cohesion to performance. Even so, it is intuitively logical to think that the task cohesion-performance relationship would decrease as group size increases (e.g. Carron, 1990; Porter and Lawler, 1965), as larger groups are more likely to suffer from clique formation, and cliques are linked with decreased performance (Carron & Chelladurai, 1981; Eitzen, 1973).

However, the group size-task cohesion relationship is not linear in nature. Shaw (1981) believed that a 10 person group is 'small' and a 30 person group is 'large', but conceded that a 25 person cohesive group can be 'small' whilst a 15 person non-cohesive group can be 'large'. Hogg (1992) offered a better account, when he proposed that the degree to which a group has common task-oriented goals will determine the group's cohesiveness. This proposal does not, however, provide concrete guidelines in terms of describing the group size which will be most task cohesive. Nonetheless, it is possible to observe that some of the training groups of both the runners and the cyclists contained a large number of athletes, and that the ability level of the athletes in these groups varied. Shaw (1981) noted that task completion is dependant upon the least competent member in conjunctive tasks, such as group training for running and cycling, in which everyone must complete the same task at once. Moreover, increased group size increases the likelihood of a group containing a member with a low degree of task competency (*Ibid,* 1981). It seems unlikely that task cohesion would exist in such circumstances, given that the purpose of competitive sport is winning. Furthermore, it follows that increased group size lessened the task-cohesion-performance relationship amongst training groups of cyclists, due to increased group size leading to less effective training being completed because of increased drafting effect (Kyle, 1994).

4.5. Implications and conclusions.

This research examined the relationship of cohesion and performance within the training groups of endurance runners and road cyclists. Literature that has previously addressed this cohesion-performance relationship has often been contradictory or inconclusive in nature. In addition, this research leaves questions unanswered, but some implications can be made based upon the findings of the two studies completed. These implications are made both at a theoretical and an applied level.

At a theoretical level, it can be noted that it was again found that social cohesion was not positively related to performance. Conversely, this research proposes that there appears to be a positive relationship between task cohesion and performance amongst the training groups of low task interdependent sports. These findings concur both with similar previous research and general conclusions about the cohesion-performance relationship made by Mullen and Copper (1994), who noted that:

> "Practically, these results indicate that efforts to enhance group performance by fostering interpersonal attraction...are not likely to be effective. Researchers interested in the problems of bolstering group performance might most efficiently direct their efforts towards determining how to increase people's liking for or commitment to group tasks" (p.224).

Other reviews also have noted that social cohesion and performance are not positively correlated, and have even suggested that measurement of the cohesion-performance relationship should be addressed solely with reference to task cohesion. For example, Goodman, Ravlin & Schminke (1987) called for cohesion to be reconceptualised as member commitment to group task, and Mudrack (1989b) concurred because he believed that this would provide a closer relationship between group behaviour and performance. This research observes that it has been shown that social cohesion is not a cause of performance, and that social cohesion does not refer to processes related to task performance. For these two reasons it makes more sense to address the cohesion performance relationship with regards to task cohesion, which has been consistently and positively related to task performance, and actually refers to group processes associated with task performance.

Conclusions can also be made at an applied level. One of the two extensions that this research made over previous cohesion literature was to examine individual performance with performance of an individual in a group. The performance in the group situation was related to cohesion levels of the group. It was found that those who trained in high task cohesion groups performed to the same level as those that trained alone, whereas training in a low task cohesion group led to significantly lower performance than training alone. It is this possible to make recommendations with regards to training that runners and cyclists should do. Individual training allows maximum opportunity to train in a physiological optimal manner, and thus should lead to the highest performances. However, training in a high task cohesion group leads to very similar performance levels, thus meaning it no worse to train in such a group. Therefore it is possible to look at other considerations as to what is likely to be best for the athlete. In this respect, there are other benefits associated with training in a group. Some of these benefits are higher motivation (Dishman & Landy, 1988); higher goal achievement (Weingart & Weldon, 1991); the opportunity to socialise (e.g. McGrath, 1962), and the opportunity to fulfil affiliation needs (Shaw, 1981). Thus it can be concluded that training in a task cohesive group would be the best training situation for athletes, provided the training group is small (see Carron, 1990; Hare, 1962), and members have similar task-oriented goals.

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Appendix.

The Group Environment Questionnaire

To answer each question just circle a number on a nine-point scale. The more you agree with a given statement the higher the number you should circle. Remember there are no right or wrong answers. Rather what is wanted is *your* thoughts on each question. When answering the questionnaire, you are required to consider those people that you normally train with.

Strongly disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9 Strongly agree**

1. I do not enjoy being part of the social activities of this **training group**.

2. Members of our **training group** would rather go out on their own than get together as a team.

3. Our **training group** is united in trying to reach our goals for performance.

4. I am not going to miss the members of the **training group** when the season ends.

5. I am unhappy with my the level of desire to win amongst **training group** members.

6. Our **training group** members rarely party together.

7. We all take responsibility for any poor performance by members of our **training group**.

8. Some of the people I train with are my best friends.

9. The **training group** to which I belong does not give me enough opportunities to improve my personal performance.

10. Our **training group** would like to spend time together in the 'off' season.

11. Our **training group** members have conflicting aspirations for their performance.

12. I would rather go to parties that did not involve my **training partners..**

13. Members of our **training group** do not stick together outside of practices and races.

14. If members of our **training group** have problems in practice, everyone wants to help them so we can get back together again.

15. For me the **training group** is one of the most important social groups to which I belong.

16. Our **training group** members do not communicate freely about each athlete's responsibilities during races or training.

17. I do not like the way that members of our **training group** train when we train together.

GEQ subscales:

ATG-T = questions 1, 4, 8, 12, and 15; GI-S = questions 2, 6, 10, and 13; GI-T = questions 3, 7, 11, 14, and 16; and ATG-T = questions 5, 9, and 17.