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Does Competition Enhance or Inhibit Motor Performance: A Meta-Analysis

Mary Beth Stanne, David W. Johnson, and Roger T. Johnson
University of Minnesota, Twin Cities Campus

A meta-analysis was conducted on the relative impact of cooperative, competitive, and individualistic efforts on motor skills performance. Competition was divided into 3 groups: zero sum, appropriate, and unclear. The motor skills tasks were divided into means-interdependent and means-independent tasks. The dependent variables were achievement–performance, interpersonal attraction, social support, and self-esteem. A total of 64 studies met the criteria for inclusion. Effects sizes were computed, and confidence intervals were used to determine their significance. A fail-safe sample size was computed to determine how many additional studies were needed to change the significance of the results. Cooperation resulted in higher achievement for means-interdependent tasks in zero-sum competition, unclear competition, and individualistic efforts, and it promoted higher achievement for means-independent tasks for unclear competition and individualistic efforts. For all comparisons, cooperation resulted in greater interpersonal attraction, social support, and self-esteem.

Motor skills performance has relevance for almost all aspects of people's lives. Motor performance is the heart of all physical recreation, sports, and exercise programs; all performing arts, fine arts, and graphic arts; and all factory work, service industry jobs (housekeepers, bank tellers, restaurants, cleaners, store clerks), and most other jobs. Whereas there is a great deal of research and discussion on various aspects of motor skills performance, whether motor skills are best performed in cooperative, competitive, or individualistic situations has been relatively ignored despite considerable research being focused on this issue. This article contains the first comprehensive review of the impact of social interdependence on motor skills performance.

To examine the impact of cooperative, competitive, and individualistic efforts on motor skills performance, we discuss the controversy concerning competition and the three factors that may resolve the controversy: social interdependence theory, the research on social interdependence, and the clarification of the nature of competition. We then discuss the posited conditions under which competition is effective. Finally, other factors influencing the effectiveness of competition (quality of relationships, social support, and self-esteem) are discussed. A meta-analysis of the research is then presented.

Pervasiveness of and Debate About Competition

Traditionally, motor skills performance has been associated with competition. There can be little doubt that competition is prevalent and widespread in U.S. society (D. W. Johnson & Johnson, 1997; D. W. Johnson & Johnson, 1989). Excellence is often defined in terms of a person's performance in relation to others. The language of business, politics, and even education is filled with "win–lose" terms. A person "wins" a promotion, "beats" the other sales clerks, "outsmarts" a teacher, becomes a "superstar," "defeats" enemies, and puts other people "in their place." Many colleges and universities have students compete against one another for grades, for places in advanced seminars, for membership in elite honorary societies, for class rank, and for admission into graduate programs. Colleges, furthermore, replace coaches who graduate all their athletes but do not achieve a winning record, even though college presidents claim that education is more important than athletics. Competition is so pervasive that some parents hold their children back a grade in school so that they will be bigger, stronger, and more developed cognitively and, therefore, more likely to achieve athletic and academic success. In addition, individuals routinely seek out competitive experiences (e.g., playing golf, tennis, handball, chess, or bridge with friends). It is difficult for many people to go through a day without engaging in some competitive activities.

Despite the prevalence of competition, its value has been debated for hundreds of years (D. W. Johnson & Johnson, 1989; Kohn, 1992). Advocates of competition point out that honoring winners of sports competitions dates back at least as far as the Ancient Greeks. Praising competition as an economic regulator of price and production goes back to at least 1776 when Adam Smith published *The Wealth of Nations.* Herbert Spencer lauded competition in the 1860s when he argued that Darwin's survival-of-the-fittest concept of evolution could be transposed to human society. Many individuals equate doing well with doing better than others and succeeding with winning. They believe that (a) competition brings out the best in a person, (b) the best and the brightest always rise to the top, and (c) the former football coach Vince Lombardi spoke the truth when he said, "Winning isn't everything, it's the only thing." Competitive experiences are perceived to be healthy for children because they teach children to deal with a competitive

Mary Beth Stanne, David W. Johnson, and Roger T. Johnson, Department of Educational Psychology, University of Minnesota, Twin Cities Campus.

Correspondence concerning this article should be addressed to David W. Johnson, Department of Educational Psychology, University of Minnesota, 60 Peik Hall, 159 Pillsbury Avenue, Minneapolis, Minnesota 55455. Electronic mail may be sent to johns010@tc.umn.edu.

society (Iso-Ahola & Hatfield, 1986) and provide children with a means for achieving recognition (Sherif, 1978). There is considerable common-day experience in which friends compete for recreation and entertainment in ways that enhance their friendship and add considerable fun, enjoyment, and "spice" to their lives. In his retirement speech, the basketball player Magic Johnson described how much his rivalry with Larry Bird had meant to him, how it had provided positive motivation to improve continually and refine his skills, and how much it had raised his level of play. Many people believe that competition can be fun, exciting, challenging, and positive.

Critics of competition have argued passionately and persuasively for the negative effects of competition (Kohn, 1992, 1993; Maehr & Midgley, 1991). They point out that competition can result in high anxiety levels that interfere with performance, low productivity, lack of motivation by those who believe they have no chance of winning, extrinsic motivation, contingent self-esteem that goes up and down depending on how one's performance compares to that of others, poor relationships, aggression toward others in an effort to "win at all costs," and cheating (even in events such as All-American Soap Box Derby and the Olympics). The destructive effects of competition were pointed out in the 1930s by Margaret Mead (1937) and in the 1950s and 1960s by Morton Deutsch (1949, 1962) and Ashley Montagu (1952/1973). The outcomes of competition are seen as so destructive by some individuals that they propose eliminating it altogether, especially from the school and the workplace.

The resolution of this controversy may lie in a consideration of a combination of three factors: (a) conceptual issues concerning social interdependence; (b) the research that has been conducted over the past 100 years comparing the relative impact of cooperative, competitive, and individualistic efforts; and (c) the clarification of the nature of competition.

Social Interdependence

To resolve the controversy over competition, one must first place it in the larger context of social interdependence. *Social interdependence* exists when individuals share common goals and each individual's outcomes are affected by the actions of others (Deutsch, 1949, 1962; D. W. Johnson & Johnson, 1989). The basic premise of social interdependence theory is that the way goals are structured determines how individuals interact, and the interaction pattern determines the outcomes of the situation. Goals may be structured so individuals promote the success of others, obstruct the success of others, or act in their own self-interest with no regard for the success or failure of others. In other words, individuals may (Deutsch, 1949, 1962; D. W. Johnson & Johnson, 1989):

1. Work together cooperatively to accomplish shared learning goals. When a situation is structured *cooperatively,* individuals' goal achievements are positively correlated; individuals perceive that they can reach their goals if and only if the others in the group also reach their goals. Thus, individuals seek outcomes that are beneficial to all those with whom they are cooperatively linked. A cooperative structure leads to promotive interaction in which individuals assist and encourage each other's efforts to achieve.

2. Work against each other to achieve a goal that only one or a few can attain. When a situation is structured *competitively,* individuals' goal achievements are negatively correlated; each individual perceives that when one person achieves his or her goal, all others with whom he or she is competitively linked fail to achieve their goals. Thus, individuals seek an outcome that is personally beneficial but detrimental to all others in the situation. Competition leads to oppositional or contrient interaction in which individuals obstruct and interfere with each other's efforts to achieve.

3. Work by oneself to accomplish goals unrelated to the goals of others. When a situation is structured *individualistically,* there is no correlation among participants' goal attainments. Each individual perceives that he or she can reach his or her goal regardless of whether other individuals attain or do not attain their goals. Thus, individuals seek an outcome that is personally beneficial without concern for the outcomes of others. An individualistic structure leads to no interaction among participants.

Research on Social Interdependence

Over 185 studies were conducted between the years 1898 and 1989 comparing the impact of cooperative and competitive situations on achievement and productivity (D. W. Johnson & Johnson, 1989). The results of these studies indicated that cooperation promoted higher individual achievement and greater group productivity than did competition. In addition, cooperation, compared with competition, resulted in significantly longer time on task, more frequent use of higher level reasoning strategies, a greater number of new ideas and creative insights generated, and greater individual transfer of what is learned to new situations. No statistically significant differences in findings were found for duration of the study, type of reward given for winning, individuals of different ability levels, male and female participants, decade in which the study was published, size of the group, ethnic background of participants, socioeconomic class of participants, age of participants, sample sizes, published and unpublished studies, and setting in which the study was conducted. Cooperation was also found to promote more positive relationships, greater social support, and greater psychological health (including higher self-esteem) than did competitive or individualistic experiences. Overall, the evidence is very nonsupportive of the use of competition compared with cooperation.

Nature of Competition

On the basis of the definitions of the three types of interdependence and the existing research comparing their relative efficacy, a clarification of the nature of competition may be made. Despite the prevalence of social Darwinism during the past 150 years or so and the hundreds of studies that have been conducted comparing the relative efficacy of cooperation and competition, there is a remarkable lack of theoretical analysis and conceptual clarification of competition. Competition has been defined as a situational variable, a cognitive variable, a trait, a motive, or an attitude. The situational approach is best represented by Deutsch (1949, 1962), who defined cooperation and competition as the positive or negative correlation among participants' goals in a given situation. He made it clear, however, that (a) what influences behavior is not the objective structure of the situation but rather a person's perception of the situation, and (b) a person's perception of a situation matches objective reality given sufficient experience with the situation, intelligence, and clarity of the situation's structure (Deutsch, 1949, 1962). A pure situational definition is the strict

behavioral definition of competition as a reward given only to the person who achieves the highest in comparison with others (Skinner, 1968). Fait and Billings (1978) also proposed a situational approach by drawing a distinction between direct and indirect competition: Direct competition exists when individuals seek the same goal and goal achievement is negatively correlated, and indirect competition exists when individuals strive to beat their past performance. Actually, indirect competition is a misnomer. Striving to beat one's past performance is an individualistic effort in which the criterion for success is to improve on previous performance.

A more cognitive approach was taken by Kelley and Thibaut (1978), who defined competition as individuals acting in ways aimed at maximizing their perceived rewards and minimizing their perceived costs in relation to others. The trait approach was taken by Helmreich, Beane, Lucker, and Spence (1978), who defined competitiveness as the desire to win in interpersonal situations. The motive approach was taken by McClintock (1972; McClintock & Allison, 1989), who defined a competitive motive as a predisposition to act competitively in a situation that allowed a choice among cooperative, competitive, and individualistic behaviors. Johnson and Norem-Hebeisen (1977) took the attitude approach by defining a competitive attitude as a preference for competitive over cooperative and individualistic situations. Although each of these approaches had their advocates and supporting research, the majority of research studies used the situational approach. The reason for this may be that in many applied situations, practitioners need to know how to structure the situation so that cooperative or competitive behavior occurs among the individuals involved.

Despite the prevalence, interest in, and research on competition, there has been little attempt to provide a more refined theory. To understand the nature of competition, it is necessary to detail its basic elements. D. W. Johnson and Johnson (1989) noted that competition involves (a) perceived scarcity, (b) an inherent uncertainty of outcome resulting from a focus on the relative performance of the particular contestants, and (c) forced social comparisons (participants receive salient and obtrusive information about how they performed in relation to others). They also noted that competitions may vary as to the types and amounts of interaction among participants and how many winners there will be.

In addition, D. W. Johnson and Johnson (1989) developed a typology of competition based on the combination of outcome interdependence and means interdependence. *Outcome interdependence* specifies the relationship among the mutual goals and rewards the individuals are striving to achieve. *Means interdependence* specifies the actions required on the part of participants to achieve their goals, and it exists when a task is structured so two or more individuals are required to complete it. It may be differentiated from *means independence,* which exists when a task is structured so that one person can complete it without help or involvement of another person. Whereas negative outcome interdependence is required for competition to exist, some competitions involve negative means interdependence and some do not. Thus, means-interdependent competition involves direct oppositional interaction toward contrient goals (such as a chess game), and means-independent competition involves parallel, alternating, or indirect interaction toward contrient goals (such as a race or a national test). The latter is described as competitive coaction by social facilitation theorists when individuals in the presence of each other independently coact on the same type of task with explicit rivalry. Social facilitation may often involve means-independent competition, as manipulation checks revealed that 80% of the participants in the coaction paradigm indicated a moderate degree of competitiveness (F. Allport, 1920).

Social interdependence theory differentiates among cooperative, competitive, and individualistic efforts. The research provides evidence that, generally, cooperation produces higher achievement and productivity than does competitive or individualistic efforts. A firm conclusion is difficult to derive from the research as competition has been defined in a wide variety of ways and there has been little attempt to clarify its nature. What the research does point toward are the conditions under which competition enhances the performance of motor skills.

Factors Influencing Effectiveness of Competition

Even though researchers conclude that the bulk of the evidence indicates that cooperation produces higher achievement than competition, there may be conditions in which the reverse is true. There is some evidence that when competition is structured appropriately, when the task is appropriate, and when means interdependence is absent, competition may be more effective than cooperative and individualistic efforts.

Type of Competition

In the past reviews of research, reviewers considered all competitive conditions to be equivalent. In examining how researchers operationalized competition, however, one can identify three types of competition. *Zero-sum competition* is the distributing of rewards on a "winner-take-all" basis. When one person achieves his or her goal, all other participants fail to achieve their goals. *Appropriate competition* is the stated attempt to meet the criteria detailed by D. W. Johnson and Johnson (1974, 1975/1999, 1978, 1989):

1. Winning is relatively unimportant. If winning is too important, high levels of anxiety result that interfere with performance, especially on motor tasks (Blau, 1954; Deutsch, 1949; Haines & McKeachie, 1967; Naught & Newman, 1966; Tseng, 1969); most individuals are likely to perceive their performance as a failure (Fait & Billings, 1978; Sherif, 1978); and losing promotes the development of "competition learned-helplessness" whereas winning can promote the development of "psychological burnout" (Roberts, 1980).
2. All participants have a reasonable chance to win. Motivation to achieve is based on the perceived likelihood of being able to achieve a challenging goal (Atkinson, 1964). Those who believe they cannot win will not try, cheat, avoid challenge, use superficial and effort-minimizing strategies, engage in impaired problem solving, use other self-handicapping strategies, and have less interest in and enjoyment of the experience (Anderman, Griesinger, & Westerfield, 1998; Butler, 1987; Deci & Ryan, 1985; Graham & Golan, 1991; Halisch & Heckhausen, 1977; Hurlock, 1927; Lepley, 1937; Matthews, 1979; Meece, Blumenfeld, & Hoyle, 1988; Nolen, 1988; Pintrich, 1989; Utman, 1997).
3. There are clear and specific rules, procedures, and criteria for winning. Ambiguity in competition interferes with achievement as energy is directed toward worrying about what is fair and unfair (D. W. Johnson & Johnson, 1974, 1989).
4. Participants are able to monitor each other's progress and engage in social comparison (Bond & Titus, 1983). There are

many positive aspects of social comparison (Festinger, 1954; Taylor & Lobel, 1989). There is evidence, for example, that social comparison can help cancer patients (Posluszny, Hyman, & Baum, 1998). Competition provides an opportunity for social comparison and may, under certain conditions, be the primary motivation for participating in a competition. The more the knowledge about one's level of competence gained from social comparison is the dominant outcome of competition rather than winning, the more constructive competition may be.

Finally, it is unclear how a number of researchers operationalized competition. *Unclear competition* is (a) the vague and unclear procedural description of competition or (b) the description of the condition as individualistic but the task was interactive and the participants were rewarded according to their respective contributions to the outcome.

The major distinction between zero-sum and appropriate competition is the strength of the negative outcome interdependence. In zero-sum competition, negative outcome interdependence is structured so strongly that winning is the most important aspect of the situation, and it can only be achieved by defeating everyone else. In appropriate competition, negative outcome interdependence is relatively weak, with winning being of little importance. Other goals, such as learning, exercise, and even fun are present in the situation. Conceptually, however, zero-sum and appropriate competition are not necessarily independent. They represent different levels of negative outcome interdependence and the presence of one or multiple goals. In the available research studies on motor performance, zero-sum competition was operationalized with no regard to the conditions of appropriateness. Unclear competition could be zero-sum, appropriate, or another form of competition, but what the researchers actually did is not described in enough detail to tell. Whereas previous reviews found that cooperation promotes higher achievement than does competition, it may be hypothesized that if competition were divided into these three types (zero sum, appropriate, and unclear), the impact of competition on performance in motor skills tasks could be clarified. A purpose of this review, therefore, is to examine the relative impact of cooperation, individualistic efforts, and zero-sum, unclear, and appropriate competition on motor skills performance.

Type of Task

A number of researchers hypothesized that the type of task affects the relationship between social interdependence and productivity (Hackman & Morris, 1975; D. W. Johnson & Johnson, 1974, 1978; Miller & Hamblin, 1963; Steiner, 1972). The Johnson and Johnson (1989) meta-analysis found that the superiority of cooperative over competitive experiences was greatest in procedural performance (combining conceptual learning of a skill with performing the skill) and least in rote performance (decoding and correcting). Early reviews of the literature (D. W. Johnson & Johnson, 1974; Miller & Hamblin, 1963) found that competition may result in higher achievement than cooperation when the task is a motor skills task and there is low or no means interdependence (i.e., completing the task requires little if any help from another person). Children, for example, pick up pegs or carry marbles more efficiently when competing than when cooperating. R. Johnson and Johnson (1979) conducted a series of experiments in which they unsuccessfully tried to demonstrate that competition would produce the highest achievement on simple drill-review tasks, individualistic efforts would be optimal on learning factual information, and cooperation would promote the highest achievement on conceptual and problem-solving tasks. They found that competitive and individualistic efforts were never superior to cooperative ones, although on some tasks there were no significant differences among the three types of social interdependence. Jackson and Williams (1985) found that competition among participants increased performance on easy tasks and reduced performance on complex tasks, whereas cooperation enhanced performance on difficult and complex tasks but not on easy ones. The type of task on which competition may promote higher performance than cooperation is motor performance tasks. Our review, therefore, focuses on such tasks.

Means Interdependence

The third condition that may increase the understanding of the relative impact of cooperation and competition is means interdependence. A number of researchers have found competition to promote greater productivity than cooperation on means-independent motor skills tasks (D. W. Johnson & Johnson, 1974, 1989; Michaels, 1977; Miller & Hamblin, 1963). In these studies, simple drill or hand–eye coordination tasks were used, such as picking up pegs, transferring marbles from one spot to another, dropping clothespins into a milk bottle, or completing a finger maze. Some of these tasks were biased against cooperation. When a finger maze has only room for one finger, it seems reasonable that a single person would complete it faster than will a group of four people who are trying to complete it together.

On the other hand, a number of researchers have found that cooperation promoted greater productivity than did competitive or individualistic efforts on means-interdependent tasks. Some of these tasks were biased against competition. Mintz (1951) required several individuals to pull cones on strings out of a milk bottle whose neck would permit only one cone to be withdrawn at a time. Under cooperative conditions the efforts of participants were coordinated, but under competitive conditions there was a traffic jam that increased everyone's time. Graziano, French, Brownell, and Hartup (1976) required children to build a single, joint tower with blocks. When rewarded for the total number of blocks in the tower, coordination existed. When rewarded for the number of own blocks in the tower, the competition caused more tower "falls" and fewer blocks being successfully added to the tower. On such tasks in which participants can block or hinder the performance of others, cooperation will tend to promote higher achievement than will competition (Crombag, 1966; Raven & Eachus, 1963). Cooperation, furthermore, typically leads to superior performance when task performance is facilitated by coordination, division of labor, or assistance, because these activities are structured to be possible to complete only under cooperative conditions (D. W. Johnson & Johnson, 1974, 1983). Finally, Deutsch (1985) and his students conducted a series of six experiments investigating the effects of three different ways of distributing rewards (winner take all, a distribution proportional to accomplishment, or an equal distribution) on tasks ranging from decoding Japanese poetry to estimating the number of jellybeans in a jar. Overall, they found that when tasks could be performed independently (i.e., there was low means interdependence) the system of distributing rewards had no effect on how good a job students did. But for those tasks in which

success depended on working together (i.e., where means interdependence was high), there was a clear difference. The system of equal rewards resulted in the highest achievement, and the winner-take-all system gave the poorest results. Overall, the research points toward means interdependence as a moderator of the relationship between cooperative and competitive efforts and productivity. A purpose of the present review, therefore, was to examine the relative impact of cooperative and competitive efforts on means-interdependent and means-independent tasks.

Other Factors Influencing Performance

The performance of motor skills may hinge on a number of factors other than the nature of competition, the task, and means interdependence. Performance may be significantly affected by the relationships among participants, the amount of social support (assistance and encouragement) for high performance, and the way doing the task makes one feel about oneself (D. W. Johnson & Johnson, 1989). In the present review, therefore, we examined the relative impact of cooperation and the three types of competition on interpersonal attraction, social support, and self-esteem. Deutsch (1949) predicted that competition would lead to less interpersonal attraction than cooperation. Previous research reviews clearly support his prediction (D. W. Johnson & Johnson, 1989). Clear examples of negative interpersonal relationships in competition are plentiful. Professional football players have written about deliberate attempts to injure opposing players (Tatum & Kushner, 1980), and Olympic figure skater Tonya Harding was found to be involved in the attack on her rival, Nancy Kerrigan. This does not mean, however, that negative relationships and hostility inevitably result from competition. Two rivals could respect each other and form a friendship even while striving to outperform each other (basketball players Magic Johnson and Larry Bird may be an example). The conditions under which competition leads to positive relationships have not been specified and researched. Zero-sum, unclear, and appropriate competition may have differential effects on relationships among competitors. A purpose of this study is to examine the relationships among participants in the three different types of competition.

There is reason to believe that social support may enhance motor skills performance. Social support in small groups facilitates adherence to exercise programs (King & Frederiksen, 1984; Weinberg & Gould, 1995), and the support of exercise partners and family members can also aid adherence (Wankel, 1984). Weinberg and Gould (1995, p. 394) suggested that exercising in a group may increase commitment through the social pressure of not letting down a friend. Theoretically, cooperation creates more social support than does competition, and there is considerable research validating that premise (Deutsch, 1949, 1962; D. W. Johnson & Johnson, 1974, 1989). There may be conditions, however, when competition promotes social support. There is a lack of research attempting to demonstrate the conditions under which competition enhances or diminishes social support among participants. A purpose of this review, therefore, was to examine the relative impact of cooperative and zero-sum, unclear, and appropriate competitive experiences on social support.

Theoretically, there are conditions under which each type of social interdependence (cooperative, competitive, and individualistic efforts) may affect self-esteem. Norem-Hebeisen and Johnson (1981) posited that there are four primary ways of deriving self-esteem from information about oneself: basic self-acceptance (a belief in the intrinsic acceptability of oneself), conditional self-acceptance (acceptance contingent on meeting external standards and expectations), self-evaluation (one's estimate of how one compares with one's peers), and real–ideal congruence (correspondence between what one thinks one is and what one thinks one should be). In their research, they found that attitudes toward cooperation were related to basic self-acceptance and positive self-evaluation, attitudes toward competition were related to conditional self-acceptance, and individualistic attitudes were related to basic self-rejection. Further evidence that competition promotes contingent self-esteem is presented by Ames and Ames (1978), who reviewed a set of studies on self and other evaluation that manipulated reward structure (cooperation vs. competition) and the success and failure of the participants. Failure in competitive situations resulted in participants engaging in self-derogation and viewing themselves as less capable; winning generated unrealistic self-appraisals in which winners exaggerated their own abilities and derogated the abilities of the losers. There is considerable evidence that cooperation promotes higher levels of self-esteem than do competitive or individualistic experiences (D. W. Johnson & Johnson, 1989). Further research on the impact of competition on self-esteem is needed. A purpose of this study, therefore, was to compare the relative impact of cooperation and zero-sum, unclear, and appropriate competition on self-esteem.

Summary

Given the importance of motor skills performance, it is important to understand the conditions under which it is maximized. Whereas the overall question involves the comparison of cooperative, competitive, and individualistic conditions, such a comparison may be misleading. A more careful examination of social interdependence theory, the existing research, and the nature of competition may lead to the specification of the conditions under which competition may enhance motor skills performance. It is necessary to differentiate among types of competition, types of tasks, and the presence (or absence) of means interdependence. To understand fully the impact of social interdependence on motor skills performance, furthermore, one must compare its impact on quality of relationship, social support, and self-esteem.

Method

Literature Search

The studies included in this meta-analysis were identified through a thorough search for relevant published and unpublished studies. Methods included conducting computer searches (Educational Resources Information Center, Psychological Abstracts, Dissertation Abstracts International, and the Social Sciences Citation Index, examining relevant bibliographies, searching of reference sections of the studies included in the meta-analysis to identify further relevant studies, and contacting relevant researchers and organizations. Keywords used in the searches were *cooperation, competition, individualistic, motor skills, motor performance, interdependence,* and *goal structures.* Keywords were used one at a time and in combinations. Over 800 studies on social interdependence were located. A study was included in the analysis if it met the following four criteria: (a) Social interdependence was the independent variable (cooperative, competitive, or individualistic experimental treatments); (b) the task was a clearly

identifiable motor task; (c) dependent variables included achievement, interpersonal attraction, social support, or self-esteem; and (d) data were reported that enabled a pairwise contrast between two treatments. The literature search identified 64 studies relevant to the analysis.

Independent Variable

The independent variable was social interdependence. The types of social interdependence were cooperative, competitive, and individualistic efforts. Pairwise contrasts of social interdependence were used in which cooperative conditions were defined as the experimental treatment and competitive or individualistic treatments were defined as the control group. Thus, the independent variable for a single study was represented by one or more of the following contrasts: cooperation versus zero-sum competition, cooperation versus unclear competition, cooperation versus appropriate competition, and cooperation versus individualistic efforts.

Cooperation was operationally defined as the presence of (a) one or more of the following—positive goal interdependence (mutual goals), positive reward interdependence (joint rewards), resource interdependence (each group member has different resources that must be combined to complete the assignment), and role interdependence (each group member is assigned a specific role)—and (b) any of four additional elements that are vital to the success of cooperative groups—face-to-face interaction, individual accountability (contribution of each member can be assessed), social skills (e.g., leadership, decision making, trust building, and conflict resolution skills), and group processing (reflecting on and discussing group effectiveness; D. W. Johnson & Johnson, 1989). The latter four elements were coded on a scale of minimal to high whenever their presence was indicated in the procedures for a study. Studies that included intergroup or team competition as part of operationalizing cooperation were included among the cooperative conditions. This condition is characteristic of sport and physical education activities. Ideally, intergroup competition would be a separate class of cooperation, but the number of studies containing intergroup competition was so small they were combined in the general cooperation category.

Competition was operationally defined as the presence of negative goal or reward interdependence. Because of the focus on competition on motor performance, competitive conditions were subdivided into three types:

1. Zero-sum competition: Those treatments in which participants were rewarded on a winner-take-all basis without any attention to including the conditions of appropriate competition.
2. Appropriate competition: Those treatments in which competition was deliberately structured so that winning was relatively unimportant, participants were assigned to homogeneous ability groups so that all had a reasonable chance to win, there were clear and specific rules and criteria for winning, and participants were able to monitor each other's progress (D. W. Johnson & Johnson, 1989).
3. Unclear competition: Those treatments in which (a) the procedural description of the condition did not provide enough evidence to designate the competition as zero sum or appropriate (this occurred primarily when competition was defined as "traditional" or the experimental design included a pretest or baseline measure) or (b) the investigators described the condition as individualistic but the task was interactive and the participants were ranked and rewarded according to their respective contributions to the outcome.

All studies in this analysis focused on competition among group members, not competition between groups.

Individualistic efforts were operationally defined as the lack of social interdependence between participants. Participants worked alone or with a minimum of interaction, and rewards were given according to set criteria so there was little opportunity for social comparison.

The conditions in each study and the type of competition used were coded by two or more analysts, both psychology professors, with extensive experience coding and analyzing research on social interdependence. Interrater reliability was calculated using the kappa coefficient (Cohen, 1960). The interrater reliability kappa was .76. The occasional difference in coding was discussed and resolved through consensus.

There are several related literatures that are not included in this review. Social facilitation research is related as it implies that under competitive conditions the presence of others will interfere with performance. The research has focused on the question, "What change in an individual's normal solitary performance occurs when other people are present?" (G. Allport, 1954). Most of the studies simply compared the presence and absence of other people and used competition as a post hoc explanation of the results (Geen, 1989). There were a few studies that compared means-independent competition with individualistic efforts (going back to Triplett's, 1898, classic study and before) but they do not (a) compare cooperation with either or (b) differentiate among the various types of competition. The social facilitation research, therefore, was not included in this review.

The research on goal-orientation theory focuses on the question, "What impact does the goal that a person has in mind in the achievement situation have on performance?" It typically compares the impact of mastery and performance goals on learning (Elliott & Dweck, 1988; Utman, 1997). Because this research focuses on individual achievement goals, it is unrelated to cooperative efforts as cooperative goals extend beyond one individual. Finally, the literatures on goal setting (Locke & Latham, 1990) and social loafing and free riding (Harkins & Szymanski, 1988) were excluded because they do not directly compare cooperative and competitive efforts.

Dependent Variables

The dependent variables were achievement or performance on motor tasks, interpersonal attraction, social support, and self-esteem. For these dependent variables, only the results of studies focusing on motor tasks were included. *Achievement or performance* was defined as an outcome measure for some type of motor performance. A variety of experimental settings and tasks were used in the studies yielding effect sizes for the dependent variable of achievement. Laboratory studies used tasks such as reaction time, tracking, and traversal (finding one's way through a maze). Field studies included tests of technical skills (cardiopulmonary resuscitation [CPR], setting up intravenous feeding [IVs]), sport skills (tennis, basketball, volleyball, bowling, fencing, tennis), fitness tests (American Alliance of Health, Physical Education, Recreation, and Dance), and basic motor skills (striking, hopping, dynamic balance). Although cognitive measures were often included in these studies, such as "rules" tests in volleyball, written recall on how to set up IVs, and cognitive CPR tests, these measures were not included in the achievement meta-analysis.

The dependent measure of *interpersonal attraction* included both behavioral and self-report measures of liking, group attraction, and integration of group members. Behavioral measures included observed amounts of interaction and the nature of interaction (friendly, cooperative, hostile, aggressive). Self-report measures included attitudinal scales (attraction to group, evaluation of team members, perceived integration) and sociometric measures (peer ratings, choice of future group members).

Social support was defined as perceived helping and encouragement from peers and instructors. Behavioral measures included turn taking, sabotage or obstruction, sharing, and communication. Self-report measures included perceptions of the helpfulness of peers and instructors.

Self-esteem was defined as self-report and attitudinal measures of feelings of self-acceptance or self-approval. The measures included global self-esteem tests and specific scales of perceived physical ability, appearance, self-acceptance, acceptance from peers and instructors, and emotional adjustment.

Moderating Variables

Moderating variables are defined as factors that might potentially influence the relationship between the dependent and independent variables.

Because of the small number of studies in the analysis, the moderating variables could be examined only for performance (not for interpersonal attraction, social support, and self-esteem). Moderating variables include age of participants, gender, experimental setting, the statistical unit of analysis (group or individual), and the presence or absence of means interdependence. Each study was read independently by two or more coders who were psychology professors; the occasional differences in coding were resolved through consensus. Interrater reliability was calculated using the kappa coefficient (Cohen, 1960). The results ranged from a kappa of .73 (for means interdependence) to 1.00 (for age) with an average reliability of .84.

Effect Size

The statistical methods and terminology for meta-analysis are from Cohen (1987), Hedges and Olkin (1985), Cooper (1989), and Glass, McGaw, and Smith (1981). The effect size *d* was the difference between treatment divided by the pooled standard deviation of the two groups (Cohen, 1987). When means were not given, but significance task results were, the *F*, *t*, or chi-square was converted to *d* (Cooper, 1989). All effect sizes were adjusted to control for small-sample bias (Hedges & Olkin, 1985). Within studies in which there were multiple achievement measures, the effect sizes were averaged to derive one effect size for each treatment contrast. The mean weighted effect size was found by multiplying each independent effect size by the inverse of its variance, and then the sum of these products was divided by the sum of the inverses. The resulting weighted mean effect size is referred to as "*d*+." Confidence intervals (95%) were calculated to determine the statistical significance of each weighted mean effect size (Cooper, 1989).

Tests for homogeneity of variance of effect sizes were calculated. To identify outliers, we used a diagnostic procedure for categorical models on data sets demonstrating a poor fit in the homogeneity tests (Hedges & Olkin, 1985, chapter 12). First, standardized residuals were calculated for all tests finding level effect sizes within each subgroup (cooperative vs. zero-sum competition, cooperative vs. appropriate competition, cooperative vs. unclear competition, and cooperative vs. individualistic efforts). Second, effect sizes were ranked according to the value of their respective residuals. Outlier effect sizes were eliminated in order of magnitude (irrespective of sign [plus or minus]). This process was repeated until an acceptable level of fit resulted. Then remaining effect sizes were again pooled (averaged) within studies, and the homogeneity analysis was repeated for the pooled effect sizes.

A number of studies did not include enough information to compute effect sizes. These studies only included statements such as, "the experimental and control conditions did not differ significantly." Excluding the studies biases the meta-analysis toward studies that report the details of their data. To reduce the bias, we estimated effect sizes for these studies. Studies reporting findings with "no significant difference" were given an effect size of zero, and studies reporting "positive" and "negative" significant findings but with no specific data were given an effect size that was estimated from the sample size assuming a .05 level of significance.

Results

Characteristics of the Studies

A total of 64 studies met the criteria for inclusion in this meta-analysis. The characteristics of the studies are found in Table 1. Eighty-eight percent of the studies have been conducted since 1960, with 41% conducted since 1980. Fifty-eight percent were conducted in laboratory settings, with the remainder being conducted in classrooms, recreation programs, and free-play settings. Most of these studies were short-term studies lasting only for one or a few sessions. No studies were carried out in the context of interscholastic sports. Seventy-six percent of the studies were published in journals. Eighty-nine percent were conducted with either undergraduates and adults or children in elementary school. Only 6 studies were conducted with junior high students, and 1 study included high school students. Forty-two percent of the studies involved mixed-gender groups. A listing of the studies appears in the Appendix.

Table 1
Characteristics of the Studies

Characteristic	No. of studies	% of studies
Year published		
1940–1949	2	3
1950–1959	5	8
1960–1969	9	15
1970–1979	20	32
1980–1989	22	35
1990+	4	6
Experimental setting		
Laboratory	36	58
Field[a]	26	42
Mode of publication[b]		
Journal	47	76
Theses	15	24
Age of participants		
Primary (Preschool–Grade 3)	14	23
Intermediate (Grades 4–6)	13	21
Junior high/middle (Grades 7–9)	6	10
High school (Grades 10–12)	1	2
Undergraduate	21	34
Adult	7	11
Gender of participants		
Female	4	6
Male	17	27
Mixed-gender groups	25	40
Same-gender groups	16	26
Means interdependence[c]		
Means interdependent	15	35
Means independent	28	65

Note. There were a total of 62 reports. Multiple studies in a single report were counted as a single study. There were multiple studies in two reports, so there were a total of 62 + 2 = 64 studies included in the meta-analysis. [a] Field studies included classroom, recreational, and camp settings. [b] Two articles in books were included as "journal." One unpublished study was included with theses. [c] For means-interdependence, the total of studies was based on studies containing achievement data only. There were a total of 42 such reports, one of which had both means-interdependent and means-independent conditions. Thus, the total *N* was 43.

Performance Results

The results represent averaged effect sizes for the four dependent variables. There may be more than one averaged effect size for a study if, for example, cooperation was compared with competition (one effect size) and cooperation was compared with individualistic efforts (a second effect size). When there was more than one unbiased effect size for a dependent variable in a single study, the effect sizes were averaged for each contrast so that each contrast was represented by a single effect size in the overall analysis. Across studies, the average effect sizes were weighted by the inverse of their variances so that studies with larger samples were more heavily weighted in the overall analysis.

The results of the meta-analyses for motor achievement are shown in Table 2. A total of 44 studies yielded 73 independent averaged effect sizes representing motor performance. The overall effect sizes for the three types of social interdependence indicate that cooperation promotes higher achievement on motor performance tasks than do competitive or individualistic efforts (effect sizes = 0.53 for cooperation and 0.36 for competitive or individualistic efforts). The studies in the competitive condition, however, are clearly heterogeneous: cooperation versus competition, $Q_w = 279.50$, $p < .05$; cooperation versus individualistic efforts, $Q_w = 69.39$, $p < .05$. When outliers were eliminated, the data loss for the cooperation versus individualistic condition was 18% (which is within acceptable limits), whereas the data loss for the cooperation versus competition condition was 33% (which is beyond acceptable limits). To reduce the heterogeneity of the studies in the cooperation and competition comparisons, we categorized operationalizations of competition as zero sum, appropriate, and unclear.

The weighted effect size was greatest for cooperation versus zero-sum competition (0.73), followed by cooperation versus unclear competition (0.35) and cooperation versus individualistic efforts (0.36), and finally, cooperation versus appropriate competition (0.12). The results for the adjusted meta-analysis differed only in magnitude (cooperation vs. zero-sum competition = 0.66; cooperation vs. unclear competition = 0.34; cooperation vs. individualistic efforts = 0.32; and cooperation vs. appropriate competition = 0.12).

Before any interpretation of these effect sizes, we must determine whether the data fit the assumption of homogeneity of variance. A fixed-effects model was used to do so (Hedges & Olkin, 1985, pp. 157–165). From Table 2, it may be seen that some factor other than chance or sampling error accounts for the difference in variance for the total group of effect sizes. The assumption of homogeneity of variance was violated for cooperation versus zero-sum competition ($Q_w = 264.71$), cooperation versus unclear competition ($Q_w = 39.68$), and cooperation versus individualistic efforts ($Q_w = 69.39$). The same procedure as before was used to identify and eliminate outliers. The homogeneity analysis was then repeated for the averaged effect sizes. The results of the adjusted meta-analysis with outliers deleted are also shown in Table 2. Of the 73 averaged effect sizes in the entire data set, 19 (26%) were eliminated, which is greater than the 10%–20% guideline recommended in Hedges and Olkin (1985, p. 250). Of these 19 outliers, 12 were deleted from the cooperation versus zero-sum competition subgroup, 5 from the cooperation versus individualistic subgroup, and 2 from the cooperation versus unclear competition subgroup. Although a loss of 12 effect sizes from the cooperation versus zero-sum competition subgroup may represent only a 19% loss from the overall data set, they form a disproportionate 48% loss from the data subgroup. The pattern of findings dropped slightly when the outliers were deleted. The studies containing outlier effects did not differ in study design from the other studies.

Table 2
Meta-Analysis of Achievement on Motor Tasks

Independent variable	*d*+	CLD 95%	k(*n*)	*Q*	*df*	fsn
All effect sizes						
Cooperation vs. competition	0.53*	±0.11	33	279.50*	32	54
Competition vs. individualistic	0.36*	±0.11	28	69.39*	27	22
Q within				348.89*	59	
Q between				4.50*	1	
Cooperation vs. zero-sum competition	0.73*	±0.13	25	264.71*	24	66
Cooperation vs. unclear competition	0.35*	±0.17	15	39.68*	14	11
Cooperation vs. appropriate competition	0.12	±0.23	5	2.00	4	1
Cooperation vs. individualistic	0.36*	±0.11	28	69.39*	27	22
Q within				375.78*	69	
Q between				30.96*	3	
Outlier effect sizes deleted						
Cooperation vs. competition	0.40*	±0.13	22	26.20	21	22
Cooperation vs. individualistic	0.32*	±0.12	23	29.09	22	13
Q within				55.30	43	
Q between				0.84	1	
Cooperation vs. zero-sum competition	0.66*	±0.17	13	16.50	12	30
Cooperation vs. unclear competition	0.34*	±0.17	13	16.71	12	9
Cooperation vs. appropriate competition	0.12	±0.23	5	2.00	4	1
Cooperation vs. individualistic	0.32*	±0.12	23	29.09	22	13
Q within				63.77	50	
Q between				16.89*	3	

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. For the combined analysis, effect sizes within studies were averaged across types of competition. A total of 44 studies yielded 121 effect sizes and 61 independent averaged effect sizes. The data loss was 61 − 44 = 17 (28%) for the total data set. When the cooperation versus competition findings were differentiated (zero-sum, unclear, and appropriate), the effect sizes within studies were averaged for each type of competition. A total of 44 studies yielded 121 effect sizes and 73 independent average effect sizes. The data loss was 73 − 54 = 19 (26%) for the total data set. The criterion *d* for fsn = 0.20.
* $p < .05$.

Moderator Variables

The data for the moderator variables for the cooperation versus zero-sum competition comparisons are listed in Table 3. The 17 studies (25 effects) were all laboratory experiments. The heterogeneity analysis (Q_w) for all of the moderator variables was significant. Standardized residuals were calculated as specified by Hedges and Olkin (1985, p. 255). For gender, age of participants, and unit of analysis, eliminating outliers eliminated an unacceptable amount of the data (40%, 44%, and 28%, respectively). For each of these potential moderating variables, many of the outliers were from the same studies. The common set of outliers were used diagnostically as specified by Hedges and Olkin (1985). The highly positive outliers clustered around means-interdependent tasks. The highly negative outliers clustered around means-independent tasks. With four outliers deleted, for means-interdependent tasks the differences favored cooperation ($1.34 < 1.56 < 1.78$), and for means-independent tasks there was essentially no difference between cooperation and zero-sum competition ($-0.11 < 0.10 < 0.31$). The difference between the means-interdependent and the means-independent effect sizes for the zero-sum comparisons was significant, $t(19) = 30.41$, $p < .0001$.

Because means interdependence was an important explanatory variable for the cooperation versus zero-sum competition condition, the analysis was applied to all conditions (see Table 4). The results for the cooperation versus zero-sum competition condition were discussed previously in Table 3. When outliers were deleted, the differences favored cooperation over unclear competition on both means-interdependent (0.89) and means-independent tasks (0.21). The difference between the means-interdependent and the means-independent effect sizes for the unclear competition comparisons was significant, $t(12) = 8.50$, $p < .001$. There were no significant differences between cooperation and appropriate competition means-independent (0.12) tasks. Cooperation promoted higher motor performance than individualistic efforts on both means-interdependent (1.03) and means-independent (0.30) tasks. The difference between the means-interdependent and the means-independent effect sizes for the zero-sum comparisons was significant, $t(21) = 2.99$, $p < .003$.

Interpersonal Attraction

A total of 23 studies yielded 26 independent, averaged effect sizes for interpersonal attraction. Both behavioral and self-report measures were coded. From Table 5, it may be seen that with all the effect sizes included, the weighted mean effect size was greatest for cooperation versus individualistic efforts (0.72), followed by cooperation versus zero-sum competition (0.56), cooperation versus unclear competition (0.52), and cooperation versus appropriate competition (0.21).

Table 3
Cooperation Versus Zero-Sum Competition: Moderating Variables

Moderating variable	*d*+	CLD 95%	k(*n*)	Q_w	*df*	fsn
All effect sizes						
Gender						
Mixed-gender groups	0.33*	±0.23	5	2.22	4	3
Same-gender groups	0.90*	±0.15	20	245.51*	19	70
Age of participants						
Preschool and primary	1.41*	±0.22	8	119.35*	7	49
Intermediate and junior high	0.36*	±0.26	3	4.78	2	2
Undergraduates and adults	0.44*	±0.19	14	87.02*	13	17
Unit of analysis						
Individual	−0.01	±0.21	9	16.82*	8	1
Group	1.14*	±0.16	16	173.29*	15	75
Means interdependence						
Means interdependence	1.67*	±0.20	13	111.54*	12	96
Means independence	0.01	±0.20	10	17.91*	9	1
Outlier effect sizes deleted						
Gender						
Mixed-gender groups	0.33*	±0.23	5	2.22	4	3
Same-gender groups	1.14*	±0.23	10	15.53	9	47
Age of participants						
Preschool and primary	1.48*	±0.30	5	7.45	4	32
Intermediate and junior high	0.36*	±0.26	3	4.78	2	2
Undergraduates and adults	0.88*	±0.36	6	6.05	5	20
Unit of analysis						
Individual	0.08	±0.22	8	5.71	7	1
Group	1.14*	±0.23	10	15.53	9	47
Means interdependence						
Means interdependence	1.56*	±0.22	11	18.03	10	81
Means independence	0.10	±0.21	8	6.49	7	1

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. The criterion *d* for the fsn was 0.20. The percentage of data loss for each moderator variable: gender, 25 − 15 = 10 (40%); age, 25 − 14 = 11 (44%); unit of analysis, 25 − 18 = 7 (28%); and means interdependence, 23 − 21 = 2 (9%).
* $p < .05$.

Table 4
Meta-Analysis of Motor Achievement by Type of Means Interdependence

Condition	*d*+	CLD 95%	k(*n*)	*Q*	*df*	fsn
All effect sizes						
Cooperation vs. zero-sum competition						
Means interdependent	1.67*	±0.20	13	11.54*	12	96
Means independent	0.01	±0.20	10	17.91*	9	1
Cooperation vs. unclear competition						
Means interdependent	0.93*	±0.35	6	9.98	5	22
Means independent	0.17	±0.19	9	15.16*	8	1
Cooperation vs. appropriate competition						
Means independent	0.12	±0.23	5	2.00	4	1
Cooperation vs. individualistic						
Means interdependent	1.03*	±0.83	3	1.50	2	13
Means independent	0.35*	±0.12	25	65.30*	24	18
Q within				241.28*	65	
Q between				166.18*	6	
Outlier effect sizes deleted						
Cooperation vs. zero-sum competition						
Means interdependent	1.56*	±0.22	12	18.03	11	81
Means independent	0.10	±0.21	9	6.49	8	1
Cooperation vs. unclear competition						
Means interdependent	0.89*	±0.34	6	6.33	5	21
Means independent	0.21*	±0.20	8	8.61	7	1
Cooperation vs. appropriate competition						
Means independent	0.12	±0.23	5	2.00	4	1
Cooperation vs. individualistic						
Means interdependent	1.03*	±0.83	3	1.50	2	13
Means independent	0.30*	±0.12	20	24.66	19	10
Q within				67.62	56	
Q between				133.10*	6	

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. The criterion *d* for the fsn was 0.20. Two studies used in the overall performance analysis were dropped because they included repeated measures on the same participants for both means-interdependent and means-independent tasks. Thus, the number of studies is 42 with 71 independent averaged effect sizes.
* $p < .05$.

The homogeneity fit statistic for social interdependence was significant ($Q_w = 56.14$, $p < .05$), indicating that some factor other than chance or sampling error accounts for the difference in the variance for the treatment variable. When one study was eliminated from each of the cooperation versus zero-sum competition and cooperation versus unclear competition subgroups and one finding was eliminated from the cooperation versus individualistic subgroup, however, the variation was nonsignificant ($Q_w = 21.68$, $p = .40$).

With these outliers deleted, the weighted mean effect size was greatest for cooperation versus zero-sum competition (0.78), followed by cooperation versus individualistic efforts (0.62), cooperation versus unclear competition (0.57), and cooperation versus appropriate competition (0.21). Because none of the confidence ranges contained zero, the null hypothesis of no difference between groups is false for all four conditions.

Social Support

Social support is actual or perceived helping (or hindering) by peers and instructors. Both behavioral and self-report measures were coded. A total of 17 studies yielded 25 independent, averaged effect sizes. From Table 6, it may be seen that the weighted mean effect size was greatest for cooperation versus unclear competition (0.83), followed by cooperation versus zero-sum competition (0.56), cooperation versus individualistic efforts (0.50), and cooperation versus appropriate competition (0.29).

The homogeneity statistic for social interdependence, however, was significant ($Q_w = 89.71$, $p < .05$), indicating that some factor apart from chance or sampling error accounts for the difference in variance for social interdependence. An inspection of the *Q* values within each of the four treatment subgroups showed that all four had significant Q_w values (see Table 6). When the outliers were deleted, however, the fit of the homogeneity statistics showed no significant results. The five outliers represented 16% of the total data set, which is less than the 10%–20% guideline of Hedges and Olkin (1985, p. 250). The adjusted meta-analysis indicates that the greatest difference in social support was between cooperation and unclear competition (0.65), followed by cooperation versus individualistic efforts (0.58), cooperation versus zero-sum competition (0.49), and cooperation versus appropriate competition (0.39). Because none of the confidence ranges include zero, the null hypothesis of no difference between groups is false for all four of the conditions.

Table 5
Meta-Analysis of Interpersonal Attraction

Independent variable	*d*+	CLD 95%	k(*n*)	*Q*	*df*	fsn
All effect sizes						
Cooperation vs. zero-sum competition	0.56*	±0.14	9	28.59*	8	16
Cooperation vs. unclear competition	0.52*	±0.15	12	18.42*	11	19
Cooperation vs. appropriate competition	0.21*	±0.19	1	0.00	0	1
Cooperation vs. individualistic	0.72*	±0.39	4	9.12*	3	13
Q within				56.14*	22	
Q between				10.82	3	
Outlier effect sizes deleted						
Cooperation vs. zero-sum competition	0.78*	±0.19*	8	8.78	7	23
Cooperation vs. unclear competition	0.57*	±0.15*	11	8.16	10	20
Cooperation vs. appropriate competition	0.21*	±0.19*	1	0.00	0	1
Cooperation vs. individualistic	0.62*	±0.40*	4	4.74	3	8
Q within				21.68	20	
Q between				18.11*	3	

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. A total of 23 studies yielded 50 effect sizes and 26 independent averaged effect sizes. The data loss was 26 − 24 = 2 (8%) for the total data set. The criterion *d* for the fsn was 0.20.
* $p < .05$.

Self-Esteem

A total of 10 studies yielded 16 independent, averaged effect sizes for self-esteem. From Table 7, it may be seen that the weighted mean effect size was greatest for cooperation versus unclear competition (0.64), followed by cooperation versus appropriate competition (0.55), cooperation versus zero-sum competition (0.53), and cooperation versus individualistic efforts (0.35). The homogeneity fit statistic for social interdependence was significant ($Q_w = 31.10$, $p < .05$), indicating that some factor apart from chance or sampling error accounts for the difference in variance for social interdependence (see Table 7). An inspection of the *Q* values within each of the four treatment subgroups showed that one of the subgroups (cooperation vs. zero-sum competition) had a significant Q_w value ($Q_w = 21.66$, $p < .05$). When one outlier was eliminated, however, all the *Q* values were nonsignificant, indicating that the effects sizes were homogeneous within the treatment groups. The order of the magnitude was cooperation versus zero-sum competition (0.99), followed by cooperation versus unclear competition (0.64), cooperation versus appropriate competition (0.55), and cooperation versus individualistic efforts (0.35).

File-Drawer Problem

A potential source of bias in reviewing a set of studies may be that only studies that tend to find significant differences are published and available for review. There may be numerous unpub-

Table 6
Meta-Analysis of Social Support

Independent variable	*d*+	CLD 95%	k(*n*)	*Q*	*df*	fsn
All effect sizes						
Cooperation vs. zero-sum competition	0.56*	±0.16	9	15.63*	8	16
Cooperation vs. unclear competition	0.83*	±0.30	7	37.27*	6	22
Cooperation vs. appropriate competition	0.29*	±0.17	3	16.26*	2	1
Cooperation vs. individualistic	0.50*	±0.21	6	20.54*	5	9
Q within				89.71*	21	
Q between				11.21*	3	
Outlier effect sizes deleted						
Cooperation vs. zero-sum competition	0.49*	±0.16	8	9.11	7	12
Cooperation vs. unclear competition	0.65*	±0.32	5	6.31	4	11
Cooperation vs. appropriate competition	0.39*	±0.19	2	1.85	1	2
Cooperation vs. individualistic	0.58*	±0.23	5	8.04	4	9
Q within				25.31	16	
Q between				2.68	3	

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. A total of 17 studies yielded 42 effect sizes and 25 independent averaged effect sizes. The data loss was 25 − 20 = 5 (16%) for the total data set. The criterion *d* for the fsn = 0.20.
* $p < .05$.

Table 7
Meta-Analysis of Self-Esteem

Independent variable	*d*+	CLD 95%	k(*n*)	Q_w	*df*	fsn
All effect sizes						
Cooperation vs. zero-sum competition	0.53*	±0.39	5	21.66*	4	8
Cooperation vs. unclear competition	0.64*	±0.24	4	6.08	3	9
Cooperation vs. appropriate competition	0.55*	±0.38	2	2.85	1	4
Cooperation vs. individualistic	0.35*	±0.27	5	0.51	4	4
Q within				31.10*	12	
Q between				2.50	3	
Outlier effect sizes deleted						
Cooperation vs. zero-sum competition	0.99*	±0.45	4	5.69	3	16
Cooperation vs. unclear competition	0.64*	±0.24	4	6.08	3	9
Cooperation vs. appropriate competition	0.55*	±0.38	2	2.85	1	4
Cooperation vs. individualistic	0.35*	±0.27	5	0.51	4	4
Q within				15.13	11	
Q between				6.19	3	

Note. *d*+ = the weighted effect size for the combined studies; CLD 95% = the value of the 95% confidence interval around the weighted effect size; k(*n*) = the number of averaged effect sizes in the meta-analysis; fsn = fail safe *N*. A total of 10 studies yielded 19 effect sizes and 16 independent averaged effect sizes. The data loss was 16 − 15 = 1 (6%) for the total data set. The criterion *d* for the fsn = 0.20.
* $p < .05$.

lished works "tucked away in file drawers" that might change the overall findings. Orwin (1983) presented a procedure for determining how many studies would have to be hidden in file drawers to change the results found. He makes an assumption that the effect sizes from unretrieved findings are equal to zero (which is very conservative). His statistic then determines how many studies in file drawers with an average effect size of zero would be needed to shift the obtained weighted mean effect size (*d*+) to a criterion level such as 0.20 (which is small as defined by Cohen [1987, pp. 25–26]). The results from Table 4 indicate that for the cooperation versus zero-sum competition comparison for means-independent tasks, and for the cooperative versus appropriate competition comparisons, even one more study might significantly change the meta-analysis results. The same is true for the interpersonal attraction and the social support results for cooperation versus appropriate competition.

Discussion

The initial question investigated in this review was whether motor performance is influenced differentially by cooperative, competitive, or individualistic situational structures. Although motor skills performance pervades all aspects of people's lives, the conditions under which motor skills performance is optimized are somewhat neglected. The impact of social interdependence (cooperative, competitive, and individualistic conditions) on motor skills performance, for example, has been examined by a number of researchers, but the overall literature has not been previously summarized and subjected to a critical analysis. It was the purpose of this meta-analysis to do so.

Overall Results

Although there have been a number of research reviews that concluded cooperation tends to promote higher achievement than do competitive or individualistic efforts, there has never been a comprehensive review of the research specifically focusing on motor performance. Thus, the results of this meta-analysis add an important new piece to both the literatures on social interdependence and motor performance. In general, cooperation was found to result in higher performance on motor performance tasks than competitive or individualistic efforts (effect sizes 0.53 for cooperation and 0.36 for competitive or individualistic efforts). These results, while congruent with the broader research literature indicating the superiority of cooperative efforts on a wide range of tasks (D. W. Johnson & Johnson, 1989), are somewhat surprising. Previous reviewers have concluded that the type of task most likely to result in competitors outperforming cooperators was motor performance tasks (Jackson & Williams, 1985; D. W. Johnson & Johnson, 1974, 1978, 1989; Miller & Hamblin, 1963). It may be that for competitors to outperform cooperators, the motor skills performance tasks have to be so simple and so overlearned (such as picking up pegs, carrying marbles, or putting on one's shoes) that few instances actually exist in daily life. It may also be that what researchers have defined as competition may be so varied that the results cloud the understanding of the ways in which competition may enhance motor skills performance. Some studies did demonstrate that competitors can outperform cooperators on motor performance tasks. Thus, although it is clear that in most situations, cooperation will promote higher motor skills performance than will competition, there is reason to believe that under certain conditions the reverse may be true and, therefore, further analysis is needed. Such analysis begins with an examination of the nature of competition as reflected in (a) the research and (b) the theorizing.

Nature of Competition: Operationalizations in the Research

The results of this meta-analysis increased the understanding of competition. Examination of the existing research studies revealed competition is not a unitary construct and had been operationally defined in markedly different ways. The results were analyzed to

separate competition into zero-sum competition, unclear competition, and optimal competition.

Cooperation versus zero-sum competition. The defining characteristic of competition is negative outcome interdependence (if one person achieves his or her goal, all others cannot achieve their goals). The more powerful the negative outcome interdependence in a situation, the stronger the effects of competition are posited to be. The most extreme form of negative outcome interdependence is zero-sum, "winner-takes-all" competition in which the winner is given a reward and all others receive nothing. Zero-sum competition is quite common. Many sports championships (e.g., World Series in professional baseball, Super Bowl in professional football, and the Olympics) operate on a zero-sum basis. Many businesses compete for contracts on a zero-sum basis, and many professional rewards (teacher of the year) are given on a zero-sum basis. In secondary schools and colleges, there is only one valedictorian. Because the practice of zero-sum competition is so frequent, it may be natural that it is the most frequently used way to operationalize competition in research investigations. It is also in zero-sum competition that the strongest results were found. In the existing research, cooperation promoted considerably higher motor skills performance than did zero-sum competition (effect size = 0.66).

When the destructive outcomes of competition are noted (Kohn, 1992), it may be zero-sum competition that is being discussed. Yet it is also clear that many individuals seek out zero-sum competitions for fun, enjoyment, and excitement. Individuals regularly participate in sports (golf, tennis, racquetball) and other leisure-time activities (chess, card games such as bridge, party games such as Trivial Pursuit) that are structured to be zero-sum competitions for recreation and health purposes. Thus, while in educational and work settings zero-sum competition may be counterproductive, there may be more to appropriate competition than making it a non-zero-sum situation. The research on zero-sum competition demonstrates its negative impact on productivity but does not clarify why so many people find it such a positive experience under certain conditions.

Cooperation versus unclear competition. In many of the research studies, the authors seemed to make the assumption that readers knew what competition was and, therefore, saw no need to describe the operations used to create it. In these studies, it was impossible to tell from the description of the experimental procedures how competition was operationalized. These studies, therefore, were placed in a separate category (e.g., unclear competition) to ensure that the results for zero-sum competition were not confounded with ambiguously structured competition. The results of this meta-analysis indicated that cooperation promoted higher performance on motor performance tasks than did unclear competition (effect size = 0.34). The results are consistent with those for zero-sum competition, but the effect size was somewhat smaller. The lack of description of how competition was operationalized makes it uncertain what the results can be attributed to. One explanation for this is that zero-sum competition existed in these studies but the setting in which the studies were conducted influenced the results. The studies classified as unclear competition were primarily field studies (academic classes, exercise programs, sport camps, and so forth) and, although such studies were the most ecologically valid, there may be sources of variance in field studies that deluded the effect of the independent variable.

Another explanation is that in these studies competition was structured in ambiguous ways (it is highly unlikely that competition would be structured appropriately without it being described). In the discussions of competition, it has been hypothesized that the more ambiguous the rules, procedures, and criteria for winning, the more destructive the competition would tend to be (D. W. Johnson, 1974, 1978, 1989). Participants, for example, may direct much of their energy toward worrying about what was fair and unfair rather than toward performing their best, and negative reactions may result when participants lose. The hypothesis that ambiguity of rules, procedures, and criteria for winning may create apprehension and distracts from and interferes with performance seems reasonable. However, we found no studies that investigated the hypothesis by contrasting clearly defined with ambiguously defined competition. Obviously, more research is needed on this issue.

Cooperation and appropriate competition. Many individuals compete for fun and enjoyment. Everyday we see instances of competition enhancing relationships and providing enjoyment and excitement. Although appropriate competition seems to exist, there have been little theorizing about its nature and few researchers attempting to demonstrate its nature and effects. A small number of field studies operationalized competition according to the conditions of constructive competition (e.g., winning is relatively unimportant, all participants have a reasonable chance of winning, the procedures and criteria for winning are clear and specific, and participants are able to monitor each other's progress) specified by D. W. Johnson and Johnson (1974, 1978, 1989). Although cooperation promoted higher motor skills performance than did appropriate competition, the size of the effect was small (effect size = 0.12) and did not differ significantly from zero (i.e., there was no significant difference on performance between cooperation and appropriately structured competition). These results imply that there may be conditions under which cooperation and competition are equally effective in promoting motor skills performance. The small number of studies, however, make the results unreliable and inconclusive. More studies are needed.

Appropriate competition is conceived as including a low enough level of negative outcome interdependence that it does not matter who wins or who loses. Secondary outcomes such as physical or mental exercise, fun and enjoyment, or relief from boredom motivate participation, not the desire to win. We found no studies that (a) have directly contrasted levels of negative outcome interdependence or (b) included primary (winning) and secondary (exercise, fun) outcomes. Although it seems reasonable to assume that competing for one dollar has different effects than competing for a million dollars, and engaging in a competition to win has different effects than engaging in a competition to obtain exercise, researchers have not actually demonstrated such differences.

Similarly, the other aspects of appropriate competition have not been directly investigated in the research reviewed. Clarity of rules, procedures, and criteria for winning were discussed earlier. The perceived likelihood of winning has been investigated in other research literatures, including perceptions of competence in relation to others. The ability to monitor competitors' progress points toward the positive aspects of social comparison and the information it provides about the level of effort required in the situation, but such aspects of competition have not yet been investigated in the social interdependence literature. Future research should di-

rectly vary the likelihood of winning, the clarity of rules and criteria for winning, and the opportunity to engage in social comparison.

Nature of Competition: Conceptual Clarification

Although competition is often discussed, the theorizing has been aimed primarily at defining the general nature of competition. There is relatively little theorizing about the conditions under which competition is constructive and destructive and the impact of the different elements that are inherent in competition on its effectiveness. Previous reviewers of the literature on competition have by and large assumed that all competition is the same and have not attempted to clarify conceptually its nature. In the future, studies should be conducted that (a) clarify the nature of competition, (b) compare hypothesized elements of constructive competition with hypothesized elements of destructive competition, and (c) highlight the similarities and differences of the various approaches to defining competition (situational variable, cognitive state, motive, trait, and attitude).

Means Interdependence and Means Independence

An important moderator variable of the effectiveness of competition was whether the completion of the task required the actions of more than one competitor (e.g., means interdependence) or could be completed separately by each competitor (e.g., means independence). The results of the meta-analysis indicated that means interdependence decreased the effectiveness of competition. The difference in motor performance between competition and cooperation was smaller when tasks were means independent.

A theoretical controversy between social interdependence and behavioral theories of competition involves the role of means interdependence (e.g., direct interaction) among participants on performance. Social interdependence theory views interaction as critical to outcomes, whereas behavior theory sees interaction unrelated to outcomes. A basic premise of social interaction theory is that the structure of the situation determines how participants interact, which in turn determines the outcomes of the situation (Deutsch, 1949, 1962; D. W. Johnson, 1970; D. W. Johnson & Johnson, 1974, 1989). The more interaction required to complete the task (e.g., means interdependence), the more powerful its effects on outcomes. In means-interdependent tasks, individuals have the opportunity to either promote and facilitate each other's success or obstruct and block each other's success. In cooperative situations they tend to do the former, whereas in competitive situations they tend to do the latter. In means-independent tasks, on the other hand, each participant can complete the task unaffected by the actions of others. No interaction is required, which reduces the opportunity to either promote or obstruct the success of others. Social interdependence theory, therefore, would predict that cooperation would produce higher performance than competition on motor skills means-interdependent tasks than on motor skills means-independent tasks. The impact of cooperation and competition is hypothesized to be much less under means independent conditions, and it is reasonable to find no differences between the two conditions.

A basic premise of behavioral theory, on the other hand, is that individuals will work hard on those tasks for which they secure a reward and will fail to work on tasks that yield no reward or yield punishment (Bandura, 1977; Skinner, 1968). Cooperation is structured by providing incentives for individuals to participate in a group effort, because it is assumed that individuals will not intrinsically help others or work toward a common goal. Competition is structured by providing incentives for outperforming others. Behavioral theory predicts no differences in participants' performance levels on motor skills means-interdependent and means-independent tasks because the interaction patterns are incidental compared with the rewards and punishments.

The results of this review tend to support the social interdependence position and do not support the behavioral theory position. There was a significant difference on means-interdependent and means-independent tasks between cooperation and both zero-sum and unclear competition. For zero-sum competition on means-interdependent tasks, higher motor skills performance was found in the cooperative than in the competitive conditions. For zero-sum competition on means-independent tasks, the results indicate no significant differences on performance but (a) not enough studies have been conducted to provide a definitive answer to the question of whether cooperation or zero-sum competition would promote the highest achievement on means-independent tasks, and (b) all the studies were conducted in the carefully controlled conditions of the laboratory. Further studies are needed on means-independent tasks in a variety of settings.

Purpose of Competition

There are aspects of competition that have not been the focus of research by social interdependence theorists. Competition, for example, may have a variety of purposes. Behavioral theorists posit that the purpose of competition is to win extrinsic rewards. Social comparison theorists posit that the purpose of competition is to evaluate level of competence. A runner, for example, may enter the Boston Marathon to win money and fame or to test his or her level of competence against some of the best marathoners in the world. These two different purposes may affect the outcomes of competition and should be investigated in the future.

Other Variables Affecting Performances

Performance on motor skills tasks is affected not only by the structure of the situation (cooperative, competitive, or individualistic) but also by the interpersonal attraction among the individuals performing the tasks, the amount of social support for engaging in the tasks, and the self-esteem associated with performing the tasks. Discussions of motor performance by and large neglect the discussion of these variables. It is important to determine the relative impact of the three types of social interdependence on these variables as well as on actual performance.

Quality of relationships. Attaining a high level of performance is influenced by the quality of one's relationships with other participants (D. W. Johnson & Johnson, 1997). The more positive the relationships among participants, the more cohesive the group, the greater the esprit de corps, and the higher the level of performance. In his original formulation of social interdependence theory, Deutsch (1949) posited that the success achieved in cooperative situations would result in a "positive cathexis" to the other participants, resulting in increased interpersonal attraction and

positive bonding. D. W. Johnson and Johnson (1989) found that the increased positive relationships result from cooperative efforts regardless of whether the group succeeded or failed. The results of the present meta-analysis indicated that completing motor performance tasks cooperatively resulted in more positive relationships among participants than did zero-sum competition, unclear competition, appropriate competition, or individualistic efforts. None of the confidence intervals contained zero, which suggests that these differences are not negligible. When the goals of a situation include creating good relationships or team spirit among participants, practitioners may wish to emphasize cooperative, not competitive or individualistic efforts.

The existing research does not clarify the conditions under which competition leads to positive relationships and interpersonal attraction among participants. Further theorizing and research are needed on this issue.

Social support. Social support is related to a wide variety of variables, including achievement and productivity, physical health, psychological health, and ability to cope with adversity (D. W. Johnson & Johnson, 1989). Given that promotive interaction takes place in cooperative situations, oppositional or contrient interaction takes place in competitive situations, and no interaction takes place in individualistic efforts, it is not surprising that in this meta-analysis, cooperation resulted in greater social support on motor skills tasks than did unclear competition, individualistic efforts, zero-sum competition, and appropriate competition in that order. Although the sample sizes are small, the results are congruent with findings on other types of tasks (D. W. Johnson & Johnson, 1989).

Self-esteem. The role of self-esteem in performance is somewhat controversial. Whereas some researchers conclude that increases in self-esteem increase performance, other researchers believe that self-esteem is a concomitant of performance (D. W. Johnson & Johnson, 1989). It may be, however, that for high performance levels on repeated tasks to be maintained over long periods of time, the performance of the task must enhance or at least not damage participants' self-esteem. The results of the present review indicated that cooperation promoted higher self-esteem than did zero-sum, unclear, and appropriate competition as well as individualistic efforts in that order on motor skills performance. This corroborates research on other types of tasks (D. W. Johnson & Johnson, 1989) and supports the position of Norem-Hebeisen and Johnson (1981). The existing research indicates that when practitioners wish to enhance participants' self-esteem on motor skills tasks, cooperation should be maximized and competitive or individualistic efforts minimized. Because the existing research does not clarify the conditions under which competition may enhance self-esteem, further theorizing and research are needed.

Maintaining high levels of performance. Whereas the present research primarily focuses on immediate performance on motor skills tasks, in most applied situations the goal is to maintain high levels of performance for a considerable time. It is doubtful that productivity will remain high for prolonged periods of time if negative relationships are fostered, participants counteract each other's efforts or ignore each other's need for help or assistance, and participants feel worse and worse about themselves the longer they work. It seems reasonable to hypothesize that long-term productivity will depend on a strong cooperative structure that promotes positive relationships with fellow participants, considerable social support for productive work, and increasing self-esteem the longer one works. Considerably more theorizing and research need to focus on the potential constructive impact of competition on the variables supporting long-term efforts to achieve.

Individualistic Efforts

In an effort to avoid competition, an individualistic approach is frequently advocated. Individuals are told to strive to improve over their previous best performance or to achieve up to a preset criterion, rather than striving to outperform others. The results of this meta-analysis indicate that cooperation, compared with individualistic efforts, results in higher performance for both means-interdependent and means-independent tasks, greater interpersonal attraction, greater social support, and higher self-esteem. Practitioners are better served by structuring cooperative rather than individualistic efforts on motor performance tasks.

It should also be noted that it is difficult to implement truly individualistic efforts in the context of motor performance, especially sports and games. The results of motor tasks are obvious and may invite social comparison and competition. F. Allport (1920) noted, for example, that when individuals coacted on means-independent tasks, 80% reported feelings of competition. Although criterion-referenced procedures are now common in physical education skills and fitness testing (Hopple, 1995), such evaluation methods are still carried out in a public context that makes it difficult for participants to monitor only their own performance and not those of others.

Future Research

The results of this meta-analysis may provide a number of promising leads for future research. First, there is a troubling gap in the participants used in the research studies. Eighty-nine percent of the studies were conducted with either undergraduates/adults or young children. Only six studies were conducted with junior high school students, and there were no studies at the high school level. In light of the studies that 80% to 90% of registered youth sport participants drop out by age 15 (Orlick, 1978), it would seem imperative for future research efforts on social interdependence and motor skills to target this age group.

Second, there is a need for more studies to be conducted in a wider variety of settings. Interscholastic sports, for example, are one of the most common settings for competition, yet there is little evidence on the effects competition has on athletic productivity and relationships among elite college athletes. Motor performance tasks are more common in industry and business than in schools, yet there is little research on the conditions that promote long-term productivity on motor performance tasks in work settings.

Third, there is a need for more studies on appropriate competition. The few studies that have been conducted indicate that appropriate structured competition may increase the effectiveness of competition considerably. Although there was some attempt to identify the conditions under which competition is constructive in the 1970s (D. W. Johnson & Johnson, 1974, 1975/1999, 1978), little research has been conducted since. There is a need for research that contrasts the conditions for constructive competition, such as varying the importance of winning or the ability of par-

ticipants to monitor the progress of other participants. With more studies on appropriate competition, increased understanding may be revealed of the nature of appropriate competition and the conditions under which competition is constructive.

Fourth, little research has been conducted clarifying the nature and effects of means interdependence and means independence and their influence on the relationship between cooperative and competitive efforts and achievement.

Fifth, a major problem with the research is that many researchers used tasks that biased the results one way or the other. There were means-interdependent tasks biased against competition, and there were means-independent tasks biased against competition. What is needed is a new set of studies that uses tasks that are not biased against cooperation or competition.

Sixth, the nature of motor performance needs to be clarified. Although there have been attempts to do so (J. Thomas & French, 1985), including differentiating between tasks requiring gross or fine-motor skills and simple and complex tasks, there are so many different types of motor performance tasks, ranging from finger mazes and picking up marbles to inserting an IV or giving CPR, that considerably more thought is required as to the nature of motor skills tasks.

Seventh, the studies on motor performance were almost entirely on single-performance situations. There is a need for studies that examine motor performance on tasks that are repeated over and over again for weeks, months, and even years.

Eighth, considerably more research is needed on the conditions under which competition may be used to create positive relationships, social support, and self-esteem. The frequency with which individuals engage in competition with friends as recreation and entertainment leads to the hypothesis that there are conditions under which competition will result in improved relationships and higher self-esteem, but what those conditions are needs to be explicated by future research.

Conclusion

Although the controversy concerning competition has not been resolved by this meta-analysis, it has been modified. It seems clear that, under most conditions, cooperation promotes higher performance on motor skills tasks than do competitive or individualistic efforts. This is an important addition to social interdependence theory and the research literatures on cooperative, competitive, and individualistic efforts and on motor skills performance. This overall conclusion, however, has been modified by the clarification that competition is not a unitary construct and has been operationally defined in many different ways by different researchers. When the type of competition is taken into account, the results indicated that cooperation is significantly more superior to zero-sum competition than for unclear and appropriate competition. In addition, the overall conclusion as to the superiority of cooperation has been modified by the findings concerning the nature of the task. When completing the task requires the actions of more than one person (e.g., means interdependence), cooperation promotes significantly higher motor performance than competitive and individualistic efforts than when the task may be completed separately by each participant (means independence). These qualifications of the overall conclusion provide more clarity to the potential answer to the controversy over the use of competition and point toward (a) future research studies to be conducted and (b) more refined use of competition by practitioners.

Asking whether competition (a) is good or bad or (b) should or should not be banned is asking the wrong question. The issue is not either-or (either cooperation or competition). The issues are identifying (a) the conditions under which cooperative, competitive, and individualistic efforts each may result in positive outcomes and (b) the essential elements within competition that make it constructive or destructive. More effort needs to be focused on conceptualizing the essential elements of competition and clarifying the conditions under which competition may be effectively used. It is hoped that doing so will lead to research that addresses more complex questions than whether competition leads to higher or lower productivity and lead to more sophisticated ways of structuring competition in applied settings.

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(Appendix follows)

Appendix

Listing of Studies Including Studies With Effect Sizes and Experimental Tasks

Authors and year	Effect d[a]	Average effect[b]	Dependent measure	M (+/−)[c]	Control condition[d]
Blechman and McEnroe (1985)	**0.07**	0.33	Blocks: individual towers	(−)	Zero sum
	0.58		Blocks: joint towers	(+)	
Brown (1988/1989)	0.86	0.86	Tennis skills total	(−)	Individualistic
Bruning, Sommer, and Jones, Study 1 (1966)	**−1.37**	−1.37	Reaction time	(−)	Zero sum
Bruning, Sommer, and Jones, Study 2 (1966)	**−0.39**	−0.39	Pursuit rotor	(−)	Zero sum
Carpenter (1986/1987)	0.19	0.15	General test: fencing	(−)	Appropriate
	−0.05		Lunge: accuracy	(−)	
	0.30		Lunge: reaction time	(−)	
Cook (1981/1982)	**2.07**	1.99	Blocks: towers	(+)	Zero sum
	1.90		Blocks: falls	(+)	
Cratty and Sage (1964)	1.56	1.56	Maze traversal speed	(−)	Individualistic
Crombag (1966)	**3.28**	3.28	Speed of leveling	(+)	Zero sum
David (1974/1975)	**−0.53**	−0.53	Bachman ladder (climbing)	(−)	Unclear
French, Brownell, Graziano, and Hartup (1977)	0.70	1.41	Blocks	(+)	Unclear[1,2]
	2.12		Falls	(+)	
	1.63	1.71	Blocks	(+)	Zero sum[2]
	1.79		Falls	(+)	
	1.84	2.27	Blocks	(+)	Zero sum[2]
	2.70		Falls	(+)	
Giannini, Weinberg, and Jackson (1988)	0.05	0.05	3-min successful shots (basketball)	(−)	Individualistic[2]
	0.46	0.46	3-min successful shots (basketball)	(−)	Individualistic[2]
	0.27	0.27	3-min successful shots (basketball)	(−)	Individualistic[2]
	−0.20	−0.20	3-min successful shots (basketball)	(−)	Appropriate[2]
Graziano, French, Brownell, and Hartup (1976)	0.96	0.98	Blocks: towers	(+)	Zero sum
	1.00		Blocks: falls	(+)	
Huddle (1958)[e]	0.08	0.08	No. of TV rectifiers assembled	(−)	Zero sum[2]
	−0.14	−0.14	No. of TV rectifiers assembled	(−)	Individualistic[2]
Jensen and Moore (1977)	1.60	1.60	Blocks	(+)	Zero sum
R. Johnson, Bjorkland, and Krotee (1983)	0.34	0.33	Golf putt: 12-hole	(−)	Appropriate[2]
	0.13		Golf putt: 15-ft test	(−)	
	0.51		Golf putt: 30-ft test	(−)	
	0.14	0.43	Golf putt: 12-hole	(−)	Individualistic[2]
	0.52		Golf putt: 15-ft test	(−)	
	0.64		Golf putt: 30-ft test	(−)	
King and Frederiksen (1984)	0.72	0.36	Jogging frequency	(−)	Individualistic[1]
	0.00				
	0.00	−0.39	Jogging frequency	(−)	Individualistic[1]
	−0.77				
Kelly, Rawson, and Terry (1973)	0.00	0.00	Tinkertoy rocket assembly	(−)	Unclear[2]
	0.00	0.00	Tinkertoy rocket assembly	(−)	Zero sum[2]
Krampf (1988/1989)	0.15	0.15	AAHPERD fitness test	(−)	Appropriate[2]
	−0.47	−0.47	AAHPERD fitness test	(−)	Individualistic[2]
Mahoney (1988/1989)	**1.23**	1.23	CPR learning time	(−)	Individualistic[1]
	1.24	1.24	CPR learning time	(−)	Individualistic[1]
Marsh and Peart (1988)	0.06	−0.04	400-m run	(−)	Unclear[2]
	0.08		Push-ups	(−)	
	−0.09		Burpees	(−)	
	−0.21		Jump-rope skips	(−)	
	−0.21		Sit-ups	(−)	
	0.06		V-situps	(−)	
	0.03		Step-ups	(−)	
	0.48	0.64	400-m run	(−)	Unclear[2]
	0.77		Push-ups	(−)	
	0.76		Burpees	(−)	
	0.46		Jump-rope skips	(−)	
	0.47		Sit-ups	(−)	
	0.64		V-situps	(−)	
	0.88		Step-ups	(−)	
Martino and Johnson (1979)[f]	**4.12**	4.12	Swimming skills test	(−)	Individualistic

Appendix (*continued*)

Authors and year	Effect d[a]	Average effect[b]	Dependent measure	M (+/−)[c]	Control condition[d]
Mender, Kerr, and Orlick (1982)[e]	0.90	0.84	Dynamic balance	(−)	Unclear
	0.84		Hopping	(−)	
	0.78		Striking	(−)	
Nelson and Madsen (1969)	**1.77**	1.77	Time/speed to solution	(+)	Zero sum
Newcomb, Brady, and Hartup (1979)	0.56	0.56	Blocks	(+)	Zero sum
O'Donnell et al. (1990)	0.43	0.43	IV setup: performance (total action units)	(−)	Individualistic[1]
	0.47	0.47	IV setup: performance (total action units)	(−)	Individualistic[1]
	−0.17	−0.17	IV setup: performance (total action units)	(−)	Individualistic[1]
O'Donnell et al. (1988)	0.01	0.01	IV setup: performance (total action units)	(−)	Individualistic[1]
	0.16	0.16	IV setup: performance (total action units)	(−)	Individualistic[1]
	0.64	0.64	IV setup: performance (total action units)	(−)	Individualistic[1]
Philp (1940)	0.74	0.31	Marble drop (complex): friends	(−)	Zero sum
	−0.12		Marble drop (complex): strangers	(−)	
Raven and Eachus (1963)	1.16	1.16	Time to level board	(+)	Zero sum
Rattigan (1985)	0.49	0.60	Skills test: bump	(+)	Unclear
	0.72		Skills test: set	(+)	
Reich (1990)	0.10	0.10	9-min walk–run	(−)	Unclear[2]
	0.00	0.00	9-min walk–run	(−)	Appropriate[2]
	−0.20	−0.20	9-min walk–run	(−)	Individualistic[2]
Richmond and Weiner (1973)	**4.93**	4.93	Time to solution: Madsen board	(+)	Zero sum
Roberts (1972)	0.00	0.00	Shuffleboard score	(−)	Unclear[2]
	0.00	0.00	Shuffleboard score	(−)	Zero sum[2]
Rosenbaum et al., Study 1, (1980)	0.36	0.29	Blocks: joint towers	(+)	Unclear[3]
	0.23		Falls: joint towers	(+)	
	1.27	1.15	Blocks: joint towers	(+)	Zero sum[3]
	1.04		Falls: joint towers	(+)	
	−0.33	−0.33	Falls: individual towers	(−)	Individualistic[3]
	0.90	0.90	Falls: individual towers	(−)	Zero sum[3]
Rosenbaum et al., Study 2a, (1980)	0.83	0.71	Blocks: joint towers	(+)	Unclear[2]
	0.59		Falls: joint towers	(+)	
	1.70	1.65	Blocks: joint towers	(+)	Zero sum[2]
	1.60		Falls: joint towers	(+)	
Rosenbaum (1980)	0.00	0.36	Collating errors	(−)	Unclear[2]
	0.00		Booklets collated: low density	(−)	
	1.09		Booklets collated: high density	(−)	
	0.00	0.36	Collating errors	(−)	Zero sum[2]
	0.00		Booklets collated: low density	(−)	
	1.09		Booklets collated: high density	(−)	
Rynders, Johnson, Johnson, and Schmidt (1980)[f]	0.00	0.00	Bowling score	(−)	Zero sum[2]
	0.00	0.00	Bowling score	(−)	Individualistic[2]
Seta, Paulus, and Schkade, Study 2, (1976)	**0.00**	0.00	Maze-performance errors	(−)	Zero sum
Stevens (1978)	1.29	1.22	Blocks	(+)	Unclear[2]
	1.15		Falls	(+)	
	1.56	2.22	Blocks	(+)	Unclear[2]
	2.87		Falls	(+)	
	2.06	2.09	Blocks	(+)	Zero sum[2]
	2.12		Falls	(+)	
Sundeen (1978)	0.70	0.35	Hours to CPR certification	(−)	Individualistic
	0.00		Repetition of performance post test		
Shaw (1958)	1.60	1.22	Time on target: males	(+)	Zero sum[2]
	1.28		Error score: males	(+)	
	1.05		Time on target: females	(+)	
	0.94		Error score: females	(+)	
	0.39	0.49	Time on target: males	(+)	Individualistic[2]
	0.51		Error score: males	(+)	
	0.47		Time on target: females	(+)	
	0.60		Error score: females	(+)	

(*Appendix continues*)

Appendix (*continued*)

Authors and year	Effect d[a]	Average effect[b]	Dependent measure	M (+/−)[c]	Control condition[d]
Thomas (1957)	2.94	2.94	Assembly of cardboard houses	(−)	Individualistic
Teasdale and Joynt (1962)[e]	1.32	1.32	Threading strings: mean daily production	(−)	Unclear
Wegner and Zeaman (1956)	1.20	1.20	Pursuit rotor: pairs	(+)	Individualistic[1]
	1.75	1.75	Pursuit rotor: quads	(+)	Individual[1]
Zajonc (1963)	0.40	0.40	Reaction time	(−)	Individualistic

Note. AAHPERD = American Alliance of Health, Physical Education, Recreation, and Dance; CPR = cardiopulmonary resuscitation; IV = intravenous.
[a] Effect: The experimental condition for all contrasts was cooperation. This column shows the effects sizes for each dependent measure in a study. Many studies included multiple dependent measures. Boldfaced effect sizes were identified as outliers. For the analysis of cooperation versus zero-sum competition, unclear competition, appropriate competition, or individualistic conditions, these effect sizes were dropped from the adjusted analyses. If the outliers represented all of the effect sizes from a study, the study was dropped. If there were additional effect sizes from a study that included an outlier effect size, the remaining effect sizes were reaveraged, and the study was included.
[b] Average effect: Effect sizes were pooled by averaging effect sizes from multiple dependent measures within studies. When there were multiple contrasts of the independent variable (cooperation, competition, or individualistic) within a single study, effect sizes were averaged for each independent contrast. Multiple studies within a single report were treated as separate studies.
[c] Means (plus or minus): Means interdependence (+) and means independence (−) were defined according to the motor task used as the dependent measure in a study. For means-interdependent cooperative–competitive contrasts, the tasks for both experimental and control conditions were means interdependent. For cooperative-individualistic contrasts, only the motor task used in the cooperative treatment was means interdependent.
[d] Control condition: This column lists how each control condition was coded. The numbered superscripts indicate the following: [1] Studies with multiple experimental (cooperative) conditions, all averaged separately within studies. [2] Studies with multiple control conditions, all averaged separately within studies. [3] Studies with multiple experimental and control conditions, all averaged separately within studies.
[e] Study with disabled participants (homogeneous).
[f] Study with disabled participants (heterogeneous).

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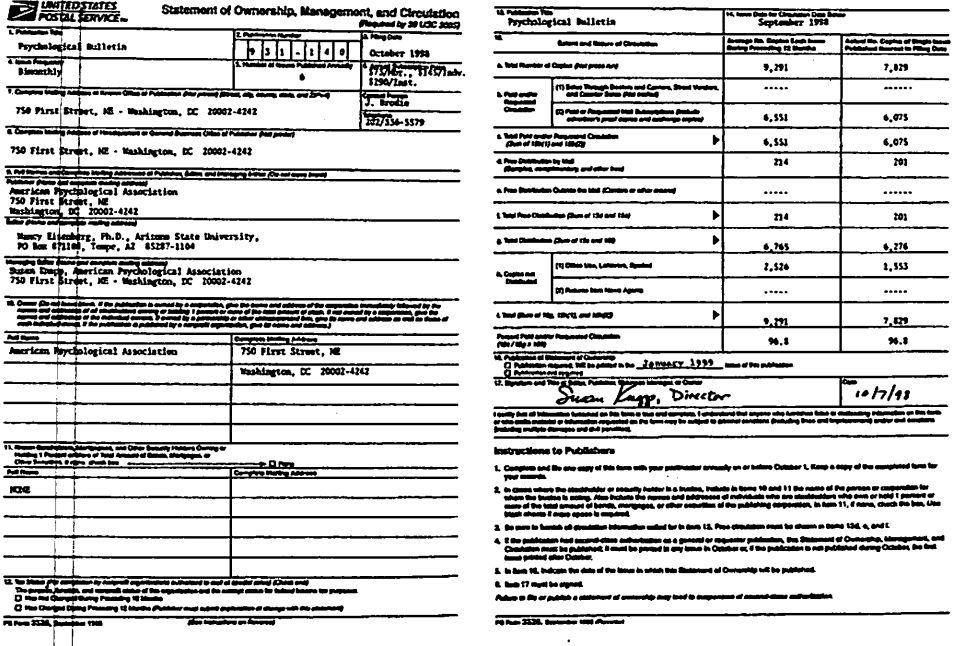

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