British Journal of Educational Psychology (2006), 76, 119–140

The British Psychological Society
www.bpsjournals.co.uk

The educational impact of team-skills training: Preparing students to work in groups

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Background. Despite a vast literature on collaborative learning (CL), there is little research on preparing students to work collaboratively.

Aims. This two-phase evaluation investigated whether team-skills training could enhance the performance of collaborative groups through the introduction of a team development programme to a group-based undergraduate key-skills unit.

Sample. Phase 1 compared two consecutive cohorts of second-year students, Cohort 1 ($N = 94$) who received no preparation, and Cohort 2 ($N = 113$) who received team-skills training. Phase 2 added Cohort 3 ($N = 88$), who also received team-skills training, to extend the analysis.

Method. In Phase 1, students in both Cohorts 1 and 2 worked on a series of curriculum based key-skill tasks across two semesters. Students worked in one group in Semester 1 and were then formed into new groups for Semester 2. Effects of the training were measured by student group marks and key-skill ratings.

Results. Marks and key-skill ratings were significantly higher for the trained cohort in Semester 1 ($p < .01$). However, in Semester 2 performance reduced for the trained cohort in comparison to Semester 1. To explore this further, Phase 2 of the study evaluated Cohort 3, where after training, collaborative groups remained intact throughout the academic year. Results for Cohort 3 showed no attenuation of performance effects in Semester 2.

Conclusions. Phase 1 results support the use of team-skills training to enhance CL group performance. The findings for Phase 2 suggest that these benefits may be lost if training groups are disrupted.

Assessing the educational impact of team-skills training

Collaborative learning (*CL*) is an educational approach in which the learning environment is structured so that students work together towards a common learning goal. Although there is a wealth of literature that has sought to understand the benefits of CL, including ways in which the learning environment should be structured so as to

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DOI:10.1348/000709904X24564

maximize these benefits, little research has focused on the preparation of students for working collaboratively. Specifically, there has been little research that has investigated the role of training students in the skills necessary to interact effectively in a group and the influence that this may have on learning outcomes. This is surprising, since a number of researchers have argued that if students are to work together successfully they must be equipped with the skills that they need to achieve this (Johnson & Johnson, 1986; Michealson & Black, 1994; Nastasi & Clements, 1991; Porter, 1993). Michaelson and Black (1994) suggest that there is no reason to assume that students will possess the skills necessary to function effectively as a group, or that such skills will develop merely as a result of being placed in a group learning environment. Indeed some researchers have argued that this may even be damaging if consequential bad experiences deter them from future group learning (Porter, 1993). The present research investigates the prior training of collaborative groups by evaluating the use of a conceptually similar, yet to this point largely unlinked literature, that of teamwork, and its research on the preparation of team members to work in teams through team-skills training.

At an intuitive level there appears to be much in common between the underpinnings of CL and those of teamwork: the combination of team member efforts to complete a common task. At a theoretical level, definitions of teamwork and CL show that these two concepts have much in common. Indeed a comparative review of teamwork and CL reveals five main elements which are consistent across their definitions: the existence of a group goal, member interdependency, coordination of member's activities, the structuring of group/task roles and a focus on interactive processes (see Table 1 for

Table 1. Citations for the common elements of teamwork and collaborative learning

	Definitions of teamwork	Definitions of collaborative learning
A common goal	Dickinson & McIntyre (1997); Glickman *et al.* (1987); Hall & Rizzo (1975); Katzenbach & Smith (1993); Kraiger & Wenzel (1997); Nieva, Fleishman, & Reick (1978); Salas, Dickenson, Converse, & Tannenbaum (1992); Sundstrom, De Meuse, & Futrell (1990)	Cooper & Mueck (1990); Davidson (1994); Johnson & Johnson (1983); Millis & Cottell (1998); Nastasi & Clements (1991); O'Donnell & Dansereau (1992); Slavin (1983, 1995); Totten (1991).
Member interdependency	Glickman *et al.* (1987); Higgs & Rowland (1992); Katzenbach & Smith (1993); Levi & Slem, 1995; Nieva, Fleishman, & Reick (1978); Salas *et al.* (1992)	Johnson & Johnson (1983, 1985); Millis & Cottell (1998); Nastasi & Clements (1991); Slavin (1983, 1995); Totten (1991)
Dynamic exchange of information	Dickinson & McIntyre (1997); Glickman *et al.* (1987); Hall & Rizzo (1975); Salas *et al.* (1992)	Gillies (2000); Johnson & Johnson (1985); Nastasi & Clements (1991).
Co-ordination of task activities	Dickinson & McIntyre (1997); Glickman *et al.* (1987); Kraiger & Wenzel (1997); Nieva *et al.* (1978); Salas *et al.* (1992)	Gillies (2000), Johnson & Johnson (1985); Millis & Cottell, (1998); Slavin (1983); Totten (1991)
Some structuring of members roles	Hall & Rizzo (1975); Kraiger & Wenzel (1997); Salas *et al.* (1992); Wagner, Hibbits, Rosenblatt, & Schulz (1977)	Damon & Phelps (1989); Johnson & Johnson (1983); Millis & Cottell (1998); Slavin (1995)

a citation summary). However, despite the similarities between teamwork and CL there has been little attempt to bring the two literatures together. This is unfortunate, since it is likely that interventions designed to promote the effectiveness of teamwork may be usefully applied to enhancing the effectiveness of CL.

Within the domain of teamwork there is a long history of providing teams with team-skills training in order to enhance team effectiveness. The principles that guide team-skills training, also called *team development* or *team building*, are not well defined, but in broad terms, team-skills training aims to enhance work-group effectiveness by improving group members' skills in goal setting, problem solving, interpersonal relations, and role clarification (Beer, 1976; Buller & Bell, 1986, Woodman & Sherwood, 1980). While the evidence to support the efficacy of team-skills training is mixed (for reviews see Salas, Rozell, Mullen, & Driskell, 1999; Woodman & Sherwood, 1980), a number of studies have reported that such training leads to improved team performance (e.g. Hall & Watson, 1971; Hall & Williams, 1970; Hughes, Rosenbach & Clover, 1983; Kimberly & Neilsen, 1975; Marks, Zaccaro, & Mathieu, 2000). A more consistent finding is the effect of team-skills training on affective outcomes (Friedlander & Brown, 1974). Woodman and Sherwood (1980) reviewed the teambuilding literature and found evidence of a range of post-intervention attitudinal improvements following training in almost all of the 30 studies they included in their review. These attitudinal improvements included variables such as organizational climate (Kimberly & Nielsen, 1975), satisfaction (Smith, 1976), morale (Smith, 1976), and cohesion (Deep, Bass, & Vaughan, 1967). Given the parallels between teamwork and CL, it seems reasonable to conclude that team-skills training could similarly be used to enhance the performance of collaborative groups in educational settings.

Potential theoretical justification for the use of team-skills training to enhance collaborative group performance can be derived from both cognitive and motivational perspectives of CL. From a cognitive perspective certain types of interpersonal interactions are seen as important in facilitating learning in CL environments. These include opportunities to consider multiple perspectives, engagement in cognitive conflicts, resolution of those conflicts, and verbal elaboration of the material to be learned (Doise & Mugny, 1984; Nastasi, Clements & Battista, 1990; O'Donnell & Dansereau, 1992; Slavin, 1995; Vygotsky, 1978). To engage in interpersonal interactions successfully, individuals must be able to coordinate their activities effectively (Bearison, 1982), and a number of researchers have advocated team training/building activities in order to facilitate this. In a review of CL, Nastasi and Clements (1991) argued that enhancing CL groups' interpersonal functioning would be beneficial, and that 'placing socially unskilled students together and directing them to co-operate will not automatically lead to successful group interactions' (p. 124). Therefore, at a cognitive level, team-skills training should improve learning outcomes by improving group processes.

Motivational theory proposes that since students can only obtain their own personal goals when the group is effective, they will be motivated to help fellow students to help the group (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Slavin 1983). Social cohesion theorists have looked at CL in a related yet slightly different way, by suggesting that learning is mediated by the cohesiveness of the group (Cohen, 1986). Further, students may be motivated to help each other to learn because they come to care about each other, in which case successful learning is mediated by the cohesion of the group (Cohen, 1986). Promoters of this theoretical position argue that the use of teambuilding

to induce cohesiveness would be critical to the working of collaborative groups (Johnson & Johnson, 1986).

The prior training of groups as an aspect of CL was identified by Druckman and Bjork (1994) as an important variable that remained largely unstudied. Unfortunately, almost 10 years on, little has changed. The CL literature makes reference to the need to develop interpersonal and small group skills such as the use of group processing (e.g. Johnson & Johnson, 1992), but rarely presents research evidence aimed at evaluating its efficacy. Two exceptions to this are early studies by Yager, Johnson, Johnson, and Snider (1986), and Johnson, Johnson, Stanne, and Garibaldi (1989). Yager *et al.* (1986) looked at the effect of group processing on the output from cooperative groups of American elementary school children. Groups were provided with a series of verbal instructions to guide group activities which required them to discuss how well they were performing on a task and how they could improve their effectiveness. Their results showed that cooperative groups that used group processing performed significantly better on an individual achievement test at the end of the course and on a retention test given a few weeks later. Johnson *et al.* (1989) extended this earlier work by looking at the effect of group processing with an older sample of students who were about to enter their first year of university. They found, at a group-product level, teams that used group processing performed better than teams that did not. Together, these studies offer support for the use of group process training in promoting better outcomes from collaborative groups, albeit through a focus on a narrow set of skills.

Despite this promising research there has been little follow-up work to test the effectiveness of alternative group preparation techniques. Rather the research has focused on the use of prescriptive collaborative structures such as *Jigsaw* (Aronson, Stephan, Sikes, Blaney, & Snapp, 1978) and *Group Investigation* (Sharan & Hertz-Lazarowitz, 1980), which perhaps to some extent removes the necessity for group members to have high levels of interpersonal and group process-related skills such as problem solving, time management, role differentiation, and so forth, since these will be largely predefined by the CL structure. While these highly structured contexts may support young collaborative learners in school settings, the collaborative activities undertaken in higher education do not to make use of such highly prescriptive approaches. Instead there is a reliance on students developing their own approaches to tasks. It seems probable that these collaborative settings would be significantly affected by the group skills of each group member, and therefore more research is warranted to identify appropriate group preparation methods.

Running in parallel with the need for more research to be carried out on how to prepare students for working collaboratively in educational settings, have been a number of government-related initiatives calling for providers of Higher Education (HE) to ensure that graduates are equipped with the skills necessary to work effectively in teams in the workplace (Coopers & Lybrand, 1998; D.E.S., 1987, 1991). The standard educational response to offering team-skills training has been to provide students with opportunities to work together on group products. The expectation has been that through this experience, students gain a greater understanding of how to work more effectively together. However, this expectation has been challenged by several researchers (e.g. Bowen, 1998; Porter, 1993; Urch Druskat & Kayes, 2000), who have argued that the development of team-skill ability is a process that needs to be facilitated, and that merely requiring students to work together will not turn them into a team. In recognition of this argument, an increasing number of departments in universities across the country have introduced generic team-skills training courses for

undergraduate and postgraduate students. This training differs from activities that could be used to support CL groups in that it seeks to address a wider range of training objectives, covering skills such as time management, planning, coordination, role allocation, and cooperation. Consequently, this type of training not only assists with the development of team working skills for future employment, but also supports student's collaborative learning.

There are many variations of team-skills training programmes, such as problem solving, goal setting, interpersonal relations, and role clarification (Beer, 1976; Buller & Bell, 1986, Woodman & Sherwood, 1980). Training directed at goal setting places emphasis on the setting of goals and objectives, the identification of obstacles to achieving these goals, and action planning to determine how goals are to be reached, and obstacles overcome. The interpersonal model focuses on the development of open communication, mutual trust, and cohesion. Role clarification models emphasize the different interacting roles that people play in a group situation and aim to increase each person's knowledge about the roles played by others. In practice, while these models serve as a basis for interventions, a generic training programme contains elements from all of these models, each one emphasized to greater or lesser degrees depending on the issues identified as training priorities.

The team-skills training environment is typically experiential in nature, designed around the principles of Kolb's learning cycle (1984). Students work in groups on a variety of tasks that require them to work together. Each task provides the focus for a subsequent review activity in which students have the opportunity to reflect on what happened during the task with the other group members, sharing their reactions and observations of the reactions of others involved. From this process students are able to integrate their experience with other information and knowledge they have acquired, develop greater understanding of why things happened in the way that they did, and establish key learning points for future team tasks. These learning points are then applied to the next task so that their new learning can be tested and practised, after which the cycle begins again. During the course, students will go through a number of iterations of this learning process, the number depending on the length of the training.

Those advocating the use of team-skills training in educational settings have argued that it not only provides students with employment skills thus addressing key-skill development requirements, but that it also facilitates student group functioning (Dunne & Prince, 1997). These views are generally based on the findings of qualitative assessments of team-skills training days using students' evaluations of the training they experienced. An evaluation of one such training programme was performed by Dunne and Prince (1997) who looked at student responses to a compulsory team development training day for first year law students using the *BP Amoco/Chalybeate Programme: Team Development in Universities*. Dunne and Prince reported that students' responses to the training they experienced were positive. Many felt that they had benefited from building up relationships with the members of their project groups and had gained a greater understanding of the benefits of group work. In addition, tutors subsequently reported that the quality of student group presentations following the training was high. Absent, however, is any formal empirical evidence of the effect of team-skills training in these student responses. Hattie, Marsh, Neill, and Richards (1997) have criticized this type of evaluation of training effectiveness because of the frequent lack of proper control groups, and the great emphasis placed on qualitative data regardless of whether there are any statistical differences between pre-test and post-test measures of individual or group performance. Consequently, these research designs

have limited the extent to which any conclusions can be drawn about the effect of training on collaborative group performance. For example, in Dunne and Prince's study no data were collected on subsequent student group marks, nor were there any control group data against which performance of the trained students could be compared. It is not possible therefore to assess whether the high quality of group presentations observed was a reflection of the effects of team training, or whether they actually performed any better than groups that had not experienced any training. As with other evaluations of team-skills training interventions (e.g. Schadler, 1995), the data did not include a measure of individual student learning, and effects of such training are therefore limited to group performance only.

With the increased use of team-skills training by universities, there is a need to further understand its impact on the performance outcomes of student learning groups. The first stage in this process is to determine whether team-skills training can indeed increase the performance of such groups beyond that of groups that do not receive training. In response to this, the current paper presents an evaluation of a generic team development intervention similar to that used by Dunne and Prince (1997), and its impact on CL group performance outcomes.

PHASE 1

Method

Design

This evaluation took advantage of the introduction of team-skills training into an existing unit of the undergraduate psychology curriculum. It was, therefore, able to make an opportunistic comparison of the task and key-skill learning performance of two consecutive cohorts of second year undergraduate students on a key skills unit within a BSc (honours) programme in psychology, before and after the introduction of team-skill training. The unit aimed to provide students with the skills necessary to report competently on psychological research through both verbal and written communication, reflective of the third year teaching and learning requirements. These skills were also regarded as being relevant to students in their later learning and employment experience. The specific skills to be practised were embedded in the substantive academic units taken during the year, drawing on the content of each unit. Therefore, the overall aim was the development both of the key skills targeted, and deeper understanding across a range of topics - social psychology, work psychology, cognitive psychology, and learning and behaviour. A crucial feature of this unit was the requirement for students to work in allocated groups on tasks related to each of these topics.

The design of this evaluation was not within our control as researchers, therefore, this is very much a naturalistic experiment. Cohort 1, the control group, undertook the key-skills unit during its first year of running, but received no prior team-skills training. Cohort 2, the experimental group, began their degree programme a year later than Cohort 1, and received team-skills training at the beginning of their second year before the key skills unit started. There were four evaluation measures: (1) individual students' marks, (2) individual students' self-ratings of key-skills, (3) individuals students' self-rated team-skill ability, and (4) individuals ratings of cohesion towards their group.

Participants

The participants were second year undergraduates following a key-skills unit as part of a 3-year honours degree in psychology. Students worked in teams of five or six on a series of curriculum based tasks over the course of the academic year. Cohort 1 consisted of 94 students. Seventy-eight of these students were female (Mean age 21.1 years; *SD* 4.9; range 19-44), and 17 were male (Mean age 23.0 years; *SD* 8.9; range 19-50). Cohort 2 consisted of 113 students. Ninety-six of these students were female (Mean age 21.1 years; *SD* 4.5; range 18-41), and 17 were male (Mean age 20.4 years; *SD* 0.9; range 19-22). There were no significant differences in age or gender mix between the two cohorts. Cohorts were similar with respect to their previous team experiences, based on a self-rating at the start of each year on a 10-item team experience questionnaire (Rentsch, 1993). These team experience ratings were averaged for each participant. Mean team experience levels for Cohort 1 ($M = 4.94$, $SD = 0.58$) and Cohort 2 ($M = 4.90$, $SD = 0.62$) did not differ significantly ($t(205) = 0.40$, $p > .05$).

Materials

Pre- and post-task key skill assessment sheets

These measured students' self-evaluations of their competency levels on each of the 23 key skills targeted as learning outcomes, both before and after each of the tasks. Skills assessed included: using a website, searching and retrieving literature through IT resources, and making a short verbal presentation, and were measured on a 7-point Likert scale where higher scores indicated higher levels of skill rating.

Pre- and post unit team-skill ability rating

This single item be further developed? of task type in the method section although in little detail. for untrained students comparedmeasured students' self-evaluations of their overall team-skill ability before and after the entire unit, measured on a 7-point Likert scale where higher scores indicated higher levels of team-skill rating.

Cohesion Questionnaire

This consisted of 19 items that measured students' self-reported perceptions of the cohesiveness of their work group. Questions were drawn from a meta-analysis by Mullen and Coppers (1994) of previous studies of team cohesion. Fifteen items were selected to measure each of the dimensions of cohesion identified in the literature: interpersonal attraction, commitment to the task, and group pride. Five of these items addressed interpersonal attraction (e.g. friendship level, feelings of closeness). Four items addressed commitment to the task (e.g. personal involvement in team activities, enjoyment gained from the task). The final six items addressed group pride (e.g. own group compares favourably with others, sense of pride in belonging to the group). To these 15 items, a further four were added to determine perceptions of how well the group had worked together as a team, and whether team members would have preferred to perform the tasks individually or within the team. All items were measured on a 7-point Likert scale where higher scores indicated higher levels of cohesion.

Tasks

Five tasks were developed for this unit. Each task was *discretionary* in nature (Steiner, 1972), such that group members were required to decide for themselves how individual

inputs related to the group product. In addition, each task required the use of a range of team skills including problem solving, decision making, planning, and time management. Each task was designed to reflect the content of one of the five compulsory psychology topics prescribed for the year. In addition, each task addressed the development of a variety of key skills. Some of these skills were required for every task such as using the Internet, while others were more closely aligned to the method of assessment of a specific task such as making a verbal presentation.

Student performance was assessed by the group mark for each task product. This mark was awarded by the group's tutor, determined both in relation to the curriculum content of their work consistent with the departmental marking criteria, and in relation to the group's success in demonstrating the acquisition of the key skill aspects of the task. An individual mark for each student was obtained allocating the group mark to each group member. This mark was then moderated by peer evaluations which were applied when 50% or more of a group agreed that an individual team member's performance was above or below the average performance of the team, with marks modified where appropriate by $\pm 10\%$. Student marks were further moderated by the unit coordinator to ensure that marking was consistent between the four staff acting as tutors, with each group's final mark being agreed at a meeting of all tutors at the end of each task. Students were given 4 weeks to complete each task, during which time they were free to meet as and when they chose.

Procedure

Cohort 1

Students were randomly assigned to one of 19 groups (15 groups of five students and 4 groups of six students). In Week 1, students were asked to complete the pre-unit team-skill ability rating. Two tasks were completed in Semester 1. Before each task was started, and again on completion, students were asked to rate their competence on a key-skills assessment form. At the end of Semester 1, students were asked to complete a cohesion questionnaire. At the beginning of Semester 2, students were formed into new groups composed of individuals who had not worked together during Semester 1. Students remained in these groups for the rest of the unit, and completed three more tasks in Semester 2. At the end of the academic year, all students again completed the team-skill rating and the team Cohesion Questionnaire.

Cohort 2

At the beginning of the following academic year, the new second year students were randomly assigned to one of 20 groups, (3 groups of five students and 17 groups of 6 students). The sequencing of events for Cohort 2 was, as far as possible, the same as for Cohort 1 apart from the introduction of a prior compulsory team-skills development day. This was undertaken on one of three days provided in Weeks 1 - 3 at the beginning of the year, with students training in the groups they were allocated to work in during Semester 1.

Team-skills development day

This training was targeted at a number of different training objectives, which were developed to different degrees during the day, dependent on the task. These included: setting objectives, problem solving, planning, decision making, time management,

agreeing roles, creating a group environment, and cooperation. The cognitive approach to CL is consistent with the use of these skills to support learning. Prior research that has evaluated this training approach has found that participants' skill level for these objectives increased during training (Prichard, Stratford, & Hardy, 2004).

Working within the theoretical framework of Kolb's learning cycle (Kolb, 1984), the students worked in groups on a variety of tasks, each of which provided the focus for a subsequent review activity. This review was facilitated by a previously trained tutor and included the sharing of reactions to the team's performance and the identification of key learning points for future team tasks. The basic format for the day involved student teams performing hour-long experiential tasks, such as making a square out of a 100-foot rope while blindfolded, and in each case followed by a tutor-facilitated review of the task performed. As part of the review process, the tutors also introduced a number of theoretical models of teamwork and team performance, such as models of team development, team-role theory and problem solving, which could be applied to aid team effectiveness. Students completed six task and review sessions in total during the day. (For full details of the team development day including information on all of the training tasks and the matching of tasks to training objectives please see Prichard *et al.*, 2004).

In all other respects, apart from this team training, Cohort 2 followed the unit in exactly the same way as Cohort 1, working in pre-allocated groups with the same tutors on five tasks, with two tasks in Semester 1 and three in Semester 2.

Data analysis

Data has been analysed at semester level rather than at individual task level, as this is more indicative of the underlying trends in the data. Owing to an administrative error concerning the running of the third task for Cohort 2, it was felt that student performance on this task would not be comparable between the two cohorts. Consequently data from the third task were excluded from the principle analysis, and comparisons between the two cohorts are based on group performance and key-skill ratings on the two tasks in Semester 1 and the last two tasks of Semester 2.

Results

Student task marks

The effect of team-skills training on Cohort 2 was assessed by comparing the mean student marks on the tasks performed in each semester for each cohort. Table 2 shows the mean student task mark in Semester 1 was higher for Cohort 2 than Cohort 1. A similar, although much smaller effect was present during Semester 2.

These mean differences were confirmed with a mixed 2 (Cohort 1, 2) × 2 (Semester 1, 2) ANCOVA. The average exam mark that students achieved in their first year of study was included as a covariate in the analysis to exclude the possibility that the higher student task marks achieved by Cohort 2 compared with Cohort 1, resulted from some difference in ability between the two cohorts. The analysis revealed that after adjusting for first-year exam marks, there was a significant main effect of cohort (Cohort 1 = 63.45, Cohort 2 = 67.74; $F[1, 200] = 79.46$, $p < .001$), and a significant interaction between cohort and semester ($F[1, 200] = 12.05$, $p < .001$), but no significant main effect of semester ($F[1, 200] = 0.17$, $p > .05$). Independent samples t tests found that mean student task marks in Semester 1 and 2 were significantly higher for Cohort 2 than Cohort 1, (Semester 1, $t[208] = 8.91$, $p < .001$; Semester 2,

Table 2. Mean scores and standard deviations for the three evaluation variables, student marks, key skill self-ratings and cohesion

		Semester 1		Semester 2	
		Mean	*SD*	Mean	*SD*
Student marks	Cohort 1	62.71	3.11	64.27	5.40
	Cohort 2	68.66	5.68	66.76	4.85
	Cohort 3	69.01	6.98	67.81	5.49
Key skill ratings	Cohort 1	4.45	0.38	4.61	0.52
	Cohort 2	4.65	0.41	4.68	0.53
	Cohort 3	4.70	0.46	4.86	0.52
Cohesion ratings	Cohort 1	5.23	0.78	5.03	0.78
	Cohort 2	5.83	0.72	5.33	0.66
	Cohort 3	5.55	0.60	5.36	0.74

$t[205] = 3.45, p > .01$). In addition, Cohort 1 student task marks increased significantly across the academic year ($t[95] = 2.45, p < .05$). In contrast, mean student task marks for Cohort 2 in Semester 2 were found to be significantly lower than in Semester 1 ($t[110] = 2.68, p < .01$).

Key-skill ratings

Individual self-ratings on the key skills measured before and after each task were averaged to give an overall key-skill rating for each student at that time point. These were then used to calculate a mean cohort key-skill rating for each semester. Table 2 shows that the mean key-skill rating is higher in Cohort 2 than Cohort 1 in both Semester 1 and Semester 2. In addition, both cohorts show an increase in key-skill ratings from pre-unit levels through Semester 1 and Semester 2. This was tested using a mixed 2 (Cohort 1, 2) × 3 (pre-Task 1, Semester 1 & 2) ANOVA. Analysis revealed no significant main effect of cohort ($F[1, 193] = 2.38, p > .05$), a significant main effect of semester (pre-Task 1 = 4.04, Semester 1 = 4.55, Semester 2 = 4.65; $F[2, 193] = 195.62, p < .01$), and a significant interaction between cohort and semester ($F[2, 200] = 5.48, p < .01$). Independent t tests found that there were no significant differences between conditions in mean key-skill ratings at the beginning of the academic year ($p > .05$). Mean key-skill ratings in Semester 1 were significantly higher for Cohort 2 than Cohort 1, ($t[210] = 3.78$, $p < .001$), but not significantly different for Semester 2, ($p > .05$). Paired sample t tests found a significant increase in self ratings of key skills across semesters for Cohort 1 ($t[95] = 3.74, p < .001$), but not for Cohort 2 ($t[108] = 1.42, p > .05$), respectively.

Team-skill ratings

Mean self-ratings of team-skill ability for each cohort were calculated at both the start of the year and at the end of the year. A mixed ANOVA revealed a significant main effect of time on the ratings between the start of the year and the end of the year ($F[1, 187] = 9.72, p < .05$). Paired sample t tests of the within subjects effect of time found that for Cohort 2 there was a significant increase in self-rated team skill (Semester 1 $M = 4.98$, $SD = 1.04$; Semester 2 $M = 5.34$, $SD = 0.67$; $t[98] = 3.08, p < .01$). There was, however, no significant difference in self-rated team-skill ability between the start of the year and the end of the year for Cohort 1, (Semester 1 $M = 5.22$, $SD = 0.98$;

Semester 2 $M = 5.39$, $SD = 0.67$; $p > .05$). The mean percentage increase in team-skill rating for Cohorts 1 and 2 was calculated to be 3.3% and 7.2%, respectively. There were no significant differences between cohorts in self-rated team-skill ability at either the start of the year or at the end of the year ($p > .05$).

Cohesion ratings

The scores for the 19 cohesion items were averaged to give a total cohesion score for each student for each semester. Table 2 shows that mean scores for Semester 1 were higher for the students in Cohort 2 than the students in Cohort 1. In Semester 2, ratings for both cohorts were lower than in Semester 1. In addition, the differential between the two cohorts was less marked.

A repeated measures ANOVA revealed a significant main effect of cohort ($F[1, 168] = 27.04$, $p < .001$), a significant main effect of semester ($F[1, 168] = 24.18$, $p < .001$), and a significant interaction between semester and cohort ($F[1, 168] = 4.39$, $p < .05$). Planned comparisons were performed both between cohorts and across semesters. Independent samples t tests found that cohesion levels in Semester 1 were significantly higher in Cohort 2 than Cohort 1 ($t[179] = 5.35$, $p < .001$). There was no difference between cohorts for Semester 2 ($p > .05$). Paired sample t tests of the within-subjects effect of semester found that for Cohort 2 cohesion levels were significantly lower in Semester 2 than in Semester 1 ($t[84] = 5.29$, $p < .001$). There was no significant difference in cohesion between semesters for Cohort 1 ($p > .05$).

Discussion

Comparing results between the two cohorts, those from Semester 1 supported our hypotheses regarding student-team task marks and individual learning: students' individual task marks were significantly higher for the team-trained student groups of Cohort 2 than the untrained groups of Cohort 1. In real terms, the size of the performance increase was considerable - the mean task mark for trained students was 6% higher than that of untrained students. This effect was not due to differences in student performance prior to team training as the students' overall mark at the end of the first year of their degree was equivalent across cohorts. Similarly, individual key-skill learning, as measured by student self-ratings, was also significantly higher for trained teams than untrained teams. These findings are consistent with that of Johnson *et al.* (1989) who found improved group performances for collaborative groups that used group processing compared with those that did not, and with the findings of Yager *et al.* (1986) who found that group processing improved individual learning (though strictly we cannot say our groups differed in actual task work processing as we were unable to measure this). It is also consistent with a number of studies in organizational settings where team-development programmes have increased work-group performance (e.g. Hughes *et al.* 1983; Kimberley & Nielson, 1975). In addition to these performance outcomes, the team cohesion ratings offered evidence for improved affective outcomes following training. As in previous research by Deep *et al.* (1967), in organizational environments, mean cohesion ratings were significantly higher for Cohort 2 than Cohort 1.

Consistent with the views of other researchers in the field (Bowen, 1998; Porter, 1993; Urch *et al.*, 2000), these findings provide empirical evidence that prior team-skills training has produced superior collaborative group work compared with that of students merely placed in unfacilitated groups. In particular, they support

the predictions made from cognitive theories of CL, and the ideas of researchers such as Bearison (1982), Nastasi and Clements (1991), and Druckman and Bjork(1994), that better coordination of effort within collaborative groups would enable the group interactions to be more successful, thus facilitating learning. Unfortunately, due to the constraints of the real-world setting, the design of the research did not allow for group member interactions to be observed during task performance, therefore it is not possible to say whether the interactions within trained teams differed from those of untrained teams. However, we have the students' view that the training did result in improved group coordination - in their ratings of their own team-skill ability - and it is probable that this led to an improvement in the group interactions which facilitate collaborative gains. The findings are also consistent with a social cohesion model of CL (Johnson & Johnson, 1986), which suggests that learning in collaborative groups is mediated by the cohesiveness of the group, which in turn can be induced through team building activities.

It is unlikely that this superior performance of the trained groups compared with the untrained groups was a consequence of differences in instructional quality during task performance. While the staff working as tutors were necessarily aware that the training intervention had been given to students in Cohort 2, and encouraged students in this cohort to apply the skills that they had learned in training to each task, they did not provide that cohort with additional teaching or coaching to support task completion.

In contrast to the findings of Semester 1, the findings for data obtained at the end of Semester 2 did not support the hypothesis. Mean student task marks for Cohort 2 were still higher than those obtained by Cohort 1, but the difference was small and had declined substantially compared with the difference between the two cohorts in Semester 1. Key skill ratings did not differ significantly between cohorts, with Cohort 2 showing no increase across semesters unlike Cohort 1, where key skill ratings increased from Semester 1 to Semester 2. Additionally, cohesion ratings for Cohort 2 were significantly lower in Semester 2 compared with Semester 1.

The key-skills unit was designed to encourage a progression in learning over the course of the year, with basic skills used in the first task further developed and added to in subsequent tasks. The final task required students to use most of the skills they had learned during the year. It could therefore be expected that over the course of the academic year student marks for the group tasks would increase as they gained experience in the skills they were learning. The findings of Cohort 1 were consistent with this expectation; but the results for Cohort 2 were not, with mean marks showing a decline in student performance across the year. This failure of Cohort 2 to retain their clear performance advantage across the Semesters is particularly interesting as it suggests team skills developed within a specific team may not transfer from one team to another.

At the beginning of Semester 2, the initial groupings were disbanded and new groups were formed. This had also happened with Cohort 1, but did not disrupt the performance on team tasks, which increased from Semester 1 to Semester 2 in line with the expectation of development across the academic year. In contrast, in Cohort 2, the disbanding and re-forming of groups was accompanied by a significant disruption to student performance. In Semester 1 these students received the team training in the same groups that they were to work with. The results show that students were able to apply the team skills they developed during training to the academic environment as reflected by their improved performance in Semester 1 when compared with Cohort 1. However, the decline in performance in Semester 2 suggests that the students were unable to transfer their greater team skill from their original training group to their

new group. This may have happened because they had insufficient training to allow generic skills to develop, or perhaps because some aspect of the benefits of training comes from the development of team specific skills, such as knowledge of other team members' skills and abilities, trust, or cohesion. The latter may facilitate more effective interaction while students remain in their original training groups but may be lost when student groups are re-formed. The possibility of these explanations is supported by the fact that student marks reverted across semesters to levels just above those achieved by the untrained students of Cohort 1. Equally, key-skill ratings can be interpreted in the same way. However, although key-skill ratings in Semester 1 were higher in Cohort 2 than Cohort 1, there were no differences between cohorts in Semester 2. In addition, unlike the ratings for Cohort 1 that increased significantly across semesters in line with expectations, ratings for Cohort 2 did not increase but remained equivalent in each semester. This suggests that team-skills training produced superior key-skill learning while students worked in their original team training groups, but that this advantage was lost when students were formed into new groups in Semester 2.

Although this explanation of the results seems tenable, an alternative interpretation can be made in terms of an attenuation of the benefits of pre-task team training over the passage of time. This may have occurred because the skills learned during training lost their salience, were forgotten, or perhaps because an initial 'post-training euphoria' had diminished (Hattie *et al.*, 1997). Such post-training euphoria, if it occurred, may have heightened student motivation following the training producing the performance benefits demonstrated in Semester 1, but not survived into the second semester. The design of the study did not permit us to distinguish between these two possible explanations, relating to the transferability or durability of the training. However, the observations of the first two semesters led to a decision by the unit coordinator, independent of this evaluation, to review the policy of re-grouping students for the third year of the unit such that student teams were not reformed half-way through the unit, but remained in their pre-task training formation for the duration of the unit. This enabled the study to be extended to further explore the implications of re-grouping.

PHASE 2

Method

Design

In the year following Cohort 2, a third cohort of 88 students (Cohort 3) underwent the team-skills training programme in their allocated task groups, but then remained in these groups for all the unit tasks across both semesters. Seventy-four of these students were female (Mean age 21.2 years; *SD* 4.7; range 18–42), and 14 were male (Mean age 20.8 years; *SD* 0.8; range 18-22). The same dependent variables were measured as in Phase 1, on four of the tasks. Unfortunately a further change had to be made in the data available for comparison following an alteration to the format of Task 1 for this cohort such that it was no longer on the same topic as for Cohorts 1 and 2. Therefore Semester 1 comparisons in Phase 2 are made on the basis of comparing two tasks for Cohorts 1 and 2 with only one task for Cohort 3.

It was predicted that Cohort 3 would show the same pattern of responses as Cohort 2 in Semester 1. Thereafter, if the performances of Cohort 3 groups in Semester 2 declined compared with Semester 1, it was hypothesized that this would be due to an attenuation of the benefits of the initial team-skills training over time ('durability'). However,

if the groups in Cohort 3 showed continued or sustained improvement in Semester 2, compared with Cohort 1, then it was hypothesized this would reflect the benefit of staying with the same group formations ('transferability'). Therefore, in summary, if Cohort 3's Semester 2 results were lower than for Semester 1, we would argue that training effects have been lost across time. If Semester 2 results are the same as or better than in Semester 1, then we can argue that group familiarity has had an effect.

Results

Student marks

Table 2 shows the mean student marks for Cohort 3 together with those for Cohort 1 and 2. A mixed 3 (Cohort 1, 2, 3) × 2 (Semester 1, 2) ANCOVA found that after adjusting for Year 1 marks, there was a significant main effect of cohort ($F[2, 271] = 45.16$, $p < .001$), no significant effect of semester ($F[1, 271] = 3.35, p > .05$), and a significant interaction between cohort and semester ($F[2, 271] = 5.78, p < .01$). *Post hoc* Scheffé tests revealed that for Semester 1, mean marks for Cohort 2 and 3 were both significantly higher than those of Cohort 1 ($p < .001$), but did not differ significantly from one another ($p > .05$). The same analysis performed on the data from Semester 2, found that mean marks for Cohort 2 and 3 were significantly higher than those of Cohort 1 ($p < .01$). Across semesters, however, while mean marks for Cohort 2 showed a significant decrease from Semester 1 to Semester 2 ($t[110] = 2.68$, $p < .01$), mean marks for Cohort 3 did not differ significantly across semesters ($t[73] = 1.15, p > .05$).

Key-skill ratings

Table 2 shows the mean key-skill ratings for Cohort 3 together with those for Cohort 1 and 2. A mixed 3 (Cohort 1, 2, & 3) × 3 (pre-Task 1, Semester 1 & 2) ANOVA revealed a significant main effect of cohort (Cohort 1 = 4.37, Cohort 2 = 4.46, Cohort 3 = 4.54; $F[2, 274] = 4.19$, $p < .05$), a significant main effect of time of rating (pre-Task 1 = 4.05, Semester 1 = 4.60, Semester 2 = 4.71; $F[2, 274] = 323.33, p < .001$), and a significant interaction between cohort and time ($F[2, 274] = 4.81, p < 0.01$). *Post hoc* Scheffé tests revealed no significant differences between conditions in average key-skill ratings at the beginning of the academic year ($p > .05$). In Semester 1, the average key-skill rating was significantly higher for Cohorts 2 and 3 than that of Cohort 1 ($p < .01$), and no significant difference was found between Cohort 2 and Cohort 3 ($p > .05$). In Semester 2, the average key-skill rating for Cohort 3 was significantly higher than that of Cohort 1 ($p < .01$). No other differences were found between cohorts ($p > .05$). Across semesters, while no significant increase in average key-skill rating was found for Cohort 2 ($p > .05$) the average key-skill ratings for Cohort 3 increased significantly across Semesters 1 to 2, ($t[85] = 3.72, p < .001$).

Team-skill ratings

A repeated measures ANOVA revealed no significant main effect of cohort ($F[2, 258] = 1.05$, $p > .05$), a significant main effect of time ($F[1, 258] = 25.63$, $p < .001$), and no significant interaction between time and cohort ($F[2, 258] = 2.48$, $p > .05$). Planned comparisons were performed across time points. These revealed that for Cohorts 2 and 3 there was a significant increase in self-rated team skill across the academic year ($t[98] = 3.08, p < .01$, and $t[71] = 4.16, p < .001$, respectively. Cohort 3, $M = 4.92$, $SD = 1.09$ and $M = 5.51$, $SD = 0.86$ for Semester 1 and 2, respectively).

No significant increase in team-skill self-rating was found for Cohort 1 ($p > .05$). The mean percentage increases in self ratings of team-skill for Cohorts 1, 2, and 3 were found to be 3.3%, 7.2%, and 12.1%, respectively.

Cohesion ratings

The scores for all items were averaged to give a total cohesion score for each student for each semester. Table 2 shows that mean scores for Semester 1 were higher for the students in Cohort 2 and 3 than the students in Cohort 1. In Semester 2, ratings for all cohorts were lower than in Semester 1. In addition, the differential between the cohorts was less marked. A repeated measures ANOVA revealed a significant main effect of cohort ($F[2, 222] = 13.53$, $p < .05$), a significant main effect of semester ($F[1, 222] = 26.75$, $p < .05$), and a significant interaction between semester and cohort ($F[2, 222] = 3.35, p < .05$). *Post hoc* Scheffé tests found that cohesion levels in Semester 1 were significantly higher in Cohorts 2 and 3 than in Cohort 1 ($p < .05$). There was no significant difference in cohesion ratings between Cohort 2 and Cohort 3 ($p > .05$). In Semester 2, cohesion ratings for Cohort 3 were significantly higher than ratings for Cohort 1 ($p < .05$). There was no difference in cohesion between Cohort 1 and 2 or between Cohort 2 and 3 ($p > .05$). Paired sample t tests of the within-subjects effect of semester found that for Cohorts 2 and 3 there was a significant reduction in cohesion levels between Semester 1 and Semester 2, ($t[84] = 5.23$, $p < .001$; $t[55] = 2.80$, $p < .05$, respectively). There was no significant difference in cohesion across semesters for Cohort 1 ($p > .05$).

Discussion

The results from Semester 1 were consistent with predictions. Mean marks and key-skill ratings were higher for the trained teams of Cohort 2 and Cohort 3 than the untrained teams of Cohort 1. The pre-unit measures, (students' first year marks and pre-unit key-skill ratings) were equivalent across cohorts, thus excluding the explanation that these performance benefits were due to differences in ability across the three cohorts. Therefore, the findings of Cohort 3 replicate the results from Cohort 2, reinforcing our earlier conclusions that team-skills training enhanced the performance of student groups working on educational tasks.

In relation to the Semester 2 findings, it had been predicted that if Cohort 3's Semester 2 results were lower than for Semester 1 we would argue that training effects had been lost across time. However, if Semester 2 results were the same as or better than in Semester 1, then we could argue that group familiarity has had an effect. Therefore, it is the comparison of the trend *across* semesters for Cohort 2 with Cohort 3 that enables us to consider between the two competing explanations. While in Cohort 2 mean marks fell significantly across semesters, in Cohort 3 there was no significant fall in marks. As discussed previously, Cohort 2's drop in performance may have been due to the benefits of the team-skills training being lost when the original student training groups were disbanded and re-formed at the beginning of Semester 2, or it may have been due to an attenuation of the effects of training over time. Results from Cohort 3 are more consistent with the first explanation. Student marks for this cohort did not differ significantly across semesters in contrast to Cohort 2. Key-skill ratings also displayed a pattern of results that differed for Cohorts 2 and 3. The findings from Cohort 2 revealed

that key-skill ratings remained equivalent in Semester 2 compared with Semester 1, and lost their performance advantage when compared with Cohort 1. In contrast, ratings for Cohort 3 showed a significant increase across semesters and these teams maintained their performance advantage over the teams of Cohort 1. These findings are not consistent with the alternative explanation of an attenuation of training skills across time, which would have predicted that the pattern of results found in Cohort 2 would be repeated in Cohort 3, and therefore this latter explanation is discounted.

In summary therefore, the sustained higher marks of Cohort 3 in Semester 2, coupled with the further increases in key-skill ratings, lead us to conclude that the loss of performance benefits for Cohort 2 in Semester 2 was due to the disruption of the original training groups. Thus by keeping students in their original group as in Cohort 3 the benefits of team-skills training were not lost in Semester 2. It is possible that the reason that student grades in Cohort 3 did not rise across semesters is due to a ceiling effect. Perhaps training raised performance to a maximum in Semester 1. However, this does not dispute the conclusion reached that a group disruption argument rather than an attenuation explanation more fully accounts for the findings.

This explanation, that training is more effective when teams stay in the groups in which they trained, is consistent with a number of reports in the psychological literature. For example, in previous research which has looked at the effect of familiarity of team members on performance, Goodman and Leyden (1991) found that lower familiarity of workers was associated with lower productivity. Similarly, Watson, Michaelson, and Sharp (1991) found that as groups become more familiar with one another, they become better able to draw out knowledge from the team and evaluate it. Could this literature thus suggest that it was not the training *per se* but rather the familiarity of members due to more time spent together because of training that accounts for the findings of this study? Is it possible, that given sufficient time together, the untrained students of Cohort 1 may have reached the levels of performance evidenced by the team-trained students in Cohort 3? Perhaps these groups were slower to develop social cohesion between group members. The cohesion findings of this research are not supportive of this possibility. Cohesion levels in all conditions fall across semesters. Of particular relevance is the fall for Cohort 3, who have spent the longest time together of the three groups, and who could therefore be argued to be the most familiar. Even if this group had reached some sort of social-cohesion plateau at the end of Semester 1, and the performance benefits were due to this alone, then the level of cohesion in this group would be predicted to remain the same. The retained levels of performance in the presence of the cohesion drop would not be predicted.

In addition to the cohesion data, qualitative reports from the tutors working on the unit would argue against the possibility of further time spent together resulting in the same levels of performance as the trained groups. These tutors commented that some of the students in Cohort 1 reported difficulties working in their groups. Although this did not influence the decision to re-group students, which had already been made at the beginning of the academic year, it seems unlikely that keeping students together for longer would have led to better performance, rather, tutors considered that it might have led to deterioration in performance as students struggled with the conflict in their groups.

Despite these tutor comments and the cohesion findings, it can be argued that to adequately address this issue a further cohort, in which students did not receive training but spent the entire academic unit in the same groups, should have been observed.

Unfortunately the real-world nature of this research prohibited this possibility as the unit coordination was not under the researchers' control, and ethically, having demonstrated benefits of training in the short term, it would have been inappropriate to withhold training and the benefits it appears to confer for the sake of testing this point. Consequently, this issue remains one worthy of further research, however, it should also be noted that even if length of time spent together does ultimately lead to performance at the same levels as the trained students, these students would still have been performing for at least one semester at levels below optimum. This suggests that under such circumstances training may fast track collaborative performance to this elevated performance level.

Moving from the research on familiarity to research aimed directly at training, recent work by Moreland, Argote, and Krishnan (1998), and Moreland and Myaskovsky (2000) may also help to explain the results observed in our research. These authors have found that groups perform tasks better if their members receive task-training to perform that specific task together rather than apart. The findings of our study, of increased group marks and increased individual key-skill ratings for trained students across both semesters, which only appears when in their original training groups, suggest a similar effect for team-skills training.

This finding is of particular interest as it casts doubt over the degree to which the skills learned in training are transferable. From the results presented here it is only possible to speculate as to the reasons why the teams that trained together and stayed together performed better than groups that were reformed. Developmental models of team performance such as the work of Morgan, Glickman, Woodard, Blaiwes, and Salas (1986) and Tuckman (1965) may offer some explanation on this issue through a consideration of the way over time that different skills develop within a group. Drawn from such models, Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) have proposed a classification of team competencies which suggests that some competencies learned in training are transferable from one team to another, while others are teams specific. The presence of team generic competencies will raise performance in any team. However, where teams develop team-specific competencies as well, further performance gains will be achieved. The team-skills training used in the present research aimed to provide students with a generic set of skills that they could use in any team, such as communication or planning skills. Our ongoing research supports this prediction in relation to skills such as time management and planning that are found to be present in trained groups regardless of re-grouping, but not in untrained groups (Prichard, 2002; Prichard, Stratford, & Bizo, in press). However, it seems probable that in training together they may have also developed team-specific competencies such as knowledge of team member characteristics, trust, and cohesion. It is speculated that these team-specific competencies that were established in training, and their associated benefits in terms of performance, were lost where training groups were disrupted. The cohesion data obtained in this study would suggest that cohesion is unlikely to be a significant specific competency that accounts for the performance advantage where groups stay together as evidenced by the fall in ratings in Cohort 3 in which groups remain intact. However, it should also be noted that despite the decrease across semesters, the cohesion in this group remained significantly higher than in Cohort 1, and it can therefore be speculated that it may make a marginal contribution to the maintenance of the performance advantage.

GENERAL DISCUSSION

The present research sought to advance our understanding of team-skills training as a preparation for students to work together collaboratively and thus enhance their academic performance. The results of Phase 1, replicated in Phase 2, show that in a real-world setting team-skills training enhanced the performance of students working in CL groups, both with regard to their task marks, and their individual learning of the key skills addressed by the unit. Despite differences in the team-skills training approaches used, the performance findings of this study are consistent with the outcomes of the previous classroom training interventions of Yager *et al.* (1986) and Johnson *et al.* (1989). In addition, the results provide empirical evidence to support the qualitative reports of Dunne and Prince (1997) and Schadler (1995). It should be noted that the evaluation measures in this research are primarily individual measures rather than measures of group performance, although the students' grades are heavily influenced by the group score awarded for the group product. We would argue that individual measures are perhaps more informative of the outcomes of collaborative learning since group measures might be unduly influenced by an individual's performance from which the other group members may benefit. Differing student contributions are not easily identifiable within some group outputs. In contrast, individual performance measures are more reflective of learning that has taken place during collaborative work. That said, future research should aim to consider more closely the relationship between group and individual performance outcomes.

Together with these previous studies, there is a growing body of evidence that team-skills training does enhance collaborative group outcomes and may be a useful educational approach for preparing students to work collaboratively with one another on certain tasks. In addition, the use of team-skills training is also helping to prepare students for subsequent performance in the workplace and therefore serves a dual role: the enhancement of CL and the provision of key skills. Interestingly, the issue of preparation for collaborative working is one that has recently been identified within the context of compulsory education. In a recent review article of pupil grouping in primary education, Kutnick, Blatchford, and Baines (2002) suggested that teachers should provide pupils with training to encourage group work. It is understood that research is currently underway to explore how this may be achieved and their findings are awaited with interest.

In relation to the findings of the present study, clearly further research is warranted to understand the loss of skills learned when students change groups, and whether there is a critical length of experience required in one group to become fluent in team-working skills sufficient to withstand the change. Equally, it is important to explore how training benefits can be maintained in the longer term as students move between learning groups.

Acknowledgements

Preparation of this manuscript was supported in part by an ESRC Postdoctoral Fellowship awarded to Jane S. Prichard. Portions of these data were presented as the British Psychological Society Centenary Conference, Glasgow, March 2001, and at the British Psychological Society Conference, Bournemouth, March 2003.

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Received 29 April 2003; revised version received 21 September 2004