Cognitive processes in learning chiropractic skills: the role of imagery

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The role of imagery in learning a chiropractic adjustment was examined. Thirty students from C.M.C.C. were randomly divided into two groups and exposed to two different types of imagery. The first group mentally rehearsed performing the adjustment, and the second group imagined the spine and the positive outcome of the adjustment. Subjects' ability to perform the adjustment was assessed before and after exposure to the imagery. The performance of the group who imagined the spine improved significantly more than the group who mentally rehearsed the adjustment. In addition, students were questioned on the types of imagery they spontaneously use in learning new chiropractic techniques. Implications for chiropractic education are discussed.

KEY WORDS: Cognitive processes, imagery, chiropractic, education.

On examina le rôle de l'image mentale dans l'étude de l'ajustement chiropratique. Trente étudiants de C.M.C.C. furent divisés, au hasard, en deux groupes et soumis à deux différentes sortes d'images mentales. Le premier groupe pratiqua mentalement un ajustement et le second imagina la colonne et le résultat positif de l'ajustement. L'habilité des étudiants à pratiquer la manipulation fut évaluée avant et après avoir été soumis aux images mentales. La performance du groupe qui avait imaginé la colonne présentait une amélioration significative sur le groupe qui avait pratiqué mentalement l'ajustement. De même, on questionna les étudiants sur les sortes d'images mentales qu'ils utilisent spontanément pour apprendre les nouvelles techniques chiropratiques. On discuta les implications de l'éducation chiropratique.

MOTS-CLEFS: cognitif, procédés, image mentale, chiropractie, éducation.

Introduction

Chiropractors, like practitioners in many health sciences learn complex motor skills that involve a coordinated movement in the whole body. Traditionally, chiropractic education has focused on teaching chiropractic skills through demonstrations and direct individual feedback. Recently, there has been considerable evidence that mental rehearsal or mental imagery can significantly improve motor skill acquisition.[1-5] This paper is concerned with exploring the use of imagery in learning chiropractic skills.

Imagery rehearsal or mental imagery involves the formation in the mind of visual and kinesthetic images of the behavior that one wishes to learn or change. Imagery rehearsal has been extensively used in behavioral counselling to help clients modify dysfunctional behaviors such as non-assertion,[6] and phobias.[7] Covertly rehearsed behavior is thought to follow the same principles of learning as actual behavior. Thus, it is not necessary to physically practice new behaviors for learning and behavior change to occur.

Interventions designed to improve motor skill performance frequently use mental imagery as a central treatment modality. Most of these studies have compared the effectiveness of physical practice of a motor skill with mental rehearsal. Ryan and Simons[2] investigated the impact of mental rehearsal in learning a novel balancing task during a single session. While physical practice was better than mental practice, both were better than no practice. Rawlings, Rawlings, Chen and Yilk[5] observed that on a task high in motor aspect and low in cognitive aspect, there was as much improvement in the mental practice as with physical practice. Two other studies[3,4] were concerned with the ability of mental practice to enchance performance on motor tasks that differed in their level of cognitive complexity. Both studies found that on a predominantly motor task, physical practice was superior to both mental practice and no practice. On the motor task which had a highly cognitive element, mental practice resulted in performance as good as physical practice and both were superior to no practice.

A number of studies have examined the role of imagery in enhancing athletic performance. Many athletes report using imagery both during practice and to enhance their ability immediately prior to the event. Weight lifters[8] systematically employ imagery prior to competition to help them "psyche-up". On an analogue hockey game, imagery rehearsal was more effective than viewing a hockey film.[9] Clark[1] found mental practice to be as effective as physical practice in improving basketball free shot and Suinn[10] has reported the successful use of mental imagery in training ski racers.

Overall, the research suggests that mental rehearsal of a complex motor task will enhance performance over a control group, and for cognitively complex motor tasks, mental practice may be as effective as physical practice.

Previous studies have been concerned either with enhancing motor skills which are directly relevant to an athletic event[1,9] or with motor skills which are easy to identify but have no immediate task relevancy.[4,5] Many health professions such as dentistry, medicine and chiropractic involve learning complex motor skills that are an integral part of diagnosing and treating the patient. While it would be expected that mental rehearsal would enhance performance in the motor skills necessary for

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health professions,[11] there has been no research addressing this issue in the training of graduates.

A second issue of interest is what types of imagery are related to the successful performance and learning of motor tasks in general, and chiropractic adjustments in particular.

Researchers have typically conceptualized imagery as visual or kinesthetic. In visual imagery, the subject "sees" themselves performing the task, while in kinesthetic imagery the subject "feels" themselves performing the task. Both visual and kinesthetic imagery have been used successfully in facilitating behavior change in a variety of clinical problems such as snake phobia,[12] compulsive behavior[13] and alcoholism.[14] Cautela and McCullough[15] and Lang[16] suggest that kinesthetic imagery may be more effective in producing behavior change than visual imagery. However, two different studies[2,9] found visual and kinesthetic imagery to be equally effective in learning a motor skill. Furthermore, the majority of studies on the impact of imagery in learning a motor skill[1-5] have combined visual and kinesthetic imagery. While the research suggests that the visual kinesthetic dichotomy may not be an important factor, very little is known as to what types of imagery people spontaneously use, and if different types of imagery are used in different situations.

The present research was designed to investigate two questions. First, can mental practice enhance learning a chiropractic adjustive technique. A pilot study found that students spontaneously either imagined themselves performing the adjustment or imagined the spine that they were working on. These two types of imagery were compared. One group was exposed to a combination of visual and kinesthetic imagery and the other group imaged the spine while they performed an adjustment. The second question which was addressed in the study, examined the kinds of imagery students spontaneously use when learning a new adjustment.

Methods and procedure

Subjects

Thirty second year students (23 male and 7 females) from the Canadian Memorial Chiropractic College participated in the study. It was announced in class that students were needed for a 1 hour study on Chiropractic technique on a Saturday morning. The first 30 students to volunteer participated in the study. Students were told that they would be participating in a study "examining how students learn chiropractic skills".

Procedure

Subjects were seen individually. Subjects were introduced to the experiment. They were told that the study was on different methods of teaching Chiropractic skills, and that the entire experiment would be explained to them at the end of the study. The subject observed a chiropractor demonstrate the "spinous push adjustment". Each subject saw the demonstration twice and was free to walk around the demonstrator while they observed. During the first demonstration the chiropractor performed the adjustment in slow motion commenting on what he was doing. During the second demonstration, the chiropractor performed the adjustment at a normal speed without any comment. The subject went to another room where he/she was evaluated on their ability to perform this adjustment on a confederate and was evaluated by two trained chiropractors. This initial evaluation constitutes the pre-treatment evaluation. Subjects were randomly divided into two groups. Group I received 10 minutes of guided imagery during which time he/she was guided through a mental rehearsal of the adjustment by a chiropractor. (Mental Rehearsal Group = MR). Group II received 10 minutes of discussion from a different chiropractor about the spinous push. Subjects in this group were shown a drawing of a spine, the diagnostic indicators for using this adjustment were discussed, and the expected results were explained to the student using the drawing of the spine. (Spine Imagery Group = SI). Subjects from both groups then practiced the adjustment on a confederate for two minutes. All subjects were re-evaluated on their ability to perform the spinous push adjustment by the initial evaluators. This second evaluation constitutes the post-treatment evaluation. Finally, all students completed an imagery questionnaire and were debriefed.

Spinous Push Adjustment

The spinous push adjustment[17] was chosen as it is a sufficiently complex adjustment that 2nd year students will have some difficulty mastering it.

Mental Rehearsal Procedure

Subjects in the mental rehearsal group were initially asked to sit down, close their eyes and relax. They were told that the chiropractor would be reading a description of the adjustment they had just seen, and they were asked to try and imagine themselves performing the movements described. The description of the spinous push included both visual and kinesthetic imagery so that students were asked to both see and feel themselves performing the movement. First, the adjustment was described at a fairly slow pace, afterwards the subject was asked to imagine him/herself doing the adjustment at a normal pace without any commentary from the chiropractor. The following are excerpts from the guided imagery:

Patient Position:

See and feel yourself placing the patient in side posture, lumbar roll position. See the patient balanced comfortably on their shoulder with their weight placed on their hip so that their body is near the edge of the table . . .

Chiropractic Stance:

Check that your body position is opposite your desired contact. Feel yourself balancing your weight on the balls of your feet in a modified fencer's stance. See and feel the patient's flexed knee between your legs. Feel your control of the patient's knee and leg . . .

Table 1 MEAN SCORES ON PRE- AND POST-TREATMENT TRIALS OF SPINOUS PUSH ADJUSTMENT

	Pre-treatment		Post-treatment	
Group	Mean	SD	Mean	SD
Mental Rehearsal	9.0	2.8	9.8	3.6
Spine Imagery	5.5	3.5	8.3	3.6

Table 2 PERCENTAGE OF CORRECT RESPONSES ON EACH BEHAVIORAL SEGMENT OF SPINOUS PUSH FOR MENTAL REHEARSAL AND SPINE IMAGERY GROUP

	Mental Rehearsal		Spine Imagery	
Spinous Push	pre	post	pre	post
Patient Position				
1 Shoulder	60	80	40	90
2 Hip	93	87	65	95
3 Arm	100	100	90	100
Doctor Position				
4 Fencer's	80	73	40	45
5 Sternum	57	60	10	40
6 Hips	50	70	20	60
Contact				
7 Forearm Prep.	40	40	40	65
8 Indifferent hand	90	93	65	60
9 Finger Reinforcer	80	73	50	70
Tissue Slack				
10 Shoulder	50	73	20	50
11 Hip	60	47	10	30
12 Joint	13	30	15	10
Thrust				
13 Push	27	33	0	40
14 Elbow	83	83	60	50
15 Speed	17	37	20	30

Spine Imagery

Subjects were asked to sit down at a desk opposite a chiropractor. On the desk facing the student was a picture of a spine. They listened to a 10-minute discussion that stressed the clinical indications for using the spinous push adjustment, and the changes that would occur in the spine as a result of the adjustment. During the discussion, subjects examined the picture of the spine, which the chiropractor constantly referred to. It was expected that this group would be encouraged to visualize the spine.

Measures

1. ***Evaluation of Spinous Push*** The two evaluators were experienced chiropractic technique instructors. The adjustment was broken down into five component parts: patient's position, chiropractor's stance, chiropractor's contact, patient soft-tissue slack and chiropractic thrust. Each part was further divided into 3 specific behavioural segments, and for each segment the evaluators agreed upon the objective criteria of competence. For each of the 15 segments, the subject received either 0 (unsatisfactory) or 1 (satisfactory) on their performance. The total scale ranged from 0 to 15 points. Thus, for example, patient's position was divided into shoulder, hip and arm; and the subject could get a maximum of 3 points for this part of the adjustment. The two evaluators were trained until they reached a reliability coefficient of alpha = 89. (See Table 2 for a list of the 15 behavior segments)

2. ***Imagery Questionnaire*** After finishing the experiment, students completed a questionnaire on how interesting they found the experiment and how much they expected the intervention to help. The questionnaire also examined the types of imagery students spontaneously used when learning a Chiropractic adjustment.

In a pilot study, ten students had been asked what types of imagery they used when learning a Chiropractic adjustment. The students reported using 4 types of imagery: seeing yourself doing the technique, as if you are outside your body watching a movie (visual imagery); feeling yourself doing the technique, as if you are actually there and can feel your body move (kinesthetic imagery); visualizing the spine of the person you are working on, and visualizing how you want the spine to move during the adjustment (spine imagery); and replaying in your mind the demonstration of the technique (Demonstrator imagery). On the questionnaire students were asked to rate the extent to which they generally use the 4 types of imagery: visual, kinesthetic, spine and demonstrator. A five point scale was used, (1 = almost never; 5 = almost always). Second, students were asked to indicate if they had used any imagery during the pre-treatment assessment of the spinous push, and if yes, which of the 4 types of imagery had they used. On this question, students could only indicate one type of imagery.

Results

Subjects

Subjects' self-report on the type of imagery they used during the post-treatment assessment was examined. This was to ensure that during the post-treatment evaluation subjects in the Mental Rehearsal Group imagined themselves performing the adjustment and did not image the spine, and that subjects in the Spine Imagery Group did image the spine and did not image themselves performing the adjustment. Four subjects in the Spine Imagery (SI) group were rejected because they did not report imaging the spine during the post-treatment evaluation. None of the subjects in the Mental Rehearsal (MR) group were rejected, as they all reported either seeing or feeling themselves perform the adjustment. In addition, one subject who had been assigned to the Spine Imagery Group did not appear and it was not possible to replace him. In the final study, the MR group had 15 subjects and the SI group had 10 subjects.

Evaluation of Spinous Push

The interjudge reliability on both the pre and post treatment scores was .99. Due to the high reliability, the scores from the two judges were combined. The subjects' ratings on the adjustment were analyzed using a 2-way repeated measure analysis of variance (Group x Time).

The main effect for Group approached significance, $F(23, 1) = 3.82$, $p <= .06$). The MR group's scores were higher than the SI group's scores (see Table 1). There was a significant main effect for Time, $F(23, 1) = 13.75$, $p <= 001$. Subjects from both groups increased their scores from pre-treatment to post-treatment. A significant Group x Time interaction effect was observed $F(23, 1) = 5.11$, $p <= .03$. The SI Group improved significantly more than the MR group.

The spinous push had been divided into 15 identifiable behavioral segments. To assess which segments were easiest for students to learn and which were the most difficult, the percentage of correct responses for each segment on the pre-treatment scores for both groups combined were examined. (see Table 2). Overall, students had the least amount of trouble with the Patient Position, and the most amount of trouble with the Slack and Thrust.

To compare the change from pre- to post-treatment for the MR and SI groups on each of the 5 parts, t tests were completed for each segment. Only Patient Position, was significant, $t(23) = 2.41$, $p <= .02$. The SI group improved significantly more than the MR group.

Imagery Questionnaire

There was no significant difference in how the MR and SI groups rated the demonstration of the spinous push adjustment, both groups found it adequate to very good. There was no significant difference in how interesting the MR and SI groups found either the guided imagery or the talk on the spine (MR: $\bar{x} = 4.47$ SI: $\bar{x} = 3.93$). Both groups felt that they had done better the second time (MR: $\bar{x} = 4.40$, SI: $\bar{x} = 4.29$). The MR group expected to improve significantly more than the SI group, $t = 4.17$ (23), $p < .001$ and the MR group reported significantly greater clarity of images while learning the spinous push than the SI group $t = 5.31$ (23), $p <= .001$.

Types of Imagery Used

The scores of the MR and SI groups were combined in examining the responses to the types of imagery "generally used".

The data were initially examined to see which were the most commonly used types of imagery. On the 5 point scale, a self report score of 4 or 5 was considered to indicate that the subject almost always used the imagery. 80% of subjects reported "almost always" using kinesthetic imagery, 68% of subjects "almost always" image the spine, 52% of subjects "almost always" use visual imagery.

A secondary question of interest was whether subjects were predominantly visual or kinesthetic. The pattern of subjects' responses on the 2 scales measuring visual and kinesthetic imagery was examined. For a subject to be considered predominantly visual or kinesthetic, they had to fulfill 2 requirements. First, they had to have checked a 4 or a 5 on only one of the scales; second, on the other scale, they had to have checked a 1 if the first scale was a 4 or a 5, or a 2 if the first scale was a 5. Thus, there would be a spread of 3 points between the visual and kinesthetic scales. Subjects were considered to be mixed visual and kinesthetic if there was a 2 point or less difference in how frequently they reported using the 2 types of imagery. 44% of subjects were predominantly kinesthetic, and only one subject was predominantly visual. 52% of subjects were mixed imagers, of these 28% "almost always" reported using both types of imagery. There was no relationship between subjects propensity to use visual or kinesthetic imagery and their use of imaging the spine or the demonstrator.

Subjects were asked which type of imagery they had predominantly used during the pre-test of the spinous push. One subject reported using no imagery. 46% of subjects imagined the demonstrator performing the adjustment (Demonstrator), 33% of subjects saw themselves performing the adjustment (Visual), 17% of subjects felt themselves performing the adjustment (Kinesthetic) and only one subject reported imaging the spine (Spine).

Discussion

The results suggest that mental imagery can enhance the learning of a chiropractic adjustment. In this study, imaging the spine was more effective than mentally rehearsing performing the adjustment. There are a number of possible explanations for this finding. First, there may have been a ceiling effect on the scores of the mental rehearsal group. The rating scale used ranged from 0 to 15. The Mental Rehearsal group's pre-treatment score was 9.0, while the Spine Imagery group's pre-treatment score was 5.5. Thus, the Spine Imagery Group had greater latitude for improvement. Another consideration is the role of subjects ability to clearly visualize. Subjects in the Mental Rehearsal group reported greater clarity of image while learning the adjustment than subjects in the Spine Imagery Group. Perhaps subjects who are good visualizers had more facility for learning the technique after one demonstration, explaining the higher pre-treatment scores of the Mental Rehearsal Group.

Recent studies suggest that imagery which depicts a successful task outcome may be more successful in enhancing performance than imagery which involves mental rehearsal of the motor activity.[18,19] The Spine Imagery Group focused on imaging the positive outcome of the adjustment, while the Mental Rehearsal Group focused on imaging the actual movements involved in the adjustment. This may explain the greater improvement of the Spine Imagery Group. While further research is needed, this would suggest an integrated teaching approach which focuses on teaching the motor aspects of the adjustment as well as the expected positive outcome.

In examining the specific scores for each behavioral segment

of the spinous push, it is possible to analyze which segments pose the greatest difficulty for students. This has important implications for teaching chiropractic technique. Ideally, it would be possible to give students specific feedback on which segments of the adjustment they had failed.

The results from the imagery questionnaire are contradictory and suggest important questions and hypotheses. When subjects were asked to indicate which types of imagery they "generally use", subjects indicated that kinesthetic and spine imagery were the most frequently used, and subjects were either predominantly kinesthetic or used a mixture of visual and kinesthetic imagery. When subjects were asked which type of imagery they had predominantly used during the pre-treatment assessment of the spinous push, kinesthetic and spine imagery were the least frequently used, and Demonstrator and visual imagery the most frequently used. One possible explanation is that different types of imagery are used at different stages in learning an adjustment. In this study, students were in the initial stages of learning an adjustment, and perhaps used seeing the demonstrator and visual imagery more than in the later stages, when kinesthetic and spine imagery is used more frequently. Further research is needed to investigate this question.

The results of this study suggest that students spontaneously use mental imagery when learning chiropractic technique. The study suggests that imaging the spine and the positive outcome of the adjustment may be more effective than the mental rehearsal of the technique when first learning an adjustment. While this needs further confirmation, it has important implications for teaching chiropractic skills.

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