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An intervention programme for children with moderate learning difficulties

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Background. Children with learning difficulties typically demonstrate problems generalising what they have learned in specific contexts to new situations. Intervention programmes that teach children regulatory skills have been shown to overcome these problems for children with reading difficulties. This study applies the principles that underlie such interventions to the design of a programme for children with more general learning difficulties.

Aim. The aim of the study reported here was to design and evaluate an intervention programme which would facilitate the transfer of skills learned over the course of the intervention to different types of task.

Sample. A total of 41 children (aged 13–16 yrs; 14 females, 27 males) with moderate learning difficulties participated in the intervention programme.

Method. The children participated in a twelve-week intervention programme designed to promote regulatory strategies over a range of activities. The children worked in pairs and were guided by an adult who provided explicit instruction and modelled appropriate strategies. The children were assessed before and after the programme to determine whether improvements in strategic behaviour were evident and whether this generalised to new situations.

Results. Gains made in regulatory skills over the course of the intervention were accompanied by improvements in other performance measures such as reading and IQ.

Conclusions. Even after a relatively short intervention, which focused on the development of regulatory skills, significant improvements on a range of tasks were observed for a group of children with moderate learning difficulties.

Children with learning difficulties can generally be identified on the basis of three characteristics. These children typically reach a lower level of performance on school tasks than their peers, they commonly demonstrate a slower rate of learning and they find it difficult to generalise what they have learned in one context to a new situation (Sugden, 1989).

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Brown & Campione (1981) describe this third characteristic of children with learning difficulties as being the result of a lack of 'flexible access' to previous learning events. The skills the children learn appear to remain 'welded' to the context in which they were first learned. It has been suggested that this difficulty may be due to poor self-regulatory or metacognitive abilities (Brown, 1978; Brown & Ferrara, 1985; Brown, Palincsar & Armbruster, 1984). Children who regulate their own learning are able to approach tasks strategically, are aware of effective problem-solving procedures, check their own performance and can reflect on their success. Children with learning difficulties, however, commonly demonstrate difficulties in the spontaneous production of these types of strategies (Belmont & Butterfield, 1969; Brown, 1974; Ellis, 1970; Paris & Oka, 1986; Torgeson, 1982; Wong, 1985).

The issue of generalisation of skills has been a growing concern in the design of intervention programmes for children with learning difficulties. Brown & Campione (1981) comment that interventions which successfully overcome the problem of generalisation share a common feature. In addition to teaching the skills required to complete the task or solve the problem, these programmes provide explicit instruction in the management and control of regulatory skills, encouraging the children to adopt strategies which can be employed later during a different task.

Working within a Vygotskian perspective, Brown *et al.* claim that this instruction of self-regulatory processes is best achieved within the context of expert 'scaffolding' (Brown & Campione, 1986). Here the child is guided through the learning situation by an adult or more able peer who also serves as an effective model. In the first instance, the more able partner guides the child through the task, making strategic, regulatory behaviours overt and explicit. As the child becomes more proficient, he or she takes progressively more responsibility for their learning, and the adult gradually reduces support (Wood, Bruner & Ross, 1976). In this way the child begins to adapt his or her own regulatory strategies and becomes increasingly in control of their own learning. During these interactions it is important that the adult draws the child's attention to the significance and relevance of the strategies which are being used by providing direct feedback about the effectiveness of their learning (Baker & Brown, 1984).

Working explicitly within this framework, Brown and her colleagues have developed an educational programme called 'reciprocal teaching' designed to improve the reading achievements of children who experience difficulty in reading comprehension (Brown *et al.*, 1986; Palincsar, 1986; Palincsar & Brown, 1984). During collaborative small group reading sessions, the pupils and teacher take turns to lead a discussion around a text which they have all read. The teacher models appropriate behaviours and scaffolds the children in the use of comprehension fostering and comprehension monitoring skills such as questioning, clarifying, summarising and predicting. Brown *et al.* (1986) demonstrate substantial improvements in pupils' reading comprehension scores after such interventions. These gains are maintained a year after intervention. In a later study, Brown & Campione (1990) comment on the children's enhanced levels of critical and reflective thinking across all aspects of the social studies curriculum.

The reciprocal teaching programme incorporates three principles. First, the children are given opportunities to rehearse the strategies which are specific to the reading task. Second, they receive explicit instruction and practice in the management and monitoring of these skills. Finally, the teacher provides the children with information

concerning the effectiveness and relevance of the regulatory strategies which are being used.

The purpose of the study described in this paper was to apply these principles to the design of a programme for children with moderate learning difficulties in a way which would facilitate transfer of regulatory skills to new situations. The focus, therefore, was on the regulatory strategies themselves, rather than on any domain-specific skills. This was achieved in three ways. First, we provided children with explicit instruction and guided support in regulatory skills according to the principles outlined above. The children were reminded, prompted and given feedback about their strategy use throughout the programme by an adult who also modelled effective strategy use where appropriate. The adult's role in the programme is described in detail in Lamb, Bibby & Wood (1997).

Second, the children practised these skills in collaboration with a peer. Each activity consisted of a co-operative activity which demanded input from both members of the dyad. These activities included variations on referential communication tasks and joint problem-solving tasks. The children were encouraged both to think about their own understanding of the activities, and to reflect on their partner's knowledge.

Third, in accordance with recommendations outlined by Brown & Campione (1986) we provided a *range* of activities in which the children practised the target skills. Across all the activities, the same regulatory strategies were emphasised, although the appropriateness of individual strategy use varied across the tasks. In this way the children were required to reflect on which strategies were most useful for particular tasks.

In order to examine whether the effects of the intervention led to transferable gains in different types of activities, the children were assessed before and after the programme on several tasks. We considered the primary indicator of the success of the intervention to be change in performance on the Map Task (Brown, Anderson, Shillcock & Yule, 1984). This is a well documented co-operative task in which subjects have to describe to each other a route on a map which can then be drawn by their partner. The task is similar to those used during the intervention in that successful performance is dependent on strategic behaviour. Changes in performance on this task would therefore represent improvements in strategic behaviour brought about by the intervention. The children's reading ability and IQ were also assessed before and after the intervention programme in order to examine the extent of transfer of regulatory skills to activities outside the specific types of task used during the intervention programme. If the children are able to generalise, we should see a systematic pattern of change in performance across the Map Task, reading and IQ measures. Gains in self-regulatory or metacognitive skills should result in independent, reflective learning which would be demonstrated in better performance on this range of tasks.

Method

Sample

A total of 41 children, 14 females and 27 males (mean age 14.1 years, SD 0.79, range 13.0–15.8 years) participated in the intervention. These children attended one of two local schools for children with moderate learning difficulties and all spoke English as their first language. However, the instability of this population and unpredictable

attendance of many of the children in the study meant that some children failed to participate in all the sessions. For this reason, only those children who completed at least eight sessions were included in the following analysis. This paper therefore reports on the effects of the intervention on 30 children with a mean age of 14 years.

The intervention programme

Procedure. The programme consisted of 12 half-hour sessions which took place once a week. The children worked with a different partner each week to ensure that improvements would not be due to particular dyads learning to work together but rather would be due to individual children's changes in regulatory processes. All pairs of children came from the same class. All sessions were recorded on videotape.

Activities. The activities used during the programme were developed from a variety of sources (for example Brown *et al.*, 1984; Palim & Power, 1990; Radziszewaska & Rogoff, 1988; Schools Council, 1972). The early tasks followed the typical referential communication paradigm where two children sit either side of a small screen and describe to each other aspects of the materials in front of them. For example, one child may have an arrangement of playing cards which they have to describe to their partner so that they can recreate the same arrangement with a second set of cards. Joint problem-solving activities, for example a co-operative version of the Tower of Hanoi, (Glachan & Light, 1982), were introduced later in the programme. Full details of the activities are described in Lamb (1996).

Strategy training. The children were instructed and scaffolded by the first author in the application of three regulatory strategies. These strategies of *asking*, *answering* and *checking* were introduced to the children during the first session. The children were explicitly told that, in order to complete the activities, they needed to think about asking questions when they do not understand, answering questions if they are asked, and checking to see if they have understood what their partner has said and that their partner has understood what they have said. Throughout the programme, the adult guided the children in the use of these strategies by reminding, prompting and giving feedback. In the first instance, this guidance took place at a 'meta' level. For example, after an ambiguous description, rather than suggesting the receiving child ask a question, the adult reminded the child to think about what he or she might do if they thought they did not understand. The adult also modelled effective questioning, answering and checking when required. In this way the children were encouraged to reflect on their own and each other's understanding. Praise and reassurance emphasised the value and relevance of appropriate strategy use. The support became more task-specific when the children ran into difficulties, but at all times the children were encouraged to think at a strategic level.

Measures

Map Task. Pairs of children sat facing each other across a table divided by a low screen which prevented them seeing each others' materials. Simple schematic maps were placed on gently sloping wooden blocks in front of the two children. One child was assigned Information Giver (IG) and the other Information Follower (IF). The IG was told to describe the marked route around the landmark features on the map in front of him or her so that the IF could draw the same route on their map. Eight landmark

features were common to both maps, four were present on the IG map but absent from the IF map. Three were present on the IF map but absent from the IG map. One of the features on the IG map was duplicated (see Appendix 1). The children were told that their maps were different in some places, but were not told where these differences were.

Each child played both IF and IG roles in the same session, but with different pairs of maps. The children were always paired with a member of their own class. Pairs of children at pretest were the same at posttest.

A measure of success was achieved by considering the accuracy of the route drawn by the Information Follower. Previous studies have done this by calculating the area deviation of the IF route from the original (Boyle, Anderson & Newlands, 1994; Doherty-Sneddon, 1996; Doherty-Sneddon, Anderson, O'Malley, Langton, Garrod & Bruce, 1996). We were unable to use this metric due to the large deviation between IG and IF routes on most of the maps. We therefore considered the number of correct landmark features visited by the IF route. The total number of features passed by the route was counted and, from this score, a deduction was made for each feature incorrectly revisited, each feature visited from the wrong direction and any visit to the one feature which was not on the IG route (see Figure 1). The maximum possible score was 12. Several routes were drawn with considerable back-tracking such that the start, finish and direction were not obvious. Such maps were given a score of 0. The maps were scored by two judges who attained 90 percent agreement.

Figure 1. Calculating the Map Task Score

Map Task Score	=	No. features visited by IF route from same direction as those visited by IG route	−	No. features visited by IF route but not visited by IG route in that order	−	No. features visited by IF route also visited by IG route but from a different direction	−	Visit by IF route to feature not on IG route

Reading. The children's reading was assessed using the Macmillan Individual Reading Analysis and the New Macmillan Reading Analysis (Vincent & de la Mare, 1985*a*, 1985*b*). This test measures both reading accuracy and reading comprehension. The test was administered according to the manual with the exception of the comprehension measure which was adapted to suit the particular needs of this group of children.

Intelligence. An abbreviated version of the Wechsler Intelligence Scale for Children, Revised (WISC-R; Wechsler, 1974) was administered according to the WISC-R manual. This consists of two verbal subtests, Information and Comprehension, and three performance subtests, Picture Arrangement, Block Design and Coding (Kennedy & Elder, 1982).

Results

The preliminary indicator of the success of the intervention was improvements on the Map Task. Scores on this measure were significantly higher at posttest ($\bar{X}=5.87$, SD = 2.03) than at pretest ($\bar{X}=4.53$, SD = 3.20; $t=2.30$, d.f. = 29, $p<.03$).

A multivariate analysis of variance was performed on reading accuracy, reading comprehension and IQ measures to examine the possibility that these measures have changed in the same direction as the Map Task scores, as the theory predicts. There was a significant multivariate effect of time ($F[3.25]=4.47$, $p<.02$). The univariate effects indicated that this effect was carried by reading accuracy ($F[1,27] = 4.69$, $p<.04$) and IQ ($F[1,27] = 9.91$, $p<.005$). Table 1 shows the means (and standard deviations) of these variables. These figures are based on 28 children's scores since two children failed to score on the test of reading accuracy.

Table 1. Mean (SD) for all measures

	Map Task		Reading accuracy		Reading comprehension		IQ	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Score	4.79 (3.15)	5.82 (2.06)	6.80 (1.23)	6.98 (1.24)	8.18 (1.09)	8.27 (1.05)	63.75 (11.55)	67.18 (11.76)

A stronger test of our hypothesis is to look at the individual performances of the children. On examination of the data, it is apparent that some children did not benefit from the intervention by making gains on the Map Task. We should not, therefore, expect to see associated changes in these children's reading and IQ scores. If there is an association between Map Task gains and gains on the other measures, then we should see associated changes in reading and IQ only for those children who improved on the Map Task.

The children were therefore split into two groups according to whether or not their Map Task score improved (improvers) or did not improve (non-improvers). Table 2 shows the means (and standard deviations) of all measures for the two groups. Pre-test Map Task scores were significantly lower for the improvers than the non-improvers ($t[1,26]=4.87$, $p<.001$). There were no significant differences between the pre-test scores of the two groups on any of the other measures.

A multivariate analysis of variance was performed on reading accuracy, reading comprehension and IQ for the children who improved on the Map Task. There was a significant multivariate main effect of time ($F[3,10]=9.61$, $p<.004$). The univariate effects indicated that this was carried by reading accuracy ($F[1,12]=7.77$, $p<.02$) and IQ ($F[1,12]=13.54$, $p<.004$). As we would predict, for the children who did not make gains on the Map Task, the same analysis revealed no significant effects of time.

An additional analysis looked at the overall pattern of change across the reading accuracy, reading comprehension and IQ measures. If a child failed to improve on any of these measures they were allocated to a group coded '– – –'. If a child improved on

Table 2. Means (SD) for all measures across improvement groups

	Map Task		Reading accuracy		Reading comprehension		IQ	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Improvers	2.61	6.38	6.69	7.26	8.06	8.41	62.85	67.85
N=13	(2.29)	(1.71)	(1.35)	(1.32)	(1.13)	(1.30)	(11.59)	(9.11)
Non-improvers	6.67	5.33	6.68	6.74	8.28	8.15	64.53	66.60
N=15	(2.54)	(2.26)	(1.14)	(1.17)	(1.08)	(0.81)	(11.87)	(13.96)

all three measures they were allocated to the '+ + +' group. Intermediary groups were constructed to cover all possibilities. Table 3 shows the numbers of children in each of the possible groups.

Table 3. Observed frequencies for Map Task improvers and non-improvers across other measures

	−−−	−−+	−++	+++
Improvers	0	1	8	6
Non-improvers	4	3	5	3

−−− a child improved on none of the measures
−−+ a child improved on one measure
−++ a child improved on two measures
+++ a child improved on all three measures

For the children who did not improve on the Map Task, seven out of 15 improved on, at most, one other measure, five improved on two other measures, and three improved on three other measures. On the other hand, of the children who did improve on the Map Task 14 out of 15 improved on at least two of the other measures. Only one child in this group improved on only one other measure, eight children improved on two other measures and six children improved on all the other measures.

Binomial probabilities ($p=0.5$) were used to examine the significance of these patterns. The first comparison was made between children who improved on one or less of the measures and those children who improved on at least two measures. Binomial probabilities indicated significantly more children improved on at least two measures (14 children) than on one or less of the measures (one child) for the Map Task improvement group ($p<.005$). This difference was not significant for the non-improvers. Significantly more non-improvers (seven children) than improvers (one child) made gains in one or less of the measures ($p<.05$), whereas there was no difference between the groups with respect to gains on at least two measures. Looking at those children who improved on none of the three measures, there was a trend for

more of these children to be in the non-improvement group (four children) than the improvement group (no children; $p = .06$). No other differences were significant.

Discussion

This study set out to examine the effects of an intervention programme designed to promote children's regulatory strategies across a range of activities. The results of the programme are encouraging. Overall, the children made significant gains, not only in their performance on a task similar to those used over the course of the intervention programme but also in reading and IQ test performance. Although these gains are small (on average two months reading gains in 12 weeks), these increases are theoretically significant given what we know about this population of children. For example, in a previous study of children with learning difficulties aged between 13 and 15 years (Lamb, Bibby, Wood & Leyden, 1997) we reported correlations between chronological age and reading age near to zero. This result led us to expect no change in reading performance over the short period of the intervention programme described here under normal circumstances.

Whilst the results, therefore, generally support our predictions, when we look at the individual performances of the children half the group fail to make gains across the measures. This raises some interesting questions. Why was the programme successful for some children and not others? How might we change the programme in order to target specifically those children who did not benefit? We believe the answers to these questions lie in the general abilities of the children and how these are combined when it comes to selecting pairs of children to work together.

On closer examination of the data it can be seen that the children whose performance on the Map Task did improve over time started with significantly lower scores than those children whose performance remained the same. It appears, therefore, that the intervention was most beneficial for children who were initially struggling with respect to the task used in the study. This may be explained by considering the nature of the interactions between the children in each dyad and between the supporting adult and the children. From a Vygotskian perspective, it is unlikely that the children who initially demonstrated poor performance on the task would be able to provide the level of interaction required to create the appropriate 'zones of proximal development' (ZPD) for their partners during the intervention. If this is the case, then we would expect the pairings of the children for the initial Map Task to comprise an improver and a non-improver. On examination of the pairings, this occurred for 82 per cent of the pairs. Whilst this could not have been planned in this study, it fits well with the theoretical explanation of the results.

It is also important to consider the level of support offered by the adult. The adult aimed to support each dyad during the intervention. It is possible, therefore, that this support was below the ZPDs of the more able children, who therefore were less likely to benefit from the experience.

In line with our predictions, we suggest that the findings of the study demonstrate that the programme was successful in promoting the generalisation of the regulatory skills targeted during the intervention for a significant number of children. By designing an intervention programme which combined peer collaboration with appropriate

scaffolding in a way which enabled children gradually to take more responsibility for their own strategy use across a range of activities, we were able to promote transfer of these skills to new situations.

There are, of course, alternative explanations for the changes we observed in the children's performance. It could be, for example, that the intervention programme was successful not in the promotion of regulatory strategies as we predicted but rather in increasing the time the children were prepared to spend on task, and their motivation and perseverance through the tasks. These are all worthwhile benefits of any programme aimed at promoting the learning skills of children with learning difficulties and are looked at favourably by teachers of these children. However, we would argue that effort alone is not a valid explanation for learning. Increasing time on task may well be an indirect effect of the intervention but cannot adequately explain the changes we observed.

A second alternative explanation for the changes in the performance of the improving group could be that the children's scores have regressed to the mean. It is unlikely that this has occurred. With regression to the mean, we would expect the lower performing group to show greater variability in their scores than the group of children who did not improve. The data demonstrate no difference in the variability of these two groups (see Table 2). A further reason to believe that regression to the mean does not explain these results is the fact that the only measure where the improving children are significantly lower at pre-test is the Map Task and this is not the only measure that shows improvement.

Whilst we must not overlook the fact that half the children in the study failed to make predicted gains, the fact that we observed transfer of skills to other situations for the rest of the children is extremely encouraging. These results have important implications for educational practice. After a relatively short period of time (each child had a maximum of 10 hours contact time) children who have found much of school learning extremely difficult have been shown to make significant gains in tasks which were not directly targeted by the intervention programme.

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Appendix 1: Maps