Group versus individual approach? A meta-analysis of the effectiveness of interventions to promote physical activity

Burke, SM; Carron, AV; Eys, MA; Ntoumanis, Nikolaos; Estabrooks, PA

Citation for published version (Harvard):
Burke, SM, Carron, AV, Eys, MA, Ntoumanis, N & Estabrooks, PA 2006, 'Group versus individual approach? A meta-analysis of the effectiveness of interventions to promote physical activity', *Journal of sport & exercise psychology*, vol. 2, pp. 19-35. <http://spex.bps.org.uk/spex/publications/sepr.cfm>

Group versus Individual Approach?

A Meta-Analysis of the Effectiveness of Interventions to Promote Physical Activity

Shauna M. Burke[1], Albert V. Carron[1], Mark A. Eys[2], Nikos Ntoumanis[3], & Paul A. Estabrooks[4]

[1]The University of Western Ontario; [2]Laurentian University; [3]The University of Birmingham;

[4]Kaiser Permanente Colorado

The published version is in:
Sport & Exercise Psychology Review Vol 2 No 1 13
 ISSN 1745-4980

Abstract

The purpose of the study was to conduct a meta-analysis to empirically compare the relative merits of different contexts typically employed in the physical activity intervention literature for five categories of outcomes: adherence, social interaction, quality of life, physiological effectiveness, and functional effectiveness. Four contexts were examined: home-based programs not involving contact from researchers or health-care professionals, home-based programs that involved some contact, standard exercise classes, and exercise classes where group-dynamics principles were used to increase cohesiveness ("true groups"). Standard literature searches produced 44 relevant studies containing 214 effect sizes. Results revealed a common trend across dependent variables; exercising in a true group was superior to exercising in a standard exercise class, which in turn, did not differ from exercising at home with contact. Furthermore, exercising at home with contact was superior to exercising at home without contact. These results have implications for practitioners in terms of the importance of contact and social support in physical activity interventions.

Key Words: meta-analysis, physical activity, exercise interventions, group-based, home-based, adherence

Group versus Individual Approach? A Meta-Analysis of the Effectiveness of Interventions to Promote Physical Activity

Physical activity plays an important role in health promotion and the prevention, delayed onset, and management of many adverse chronic health conditions (British Heart Foundation National Centre for Physical Activity and Health [BHFNC], 2005; U.S. Department of Health and Human Services [USDHHS], 2000). Similarly, the psychological benefits of sustained physical activity are well documented (Hausenblas, Dannecker, & Focht, 2001). In fact, although physical inactivity is related to 37% of deaths resulting from heart disease in the United Kingdom, the majority of British adults are not physically active at frequency and intensity levels that are sufficient to result in health benefits or disease prevention (BHFNC, 2005). Thus, there is an ongoing interest in developing protocols to stimulate involvement in and maintenance of physical activity—a daunting task considering that approximately 20-50% of adults who begin a structured exercise program will withdraw from the program within the first 6 months (Dishman, 1988; Oldridge, 1984; Ward & Morgan, 1984).

The numerous benefits, low prevalence, and high attrition associated with physical activity have stimulated the development of a number of interventions and strategies to promote regular physical activity. This is evidenced by reviews of the literature on physical activity promotion in communities (Atienza, 2001; Hillsdon, Thorogood, Anstiss, & Morris, 1995; Kahn et al., 2002; King, Rejeski, & Buchner, 1998), worksites (Dishman, Oldenburg, O'Neal, & Shephard, 1998; Proper et al., 2003), health-care settings (Ashenden, Silagy, & Weller, 1997; Eaton & Menard, 1998; Eden, Orleans, Mulrow, Pender, & Teutsch, 2002), or a combination of settings (Dishman & Buckworth, 1996; Holtzman et al., 2004; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998). In a recent comprehensive review, the United States Task Force on

Community Preventive Services examined more than 100 studies on informational, behavioural/social, and environmental/policy approaches to promoting regular physical activity (Kahn et al., 2002). Relative to these approaches, the authors concluded that there was strong evidence both for the effectiveness of community wide campaigns, school-based physical education, social support interventions delivered in communities, individually tailored interventions, and for providing access to physical activity resources (Kahn et al., 2002).

Even with the success of a number of intervention strategies, one fundamental consideration pertaining to any protocol aimed at increasing physical activity is the *context* that ought to be emphasized. The most common contexts for physical activity are either *group-based* (e.g., structured classes) or *individually-based* (e.g., home-based; Iverson, Fielding, Crow & Christenson, 1985). This contextual distinction can be made regardless of the setting of intervention. For example, a health-care system may offer group-based educational classes or individual counseling for physical activity. Similarly, a worksite may offer an individually targeted Internet intervention or regular fitness classes to promote physical activity. Which of these two basic contexts (i.e., group-based versus individually-based) is superior in terms of individual adherence to physical activity programs has been the focus of considerable research attention and some controversy (e.g., Atienza, 2001; Carron, Hausenblas, & Mack, 1996; Dishman & Buckworth, 1996; King, Haskell, Taylor, Kraemer, & DeBusk, 1991). Three reviews of literature serve to illustrate the nature of the controversy.

In one, support was shown for the efficacy of group-based interventions (versus individually-based programs). Dishman and Buckworth (1996) empirically synthesized the results from 127 studies containing approximately 131,000 participants who were targeted with physical activity interventions in community, school, worksite, home, and health-care settings.

Interventions delivered to *groups* (i.e., in a group setting) yielded much larger effects (r = .75) in comparison to interventions delivered to *individuals* (i.e., one-on-one, with little contact from other participants; r = .16), to the *family* (i.e., with individual family members and/or an entire family; r = .05), and to *individuals within a group* (i.e., participants receiving individual attention in addition to participation in group activities; r = .04).

In a second review, the efficacy of home-based interventions (versus group-based programs) was endorsed. Atienza (2001), on the basis of his narrative review of 39 studies (containing 3,626 participants), concluded that, "exercise adherence in community samples was higher for home-based aerobic exercise compared to group-based exercise" (p. S50). In another observation that is pertinent to the present report, Atienza suggested that telephone contact and counseling of home-based participants might also serve to facilitate adherence.

In a third review, an entirely different conclusion was reached. Van der Bij, Laurant, and Wensing (2002) examined 38 studies that included 57 physical activity interventions and a combined sample of 16,403 participants. They concluded that home-based, group-based, and education interventions were equally effective at promoting physical activity over the short-term. They also suggested that interventions delivered in each context were unlikely to lead to sustained physical activity.

Obviously, the reviews and conclusions offered by Dishman and Buckworth (1996), Van der Bij and colleagues (2002), and Atienza (2001) contrast markedly with one another. Thus, a question that arises is how a seemingly identical literature could lead to such discrepant perspectives. One possibility is associated with the operationalization of the contexts used in the various studies. As was pointed out above, the two basic contexts in which physical activity can be undertaken are individually-based and group-based (Iverson et al., 1985). In previous literature, the former typically has fallen under the rubric of home-based programs while the latter has fallen under the rubric of standard exercise classes. However, there is the potential for considerable variation in each of these two contexts. For example, a home-based physical activity program without contact and/or counseling from researchers or health-care professionals represents a different psychological environment than a home-based program characterized by relatively frequent telephone contact and/or counseling. Kahn and associates (2002) demonstrated that individually tailored interventions with frequent contacts (e.g., mail or telephone), which typically fall under the home-based context, effectively increase physical activity. In contrast, Eden and associates (2002) found that there was inconclusive evidence for the effectiveness of physician counseling (i.e., little or no follow-up contact) to increase home-based physical activity. These discrepant findings contribute to the hypothesis that the effectiveness of home-based interventions is dependent upon the frequency of contact and/or counseling.

Similarly, from the perspective of group-based programs, a standard exercise class represents a different psychological environment than an exercise class where group dynamics principles have been used to enhance task and/or social cohesion among participants. Support for the increased effectiveness of group-based programs that use strategies that target group dynamics principles was provided by Carron, Hausenblas, and Mack (1996). They conducted a meta-analysis (involving 87 studies with 49,948 participants) to quantify the effect of social influence (in the form of important others, family, class leaders, co-exercisers, and participation in groups characterized by higher social or task cohesiveness) on exercise adherence. They found support for the Dishman and Buckworth (1996) conclusion that exercising with others was superior for adherence in comparison to exercising alone (effect size of .32). More pertinent to the purpose of the present discussion, however, Carron and associates found that participation in classes characterized by higher task cohesiveness (i.e., the primary outcome of group dynamics strategies; Carron & Hausenblas, 1998) was superior to participation in standard exercise classes (effect size = .62).

Fortunately, research is available to empirically examine the contrasting perspectives emanating from the reviews highlighted here. Thus, the general purpose of the present study was to conduct a meta-analysis to empirically compare the relative merits of the different contexts typically employed in the physical activity intervention literature for five general categories of outcomes: adherence, social interaction, quality of life, physiological effectiveness, and functional effectiveness. Specifically, studies were included in the meta-analysis if they provided a direct comparison between at least two of four contexts: home-based programs that did not involve contact from researchers or health-care professionals, home-based programs that involved some contact, standard exercise classes, and exercise classes where group-dynamics principles were used to increase their cohesiveness (hereafter referred to as “true groups”).

It was hypothesized that intervention protocols would fall along a continuum of effectiveness (i.e., from effective to not effective). That is, insofar as the various dependent measures (i.e., adherence, functional effectiveness, etc.) assessed in physical activity intervention programs are concerned, it was hypothesized that exercising in true groups would be superior to exercising in standard exercise classes which, in turn, would be superior to exercising in home-based programs. Further, relative to the latter situation, it was hypothesized that home-based programs with contact from health professionals and/or the research team would be superior to home-based programs without contact.

Methods

Selection of the Studies for Inclusion

As indicated above, given the nature of our research question, all studies included in the meta-analysis contained at least one *direct* comparison of the efficacy of home-based programs without contact versus home-based programs with contact versus standard exercise classes, and/or versus true groups.

The studies were obtained through three principle sources: computer searches, manual searches, and journal searches. The computer searches consisted of an investigation of various computer databases [e.g., PsycINFO (1887-current), PsycARTICLES, MEDLINE--OVID (1966-current), and SPORT Discus (1830-current)]. The keywords presented for the computer searches included *physical activity interventions, exercise, aerobic, adherence, attendance, home-based exercise*, *exercise classes*, and *group exercise*. The manual searches involved utilizing the reference lists of existing empirical summaries and narrative reviews (e.g., Atienza, 2001; Carron et al., 1996; Dishman, 1991; Dishman & Buckworth, 1996; Van der Bij et al., 2002) in order to locate and retrieve articles. The journal searches focused on publications likely to contain relevant information pertaining to exercise, health, group dynamics, and physical activity interventions. Such journals included *Group Dynamics*, *Health Psychology, Journal of Aging and Physical Activity*, *Journal of Behavioral Medicine*, *Journal of Sport and Exercise Psychology, Journal of Sport Medicine and Physical Fitness, Journal of the American Medical Association, Perceptual and Motor Skills, Preventive Medicine*, *Research Quarterly for Exercise and Sport, Small Group Research*, *The Gerontologist*, and *The Sport Psychologist.*

The data searches produced a total of 148 potentially relevant articles reporting on a physical activity intervention. Consistent with the point made above, a study was excluded from the meta-analysis if it did not explicitly compare the effects of two or more physical activity contexts (i.e., it included only one physical activity context, or one physical activity context plus a control condition), or if it failed to provide the statistics necessary to compute an effect size. Within these parameters, a total of 44 studies[1] containing 4,578 participants were included in the meta-analysis.

Dependent Variables

A large variety of dependent variables were identified in the 44 studies included in the meta-analysis, 102 of which were deemed appropriate and subsequently coded. The result was a total population of 1,046 effect sizes. Ultimately, 214 effect sizes were used in the meta-analysis—the rationale and protocol underlying the reduction from 1,046 to 214 are outlined below.

The 102 dependent variables fell into five general categories: adherence, social interaction, quality of life, physiological effectiveness, and functional effectiveness. Table 1 contains a listing of the specific measures included in the original studies and their subsequent categorization by us for the meta-analysis.

A large number of the original population of 1,046 effect sizes represented *multiple endpoints* (i.e., multiple measures). For example, Brown et al. (2000) assessed various measures of strength (n = 14), balance (n = 9), gait (n = 9), and flexibility (n = 9) prior to and following a three-month physical activity program for older adults in both supervised and unsupervised conditions. Consequently, Brown and her colleagues provided a considerable amount of data pertinent to the examination of the relative merits of a supervised physical activity context (in this case, a typical exercise class) versus an unsupervised physical activity context (in this case, a home-based program without contact), as well as an examination of the possible changes for participants in each context over time (i.e., from pre- to post-intervention) on a wide range of dependent measures.

Multiple endpoints violate the assumption of independent data points (Bangert-Drowns, 1986; Gleser & Olkin, 1994). The Brown et al. (2000) study (or any other study with multiple measures) had the potential to exert an inordinate influence on the results relative to, for example, a study with a single measure of each of the same dependent variables. Thus, we used average effect sizes where multiple endpoints were present, but in a manner that permitted examination of the major question of interest (see below). In the example of the Brown et al. study, the original measures relating to strength, balance, flexibility, and gait were averaged to produce a single measure referred to as *functional effectiveness*.[2]

Independent Variables

The principal research question, as was pointed out above, pertained to the relative effectiveness of various contexts. In the 44 studies, data were available to examine changes over baseline in experimental groups referred to hereafter as true group, collective, home-based with contact, and home-based without contact. Direct comparisons were also possible among these experimental groups for a large number of dependent variables. As indicated above, *true group* was the label assigned to any experimental group in which a team building strategy was used in an attempt to increase the sense of cohesiveness among participants. Standard exercise classes in which participants engaged in physical activity in the presence of an instructor were referred to as a *collective*. Any experimental group in an intervention program carried out at home where the participants received periodic contact (e.g., telephone calls) from health professionals, experimenters, and so on was designated *home-based with contact*. Finally, *home-based without contact* was the label assigned to any experimental group in which participants were involved in an intervention program on their own and without contact from personnel associated with the research.[3]

Calculation of Effect Sizes

There are essentially two types of statistical models that can be used to calculate and interpret effect sizes in meta analyses; fixed effects models and random effects models (Field, 2001; Hedges & Vevea, 1998; Hunter & Schmidt, 2000). The statistical techniques used in the present study were based on the random effects procedures of meta analysis outlined by Hedges and Olkin (1985, Ch.9). Research has shown that when compared to random effects methods, fixed effects models tend to result in (a) higher Type I error rates, and (b) narrower confidence intervals that could result in overstating the accuracy of meta-analytic findings (Hunter & Schmidt, 2000). Despite these issues, it has been argued that the decision to use one procedure over the other should be guided primarily by the inference(s) that one wishes to make based on the findings (Hedges & Vevea, 1998). That is, if a researcher wishes to make generalizations based solely on the studies included in the sample (i.e., conditional inferences), a fixed effects approach is appropriate. However, if a researcher is interested in making generalizations about effect size parameters that extend beyond the set of observed studies (i.e., unconditional inferences), a random effects approach is more appropriate (Field, 2001; Hedges & Vevea, 1998). We concluded that despite our considerable efforts, it was possible that we did not locate *all* studies relevant to our topic of interest. Thus, the use of a random effects model of meta analysis was deemed more appropriate because it allows for the generalization of findings beyond the sample of studies that have been collected.[4]

Finally, Cohen (1969, 1992) has recommended that effect size (*d*) values of .20, .50, and .80 be viewed as small, medium, and large, respectively. This terminology is used throughout.

Results

Descriptive Statistics

Table 2 contains the descriptive characteristics pertaining to the 44 studies included in the meta-analysis. With regard to comparisons among the four types of context, 52.3% (n = 23 studies) included a direct comparison between a collective condition and a home-based with contact condition, while 31.8% (n = 14 studies) compared a collective and a home-based without contact condition. Only 20% (n = 9 studies) directly compared a true group and a collective condition, and an even smaller percentage (5%; n = 2 studies) contrasted the two home-based conditions (with and without contact).[5] Unfortunately, no studies were located that contained a direct comparison between the true group condition and either of the home-based conditions.[6]

Testing for Homogeneity of Variance

The homogeneity of effect size parameter has also been associated with the selection of a fixed- versus a random effects method of analysis. It has been suggested that a random effects model is more desirable if there is evidence of heterogeneity in effect size variance in the sample (Hedges & Vevea, 1998). Thus, a formal test of homogeneity was conducted. Specifically, the Q statistic was computed in order to test the hypothesis that the effect size variance component is zero (Hedges & Olkin, 1985). Results showed that the value of Q for the sample used in the study (n = 214) was highly significant (Q = 644.03, p < .001); thus, the distribution of effect sizes was not homogeneous which provided further support for the use of a random effects model.

Further, as Table 3 shows, the data set was subsequently subdivided to examine the impact of various moderators including, for example, the five categories of dependent variables (i.e., adherence, social interaction, etc.). Prior to each of these analyses, the Q statistic was again computed to determine if the effect size variance was zero. In every analysis, the *Q* value was statistically significant ($p < .01$).

Overall Analysis

An average effect size (and a 95% confidence interval [CI]) was computed for the sample of effect sizes used in the meta-analysis ($n = 214$, $d = .28 \pm .48$; CI = .20 to .35). When testing effect sizes for statistical significance, several researchers have recommended that a CI ought to be used rather than formal significance tests (e.g., Hedges & Olkin, 1985; Hunter, 1997; Schmidt, 1996). In this regard, effect sizes are considered statistically significant if the CI does not include or pass through the value of zero; if the CI contains the value of zero (i.e., has a lower CI value that is negative and an upper CI value that is positive), the ES is not considered statistically significant (Hedges & Olkin, 1985). Thus, the results reported above support a conclusion that, in general, physical activity interventions produce a small yet significant ($p < .05$) positive effect on a wide variety of outcomes.

The Influence of Context

Overall. Table 3 provides a summary of the overall effect of context independent of the nature of the dependent variable (i.e., the five categories of dependent variables were combined and comparisons were carried out among the four types of contexts). It is apparent that seven contrasts/comparisons were possible with the data set with the magnitude of difference varying from $d = .11$ (i.e., representing the effect sizes for the comparisons between (a) baseline values and interventions administered at home without contact, and (b) collectives and home-based conditions with contact) to $d = .73$ (i.e., representing the effect size for interventions delivered to true groups versus collectives).

As Table 3 shows, two out of three conditions produced small but significant improvements over baseline. Specifically, for all dependent variables combined, significant (p < .05) improvements over baseline were observed for both the collective condition (d = .34) and the home-based condition with contact (d = .23). The home-based condition without contact did not yield a significant improvement over baseline (d = .11, p > .05).

In *direct* comparisons between physical activity contexts (see Table 3 again), a trend consistent with our a priori hypotheses emerged. That is, exercising in a true group was significantly (p < .05) superior to exercising in a collective (d = .73), which in turn, was significantly (p < .05) superior to exercising at home without contact (d = .39). Exercising in a collective was minimally superior to exercising at home with contact (d = .11), which in turn, was superior to exercising at home without contact (d = .26), although neither of these latter two effect sizes were significant (p > .05).

Context and Type of Dependent Variable

Adherence. Table 3 also contains the results of analyses comparing the influence of various contexts on adherence behaviour. Contrary to our a priori hypothesis, the improvement shown by the collective condition over baseline (d = .64) was comparable to the improvement shown by the home-based condition with contact over baseline (d = .68), and *both* contexts produced significant improvements over baseline (p < .05). Thus, these two effect sizes did not fall in their expected order along the continuum proposed—that is, in terms of adherence, exercising in a collective condition was identical to exercising in a home-based condition with contact (i.e., in terms of improvement over baseline).

As Table 3 also shows, the true group condition was significantly (p < .05) superior to the collective condition (d = .74) and the latter was significantly (p < .05) superior to the home-based condition without contact ($d = .72$). Finally, as indicated above, the collective and home-based with contact conditions did not differ from one another ($d = .09$, $p > .05$).

Social interaction. Data were available to examine the changes in social interaction measures over baseline in two contexts—collectives and home-based conditions with contact (Table 3). Neither effect size was statistically significant ($p > .05$).

Table 3 also shows that although the remaining effect sizes were in the hypothesized direction (i.e., the true group condition was superior to the collective [$d = .21$], and the collective was superior to exercising at home with contact from researchers and/or health professionals [$d = .15$]), these results were nonsignificant ($p > .05$).

Quality of life. Table 3 provides a summary of analyses pertaining to the influence of context on changes in quality of life. Again, contrary to the hypothesis, highly similar results were found for the home-based with contact and collective conditions. Although both the home-based with contact ($d = .24$) and collective conditions ($d = .25$) were associated with small to moderate improvements in quality of life measures over baseline, neither was statistically significant ($p > .05$).

A consistent pattern of results was obtained from studies where direct comparisons were made between the home-based condition with contact and the collective condition; virtually no differences were found ($d = .03$), and the effect was not significant ($p > .05$). The collective condition was superior, however, to the home-based condition without contact ($d = .34$), although this effect was also nonsignificant ($p > .05$).

Physiological effectiveness. As Table 3 shows, the pattern of results for improvements in physiological parameters over baseline were consistent with the a priori hypothesis. That is, the collective condition ($d = .45$) was associated with a significant ($p < .05$) small to moderate improvement whereas the home-based with contact (*d* = .15) and the home-based without contact (*d* = .23) conditions were associated with only small and nonsignificant ($p > .05$) improvements.

When direct comparisons were made among the various contexts (see Table 3 again), the results were in the direction proposed (i.e., collectives were superior to home-based conditions with contact which were, in turn, superior to home-based conditions without contact) but were not statistically significant ($p > .05$).

Functional effectiveness. The results for the fifth dependent variable, functional effectiveness, are also presented in Table 3. Once again, although not statistically significant ($p > .05$), a trend consistent with our hypotheses emerged; that is, exercising in a collective showed greater improvements over baseline (*d* = .22) than exercising at home with contact (*d* = .03) and at home without contact (*d* = .05).

Also consistent with our hypothesis, the effect sizes for studies that directly compared two contexts showed that exercising in a collective was significantly ($p < .05$) superior to exercising at home without contact (*d* = .56). Interestingly, as was observed previously, the comparison between the collective and the home-based condition with contact revealed a small yet nonsignificant ($p > .05$) difference (*d* = .19).

Discussion

The general purpose of the study was to conduct a meta-analysis to empirically compare the relative merits of the different contexts typically employed in the physical activity intervention literature for five general categories of outcomes: adherence, social interaction, quality of life, physiological effectiveness, and functional effectiveness. With regard to the overall influence of *context* (i.e., with all dependent variables combined), support was found for the hypothesized continuum of effectiveness. That is, exercising in a true group is superior to exercising in a collective, which, in turn, is superior to exercising in a home-based situation without contact. Moreover, whereas the improvements over baseline are significant for both the collective and the home-based condition with contact, the improvements for the home-based condition without contact do not differ significantly from baseline. Thus, generally speaking, these results demonstrate that as the amount of contact and/or social support available from researchers, health professionals, and/or other exercise participants in an intervention increases, so too do the beneficial effects of that intervention.

These findings are certainly not surprising. In their meta analysis, Carron et al. (1996) reported that (a) *intention* to engage in physical activity is associated with social support from both important others (d = .44) and family (d = .49), (b) *efficacy* for activity is associated with social support from family (d = .44), and (c) *affect* relating to activity is associated with social support from both important others (d = .63) and family (d = .59). Similarly, Kahn and associates (2002) found strong support for physical activity interventions that include social support. Clearly, others—in the form of members of cohesive classes, members of collectives, interested family and friends, interested and concerned professionals and researchers—do have an effect on the involvement in and benefits derived from physical activity.

The analyses of each of the five categories of dependent variables also revealed differences (and in some cases, lack of differences) that should be noted. First, contrary to our hypothesis, no significant differences were found between the home-based condition with contact and the collective condition both overall and for all five dependent variables. These results were especially surprising for adherence, given that some previous meta-analyses have shown that collectives are superior to home-based conditions (Carron et al., 1996; Dishman & Buckworth, 1996). There are at least two possible explanations to account for the failure to find adherence differences (i.e., between the collective and the home-based condition with contact) in the present meta-analysis. First, we differentiated the home-based condition on the basis of amount of contact with others—home-based with contact and home-based without contact. As a consequence, both the home-based with contact and the collective conditions might have been similar in terms of the supportive environment provided. In collective conditions (i.e., standard exercise classes), support was likely available from the instructor and/or other exercise participants; in home-based conditions with contact, support was available from researchers and/or health professionals in the form of telephone contact.

Another possible explanation for the failure to find differences in adherence for the home-based with contact and collective conditions may be the manner in which adherence was operationally defined. For some of the studies in our meta-analysis (e.g., Cox, Burke, Gorely, Beilin, & Puddey, 2003; King, Kiernan, Oman, Kraemer, Hull, & Ahn, 1997; King, Pruitt, Phillips, Oka, Rodenburg, & Haskell, 2000; Messier, Royer, Craven, O'Toole, Burns, & Ettinger, 2000), adherence was assessed *subjectively* for participants who exercised at home with contact (e.g., self-reported adherence was obtained via an exercise log) and *objectively* for participants in collectives (e.g., attendance taken or verified by an instructor). The former, of course, is subject to reporting bias. In order to test this post hoc explanation, a further series of analyses were undertaken on those studies where adherence was the dependent variable. The home-based with contact and collective conditions were compared for three categories of operational measures of adherence: (a) where participants in both conditions were assessed via objective indices such as work output and exercise duration, (b) where measures such as absenteeism, dropout, and return rates were assessed subjectively for the home-based condition with contact but objectively for participants in the collective condition, and (c) where the dependent variables were measured in an identical manner (whether subjectively or objectively) for both home-based with contact and collective participants.

In the analysis of studies where adherence was measured via objective indices such as work output and exercise duration, a small positive effect size of .27 $\pm$ .36 (CI = -.08 to .63) was found pointing to the superiority of interventions delivered to *collectives* versus home-based conditions with contact. In the analysis of studies where attendance indices were assessed objectively for participants in a collective but subjectively for participants in the home-based with contact condition, a small effect size of -.16 $\pm$ .50 (CI = -.62 to .31) was found reflecting the superiority of the *home-based with contact* condition over the collective condition. Finally, in the analysis of studies where attendance indices were assessed in an identical fashion (i.e., both objective or both subjective) for participants in collectives and home-based conditions with contact, a negligible negative effect size of -.02 $\pm$ .03 (CI = -.65 to .61) was found. Therefore, although these effect sizes were not statistically significant, the observed pattern suggests that the unexpected ranking of the home-based with contact condition and the collective condition for the dependent variable of adherence might be due, at least in part, to the fact that in some instances, adherence was measured differently for these two contexts. Additional research is needed to examine this issue in greater depth.

The results of our meta-analysis are in contrast with the Van der Bij et al. (2002) results showing that home-based and group-based interventions are equally effective at promoting physical activity, as well as with Atienza’s (2001) conclusion that home-based physical activity programs are superior to group-based programs. Rather, our results offer support for the Dishman and Buckworth (1996) findings that in terms of adherence to physical activity, *group-*

based programs are superior to home-based programs (particularly those that do not include contact with participants). Is it possible to reconcile the differences? Possibly.

It was pointed out above that Atienza (2001) has suggested that telephone contact and/or counseling of home-based participants may enhance adherence to physical activity programs. Indeed, the advantages of offering contact to participants at home were demonstrated in the present meta-analysis by the lack of difference between participants in the home-based condition *with* contact and those in the collective condition in terms of adherence (in comparison to the superiority of the collective condition over the home-based condition *without* contact for adherence). Our results contribute to the suggestion that there can be substantive differences in the quality of the home-based experience. Across all dependent variables examined here (with the exception of social interaction), a trend emerged in which the home-based condition without contact was inferior to every other intervention context.

What has yet to be explored is whether the *amount* of contact provided to participants at home (e.g., one telephone call per week versus one telephone call per month) makes a difference in terms of adherence and/or other variables related to physical activity. An examination of this issue would be a worthwhile topic for future investigation. Another potential topic for future research would be to examine the effect of exercising in a true group (i.e., a group that has experienced some form of team building) on outcomes *other than* adherence and/or social interaction. Our results clearly showed that exercising in a true group is superior to exercising in a collective for adherence, operationalized as attendance, lateness, dropouts, etc.; however, a minimal number of studies were found that utilized a true group, and these studies measured adherence only.

The present meta-analysis is not without its limitations. First, for the majority of studies (70.5%; *n* = 31), participants were 50 years of age or greater, and 29.5% (*n* = 13 studies) involved a clinical sample (i.e., participants were referred by a health professional). Further, only 9.1% (*n* = 4) of the 44 studies reported that the participants involved were randomly selected. Thus, it is important to note that depending on their preferences and/or comfort level, participants may have been attracted to a study as a result of its primary focus (i.e., group-based versus home-based exercise). The work of Burke, Carron, and Eys (2005) has shown that adults' (ages 30-60; *n* = 220) top two context preferences for aerobic activity are exercising with others outside of a structured class setting (32.9%) and exercising completely alone (32.4%). Further, 56.6% of participants in the Burke et al. study rated exercising in a structured class as the least preferred context for aerobic activity. Thus, it follows that participants who are randomized to a non-preferred context (e.g., a structured exercise class) may perform/adhere more poorly than participants who are randomized to a preferred context (e.g., exercise at home with contact from others).

A third limitation was that the majority (86.4%; *n* = 38 studies) of interventions were 12 months or less in duration. Thus, the long-term effectiveness of physical activity interventions remains unclear, although it has been suggested that the beneficial effects of both home- and group-based interventions are generally short-lived (Van der Bij et al., 2002). Because continued physical activity participation is required in order to maintain health benefits, this issue is of primary interest to researchers and health professionals and is therefore worthy of additional research.

A final limitation, one that is inherent in most meta-analyses, is the fact that a wide range of studies was included. In short, the studies examined varied in factors such as the length of the physical activity intervention, the target population, the various outcomes assessed, and so on. In fact, the heterogeneity of the studies included in the study is representative of a classic criticism of meta-analyses; namely, that they are a "mixing of apples and oranges" (Thomas & French, 1986).

These limitations notwithstanding, interventions are costly and there is a fundamental desire on the part of health-care professionals to do it right—to implement an intervention that has the highest probability of success. In the absence of detailed information on exceptions to the rule, a meta-analysis provides the basis for reasonable generalizations. Thus, the results of our meta-analysis may help to increase the effectiveness of physical activity interventions by offering valuable information regarding the importance of contact and social support to participants. Specifically, it appears that in terms of adherence to exercise programs in particular, participants benefit most from physical activity when they are given the opportunity to interact with others, whether they are fellow exercisers, health practitioners, or researchers. Thus, for at least the short-term, it is clear that contact with and among participants is invaluable in terms of at least one important outcome associated with exercise—and judging by the present results, it is also clear that contact in the form of a close-knit, cohesive group represents the optimal context.

References

Note. References highlighted by an asterisk (*) were included in the meta-analysis.

*Ades, P. A., Pashkow, F. J., Fletcher, G., Pina, I. L., Zohman, L. R., & Nestor, J. R. (2000). A controlled trial of cardiac rehabilitation in the home setting using electrocardiographic and voice transtelephonic monitoring. *American Heart Journal, 139*, 543-548.

*Allegrante, J. P., Kovar, P. A., MacKenzie, C. R., Peterson, M. G. E., & Gutin, B. (1993). A walking education program for patients with osteoarthritis of the knee: Theory and intervention strategies. *Health Education Quarterly, 20,* 63-81.

*Analay, Y., Ozcan, E., Karan, A., Diracoglu, D., & Aydin, R. (2003). The effectiveness of intensive group exercise on patients with ankylosing spondylitis. *Clinical Rehabilitation, 17,* 631-636.

Ashenden, R., Silagy, C., & Weller, D. (1997). A systematic review of the effectiveness of promoting lifestyle change in general practice. *Family Practice, 14*, 160-176.

Atienza, A. A. (2001). Home-based physical activity programs for middle-aged and older adults: Summary of empirical research. *Journal of Aging and Physical Activity, 9,* S38-S58.

Bangert-Drowns, R. L. (1986). Review of development in meta-analytic method. *Psychological Bulletin, 99*, 388-399.

*Binder, E. F., Schechtman, K. B., Ehsani, A. A., Steger-May, K., Brown, M., Sinacore, D. R., et al. (2002). Effects of exercise training on frailty in community-dwelling older adults: Results of a randomized, controlled trial. *Journal of the American Geriatrics Society, 50*, 1921-1928.

British Heart Foundation National Centre for Physical Activity and Health. (n.d.). Retrieved May 2, 2005, from http://www.bhfactive.org.uk/

*Brown, M., Sinacore, D. R., Ehsani, A. A., Binder, E. F., Holloszy, J. O., & Kohrt, W. M. (2000). Low-intensity exercise as a modifier of physical frailty in older adults. *Archives of Physical Medicine and Rehabilitation, 81*, 960-965.

Burke, S. M., Carron, A. V., & Eys, M. A. (2005). *Adults' preferences for physical activity context*. Manuscript in preparation.

Carron, A. V., & Hausenblas, H. A. (1998). *Group Dynamics in Sport* (2nd ed.). Morgantown, WV: Fitness Information Technology, Inc.

Carron, A. V., Hausenblas, H. A., & Mack, D. E. (1996). Social influence and exercise: A meta-analysis. *Journal of Sport and Exercise Psychology, 18*, 1-16.

*Carron, A. V., & Spink, K. S. (1993). Team building in an exercise setting. *The Sport Psychologist, 7*, 8-18.

*Caserta, M. S., & Gillett, P. A. (1998). Older women's feelings about exercise and their adherence to an aerobic regimen over time. *The Gerontologist, 38,* 602-609.

*Chow, R. K., Harrison, J. E., Sturtridge, W., Josse, R., Murray, T. M., Bayley, A., et al. (1987). The effect of exercise on bone mass of osteoporotic patients on fluoride treatment. *Clinical and Investigative Medicine, 10*, 59-63.

Cohen, J. (1969). *Statistical power analysis for the behavioral sciences*. New York: Academic Press.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155-159.

*Cox, K. L., Burke, V., Gorely, T. J., Beilin, L. J., & Puddey, I. B. (2003). Controlled comparison of retention and adherence in home- vs. center-initiated exercise interventions in women ages 40-65 years: The S.W.E.A.T. study (Sedentary Women Exercise Adherence Trial). *Preventive Medicine, 36,* 17-29.

*Craighead, L. W., & Blum, M. D. (1989). Supervised exercise in behavioral treatment for moderate obesity. *Behavior Therapy, 20*, 49-59.

*DeBusk, R. F., Haskell, W. L., Miller, N. H., Berra, K., Barr Taylor, C., Berger, W. E., & Lew, H. (1985). Medically directed at-home rehabilitation soon after clinically uncomplicated acute myocardial infarction: A new model for patient care. *American Journal of Cardiology, 55*, 251-257.

*DeBusk, R. G., Houston, N., Haskell, W. L., Fry, G., & Parker, M. (1979). Exercise training soon after myocardial infarction. *The American Journal of Cardiology, 44*, 1223-1229.

Dishman, R. K. (1988). Exercise adherence research: Future directions. *American Journal of Health Promotion, 3*, 52-56.

Dishman, R. K. (1991). Increasing and maintaining exercise and physical activity. *Behavior Therapy, 22*, 345-378.

Dishman, R. K., & Buckworth, J. (1996). Increasing physical activity: A quantitative synthesis. *Medicine and Science in Sports and Exercise, 28*, 706-719.

Dishman, R. K., Oldenburg, B., O'Neal, H., & Shephard, R. J. (1988). Worksite physical activity interventions. *American Journal of Preventive Medicine, 15*, 344-361.

*Duncan, K., & Pozehl, B. (2003). Effects of an exercise adherence intervention on outcomes in patients with heart failure. *Rehabilitation Nursing, 28*, 117-121.

Eaton, C. B., & Menard, L. M. (1998). A systematic review of physical activity promotion in primary care office settings. *British Journal of Sports Medicine*, *32*, 11-16.

Eden, K. B., Orleans, T., Mulrow, C. D., Pender, N. J., & Teutsch, S. M. (2002). Does counseling by clinicians improve physical activity? A summary of the evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine, 137*, 208-215.

*Estabrooks, P. A., & Carron, A. V. (1999). Group cohesion in older adult exercisers: Prediction and intervention effects. *Journal of Behavioral Medicine, 22*, 575-588.

*Estabrooks, P. A., Fox, E. H., Doerksen, S. E., Bradshaw, M. H., & King, A. C. (in press). Participatory research to promote physical activity at congregate meal sites. *Journal of Aging and Physical Activity*.

Field, A. P. (2001). Meta-analysis of correlation coefficients: A Monte Carlo comparison of fixed- and random-effects methods. *Psychological Methods, 6*, 161-180.

*Frost, H., Lamb, S. E., Klaber Moffett, J. A., Fairbank, J. C. T., & Moser, J. S. (1998). A fitness programme for patients with chronic low back pain: 2-year follow-up of a randomised controlled trial. *Pain, 75*, 273-279.

*Gandhi, N., DePauw, K. P., Dolny, D. G., & Freson, T. (2002). Effect of an exercise program on quality of life of women with fibromyalgia. *Women and Therapy, 25*, 91-103.

*Gillett, P. A. (1988). Self-reported factors influencing exercise adherence in overweight women. *Nursing Research, 37*, 25-29.

Gleser, L. J., & Olkin, I. (1994). Stochastically dependent effect sizes. In H. Cooper & L. V. Hedges (Eds.), *The handbook of research synthesis* (pp.339-357). New York: Russell Sage Foundation.

*Grosbois, J. M., Lamblin, C., Lemaire, B., Chekroud, H., Dernis, J. M., Douay, B., & Fortin, F. (1999). Long-term benefits of exercise maintenance after outpatient rehabilitation program in patients with chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation, 19*, 216-225.

*Hands, M. E., Briffa, T., Henderson, K., Antico, V., Thompson, P., & Hung, J. (1987). Functional capacity and left ventricular function: The effect of supervised and unsupervised exercise rehabilitation soon after coronary artery bypass graft surgery. *Journal of Cardiopulmonary Rehabilitation*, *7*, 578-584.

Hausenblas, H. A., Dannecker, E. A., & Focht, B. P. (2001). Psychological effects of exercise with general and diseased populations. *Journal of Psychotherapy in Independent Practice, 2*, 27-47.

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis.* New York: Academic Press.

Hedges, L. V., & Vevea, J. L. (1998). Fixed- and random-effects models in meta-analysis. *Psychological Methods, 3*, 486-504.

Hillsdon, M., Thorogood, M., Anstiss, T., & Morris, J. (1995). Randomised controlled trials of physical activity promotion in free living populations: A review. *Journal of Epidemiology and Community Health, 49*, 448-453.

Holtzman, J., Schmitz, K., Babes, G., Kane, R. L., Duval, S., Wilt, T. J., et al. (2004). *Effectiveness of behavioral interventions to modify physical activity behaviors in general populations and cancer patients and survivors.* (Rep. No. Evidence Report/Technology Assessment No. 102). Rockville, MD: Agency for Healthcare Research and Quality.

Hunter, J. E. (1997). Needed: A ban on the significance test. *Psychological Science, 8,* 3-7.

Hunter, J. E., & Schmidt, F. L. (2000). Fixed effects vs. random effects meta-analysis models: Implications for cumulative research knowledge in psychology. *International Journal of Selection and Assessment, 8*, 275-292.

Iverson, D. C., Fielding, J. E., Crow, R. S., & Christenson, G. M. (1985). The promotion of physical activity in the United States population: The status of programs in medical, worksite, community, and school settings. *Public Health Reports, 100*, 212-224.

Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., et al. (2002). The effectiveness of interventions to increase physical activity: A systematic review. *American Journal of Preventive Medicine, 22*, 73-107.

*King, A. C., & Frederiksen, L. W. (1984). Low-cost strategies for increasing exercise behavior: Relapse prevention training and social support. *Behavior Modification, 8*, 3-21.

*King, A. C., Haskell, W. L., Taylor, C. B., Kraemer, H. C., & DeBusk, R. F. (1991). Group- vs. home-based exercise training in healthy older men and women. *Journal of the American Medical Association, 266*, 1535-1542.

*King, A. C., Haskell, W. L., Young, D. R., Oka, R. K., & Stefanick, M. L. (1995). Long-term effects of varying intensities and formats of physical activity on participation rates, fitness, and lipoproteins in men and women aged 50 to 65 years. *Circulation, 91*, 2596-2604.

*King, A. C., Kiernan, M., Oman, R. F., Kraemer, H. C., Hull, M., & Ahn, D. (1997). Can we identify who will adhere to long-term physical activity? Signal detection methodology as a potential aid to clinical decision making. *Health Psychology, 16*, 380-389.

*King, A. C., Pruitt, L. A., Phillips, W., Oka, R. K., Rodenburg, A., & Haskell, W. L. (2000). Comparative effects of two physical activity programs on measured and perceived physical functioning and other health-related quality of life outcomes in older adults. *Journal of Gerontology: Medical Sciences, 55*, M74-M83.

King, A. C., Rejeski, W. J., & Buchner, D. M. (1998). Physical activity interventions targeting older adults: A critical review and recommendations. *American Journal of Preventive Medicine, 15*, 316-333.

*King, A. C., Taylor, C. B., & Haskell, W. L. (1993). Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. *Health Psychology*, *12*, 292-300.

*King, M. B., Whipple, R. H., Gruman, C. A., Judge, J. O., Schmidt, J. A., & Wolfson, L. I. (2002). The performance enhancement project: Improving physical performance in older persons. *Archives of Physical Medicine and Rehabilitation, 83*, 1060-1069.

*Lan, C., Chen, SY., Lai, JS., & Wong, MK. (1999). The effect of Tai Chi on cardiorespiratory function in patients with coronary artery bypass surgery. *Medicine and Science in Sports and Exercise, 31*, 634-638.

Marcus, B. H., Owen, N., Forsyth, L. H., Cavill, N. A., & Fridinger, F. (1998). Physical activity interventions using mass media, print media, and information technology. *American Journal of Preventive Medicine*, *15*, 362-378.

*McAuley, E., Courneya, K. S., Rudolph, D. L., & Lox, C. L. (1994). Enhancing exercise adherence in middle-aged males and females. *Preventive Medicine, 23,* 498-506.

*Messier, S. P., Royer, T. D., Craven, T. E., O'Toole, M. L., Burns, R., & Ettinger, W. H. Jr. (2000). Long-term exercise and its effect on balance in older, osteoarthritic adults: Results from the Fitness, Arthritis, and Seniors Trial (FAST). *Journal of the American Geriatrics Society, 48*, 131-138.

Mokdad, A. H., Marks, J. F., Stroup, D. F., & Gerdes, D. A. (2004). Actual causes of death in the United States, 2000. *Journal of the American Medical Association*, *291*, 1238-1245.

*Morey, M. C., Schenkman, M., Studenski, S. A., Chandler, J. M., Crowley, G. M., Sullivan, R. J., et al. (1999). Spinal-flexibility-plus-aerobic versus aerobic-only training: Effects of a randomized clinical trial on function in at-risk older adults. *Journal of Gerontology: Medical Sciences, 54*, M335-M342.

Oldridge, N. B. (1984). Compliance and drop-out in cardiac exercise rehabilitation. *American Journal of Cardiology, 4*, 166-177.

*Owen, N., Lee, C., Naccarella, L., & Haag, K. (1987). Exercise by mail: A mediated behavior-change program for aerobic exercise. *Journal of Sport Psychology, 9*, 346-357.

*Patterson, R. B., Pinto, B., Marcus, B., Colucci, A., Braun, T., & Roberts, M. (1997). Value of a supervised exercise program for the therapy of arterial claudication. *Journal of Vascular Surgery, 25*, 312-319.

*Perri, M. G., Martin, A. D., Leermakers, E. A., Sears, S. F., & Notelovitz, M. (1997). Effects of group- vs. home-based exercise in the treatment of obesity. *Journal of Consulting and Clinical Psychology, 65*, 278-285.

Proper, K. I., Koning, M., Van der Beek, A. J., Hildebrandt, V. H., Bosscher, R. J., & van Mechelen, W. (2003). The effectiveness of worksite physical activity programs on physical activity, physical fitness, and health [Critical Review]. *Clinical Journal of Sport Medicine*, 12, 106-117.

*Rejeski, W. J., Brawley, L. R., Ambrosius, W. T., Brubaker, P. H., Focht, B. C., Foy, C. G., & Fox, L. D. (2003). Older adults with chronic disease: Benefits of group-mediated counseling in the promotion of physically active lifestyles. *Health Psychology, 22*, 414-423.

Schmidt, F. L. (1996). Statistical significance testing and cumulative knowledge in psychology: Implications for the training of researchers. *Psychological Methods, 1*, 115-129.

*Skelton, D. A., Young, A., Greig, C. A., & Malbut, K. E. (1995). Effects of resistance training on strength, power, and selected functional abilities of women aged 75 and older. *Journal of the American Geriatric Society, 43*, 1081-1087.

*Sparks, K. E., Shaw, D. K., Eddy, D., Hanigosky, P., & Vantrese, J. (1993). Alternatives for cardiac rehabilitation patients unable to return to a hospital-based program. *Heart and Lung, 22*, 298-303.

*Spink, K. S., & Carron, A. V. (1993). The effects of team building on the adherence patterns of female exercise participants. *Journal of Sport and Exercise Psychology, 15*, 39-49.

*Stevens, R., & Hanson, P. (1984). Comparison of supervised and unsupervised exercise training after coronary bypass surgery. *American Journal of Cardiology, 53*, 1524-1528.

*Taylor, C. B., Houston-Miller, N., Ahn, D. K., Haskell, W., & DeBusk, R. F. (1986). The effects of exercise training programs on psychosocial improvement in uncomplicated postmyocardial infarction patients. *Journal of Psychosomatic Research, 30*, 581-587.

Thomas, J. R., & French, K. E. (1986). The use of meta-analysis in exercise and sport: A tutorial. *Research Quarterly for Exercise and Sport, 57*, 196-204.

*Timonen, L., Rantanen, T., Ryynänen, O. P., Taimela, S., Timonen, T. E., & Sulkava, R. (2002). A randomized controlled trial of rehabilitation after hospitalization in frail older women: effects on strength, balance and mobility. *Scandinavian Journal of Medicine and Science in Sports, 12*, 186-192.

*Timonen, L., Rantanen, T., Timonen, T. E., & Sulkava, R. (2002). Effects of a group-based exercise program on the mood state of frail older women after discharge from hospital. *International Journal of Geriatric Psychiatry, 17*, 1106-1111.

U. S. Department of Health and Human Services (2000). *Healthy people 2010: Understanding and improving health* (2nd ed., pp. 1-50). Washington, DC: U.S. Government Printing Office.

Van der Bij, A. K., Laurant, M. G. H., & Wensing, M. (2002). Effectiveness of physical activity interventions for older adults: A review. *American Journal of Preventive Medicine, 22*, 120-133.

*Wankel, L. M., Yardley, J. K., & Graham, J. (1985). The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. *Canadian Journal of Applied Sport Sciences, 10*, 147-156.

Ward, A., & Morgan, W. P. (1984). Adherence patterns of healthy men and women enrolled in an adult exercise program. *Journal of Cardiac Rehabilitation, 4*, 143-152.

*Yilmaz, F., Yilmaz, A., Merdol, F., Parlar, D., Sahin, F., & Kuran, B. (2003). Efficacy of dynamic lumbar stabilization exercise in lumbar microdiscectomy. *Journal of Rehabilitation Medicine, 35*, 163-167.

Author Note

Shauna M. Burke and Albert V. Carron, School of Kinesiology, University of Western Ontario, London, Ontario, Canada, N6A 3K7.

Mark A. Eys, School of Human Kinetics, Laurentian University, Sudbury, Ontario, Canada, P3E 2C6.

Nikos Ntoumanis, School of Sport and Exercise Sciences, The University of Birmingham, Edgbaston, Birmingham, UK, B15 2TT.

Paul A. Estabrooks, Clinical Research Unit, Kaiser Permanente Colorado, Denver, Colorado, 80237-8066.

Correspondence should be directed to Shauna M. Burke, School of Kinesiology, University of Western Ontario, London, Ontario, Canada, N6A 3K7. Email address: sburke7@uwo.ca; Fax: (519) 661 2008.

Footnote

[1]These 44 studies are identified in the reference list by an asterisk (*).

[2]The Brown et al. (2000) study is useful to illustrate another aspect of the analyses. They tested their two groups at baseline and three months later. Thus, 3 comparison points were possible: Time 2 versus baseline for the standard exercise class (n = 3 effect sizes); Time 2 versus baseline for the home-based condition without contact (n = 3 effect sizes); and, the standard exercise class versus the home-based condition without contact at time 2 (n = 3 effect sizes). In short, comparisons with a total of 9 effect sizes were made with the data from the Brown et al. study.

[3]Participants in the *home-based without contact* conditions did not receive contact from investigators and/or health professionals; these participants were, however, contacted during data collection periods and in some cases, introductory sessions designed to set up or explain the home-based exercise programs. Conversely, the contact referred to in the *home-based with contact* conditions was that over and above the amount offered by the researchers and/or health professionals during data collection and/or instructional meetings.

[4]We are indebted to an anonymous reviewer who spent a considerable amount of time discussing pertinent issues associated with random and fixed effects models of meta analyses.

[5]As mentioned previously, the number of effect sizes reported for each context comparison (e.g., true group versus collective) is greater than the number of studies reported because in many cases, one study resulted in more than one effect size.

[6]The percentages provided add up to more than 100% because some studies involved multiple context comparisons (e.g., home-based with contact versus collective, home-based without contact versus collective).

Table 1

Categorization of Dependent Variables

Variable Label	Variables Included Under Label
Adherence	Adherence, Lateness, Attendance, Early Departure, Return Rate, Exercise Duration, Treadmill Duration, Peak Workout, Metabolic Equivalents (METS)
Social Interaction	Social Functioning (Health Status Questionnaire; HSQ), Social Functioning (SF-36), Attraction to the Group-Task (Group Environment Questionnaire; GEQ), Attraction to the Group-Social (GEQ), Group Integration-Task (GEQ), Group Integration-Social (GEQ), Peer-Group Factors (Gillet Feelings About Exercise Scale; GFES), Structural Features (GFES), Companionship and Support (GFES)
Quality of Life	Quality of Life, General Quality of Life, Health-Related Quality of Life, General Health Perceptions (SF-36), Standard Mental Component (SF-36), Physical Function Scale, Self-Reported Functional Limitations, Self-Reported Number of Symptoms, Physical Functioning (HSQ), Emotional Role Limitations (HSQ), Physical Activity (Arthritis Impact Measurement Scale; AIMS), Arthritis Impact (AIMS), Pain (AIMS), Physical Functioning (SF-36), Role Limitations-Physical (SF-36), Role Limitations-Emotional (SF-36), Bodily Pain (SF-36), Mental Health (SF-36), Standard Physical Component (SF-36), Standard Mental Component (SF-36), Pain, Morning Stiffness, Disability, Perceived Stress, Anxiety, Depressed Mood, Trait Anxiety, Fatigue (POMS), Zung Self-Rating Depression Scale, Depression (Beck Depression Scale)
Physiological Effectiveness	Max VO_2 (ml/min/kg), Resting Heart Rate (HR), Maximal HR, Exercise HR, Minnesota Living With Heart Failure Test, Maximal Ventilation (VE), Baseline Dyspnea Index (BDI), Respiratory Rate (RR), Systolic Blood Pressure (BP), Diastolic BP, Maximal Systolic BP, Maximal Rate-Pressure Product (RPP), Weight, Body Mass Index (BMI), Low-Density Lipoprotein (LDL) Cholesterol, High-Density Lipoprotein (HDL) Cholesterol, Triglycerides
Functional Effectiveness	Flexibility, Axial Rotation, Reach, Timed Bed Mobility, Tragus-to-Wall Distance, Modified Lumbar Schober, Fingertip to Floor Distance, Intermalleolar Distance, Back Flexibility, Strength, Hip Extension, Hip Abduction, Knee Extension, Hand Grip, Elbow Flexion, Spine Flexion, Chest Expansion, Progressive Iso-Inertial Lifting Evaluation (PILE), Spine Extension, Balance, Gait, Distance Walked, Walking Speed, Functional Ability, Chair Rise-Normal, Chair Rise-Fast, Chair Rise-Speed, Kneel Rise-Normal, Kneel Rise-Fast, Floor Rise, Self-Paced Walking Speed, Self-Paced Stair Speed, Step-Up Height, Step-Down Height, Bag Raise, Standing Balance, Physical Performance Test

Table 2

Descriptive Statistics of Studies (n = 44) Included in the Meta-Analysis

Study/Sample Characteristics	Number (%) of Studies
Context Comparisons*	
True group vs. collective	9 (20.0%)
True group vs. home-based with contact	0 (0.0%)
True group vs. home-based without contact	0 (0.0%)
Collective vs. home-based with contact	23 (52.3)
Collective vs. home-based without contact	14 (31.8%)
Home-based with contact vs. home-based without contact	2 (5.0%)
Mean Age of Participants	
Less than 30 years	4 (9.1%)
30-49 years	8 (18.2%)
50-65 years	18 (40.9%)
66 years and greater	13 (29.5%)
Not specified	1 (2.3%)
Gender of Participants	
Male	11 (25.0%)
Female	15 (34.1%)
Mixed	18 (40.9%)
Clinical Referral Status	
Yes	13 (29.5%)
No	29 (65.9%)
Not specified	2 (4.5%)
Activity Level	
Previously sedentary	18 (40.9%)
Previously active	3 (6.8%)
Not specified	23 (52.3%)
Intervention Length	
3 months or less	21 (47.7%)
4-8 months	10 (22.7%)
8-12 months	7 (15.9%)
13 months or more	6 (13.6%)
Selection of Participants	

Volunteer	16 (36.4%)
Random	4 (9.1%)
Targeted	24 (54.5%)

*Percentages add up to more than 100% because some studies involved multiple context comparisons.

Table 3

Effect Sizes, Standard Deviations (SD), and Confidence Intervals (CI)

Experimental Condition	Control Condition	Number of Effect Sizes	Mean Effect Size (*d*)	*SD*	CI (95%)	Significance[a] (*)
			All Dependent Variables Combined			
OVERALL						
Contexts Compared Against Baseline:						
Collective	Baseline	44	.34	.34	.18 to .57	*
Home-Isolation	Baseline	9	.11	.33	-.26 to .48	
Home-Contact	Baseline	36	.23	.23	.05 to .40	*
Direct Comparisons Between Contexts:						
True Group	Collective	15	.73	.77	.45 to 1.00	*
Collective	Home-Isolation	41	.39	.39	.21 to .57	*
Home-Contact	Home-Isolation	6	.26	.09	-.16 to .68	
Collective	Home-Contact	62	.11	.63	-.03 to .24	
			Dependent Variables			
ADHERENCE						
Contexts Compared Against Baseline:						
Collective	Baseline	5	.64	.33	.12 to 1.16	*
Home-Contact	Baseline	3	.68	.73	.01 to 1.35	*
Direct Comparisons Between Contexts:						
True Group	Collective	10	.74	.81	.39 to 1.08	*
Collective	Home-Isolation	6	.72	.42	.21 to 1.23	*
Collective	Home-Contact	18	.09	.37	-.16 to .35	
SOCIAL INTERACTION						
Contexts Compared Against Baseline:						
Collective	Baseline	3	.35	.45	-.24 to .95	
Home-Contact	Baseline	3	.33	.05	-.26 to .92	
Direct Comparisons Between Contexts:						
True Group	Collective	2	.21	.01	-.49 to .90	

Collective	Home-Contact	3	.15	.32	-.45 to .75	
QUALITY OF LIFE						
Contexts Compared Against Baseline:						
Collective	Baseline	15	.25	.38	-.02 to .52	
Home-Contact	Baseline	16	.24	.19	-.02 to .50	
Direct Comparisons Between Contexts:						
Collective	Home-Isolation	9	.34	.15	-.05 to .74	
Collective	Home-Contact	16	.03	.01	-.23 to .29	
PHYSIOLOGICAL EFFECTIVENESS						
Contexts Compared Against Baseline:						
Collective	Baseline	13	.45	.35	.14 to .76	*
Home-Isolation	Baseline	4	.23	.01	-.35 to .81	
Home-Contact	Baseline	9	.15	.02	-.22 to .51	
Direct Comparisons Between Contexts:						
Collective	Home-Isolation	14	.13	.23	-.18 to .44	
Home-Contact	Home-Isolation	4	.23	.14	-.29 to .75	
Collective	Home-Contact	20	.16	1.06	-.08 to .41	
FUNCTIONAL EFFECTIVENESS						
Contexts Compared Against Baseline:						
Collective	Baseline	8	.22	.03	-.15 to .58	
Home-Isolation	Baseline	3	.05	.02	-.55 to .65	
Home-Contact	Baseline	5	.03	.02	-.44 to .50	
Direct Comparisons Between Contexts:						
Collective	Home-Isolation	12	.56	.20	.24 to .89	*
Collective	Home-Contact	5	.19	.01	-.28 to .65	

[a]An effect size is considered significantly different from zero if the 95% confidence interval does not include or pass through zero (Hedges & Olkin, 1985).