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Internal and External Mental Imagery Perspectives and Performance on Two Tasks

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It has been well documented that mental practice can improve performance on various cognitive and motor skills. However, the processes involved in mental practice and the theoretical explanations are less clear. The present study examines two variables that contribute to the efficacy of mental practice--imagery perspective and task type. Subjects, who were natural internal or natural external imagers, mentally practiced a cognitive/visual task (an angles estimation task), and a motor/kinesthetic task (a stabilometer). Only the external imagers showed greater performance than the control on the motor/kinesthetic task, and only internal imagers showed greater improvement than the control group on the cognitive/visual task. Subjective reports of visual and kinesthetic imagery clarity also differed depending on the type of task being imaged.

Selon la documentation scientifique, on s'entend sur le fait que la pratique mentale peut améliorer la performance d'une variété d'habilités cognitives et motrices. Par contre, les processus liés à la pratique mentale et les explications théoriques sont moins connues. La présente étude examine deux variables contribuant a l'efficacité de la pratique mentale, soit la perspective d'images et le type de tâches. Les sujets appelés, soit imageurs externes naturels (ceux qui produisent naturellement des images mentales ayant une perspective externe), ou imageurs internes naturels (ceux qui produisent naturellement des images mentales ayant une perspective interne), ont pratiqué une tâche cognitovisuelle (estimation d' angles) et une tâche moto-kinestéque (stabilomètre). Seuls les imageurs externes ont mieux execute la tâche moto-kinestesique, comparés au groupe-témoin, et seuls les imageurs internes ont montré une meilleure amélioration dans l'exécution de la tâche cognito-visuelle, comparés au groupe-émoin. De plus, des rapports subjectifs concernant la clarté des images visuelles et kinestésiques ont différé dépendemment de la tâche imaginée.

The positive effects of mental practice (MP) are well documented (Corbin, 1967, Richardson, 1967a, 1967b; Weinberg, 1982; Feltz & Landers, 1983; Feltz, Landers, & Becker; 1988, Hinshaw, 1991-92), but due to variability across studies it has been difficult to determine which specific aspects of mental practice yield the greatest improvement in performance (Murphy, 1990). Studies have examined moderator variables such as type of task (Ryan & Simons, 1981, 1983), imagery ability (Mumford & Hall, 1980), and imagery perspective (Epstein, 1980) in an attempt to understand both the theoretical aspects and practical applications of MP. These investigations, however, have usually examined only a single moderator variable. The present study will attempt to add to the global picture of processes involved in mental practice (Hinshaw, 1991-92) by exploring how two important moderator variables—imagery perspective and type of task—interact to affect both performance enhancement and subjective ratings of visual and kinesthetic imagery.

Mahoney and Avener (1977) categorized mental imagery into two perspectives: external which is an outside-of-body or videotape perspective, and internal which is the same as what one would experience if physically doing the task. Epstein (1980) and others (e.g., Hale, 1982; Harris & Robinson, 1986) have called this latter approach "potentially kinesthetic" because they believed rehearsing the task from within the body may include the feel of movement in the image. External imagery, on the other hand, has been suggested to be a primarily visual approach (Hinshaw, 1991-92). Although imagery perspective and imagery modality are different facets of mental imagery, they are frequently viewed in the literature as synonymous concepts.

Some sport psychologists studying imagery with skilled athletes suggest that when more successful athletes use imagery they tend to have an internal perspective and report more kinesthetic sensations compared to less successful athletes (e.g., Hall & Erffmeyer, 1983; Mahoney & Avener, 1977; Orlick & Partington, 1988; Hall, Rodgers, & Barr, 1990). Other researchers have not found differential effects for internal versus external imagery or for kinesthetic over visual imagery (e.g., Highlen & Bennett, 1979; Meyers, Cooke, Cullen, & Liles, 1979; Mumford & Hall, 1985).

The neuromuscular feedback theory (initially proposed by Carpenter in 1894; cited in Hale, 1982) suggests that localized muscular activity occurs during imagery, and the muscular activity is identical in pattern but weaker in magnitude to the muscle activation involved in the physical execution of the task. Corbin (1972) proposed that the kinesthetic feedback that accompanies this type of imagery may be the key component in improved motor performance. Further, this kinesthetic feedback from muscular activity has been hypothesized to occur only when subjects use internal or first person imagery (e.g., Hale, 1982; Harris & Robinson, 1986), or to occur at least to a greater extent in internal versus external imagery perspectives (Harris & Robinson, 1986). Other researchers do not accept the neuromuscular theory (see Feltz & Landers, 1983; or Feltz, Landers, & Becker, 1988 for a review).

The study of mental imagery perspective has been plagued with many problems, most notably that of subjects switching imagery perspectives (Epstein, 1980; Harris & Robinson, 1986). Some researchers suggest that one can never be assured of control over imagery perspective (Harris, 1986), whereas others (e.g., Hale, 1982; Hall & Erffmeyer, 1983) propose various methods for insuring stable imagery perspectives, such as video tape visual aides and imagery scripts that emphasize the correct responses. In the present study, natural imagery perspective and ability was measured before the experiment and only those prospective subjects who used solely one perspective or the other were chosen for the study. In addition, video cameras were used to demonstrate the external imagery perspectives, and subjective measures of imagery perspective were taken during the study to ensure maintenance of the appropriate perspective. It was hoped that these procedures would prevent the problem of perspective switching (Epstein, 1980; Harris & Robinson, 1986).

Mental practice has been studied using a wide range of tasks. Meta-analyses indicate that, in general, performance on cognitive tasks shows greater improvement from mental practice compared to performance of either motor or strength tasks (Feltz & Landers, 1983; Feltz, Landers, & Becker, 1988). This finding has been explained by the symbolic learning theory (initially proposed by Sackett, 1934) which suggests that after a brief physical exposure to a task, subjects become more familiar with the "symbolized elements" of the task through use of mental imagery. Therefore, a task with a greater number of "symbolized elements," which is assumed to be the case with tasks that are predominantly cognitive in nature, should show the greatest improvement following MP.

For example, a recent study by Hird, Landers, Thomas, and Horan (1991) found better performance with physical practice for both a motor task (the pursuit rotor) and a cognitive task (pegboard), but a larger effect size for the cognitive ($ES = 1.06$) than the motor ($ES = .50$) task with mental practice. None of the above studies specified which imagery perspective subjects were using while mentally practicing these skills.

In the present experiment the tasks came from opposite ends of the cognitive-motor continuum, as defined by Hinshaw (1991-92). In cognitive tasks "the focus is primarily on spatial, temporal, or sequential aspects of the task while the actual motor response is secondary to these processes" (p. 5). The first task, a stabilometer balancing task, has been judged to be at the motor end of the continuum (Ryan & Simons, 1981); and a second task, an angles judgment task, in which subjects must make visual judgments of angles and line continuations, was chosen as a task at the cognitive end of the continuum. Alternatively, the motor task might be viewed as a kinesthetic task and the cognitive task as a visual one.

The two most popular theories of mental practice (Murphy, 1990), neuromuscular and symbolic learning, have remained separate and somewhat contradictory. However, it may be that the type of task and the imagery perspective employed could differentially favor one theoretical explanation over the other. The present study examines the effects of different imagery perspectives (internal and external) on two types of tasks (kinesthetic and visual) and then relates these findings to current theories. We hypothesized that the use of internal imagery will result in the greatest improvement on the motor/kinesthetic task, but that there will be no difference between the external and internal imagery conditions in the amount of improvement on the cognitive/visual task. A secondary purpose of this study is to examine how subjective ratings of the clarity of kinesthetic and visual images would differ across these imagery perspectives and tasks.

Method

Subjects

We recruited subjects from undergraduate classes in Psychology and Exercise and Sport Sciences. Subjects initially filled out an Imagery Assessment Questionnaire (IAQ, derived from Vigus & Williams, 1985). The IAQ assessed if and how imagery was used, imagers' natural and preferred imagery perspective, and clarity of imagery. An explanation and demonstration of mental imagery perspectives was given to all subjects by the experimenter. Imagery perspective, visual imagery clarity, and kinesthetic imagery clarity were assessed on 11-point Likert-type scales. Subjects who scored either six or above (indicating an external perspective was preferred) or two or below (indicating an internal perspective) and who reported visual and kinesthetic imagery clarity to be above the midpoint were asked to return for a second experiment for which they received either a small monetary payment or research participation credit toward their course. A total of 47 subjects participated in the study. For reasons indicated later, some subjects had to be dropped. Data was analyzed for 42 subjects, of which 21 subjects used an internal imagery perspective and 21 used an external perspective.

Cognitive/visual task. This task was designed specifically for this experiment. It consisted of an 8 1/2 x 11 inch paper board, attached to a larger background. Both the sides and the top of the board contained a numbered measuring plate, marked in tenths of inches. The goal of this task was to estimate how various straight lines might extend to and reflect off adjacent sides.

To facilitate performance, each subject was taught a law of physics stating that "the angle of incidence is equal to the angle of reflection." Thus, a line would essentially rebound off a side at the same angle it originally hit the side.

Subjects were first shown a one inch line (see Figure 1, line a). They were then asked to estimate or visualize the continuation of the line and indicate the point at which they would expect the line to touch the left side (Figure 1, line b). Next, they would imagine where the line would rebound to, based on their knowledge of the governing law and their estimation of the angle of incidence. Thus, they would predict and indicate the final point of contact with the next side, which could be either the top side or the right side, depending on the size of the angle of reflection (Figure 1, line c). In other words, subjects had to estimate the extension of a line, the angle at which it would contact the first side (angle of incidence), then using this governing rule estimate the angle it would rebound off, and finally indicate where the line would contact the final side. Subjects were shown one example and the experimenter assured that the subject understood the task. Subjects were not allowed to physically draw the lines, but could only imagine where they would be drawn. Performance was measured by the difference (in tenths of inches) between the subjects' estimates and the correct point of contact based on the above physics law.

There were a total of 20 lines and for counterbalancing purposes, these were arranged in four groups of five lines. Each group contained a similar selection of lines, so that each had a line starting in at least one of four quadrants of the bottom line and at least two steep and two shallow angles.

Motor/kinesthetic task. This task involved balancing on a stabilometer (Lafayette Instrument Company, Model 16020). The apparatus consists of a 42 x 35 inch board that extends 21 inches on either side of a 6 inch high fulcrum. Standing on the board with one foot on either side of the fulcrum, the subject tried to keep the board level and from not touching the floor. An electronic device recorded the number of seconds that the board was in balance, that is, within 5 degrees of an exactly horizontal position. Each trial lasted twenty seconds. Performance was measured by the number of seconds that the board was kept in balance.

Procedure

When subjects came to the laboratory, they were first given a second more detailed description of mental imagery perspective. After subjects had indicated that they clearly understood the differences between internal and external perspective, they were asked to reread their IAQ and make any necessary changes. The five subjects who changed their indicated imagery perspective at this time or at any later point in the experiment were dropped from the study. Of the 21 internal and 21 external imagers

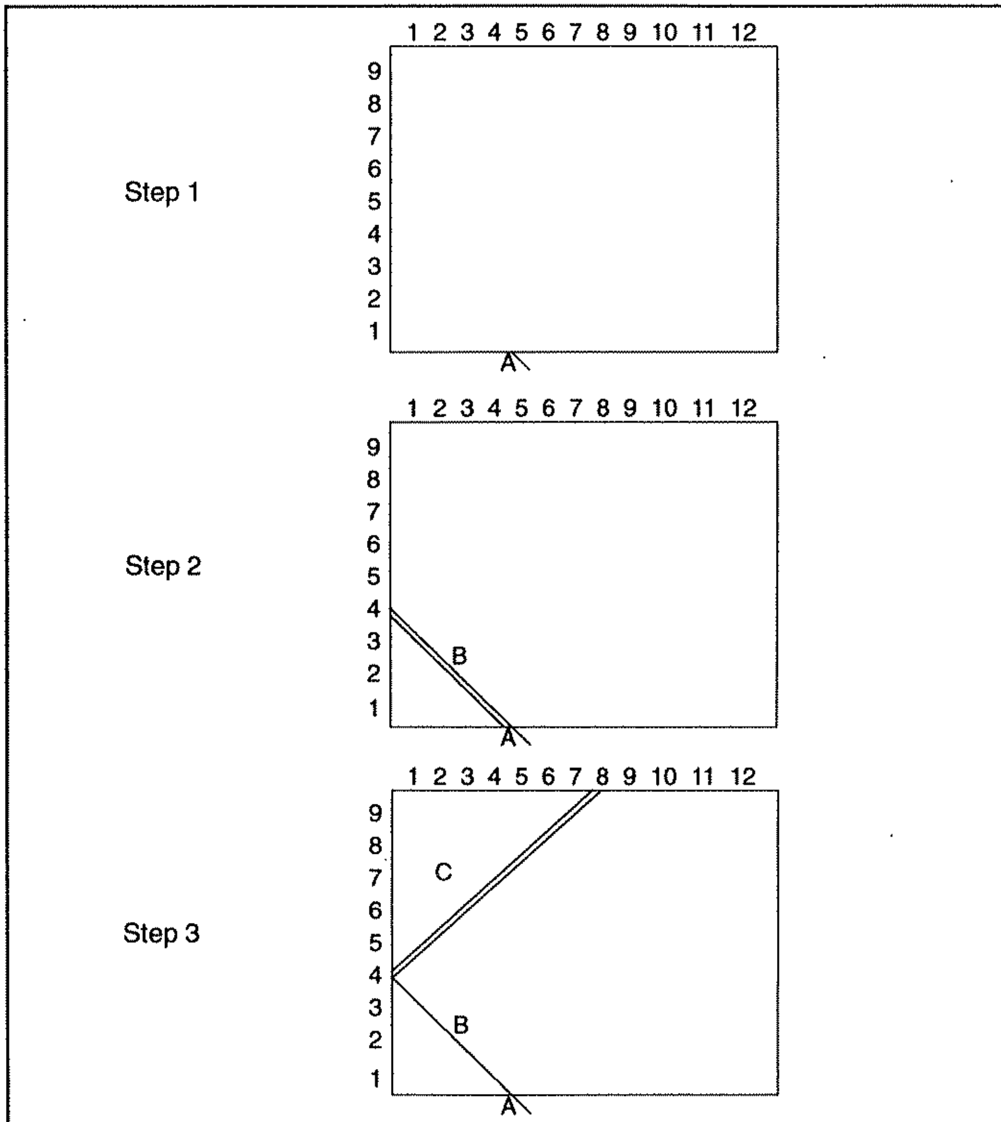

Figure 1: An example of the cognitive/visual task.

(based on IAQ scores) seven of each were randomly assigned to a control group. The remaining 14 internal imagers comprised the internal imagery group and the remaining 14 external imagers comprised the external imagery group.

All subjects performed both the novel cognitive/visual and motor/kinesthetic tasks, with task order counterbalanced. Prior to each task, subjects were given a demonstration and one practice trial to make sure that they understood the tasks. For each task, subjects first performed five baseline trials. Following baseline assessment, the imagery groups performed five imagery trials followed by five physical test trials. This was repeated three times so that all subjects received a total of 15 imagery trials and 15 physical test trials, beyond the initial baseline trial. The length of all trials was 20 seconds, with a brief rest between trials. The protocol for the control group was identical except that they performed a category generating task in place of the imagery trials. They were asked during a 20 second period to name as many items as they could that belonged to a specific category. Therefore, all groups received 5 baseline trials, followed by either five imagery trials or five category trials, followed by test session 1 (T1) which consisted of 5 physical trials. They then received another set of five imagery/category trials, followed by test session 2 (T2) which again consisted of five physical trials, followed by a final set of five imagery/category trials, finishing with a final test session (T3).

Experimental Groups. On the 15 imagery trials, subjects were told to think back to one of their best baseline trials and to try to recall what they did well during that trial. They were then told to use that trial to imagine a good line estimate or a good balancing trial. Instructions were not explicit in terms of what to see or feel, but subjects were told to maintain their particular imagery perspective. Instructions for subjects in the internal imagery group emphasized a first person, or inside the body perspective. The external imagery instructions asked subjects to use a videotape, or third person perspective. Also, before each of the tasks, a video camera was used to demonstrate to the external imagery subjects what they looked like from an external perspective to insure they understood what was meant by an external perspective (Hale, 1986). Subjects in both groups were told to use as many sensory modalities as they could to make the image as realistic as possible, including both the visual and the kinesthetic modalities.

Both the external and internal subjects rated their perspective and quality of image after every imagery trial. Three eleven-point Likert scales assessed imagery perspective (10 indicated a completely internal perspective and 0 indicated a completely external perspective) and clarity of visual and kinesthetic images (10 indicated a very clear image and 0 indicated no image at all).

Results

Motor/kinesthetic task. Table 1 presents descriptive statistics for the three groups. Performance improvement was calculated based on the difference between the mean baseline score and the mean test session 3 (T3) score. Note that a higher score indicates improvement in maintaining balance on the stabilometer, in seconds. Planned comparisons showed that there was a significant improvement from baseline to T3 in all conditions, $ts > 1.96$, $ps < .01$. Amongst the groups, the only statistically significant difference occurred between the external imagery group and the control group, indicated by the external group improving significantly more than the control group $t(26) = 2.08$, $p < .05$. The effect sizes were calculated using the difference between the means of the experimental groups and the control group, divided by the control group standard deviation (Glass, 1977; Thomas & French, 1986). For the external imagery group, $ES = 0.38$, and for the internal imagery group, $ES = 0.35$.

Table 1
Descriptive Statistics of Tasks Across Trials

	Control		External		Internal	
	M	*SD*	*M*	*SD*	*M*	*SD*
Stabilometer[1]						
base	4.71	2.13	4.72	2.12	4.85	1.48
T1	8.25	3.04	7.72	3.51	7.97	3.56
T2	9.67	3.39	9.91	4.05	9.48	3.47
T3	10.46	3.67	11.84	2.91	11.74	3.40
Angles[2]						
base	3.13	1.40	3.51	1.87	5.10	3.84
T1	3.88	1.97	4.28	2.68	4.53	3.23
T2	3.09	1.64	2.64	1.12	5.02	5.90
T3	3.07	1.34	2.77	1.24	2.31	0.95

[1] Time in balance measured in seconds.
[2] Difference from actual point in inches.

Cognitive/Visual task. See Table 1 for descriptive statistics. Performance improvement was again calculated based on the differences between the mean baseline score and the mean Trial 3 score. Note that a lower score indicates better performance in this task. The internal imagery group was the only group that showed an improvement from baseline to T3, $t(26) = 3.35$, $p < .01$. The improvement in the internal group was greater than the improvements in both the external imagery group and the control group, $t(26) = 2.12$, $p < .05$. For the external imagery group, $ES = 0.22$, and for the internal imagery group, $ES = 0.57$.

Imagery Ratings. A 2 x 2 x 2 (imagery perspective x type of task x imagery modality) Analysis of Variance was performed on the clarity of image ratings (see Table 2). The analysis indicated a main effect of perspective, indicating higher overall clarity ratings for the internal imagery group ($M = 7.92$) compared to the external imagery group ($M = 6.86$). A main effect of task indicated greater clarity on the imagery ratings for the stabilometer task ($M = 8.03$) compared to the angles task ($M = 6.74$). A main effect of type of image, indicated a higher rating of clarity on the visual images ($M = 7.88$) than the kinesthetic images ($M = 6.90$) . However, a significant interaction between task and type of image, overrides the significant main effects for these variables. This interaction indicated that ratings of visual and kinesthetic imagery did not differ on the stabilometer task. However, the kinesthetic imagery was rated as significantly less clear than visual imagery on the angles task.

Table 2
ANOVA Summary Table

Clarity of Subjective Imagery Ratings as a Function of		
Task	$F(1,26) = 30.59$	$p < .001$
Modality	$F(1,26) = 17.76$	$p < .001$
Perspective	$F(1,26) = 4.81$	$p < .05$
Task x Modality	$F(1,26) = 8.11$	$p < .01$
Task x Perspective	$F(1,26) = 3.52$	$p < .06$

There was also a marginally significant interaction between task and perspective, suggesting that the external imagery group rated their imagery clarity lower on the angles task than on the stabilometer task, whereas the internal imagery group did not differ across tasks in their ratings.

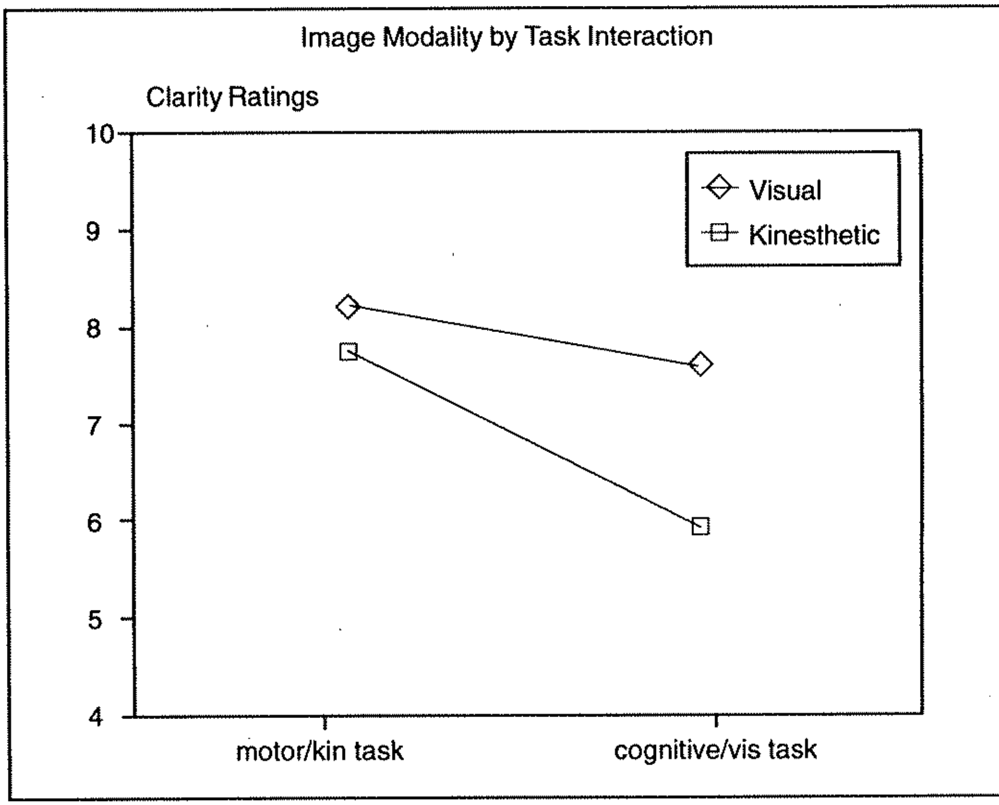

Figure 2: Interaction between imagery modality and task.

Discussion

The imagery perspective used by the subjects determined whether or not imagery improved performance on the stabilometer (a strongly motor task) and the angles (predominantly cognitive) task following mental imagery. Only the external imagery group on the stabilometer and the internal imagery group on the angles task differed significantly from the performance of their respective control group.

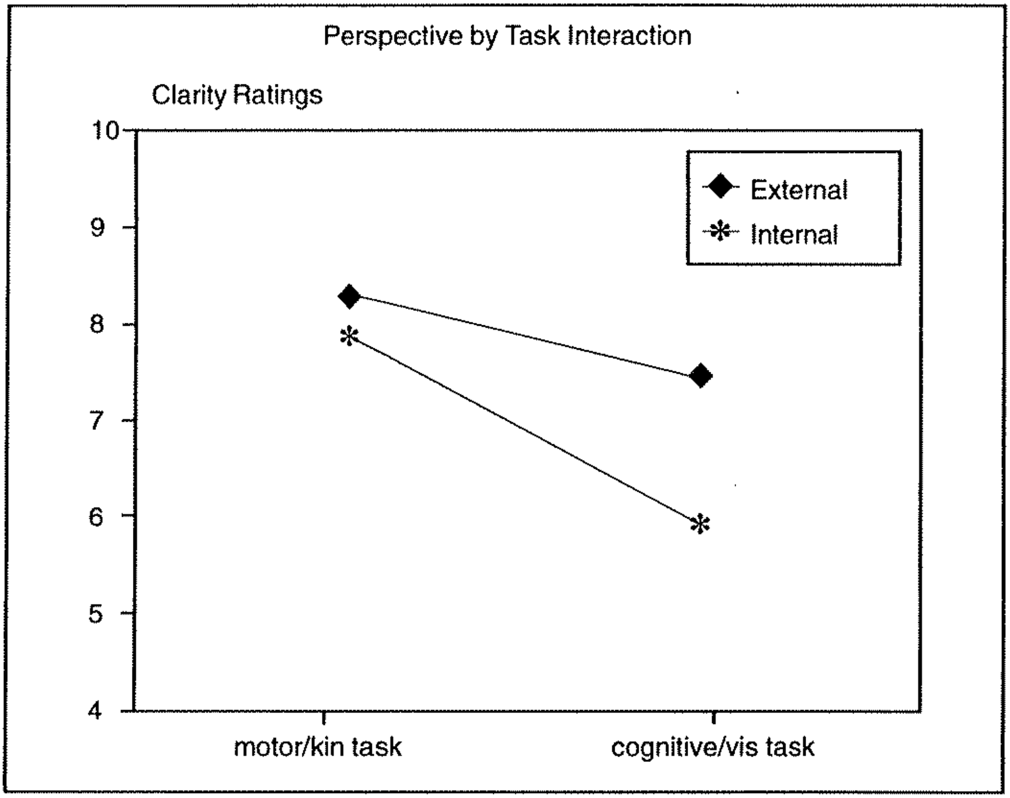

Figure 3: Interaction between imagery perspective and task.

Although superior performance on the cognitive/visual task by the internal imagery group is consistent with the current literature, the explanations that have previously been proposed to explain this benefit cannot easily account for the present results. The greater effects of internal imagery have usually been attributed to the kinesthetic feedback provided by imagery (e.g., Corbin, 1972) or to the parallel muscle innervations occurring in the actual muscles during imagery (e.g., Hale, 1982). The angles task involved very little muscle movement and the movements that did occur (moving a hand along the page) were trivial for the actual performance of the task. Many subjects, when asked about the quality of their kinesthetic imagery, stated that the task had no kinesthetic component to image and they therefore reported little or no kinesthetic imagery. This is reflected in the overall lower kinesthetic ratings for the angles task. In contrast, on the stabilometer task in which using external imagery provided superior performance to the control group, equal clarity ratings occurred for imagery in the visual and kinesthetic modality.

These results suggest that perspective of imagery may have mistakenly become synonymous with the sensory modality involved, such that the internal perspective is viewed as involving primarily the kinesthetic modality and the external perspective as being predominately visual (e.g., Epstein, 1980; Hale 1982; Hinshaw, 1991-92). Perhaps imagery perspective should merely refer to the viewpoint (first versus third person) the subject is taking during the mental imagery, and not necessarily to the modalities involved. It may be that imaging from the 'correct' visual viewpoint is the major contributor to the greater efficacy of an internal mental practice perspective over the external perspective. In this study, the internal perspective provided a clear advantage over the external perspective in improving performance on the angles task, which contains little, if any, kinesthetic component. The visual viewpoint may be a critical component in the judgments required for optimal learning on the angles task.

The favorable external imagery perspective on the stabilometer task does not support the claim that an internal imagery perspective will enhance performance more than an external perspective, particularly on a predominantly motor task (see Hinshaw, 1991-92 for a review). Thus, the present findings suggest that internal imagery may not always be the optimal perspective for performance enhancement on motor/kinesthetic tasks. Motor learning theory and research offers a possible explanation for this finding. In the present study, all subjects were novices on the balancing task. Fischman and Oxendine (1993) state that the first stage of motor learning is called the cognitive stage, because the learner uses verbal and cognitive cues to initially represent the task. They go on to say that in this stage the dominant sensory system is vision: "We visually monitor our limbs" (p. 12). Therefore, in the early stages of motor learning it may be more advantageous for subjects to adopt an external imagery perspective, in order to get the best comprehensive view of their own limbs and to process more relevant visual cues. The external perspective may allow subjects to examine the motor components involved in the new skill from outside their bodies, and gain an understanding of how the skill is to be performed. It is important to note that although the external imagery group was the only group that differed statistically from the control group, the calculated effect sizes were very similar for the internal and the external imagery groups on this motor task.

The present stabilometer results provide some support for a symbolic learning imagery hypothesis for the early stages of learning motor tasks. Ryan and Simons (1981) suggest that it is difficult to find a "pure motor skill," and that most skills will have some cognitive elements. It is therefore possible that improvement on the stabilometer occurred through the learning and mental rehearsal of these cognitive elements. Mental practice of the symbolized elements, which would come from the instructions and initial physical performance, would allow these subjects to retain and learn this information more quickly than the control group. Thus, perhaps at this stage of learning, these cognitive and visual components are more important than the kinesthetic elements.

A comparison of the effect sizes for each imagery group, across the two types of tasks is consistent with previous literature, which suggests that more cognitive tasks will show a greater improvement following imagery than motor tasks (Hird et al., 1991). However, in the current study, the performance on the cognitive/visual task did show the greatest improvement following imagery, but this was only the case for the internal imagery group ($ES = .57$).

Another interesting finding was the absence of differences in the ratings of kinesthetic imagery experienced between the external and internal imagery groups. Previous literature would predict that the internal imagers would experience more kinesthetic imagery (e.g., Hale, 1982; see Vigus & Williams, 1985 for an exception). If the current subjects are accurate in their subjective ratings of clarity and perspective, then it appears that one can experience kinesthetic imagery while imaging externally. This would follow the result obtained in an EMG study by Vigus and Williams (1985). They found that the external imagers experienced as much EMG activation when imaging as the internal imagers. Some may argue that if the external imagers are getting kinesthetic imagery, they must be switching into the internal perspective (e.g., Epstein, 1980). According to subjective perspective ratings obtained in the present study, subjects in the two imagery groups were maintaining significantly different perspectives. In explanation of their kinesthetic perceptions, subjects in the external group emphasized that they were 'seeing' themselves from the outside and that they were 'seeing' their own muscle movements such that they experienced a 'feeling' of that movement. Because individuals were screened for their natural imagery perspective and eliminated if they changed perspectives during the study, the problem of perspective switching that has plagued other studies (e.g., Epstein, 1980; Harris & Robinson, 1986, Hinshaw, 1991-92) was minimal in the present study.

Demonstrations of interactions between various moderator variables is an important step in mental practice research as well as in applied sport psychology. This study found that different tasks may show differential benefits from different imagery perspectives, and that imagery perspective may not be synonymous with imagery modality. Further study is needed to examine whether perspective actually should simply refer to only the visual viewpoint and not include specific modalities.

Athletes should perhaps use different imagery perspectives depending on the type of sport or skill they are trying to enhance, and depending on their level of experience with that skill. The influences of other moderator variables such as skill level and natural imagery ability and perspective, in combination with the variables examined in this study would likely further the understanding of mental practice processes and allow athletes to use mental practice more efficiently.

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