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Predicting team performance from a learning process model

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Keywords Teamwork, Learning, Modelling

Abstract This paper determines the effectiveness of a learning process model in the prediction of team performance. The team performance of 19 teams was objectively measured by using a “first past the post” criterion after completion of a demanding exercise. Performance scores were predicted by means of Honey and Mumford’s learning styles questionnaire. Results indicated that a model based on team learning is predictive of team success and that team members’ scores should be averaged to best predict performance. In comparison, Belbin’s team role questionnaire was not predictive of team performance.

Introduction
The theory of learning styles which has received the most attention in the management literature is that of Kolb’s (1984) four-stage experiential learning cycle. Honey and Mumford (1992) designed a learning styles questionnaire (LSQ) that was specifically designed to measure the four stages of Kolb’s (1984) cycle:

(1) Activists who thrive on the challenge of new experiences.
(2) Reflectors who observe and ponder on what they have experienced.
(3) Theorists who enjoy the process of integrating these observations into a theoretical framework.
(4) Pragmatists who are more interested in testing the theory through practical application.

Furnham (1992) provides a fuller description of these terms.

The LSQ has a wide following in training and occupational psychology across the whole world, but particularly within Europe. For individuals, the LSQ appears to have at least satisfactory reliability and validity (Allinson and Hayes, 1990; De Ciantis and Kirton, 1996; Furnham, 1992; Furnham et al., 1999, 2001; Jackson and Lawty-Jones, 1996; Furnham and Medhurst, 1995; Goldstein and Bokoros, 1992; Tepper et al., 1993). Swailes and Senior (1999) reported some weaknesses in the factor structure of the LSQ and that it seemed just to measure three independent learning styles. However, the contribution of learning preferences to team performance remains unexplored and exactly how a questionnaire measuring individual learning preferences might relate to a measurement of team learning is far from clear. This is surprising since there

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Since the publication of this article in 2002, it has come to the Publisher’s knowledge that Laura Frith, formerly based at the University of Surrey, School of Psychology, should have been attributed as the second author of the paper. This correction note has been added to the online version of the article in 2007 at the request of both authors.
would seem to be a relatively clear link between conceptualizations of experiential learning and Belbin’s (1983) theoretically based team process model as shown in Table I. Team members with a reflector learning style are likely to be most effective in the early stages of team activity, which are associated with identifying needs and finding ideas. The theorist learning style is highly similar to Belbin’s stages of formulating plans. The activist learning style is similar to being able to make contacts and establish the organization, and the pragmatist learning style is associated with following through (Belbin, 1993). Following this perspective, it seems that team members’ overall learning preferences may predict team performance. Testing this proposition was the main purpose of this study.

Belbin (1981, 1993) also theorises that an optimal team is one that has at least one team member that scores highly on each team role. This represents a conjunctive model in which a team composed of many high scorers on one role cannot compensate for weakness in another role. An alternative model is a simple average or compensatory model, in which high scores on one scale can compensate for low scores on another. In fact, the average scoring method represents quite an attractive alternative to Belbin’s proposal as it is more resistant to the effects of any extreme ratings made by people. In this study, both conjunctive and compensatory models were used to combine scores. The second aim of the study was to determine the optimal method for combining learning preferences from individual team members to predict team performance better.

The third purpose of the study was to examine claims that Belbin’s team role questionnaire (BTRSPI) is predictive of team success. The psychometric properties of Belbin’s original questionnaire have been criticised by Furnham et al. (1993) in terms of its ipsative scoring, and the lack of theoretical

<table>
<thead>
<tr>
<th>Component of learning cycle</th>
<th>Key stages of team activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflector</td>
<td>1 Identifying needs. Key figures at this stage are individual with a strong goal awareness</td>
</tr>
<tr>
<td></td>
<td>2 Finding ideas. Once an objective is set, the means of achieving it are required</td>
</tr>
<tr>
<td>Theorist</td>
<td>3 Formulating plans. Two activities help ideas turn into plans. One is weighing up the options, the second is making good use of all relevant experience and knowledge to ensure a good decision</td>
</tr>
<tr>
<td>Activist</td>
<td>4 Making contacts. People must be persuaded that an improvement is in prospect. Champions of the plans and cheer leaders must be found</td>
</tr>
<tr>
<td></td>
<td>5 Establishing the organization. Plans need turning into procedures, methods and working practices to become routines; however, need people to make them work</td>
</tr>
<tr>
<td>Pragmatist</td>
<td>6 Following through. Too many assumptions are made that all will work out well in the end. Good follow-through is needed</td>
</tr>
</tbody>
</table>

**Source:** Description of activities from Belbin (1993, pp. 100-1)

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**Table I.**

Key team activities
underpinning. Furnham et al. (1993) went on to show that the factor structure of Belbin’s questionnaire provided no evidence in favour of four higher order team functions. Evidence of the validity of BTRSPI, collected by Belbin (1981), and normative variants of the BTRSPI (Senior, 1997; Higgs, 1999) seem quite promising although the ipsative nature of the BTRSPI suggests validity may in fact be quite low since it is unlikely to be able correctly to rank order individuals in terms of their preference for engaging in certain team roles; and without correct ranking of individuals, the BTRSPI is unlikely to show reasonable validity.

In Belbin’s original work (Belbin, 1981; Dulewicz, 1995), team performance was measured in terms of winning and losing. This study uses this simple and specific “first past the post” criterion and contrasts with Higgs (1999), who used three subjective measures of team performance (team cohesion, improvement orientation and team achievements), and Senior (1997), who used group repertory grids to derive an outcome measure.

Three hypotheses were tested:

- **H1.** Measurement of an individual’s contribution to a team by means of the team learning model will predict overall team performance.
- **H2.** The average team score of a learning process model will predict team performance better than the conjunctive team score.
- **H3.** Belbin’s BTRSPI will not predict team performance due to suspect factor structure and/or ipsative scoring method.

**Method**

**Participants**
A total of 182 employees of a national insurance company participated in this study. Participants were 89 men and 93 women, of 38 work teams, all aged between 20 and 45 years.

**Measures**
All participants completed the LSQ (Honey and Mumford, 1992) and the nine-scale ipsative version of the BTRSPI (Belbin, 1993). Overall scores for the LSQ (on a five-point scale labeled from 5 = very strong learning preference to 1 = very low learning preference) and BTRSPI (on three-point scales labeled 3 = preferred, 2 = manageable and 1 = least preferred) were available for analysis. This scoring system reflects the norm classifications contained in each of the test manuals.

**Procedure**
Participants attended one of 19 two-day residential team-building exercises. Throughout the two-day course, participants developed their skills and knowledge of team building by exploring issues such as goal setting, participation, repetition, reinforcement, feedback, modeling, distributed practice, part learning of complex tasks and transfer of learning. Participants completed all the exercises in two groups, which were their normal work groups within their organization.
At the start of the course, participants completed a first exercise (see the Appendix) which required the full participation and co-operation of team members to complete. The exercise was specifically designed to demonstrate team work skills. Delegates were randomly put into two teams which competed against each other. The winning team out of each pair of competing teams was noted (i.e. “first past the post”). It should be noted that results from each of the 19 times that the exercise was run could not be directly compared, since the exercise varied in minor ways on each occasion.

Statistical analysis

H1 was tested by determining the number of times the LSQ correctly predicted a “first past the post” criterion. H2 was tested by comparing predictions from both the arithmetic mean and a conjunctive model by combining data from different scales. H3 was tested by determining the number of times the BTRSPI correctly predicted the criterion.

Results

The descriptive statistics of the LSQ are shown in Table II. The BTRSPI scores are not described due to the ipsative nature of the scores. Table III shows the results of 18 out of the 19 team comparisons (in one case the two teams drew and this case was excluded from the analysis). For each team, the average learning style across the four scales, number of scales with at least one team member scoring “strongly preferred” or more, average BTRSPI score across nine scales, and number of BTRSPI scales with at least one individual scoring “preferred” was calculated. A comparison was made between the winning and the losing team in each pair, and the number of occasions the winning team had a greater score than the losing team with each of the four models was recorded. Results showed that 17/18 (94 percent) of average LSQ comparisons were in the desired direction and 13/18 (72 percent) of the conjunctive LSQ comparisons were in the desired direction.

In contrast, 4/18 (22 percent) of the average BTRSPI comparisons were in the desired direction and 8/18 (44 per cent) of the conjunctive BTRSPI comparisons were in the desired direction.

A $\chi^2$ indicated that the average LSQ model was significantly better than chance at predicting team success ($\chi^2 = 14.2, p < 0.001$). The average BTRSPI score was in fact so poor at predicting team success that the low scoring team tended to win significantly more than could be expected by chance.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>R</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activist</td>
<td>2.91</td>
<td>1.09</td>
<td>−0.28**</td>
<td>−0.28**</td>
<td>−0.12</td>
</tr>
<tr>
<td>Reflector</td>
<td>2.90</td>
<td>1.05</td>
<td>0.22**</td>
<td>−0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Theorist</td>
<td>2.95</td>
<td>0.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pragmatist</td>
<td>3.10</td>
<td>0.97</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: * $p < 0.05$; ** $p < 0.01$

Table II. Descriptive statistics and correlation coefficients between the LSQ scores
Table III. Success of Learning preferences in prediction of team performance

|     | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | E9 | E10 | E11 | E12 | E13 | E14 | E15 | E16 | E17 | E18 | %  | $\chi^2$ | df | p  |
|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|-----|---|---|
| LSQ | Win M 3.00 | 3.10 | 2.96 | 2.88 | 2.88 | 3.10 | 3.22 | 2.79 | 2.88 | 3.44 | 3.50 | 3.25 | 3.50 | 3.69 | 3.00 | 3.10 | 3.33 | 3.15 | 94 | 14.2 | 1 | < 0.001 |
|     | Los M 3.60 | 2.75 | 2.81 | 2.28 | 2.56 | 2.50 | 2.44 | 2.55 | 2.38 | 2.26 | 3.05 | 2.88 | 2.88 | 3.00 | 2.65 | 2.69 | 2.85 | 3.05 | 3.05 | 1 | n.s. |
|     | Win max 1 | 2 | 4 | 4 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 4 | 2 | 3 | 4 | 72 | 3.55 | 1 | n.s. |
|     | Los max 3 | 1 | 1 | 3 | 3 | 1 | 2 | 0 | 1 | 2 | 4 | 1 | 2 | 3 | 1 | 1 | 3 | 4 |  |  |
| BTRSPI | Win M 1.93 | 1.87 | 1.81 | 2.06 | 2.02 | 2.07 | 2.04 | 2.04 | 1.97 | 2.09 | 2.00 | 2.00 | 1.98 | 1.84 | 1.98 | 1.98 | 22 | 5.56 | 1 | < 0.05^* |
|     | Los M 1.86 | 1.97 | 2.03 | 2.02 | 1.92 | 2.00 | 1.97 | 2.04 | 2.14 | 2.08 | 2.13 | 2.00 | 2.00 | 2.00 | 1.92 | 1.91 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 |
|     | Win max 4 | 7 | 8 | 7 | 8 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 4 | 6 | 5 | 8 | 44 | 0.22 | 1 | n.s. |
|     | Los max 6 | 5 | 7 | 9 | 5 | 6 | 5 | 7 | 8 | 6 | 7 | 8 | 5 | 8 | 7 | 4 | 7 | 9 |  |  |

Notes: E = exercise (numbered from 1 to 18), results are not presented for the 19th exercise, in which the two teams drew; Win M = mean score of winning team; Los M = mean score of losing team; Win max = number of scales in the winning team with at least one team member scoring near maximum; Los max = number of scales in the losing team with at least one team member scoring near maximum; the winning team is italicised in this table only if the score is higher than that of the losing team; equal scores are regarded as a failure of the model to make a correct prediction; % = percentage of trials in which the model correctly predicts the outcome; * this $\chi^2$ shows that there is a significant difference between frequencies of winning and losing but the difference is not in the expected direction.
Results therefore supported the three hypotheses: the learning process model predicts team performance; the averaging method is better than the conjunctive method and the BTRSPI does not predict team performance.

Discussion
Results of this study show that a team designed to achieve a balanced team learning process is strongly related to team performance. This finding is of special importance to trainers, consultants and team managers, as it suggests that the LSQ has considerable utility within the workplace to aid team performance. The usefulness of measuring experiential learning for individuals in the workplace has already been noted (Furnham et al., 1999), but this study extends its apparent utility to groups of individuals. It seems that the idea of the “learning team” would be a fruitful area of research. Focusing on team members’ contribution to the team process as opposed to their team role has the following advantages:

- Roles are not considered to be situational, whereas the process model advocates that different team members lead in different team activities (or learning situations). Designing teams that reflect the dynamic nature of team activities has great appeal in that it gives all team members a more equal opportunity to contribute and a more equal opportunity to be valued.

- The team role model does not have as good a theoretical basis (Broucek and Randell, 1996) as a team process model.

The results of this study should also send a warning to the large numbers of people who continue to use the BTRSPI as part of their work with teams. Although this study has limitations (see below), this study suggests Belbin’s team role model does not predict “first past the post” performance and may, in fact, be deleterious to team performance. Results of this study cannot say whether there is a fault with the team role model or the ipsative nature of the scoring method, but results do quite clearly show that the BTRSPI does not predict team success. Further studies need to be conducted across a broad range of team situations to add weight to the conclusion drawn from this study.

We also found that the average score predicted team performance better than the conjunctive model. Whilst this result contrasts with Belbin’s (1991, 1993) approach of defining what is meant by a balanced team, the literature tends to support the superiority of averaging over many ways of combining data (see, for example, Dawes and Corrigan (1974) and Pritchard (1977).

There are several limitations that need to be noted. First, our criterion of being successfully “first past the post” (win/lose) in the measurement of team performance. It has the advantages of simplicity, objectivity, good sense and follows from the work of Belbin (1981, 1993). Nevertheless, there are alternative measures of team performance that were not measured in this study, and which are less narrow. These include tracking the effects of decision making, measuring performance by questionnaire, and rating constructs of team performance. Such methods may be the only ways of measuring team performance in the real world, but will tend to lead to an inevitable subjective
bias in the criterion. A further problem of dichotomous classification into winning and losing is that small differences in team performance have as much weight in the model as large differences. Thus some of the differences in the mean scores between winning and losing teams in Table III are very small and may not in reality be that different from each other.

Second, it is important to question the degree to which the artificial exercise used in this study reflects the way teams work in real life. Whilst it might be argued that the artificial exercise is not wholly representative of the kind of things that teams do within organizations, there is little reason to believe that the underlying processes and team interactions are so very different. Moreover, an artificial exercise has the very important advantage of control of important variables that might effect team performance in the real world (such as team purpose, individual status of team members, intelligence, motivation, autonomy and skills of team members and location of teams within organizational structure).

Third, a more valid criticism of the results of this study is that the management teams were created specifically for this study, whereas real-world management teams may operate for months. Moreover, it may also be true that the average size of a real-world management team may not be equivalent to the size of the management teams used in this study.

References


**Appendix. The team exercise: Riddler on the hoof**

Your mission is to solve the riddles. You will find all the answers around the estate. When you have solved the riddle, then find the place and then, and only then, you will be told if the answer is correct. Confirmation of a correct answer can only be given on location by the trainer. All team members must be present at this time. There are a pair of walkie-talkies available for auction with a reserve price of five minutes penalty time. Only one person from each team may attend the auction, which will be held shortly.

- Your objective is to solve the following riddles before the other team.
- (1) Where are these produced? Pink Floyd made one famous?
- (2) Poles apart, but what a strange telephone number: DP 301 JC20?
- (3) A slang word for insane? But put ER before the letter Y.
- (4) You would be a loaf if you did not get this one? (It is not so evident any more).
- (5) Enaporp Rolac No: N91DV. Are you enjoying it so far? It is a gas, isn’t it?
- (6) Slippery steps would lead you right into deep . . .? But how many?
- (7) Why can’t cows cross here and we can?
- (8) This poor lady cannot be feeling very well with no arms or legs. She has even lost all her hair. It is not nice being left in the corner to sulk, but at least it sounds pleasant here with the trickle of water all day long.
- (9) Fourteen steps that will drive you up the wall. Take care and do not get dizzy!
- (10) Octagon table – for what, I wonder?
- (11) Do you know where to find a row of 24 lime trees?
- (12) The woodcutter who worked here would appear to be into ecology. Why is that?
- (13) Have you paid for the car park yet? But where do you put the money in?
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