Visual inhibition as an aid to developing gymnastic skills

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Visual inhibition as an aid to developing gymnastic skills

Abstract
Four college-aged women gymnasts participated in a study to investigate the effect visual inhibition had on their gymnastic development and performance. Five experimental sessions were designed where the gymnasts wore "fogging" hydrophilic contact lenses during regular practice sessions. Written responses to both a pre- and post-study survey were presented by the subjects. The subjects felt the inhibited vision hindered spatial localization, heightened awareness of body parts, enhanced their ability to inhibit fear and had mixed opinions with respect to the effects of timing, rhythm, and balance.

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VISUAL INHIBITION
AS AN AID TO
DEVELOPING GYMNASITC SKILLS

A senior research project by
Sharon Chinn
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Gymnastics
Sensory Deprivation

Advisor: Dr. William E. Preston
1982
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ABSTRACT

Four college-aged women gymnasts participated in a study to investigate the effect visual inhibition had on their gymnastic development and performance. Five experimental sessions were designed where the gymnasts wore "fogging" hydrophilic contact lenses during regular practice sessions. Written responses to both a pre- and post-study survey were presented by the subjects. The subjects felt the inhibited vision hindered spatial localization, heightened awareness of body parts, enhanced their ability to inhibit fear and had mixed opinions with respect to the effects of timing, rhythm, and balance.
A. INTRODUCTION

The role of the optometrist is becoming more varied and diversified as new fields are being explored. The traditional role of the refractionist is now considered an obsolete and inefficient use of the optometrist's training and expertise. Today's students of optometry are exposed to a much broader scope and are encouraged to apply themselves in areas that were not considered necessary, appropriate, or useful during the history of optometry as a profession. Those who wish to confine the optometrist to the exam room are as shortsighted as those optometrists who adhere to this self confinement.

Vision and visual functioning are an integral part of the mental processes of every individual. There is not an expert today who can define where, how, or why visual functioning interrelates with higher mental processes. Since optometrists concern themselves with visual functioning they must also concern themselves with how this functioning co-exists with higher thinking and how they collectively contribute to the functioning of the individual as a whole. This is not a new concept as optometrists specializing in developmental vision have been exploring this for years. It is therefore obligatory that optometrists uncover areas of involvement where they feel their expertise can lend new insight or expose new avenues of thinking and submit their contribution. One such area of optometric involvement is the subspeciality of sports vision.
Most of the studies in sports vision deal with investigating the requirements of importance of vision as it relates to a particular activity and more specifically how an individual can prepare or enhance himself visually to participate and/or be successful in a sport. The first question that should be investigated is how visual functioning can contribute to the athlete's performance as a whole. After a keen understanding of this is established, the optometrist must then deliberate on how he/she can possible improve or enhance the athlete's abilities by manipulating visual functions. This may take the form of enhancing visual awareness or readiness, improving visual acuity, or involving the athletic participant in any or all of the exercises in a traditional visual training program. But does every sport require a visual readiness? Is there a sport where vision does not necessarily contribute to the overall performance of an athlete? Can vision be a detriment in the training process for a particular athlete? This study concerns itself with women's gymnastics and the contribution optometry can make to the improvement of gymnastic performances.

Gymnastics is unlike many sports in that there is no ball to hit, bat to swing, pins or other athletes to knock over. Instead it is very much like diving or figure skating in which precise and intricate movements are executed with the aid of an apparatus in a creative yet mandated way to achieve a subjective score from a
panel of certified judges. The ultimate goal of the gymnast is to execute a prescribed set of maneuvers that is required by the rules of gymnastics and limited only by the creative ability of the individual.

To truly assess the contribution that the visual system makes to the overall athlete's performance, one must look at the total involvement of all mental and physical components and abilities available to the gymnast. The investigators of this study have a combined involvement in gymnastics of over twelve years in the areas of personal competition, coaching, and judging. With this background, we have acknowledged three broad theoretical principles that can contribute to the overall abilities of the gymnast. These three principles are as follows.

1. The Highest Mental Processes

   At least one very powerful tool exists in the higher mental processes that can be utilized by the gymnast. This process is the power of visualization.

   Visualization is a major contributor to overall consciousness and human information processing. Elliott Forrest defines:* 

   It (visualization) involves some form of mental picture or spatial representation no matter how vague it is and regardless of whether it is every utilized efficiently. The essence of visualization, therefore, is internal visual imagery put to use.

   Can a gymnast then apply or put to use imagery to improve his/her gymnastic ability? Many superior gymnasts do.

In order for this process to begin, the gymnast must have a particular maneuver she wants to execute. Her ability to visualize must first start by willfully blocking out as much mental "noise" as possible and focusing her awareness on the impending maneuver. The visualization process however does not necessarily have to exist only in the gym. Many a gymnast has looked at this investigator skeptically when advised to "perform your routine in your mind" but later agreed to the benefits of this mental exercise.

After the gymnast has cleared her mind of all but the maneuver at hand, she must conjure up a dynamic pictorial representation of her body performing the move in slow motion (similar to a slow motion instant replay) where she is a spectator watching herself. She must see herself performing the move with ultimate extension, maximum virtuosity, and exacting precision to its own natural conclusion. After the gymnast can visualize in this way, she must do it again and again making the picture more clear but now conjuring up this mental image from different viewpoints. She can now add the colors of her uniform and the colors of the mats or other objects in the gym to her mental picture. These will help to simulate a real situation. Once the gymnast can visualize herself as a spectator would see her, she must return to "her own body" and visualize the maneuver as she would see it in a real-life situation stressing the ultimate execution.
Many gymnasts find this exercise extremely frustrating and many coaches are unaware of the benefits of such a mental execution. Here is one area in which the optometrist can contribute his services by instructing the gymnasts in visual/spatial manipulation.

2. The Subconscious Processes

Everyday motor coordination is an example of a process controlled by this level of consciousness. No active thinking is involved and yet a certain level of activity is carried on. It would be to the performer's advantage to strive to place the initiation and integration of every move under the control of the lower processes of the mind. Experience or habituation is the means by which this process can be actuated.

In order for a gymnast to attain a superior level of performance there is no substitute for training and habituation. The actual performance of the maneuvers must become so habitual that the gymnast need no longer think about the small mechanical problems in the execution of the move. This habituation process is no small task and takes years to place this process in the subconscious. It was explained that the gymnast must actively visualize the ultimate execution of her moves. The execution of each maneuver during this habituation phase must therefore be done with the most virtuous visualization. In order for the gymnast to reach a superior level of performance, she must never attempt a maneuver half-way. It is usually this half-hearted attempt that leads to injuries. The initiation of each move must therefore be done in a way to obtain the ultimate level of execution and it is
this "all out effort" that must become habitual. Eventually the mechanics of each move will become as unconscious as breathing.

But how does the gymnast know she is obtaining the ultimate level of execution? How must her training program develop and in what direction should she train to obtain this goal? The answer lies in the wealth of information obtainable from the bodily senses, which leads into principle number three.

3. The Monitoring of the Bodily Senses

There is a multitude of information obtainable through the bodily senses that can tell the gymnast she is obtaining the maximum level of execution. The resources include the following:

1. Visual input
2. Input from vestibular mechanisms
3. Rhythm and temporal awareness
4. Input from kinesthetic senses
5. Tactal input
6. Spatial awareness

We can see that the gymnast can use many cues from her environment in monitoring execution. In order for the gymnast to reach her goal of superior execution, she must effectively monitor every movement via these bodily senses and be able to assimilate from this information where she "is" now and what she needs to do to reach her maxim. This necessitates being acutely aware of all these cues and making modifications in her execution in order to obtain feedback from her senses that she is performing with precision and virtuosity.
Now that we have acknowledged three principles that all contribute individually and collectively to gymnastic abilities we must ask now does one use these principles towards the improvement of the gymnastic performance? Assimilating these theoretical principles of gymnastic abilities into a practical format would necessitate four steps.

1. Monitoring or acknowledging an awareness of these cues
2. Learning to modify execution via feedback from these cues
3. Habituating this execution
4. Actively visualizing the ultimate execution in order to keep the gymnast's awareness focused on the task at hand

Visual input is only one cue and yet we know that vision is the dominant sense; so dominant in fact that it may suppress or actually override the lesser senses (i.e. visual capture). Due to this the gymnast may not be making effective use of all the environmental cues available to her. This study involves investigating the role the visual system plays in the first step of gymnastic ability development—the monitoring of all bodily senses. It is the premise of the investigators that if visual input can be inhibited and awareness of all other bodily senses enhanced, the gymnast will be in a better position to monitor these senses and receive feedback as to where and how she is falling short of superior
execution. This study does not focus on trying to "make" better gymnasts but rather to make them aware of information they are missing by the dominance of the visual system, and for them to be able to direct their awareness to the different cues available to them.
B. Materials and Methods

Four female college students served as the subjects in this study. Each had previous experience with gymnastics. (See Table 1)

Each gymnast had a history of gymnastics training involving no visual inhibition. The investigators felt that this prior training should be used as a control by which the subjects could compare the training they received in this study to their previous training history.

The first aspect of this study involved gathering the opinions of the gymnasts as to the extent of their dependence on their visual system and their dependence on other cues (especially kinesthetic and vestibular) during the execution of their moves. The four gymnasts were given a pre-study survey, which they answered in writing, prior to the start of the five investigatory sessions (Table 2).

The second aspect of this study involved constructing a mini-training program consisting of five one-hour workout sessions. One of the experimentors served as the coach, while his partner recorded all observations and verbal comments during the training sessions. The workout sessions were conducted at the Pacific Elite Gymnastics Academy in Forest Grove, Oregon, and were completed within two weeks.

The first session began with an exercise in body awareness while having no input from the visual system. Each gymnast was blindfolded and asked to do various moves on the floor mats. This included dance moves as well as some tumbling. The coach
also had the women estimate the size of the mats by pacing off the dimensions. The gymnasts also did some walking and tumbling on the balance beam, as well as some simple swinging moves on the uneven parallel bars. The coach's instructions and the feelings of the gymnasts while doing the activities were all recorded and they are written in more detail in the section listing the results of the study. After the session with the blindfolds was completed, the experimenters inserted the gymnast's contact lenses such that they now would have limited visual input. The soft contact lenses were selected for each woman individually so that she would be able to see gross structures such as the balance beam, uneven parallel bars, etc., but obstruct any visual input she would normally try to assimilate (Table 3).

The second and third sessions involved all four gymnasts wearing the contact lenses. Floor exercise, the uneven bars, and the balance beam were the areas practiced. These sessions were conducted much like a regular gymnastic team training session. Vaulting was excluded from these sessions due to the known visual demand of this event, and its difficulty in relating its technique with the nature of this study.

In the fourth session, all three events were covered in the workout. Some new maneuvers were introduced to the gymnasts by the coach, but the emphasis of this session was perfecting stunts learned previously. These served as a control. Gymnast B did not wear the contact lenses during this workout. This was a test to see if the attention given by the coach was the reason for the
improvement or detriment in the gymnasts' performances, as compared to the effect of visual inhibition in conjunction with the coach's attention.

The experimenter recording the data was aware of the visual status of Gymnast B, but the coach did not know she was without lenses. It was observed that the coach treated each gymnast equally during the session, just as he had previously.

The fifth and final session was a time for the gymnasts to apply the skills and information gained while working with the contact lenses by performing maneuvers with vision fully restored. The gymnasts wore the lenses for the first twenty minutes of the session, then removed them and continued to practice. The maneuvers performed in previous sessions were now repeated without the contact lenses.

A post-study survey was presented to each gymnast, and their verbal answers to the questions were recorded. This survey was each gymnast's opinion of this training method of visual inhibition (Table 4).
1. In your own words define what is meant by an "air sense", or similar term.

Gymnast A - Body awareness in relation with the space and apparatus around you.

Gymnast B - How you feel in air.

Gymnast C - It is the ability to feel where you are in the air when you can't see anything which would help you know.

Gymnast D - This subject indicated that she would define "air sense" as it was defined in question two of the survey.

2. Do you feel the following is an adequate definition of "air sense"?

Air Sense: The conscious and unconscious assimilation of an individual's sensations with respect to 1) position of his/her individual body parts, 2) isolated movements of individual body parts, 3) awareness of balance or equal forces on specific body areas, and 4) awareness of the direction and velocity of movements the body as a whole is experiencing.

Gymnast A - Yes

Gymnast B - Yes

Gymnast C - Yes

Gymnast D - Yes
3. a. How important do you feel it is for a gymnast to have a well developed "air sense"?

Gymnast A - Very important
Gymnast B - Very
Gymnast C - It is very important. Gymnastics is dependent upon this "air sense".
Gymnast D - Important, but I was trained to use visual cues, too. If gymnasts were taught to rely on "feeling the moves" more than visual cues from the very beginning, I think it could become a more reliable source of learning. Even though I was taught to think about visual cues, I was also trained to feel when I came to the top of a jump (for a back) and etc., so this "air sense" comes along with any training.

b. How important do you feel it is for a gymnast to have a well developed visual system?

Gymnast A - The visual part in gymnastics is important, but I think perfection can be achieved without it.
Gymnast B - Moderate.
Gymnast C - It is not real important to have good eyesight, as long as they are able to feel where their body is.
Gymnast D - If gymnasts were taught from the beginning without sight or concentrating on it, I don't think the visual system would be a very vital part of the training.
4. a. Can you estimate in approximate percentage the number of individual moves in your competitive routines where a well developed "air sense" would be helpful if not essential?

Gymnast A - 100%
Gymnast B - 85%
Gymnast C - Air sense is essential in all areas of my moves (100%).
Gymnast D - 99%--in just about everything you do, it is helpful to feel what your body is doing.

b. Can you estimate in approximate percentage the number of individual moves in your competitive routines where a well developed visual sense (consider depth perception) would be helpful if not essential?

Gymnast A - 50%
Gymnast B - 100%
Gymnast C - I have developed my eyesight to help me spot points to help me gain height or know when to do a move. Approximately 90% needs eyesight.
Gymnast D - 90%--I would say this is a lower percentage because on fast bar or tumbling moves you can't see anything anyway.

5. Are there any times in performance of training where your vision or visual input "gets in your way" (is detrimental)?

Gymnast A - Yes, mostly in the fear aspect of most skills.
Gymnast B - No.
Gymnast C - Yes, especially when one gets to fearing a move, sometimes it might be better not to see how far it is to the floor.

Gymnast D - Yes, when trying to learn a new tumbling move on the beam, it seems like it would be less frightening if you could see how far off the floor you were. Same on some bar moves.

6. a. Have you, in your history of gymnastics training, ever used training techniques requiring that you "look for a move" or focus your visual attention on a particular object or spot on the apparatus, floor, or your own body to achieve the proper execution of a move? Give examples. How successful do you feel these techniques were/are?

Gymnast A - During my gymnastics career I remember vaulting, beam and floor-ex to be the events in which I was told to focus my eyes on a particular object or spot. At that time I felt visual focus to be an important part in my routines. It seemed to tell you when to stop, respond or at what point to give it your utmost (for example, vaulting).

Gymnast B - Yes--spotting turns on beam, kips on bars.

Gymnast C - Yes, I think it has been helpful. On moves such as back tucks or on vault, spotting an object has helped my execution and height.
Gymnast D - Yes--backs (spot wall), hechts (spot wall), fast turns (spot), fronts (spot wall), most moves on beam-spot end of beam, regrasp moves on bars. When you are in your own gym, they are fine, but when you go to another gym, you have to get readjusted.

b. Have you, in your history of gymnastics training, ever used training techniques requiring that you "feel the move" or focus your attention on body placement and movement to achieve the proper execution of a move? Give examples. How successful do you feel these techniques were/are?

Gymnast A - Yes--in every move I have every done in gymnastics I was told by coaches to "feel the correct way" and to work for that particular feeling. Example, vaulting, tumbling, turns, dance, bars, etc. I feel that this technique is very successful in gymnastics and all other sports.

Gymnast B - Yes--beam visual perceptual feeling techniques were very successful.

Gymnast C - Yes--on vault we were told to make our bodies tight and pull our toes to the wall. It helped us get distance on our vaults. It does help in certain areas.

Gymnast D - Yes--front tumbling on beam, leaps (feel if you are split), eagles (bars), any move that you cannot see where you are going to end up.
7. Do you feel it would be beneficial to a gymnast to incorporate a training program aimed at developing an "air sense"?

Gymnast A - Yes--I feel that a strong knowledge of "air sense" could be very beneficial.

Gymnast B - Yes.

Gymnast C - Yes--it would help her not be so dependent on spotting an object. It throws one off when they move to a different gym and that spot on the wall isn't there. It would also help a gymnast feel where their legs are and if they are together, etc.

Gymnast D - Yes--I think it would be great to start kids out from the beginning to feel what their bodies are doing in every move. This way you don't have to rely on cues or other people's input. You would know, by the way a move felt to you, what was correct or not.
Training Sessions

Session 1

This session began with a warm-up, then blindfolds were placed over the gymnasts' eyes. The coach instructed them to raise their arms straight out in front of them, straight up, and out to the sides. Each of the girls felt their arms were in the proper place, but observing them, one could see that their arms were a little high or low, a little too far forward or back. The coach stressed upon them to feel where their arms were, since they could not rely on their vision. With this suggestion, the gymnasts were better able to assess when their arms were properly placed.

The coach then had them do a forward scale and a side scale. All of the women found this difficult to do without their vision. Using a barre aided the gymnasts in achieving balance.

The next exercise dealt with judgement of distance. While blindfolded, the gymnasts were asked to start from one corner of the floor exercise mat (these mats were regulation size--40 ft. by 40 ft.), walk toward the center (diagonally), the stop. They were told to do their best to pace the mats in a straight line. Gymnast A veered to the right, Gymnast B also missed the center, but noted that she could tell she was crooked, and was able to correct the error and continue to walk straight. Gymnast C was somewhat crooked, and Gymnast D was quite accurate in her estimation.

The coach also had them walk along one side of the mats, stopping at the midpoint, the continuing on. Three of the gymnasts did this well, and one was slightly short of the goal. Gymnast B
noticed that this task was easier when she walked more quickly. These basic exercises began to get the gymnasts concentrating more on body awareness.

Tumbling runs were the next step in this series of blindfolded moves. The first run consisted of two front handsprings on a straight line. Two of the women were successful, while the other two veered off to one side. The latter two could readily report that they have not been straight.

The last of the floor work included backhandsprings. Gymnast A reported that doing the move blindfolded "didn't feel any different". Gymnast B was slightly inhibited at first due to the lack of vision, but once the move was completed, performance was good. Gymnasts C and D both had little trouble with the backhandsprings.

General comments on the tumbling basically showed little difference between performing sighted versus non-sighted. Gymnast B did report that the ground was harder to find when doing backward moving maneuvers, and Gymnast C felt that the ground came up sooner than she expected when doing backhandsprings.

The next event was the balance beam. First, the gymnasts felt the beam with their hands, noting its length and width. Sitting on the beam, raising arms straight above their heads, they were to bring their hands down in front of them, such that they were centered on the surface of the beam. All did this successfully.

Secondly, the coach instructed them to walk the length of the beam, both forwards and backwards. The presented no problem
to the gymnasts. Gymnast D did comment that she was more aware of balancing while blindfolded. Gymnast A, while walking backwards, felt that the beam curved, but she also noted that she was becoming better at being aware of other cues besides vision.

Turns were the next step on the beam. The women began with $180^\circ$ turns, and found this to be more difficult than previous moves. "Overthrowing" and getting back on the beam were the two major problems. $360^\circ$ turns were discovered much easier to perform than $180^\circ$, and all were able to complete these satisfactorily.

Two general comments stemming from these exercises seemed to be that both aggressiveness and tightening of the body were beneficial to performing a move well while blindfolded.

From turns, the gymnasts moved on to dance steps. Each gymnast worked on steps relevant to their individual abilities, and each woman was able to perform quite well. Their skills without vision were much better than expected by the experimentors.

The last maneuver to be performed on the beam was a front walkover. Gymnasts A and B both tried this, and were quite adept at knowing whether they were on the center of the beam, right, or left, with their leading foot.

The uneven parallel bars were the last event tried while blindfolded. The coach stressed mental observation while the gymnasts were grasping the bars, swinging, and beating the bars with their hips. Of all the events, this seemed to be the most difficult to practice with no vision. The gymnasts felt that the distances between bars, and the distances between themselves and the bars, were difficult to judge.
The blindfolds were then removed, and the respective soft contact lenses were inserted into the gymnasts' eyes. Gymnast A said she was aware of them for about five minutes, but they were soon forgotten. Gymnasts B, C, and D all adjusted to the contact lenses quickly. The gymnasts walked around the gym, tumbled some, then the lenses were removed.

Session 2

At the start of the workout, the contact lenses were inserted, and the gymnasts warmed up. The coach began the session with a tumbling run consisting of a round-off, backhandspring, tinsica, inward pirouette, with the last maneuver being a new move for all of the women. The coach stressed the thought of even weight distribution while performing. All four found that the contact lenses did not make the tumbling any more difficult. Gymnast A also found that it "seemed funner to do because you can't see".

On the uneven parallel bars, the coach had the gymnasts perform a cast, beat, and full turn regrasp. Gymnast A commented that with blurry vision "things seemed slower". She tried the maneuver after removing the contact lenses and reported that "the trick felt better" with her vision, although the experimentors and other gymnasts observed that the performance appeared no different.

Working out of the beam, the gymnasts practiced 360° turns, cartwheels, and dance moves. Gymnasts C and D were prompted by the coach to "feel" their body positions as they practiced. Both
gymnasts felt their moves improved when concentrating on this "feeling". Gymnast C mentioned that during previous training she chose to "spot" a point on the beam while performing a cartwheel. During this session, she was able to cartwheel with no more difficulty than before.

At the completion of session two, the consensus was that in regards to the uneven bars and floor exercise, there was no real difference in difficulty between performing with the contact lenses in place and with full vision acuity. There was, however, mention that the contact lenses made things appear to be moving in slow motion at times.

Session 3

Each gymnast's contact lenses were inserted, followed by a warm-up session. Tumbling was the first event, and each gymnast worked on their own skills. Gymnast C worked on backhandsprings. She felt that without good vision, concentration improved for keeping her legs together; her form was easier to concentrate on. She felt her handsprings improved, and the experimenters agreed.

Gymnast B practices her back walkovers on the beam. The coach had her hold her arms above her head as she began the walkover, to improve the line of the stunt. The gymnast was able to perform quite readily with the contact lenses.

Gymnast B practices leaps, trying to move her feet properly, such that she would have a square landing on the beam. Again, the coach stressed the thought of "feeling" where the feet were landing.
Gymnast A was working on split leaps on the floor. She was just leading and putting emphasis on her front leg (leading leg), with her trailing leg dropping. With the lenses, she became more aware of her trailing leg, and put more emphasis on lifting her leg; she said she was able to "refocus" on her trailing leg. This resulted in an improved split leap, noted by the experimentors as well as the gymnast.

As just a brief demonstration of the concentration and attention needed to perform gymnastics, the coach did some balance beam exercises with the gymnasts. He had them walk the length of the beam while asking them questions such as "What is your name?", "What is your address?", etc. Although the questions were simple, the gymnast reported that it was "tougher" to balance when having to think about something else.

Added visual cues also made balancing a more difficult task. When the coach asked the gymnasts to follow his moving finger with their eyes as they attempted to walk across the beam, the women found it easy to lose their balance.

The contact lenses were then inserted into three of the four gymnasts' eyes; Gymnast B went without lenses this session. The coach was unaware that any of the gymnasts had their full vision, and he conducted the training session in the same manner as previous ones. Gymnasts B worked out just as hard as before; she claimed she was doing the best that she could. The other experimenter, knowing about the lack of lenses, was able to record all of the comments during the session, and afterwards.
Tumbling was first on the agenda, and the women practiced aerials. Gymnast D worked on front and side aerials, while Gymnast A worked on aerials plus side somersaults. Performances were good. Gymnast B worked on backhandsprings, and she stated that the stunts did not feel as good as they had before. The coach also observed that her performance was not up to the quality of earlier workouts.

Although no conclusions can be made from the behavior of one individual during one training session, it is interesting to note that the level of performance as exhibited by Gymnast B, who during this training session did not wear the contact lenses, was not up to previous standards. Whereas the observed behavior of the other subjects was influenced by the coach's training techniques and inhibited vision, Gymnast B's behavior was only influenced by the coaching techniques. The investigators can only present the fact that both Gymnast B and the investigator serving as coach felt that a previous level of performance was not achieved but can not conclude that this shortcoming was solely the effect of restored vision.

In retrospect the small internal check served another purpose. Since the experimenter serving as coach saw that Gymnast B was not performing as he would have liked, undue attention could have been given to this gymnast to the exclusion of the other subjects. The experimenter who served as recorder and observer, however, found no biased attention given to Gymnast B, even though she was not performing as the coach would have liked. Therefore, the experimentors feel secure in stating the the coaching techniques were fairly and equally presented to the four individual subjects.
When speaking to Gymnast B later, she told the recorder that it was "harder to concentrate without the contact lenses". She felt that seeing the coach's face was a factor in the loss of concentration. Being able to see as soon as she turned over, she was able to see the coach's facial expression. This, she said, "made her lose her concentration sooner."

The women spent the remainder of the session working on the balance beam and the bars. Press handstands were attempted on the bars. This stunt proved to be too far advanced for this stage of the gymnasts' abilities, so they moved on to the beam.

Gymnast D worked on her front aerials off of the beam. Gymnast B worked on leaps and back walkovers, and Gymnast C worked on dance. All of the gymnasts felt more sure of themselves, and all felt that they were improving. Visual observation by the experimentors noted the improvements.

The coach was told at the end of the session that Gymnast B had her full visual abilities. He did note that her performance, especially in tumbling, was not as good as before, but he never knew that she could see well. He thought that she might have been having a "bad day". The gymnast did admit that it was more difficult for her to concentrate without the contact lenses.

Session 5

With the contact lenses in, the women began working on back handsprings. Then they tried some turns on the floor. All of the gymnasts noted little difference in turning while wearing the lenses. With the lenses or without, dizziness never became a factor.
On the unever bars, the coach had them work on sole circles, half turn, beat. Gymnast B noted that she did not pull her shoulders in enough when trying the stunt. She also felt that her depth perception was "off" when working on the bars.

After they all worked on bars, the contact lenses were removed, and they repeated the stunts just practiced.

Gymnast A felt little difference. She did note added concentration when visually inhibited. Gymnast B felt that it was easier to judge depth when she was able to see. She said she could "just go for the move, without having to think about it."

Gymnast C said that as soon as the lenses were out, she went right back to her old way of training. Then when she repeated the stunt, she remembered what she thought about when performing with the contact lenses, and it was an aide. Gymnast D said that she would much rather have the contact lenses because she was the "world's biggest chicken." She claimed her vision did not always help.
Gymnast D - Blindfolded--terrible; floor--OK; beam--OK, as long as she knew where the end of the beam was; turns--not seeing didn't effect much, can't see anyway.

6. your awareness of body parts?

  Gymnast A - Helped.
  Gymnast B - Helped.
  Gymnast C - Awareness aided with concentration with contact lenses.
  Gymnast D - More aware of body than I thought would be.

7. Did you feel that the contact lenses caused you to think about your eyes more, or were you perhaps constantly aware of their presence?

  Gymnast A - Could forget about it.
  Gymnast B - Given time--not thinking about them.
  Gymnast C - Got used to them.
  Gymnast D - Didn't think about eyes much.

8. Were you better able to assess what "body parts" were causing your problems in performing your moves or were your better able to "monitor" body parts to gather information as to where the move was lacking in execution?

  Gymnast A - More helpful.
  Gymnast B - No effect.
  Gymnast C - Just helped because of concentration.
  Gymnast D - More conscious of it.

9. Do you feel your abilities could be improved if enough time was spent practicing with the contact lenses?
TABLE 4
POST-STUDY SURVEY

What effect did wearing the "fogging" contact lenses have on . . .

1. your ability to concentrate on the move you were performing?
   Gymnast A - Better, not watching other things.
   Gymnast B - Helped.
   Gymnast C - Helped concentration.
   Gymnast D - Had to concentrate more with contact lenses; easier to forget about surroundings.

2. your timing or rhythm?
   Gymnast A - Slower, but intermediate.
   Gymnast B - Threw timing off, floor faster, beam slower.
   Gymnast C - Didn't bother.
   Gymnast D - No effect.

3. your ability to inhibit fear?
   Gymnast A - Less afraid with contact lenses.
   Gymnast B - Helped.
   Gymnast C - Fearless.
   Gymnast D - Fearless, especially bars and beam.

4. your ability to judge distance? (spatial localization)
   Gymnast A - Less able to judge distances.
   Gymnast B - Diminished depth but not necessarily bad.
   Gymnast C - Bars, hard to judge distance.
   Gymnast D - Hard.

5. balance?
   Gymnast A - Detrimental to balance.
   Gymnast B - No effect.
   Gymnast C - Little different, couldn't spot.
Gymnast A - Yes, at times.
Gymnast B - For certain events (floor).
Gymnast C - Yes.
Gymnast D - Yes.

10. Do you feel this technique of visual inhibition would be helpful to a beginning gymnast?
   Gymnast A - Yes, beginning gymnasts need to be more aware.
   Gymnast B - Yes, because of fear inhibition.
   Gymnast C - Yes.
   Gymnast D - Yes, in time.

11. Do you feel there were moves that are so dependent on good vision that proper execution could not be achieved with the fogging contact lenses?
   Gymnast A - No, except for superior difficulty moves.
   Gymnast B - None that we did--but if in shape, yes!
   Gymnast C - True, vaulting, somersaults on bars.
   Gymnast D - Yes, you could.

12. When the contact lenses were removed, did you feel that you were able to transfer any abilities that you learned and intermix them with vision?
   Gymnast A - Yes.
   Gymnast B - Could transfer.
   Gymnast C - Transfer some.
   Gymnast D - Could transfer--first time without lenses, went back to her old way. Then I remembered what I felt with the lenses, and applied this on repeating the stunt.
## TABLE 1

<table>
<thead>
<tr>
<th>Age</th>
<th>Years experience as a gymnast</th>
<th>Worked with a gymnastic's club</th>
<th>Taught gymnastics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnast A</td>
<td>22</td>
<td>8 years</td>
<td>yes</td>
</tr>
<tr>
<td>Gymnast B</td>
<td>19</td>
<td>3 years</td>
<td>no</td>
</tr>
<tr>
<td>Gymnast C</td>
<td>19</td>
<td>7 years</td>
<td>no</td>
</tr>
<tr>
<td>Gymnast D</td>
<td>18</td>
<td>6 years</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>Refractive Error</td>
<td>Soft contact lens</td>
<td>Visual Acuity</td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Gymnast A</td>
<td>OD +0.50</td>
<td>+ 11.00 B3</td>
<td>6/200</td>
</tr>
<tr>
<td></td>
<td>OS +0.25 - 0.25 x 170</td>
<td>+ 11.50 B3</td>
<td>5/200</td>
</tr>
<tr>
<td>Gymnast B</td>
<td>OD -0.25 - 0.50 x 80</td>
<td>+ 11.00 H3</td>
<td>6/200</td>
</tr>
<tr>
<td></td>
<td>OS -0.25 - 0.25 x 60</td>
<td>+ 11.00 N</td>
<td>6/200</td>
</tr>
<tr>
<td>Gymnast C</td>
<td>OD -0.50 DS</td>
<td>+ 10.50 F3</td>
<td>6/200</td>
</tr>
<tr>
<td></td>
<td>OS -0.75 DS</td>
<td>+ 10.00 F3</td>
<td>6/200</td>
</tr>
<tr>
<td>Gymnast D</td>
<td>OD -2.00 - 0.25 x 180</td>
<td>+ 8.50 F3</td>
<td>7/200</td>
</tr>
<tr>
<td></td>
<td>OS -1.50 - 0.50 x 175</td>
<td>+ 9.00 F3</td>
<td>7/200</td>
</tr>
</tbody>
</table>
C. DISCUSSION

There is no denying that the development of gymnastic skills involves a universe of abilities which include physical and mental abilities, psychological set, individual initiative and motivation not only from the individual gymnast but also from significant others such as team mates and coaches. The investigators of this study readily acknowledge the subjectivity of this project with respect to the questions put to the subjects and their respective answers to the questions. However, this does not necessarily invalidate the results and conclusions about to be presented because the investigators believe an individualized and subjective approach is the only way to address this study.

In the formation of this study the investigators decided not to include the vaulting event. This decision was made after analyzing the visual requirements needed to perform on the vaulting apparatus and projecting the possible risks involved to the subjects if they were to vault with inhibited vision. To perform a vault in gymnastics, the gymnast must run at top speed towards the apparatus from a distance of approximately 50 feet, transfer the momentum that has been built up from the approach to a spring board or rheuter board, make contact with the apparatus, then execute a maneuver in mid-space before making a landing involving extraneous movements or steps. To perform on the vaulting event the gymnast must have good distant visual acuity, good dynamic visual acuity, good spatial awareness, adequate accommodative facility to allow the individual to focus from infinity to arms
length when the individual is approaching the object as opposed to the object approaching the individual, and an inhibition of fear. It was felt the fogging lenses would be too degrading to distance and dynamic visual acuity, and fear could easily be enhanced rather than decreased when performing the vault. Since the investigators projected that the other three events would lead to sufficient data and involve fewer risks, the vaulting event was excluded from the study.

Before the discussion can continue the reader must be reminded of the main objectives of the study. The investigators are seeking an answer to the question of how important or necessary the visual system is in the development of gymnastic skills. Would the inhibition of vision enhance the gymnast's training program? These basic questions are most appropriate to this individual study in their specificity and application but stem from a much broader thesis concerning the functioning of the visual system. A broader, more universal thesis could be introduced with the following questions:

Does the visual system have the ability and "will" to capture and retain more sensory data than is necessary to perform a specific maneuver? Can this "overload" of visual input possibly pre-empt data gathered by other senses which might be more useful to the gymnast in performing the maneuver in question? If this "visual will" does indeed exist, can it be identified, labeled, and disciplined via conscious control in such a way that other sensory detectors can more effectively contribute input to elicit the most appropriate responses?
The reader may question how these more broad questions relate or are applicable to this study. The investigators submit the following:

A mode of behavior had to be chosen where there is much environmental and intrinsic stimuli (including visual) and where the individual must consciously and unconsciously make willful and reflex responses to the stimuli so as to satisfactorily achieve this mode of behavior. The responses of the individuals would then be contrasted by eliminating some or all of the visual stimuli. If the responses were more appropriate or efficient in one achievement of the behavior than in the other then certain contemplation would lead one to question the subjective advantage of achieving this mode of behavior with or without vision. Because of the investigators background and interest, the mode of behavior that was selected was gymnastic performance since much sensory input must be processed and many physical and mental responses must be made to achieve this mode of behavior. The matter of eliminating visual input had to be considered carefully. Complete visual inhibition would be too hazardous during a gymnastic performance. The investigators therefore defined visual inhibition "as the amount of photosensory and perceptual stimuli that could be eliminated but still allow for the individual to use gross object blur interpretation as a primary source of visual input." The limitation was quantified in terms of reduced visual acuity. If visual input could be limited to the amount as defined in the above,
what sort of responses could be anticipated with respect to superior gymnastic execution? By following this protocol, we learn the influence the visual system has on the input, processing, and responses made to achieve a very specific mode of behavior, i.e., superior gymnastic execution.

Even the casual reader should question whether or not a conclusion can be drawn from this study alone considering the limited number of subjects and the format of the methods themselves. It would be more appropriate to label this project a pilot study since the proposed questions can not be conclusively answered but instead, the flavor of the answers sampled.

Concerning the mechanism for inducing myopia, the investigators decided on hydrogel contact lenses for many reasons. The hydrogel lenses would afford little if any retinal image magnification as compared to spectacle lenses of the same dioptric power. Spectacle lenses would also be awkward and inhibiting to gymnastic performance. The ease of hydrogel adaptation and comfort by the subjects would also be superior to non-flexible corrective contact lenses.

Concerning the powers of the hydrogel lenses used in this study, the reader is referred to Table 3. Although the investigators planned to use powers of +10.00 diopters over the distance refractive error for each gymnast, this was limited to the availability of the hydrogels in the trial lens series of the Pacific University clinic. The amount of induced myopia extended from +10.62 D to +11.87 D. Distance Snellen acuity ranged from 5/200 to 7/200. The investigators felt these were acceptable ranges since the amount of induced myopia was arbitrary as long as the basic premise of inhibited vision without the elimination of gross blur interpretation was the status of the subject's visual systems.
D. PRE-STUDY SURVEY DISCUSSIONS

The pre-study survey was constructed to receive information concerning the subject's knowledge of what we proposed to investigate in the study. This was done because the main thesis of our study has been introduced into small esoteric circles within the gymnastic community of followers and participants. The philosophy of relying on bodily cues to achieve superior execution is not an original idea and stems most rigidly from participants of the trampoline where the term "air sense" was first employed. Within the milieu of the gymnastics community, training techniques and philosophies are rarely documented. Therefore, it is mandatory that this study define what is meant by air sense and to investigate the relationship between air sense and the monitoring of bodily senses.

The first two questions of the pre-study survey investigate what the subjects know about the term "air sense". The first question involves what the participants bring with them concerning their individual definitions of air sense and the second question involves consenting to a common definition for the purpose of the study. The definition of air sense as defined in question two makes no reference to vision. The reason for this is important. It is the assumption of the investigators that superior execution can better be achieved if the gymnast can expand his/her mental awareness to assimilate as much input as possible from body parts, positions, velocity, direction, etc. The axiom that follows from this would be: "the greater the quantity and variety of input, the
more able the individual will be to make appropriate responses assuming all the input can be processed." This is the essence of air sense; to utilize all appropriate stimuli effectively to achieve a superior performance. Therefore, air sense is the gymnastic term for monitoring bodily senses.

This naturally leads us to the first question in this study. What effect does the assimilation and processing of visual input have on the quantity and variety of processed input from other sensory sources.

To investigate our subjects' opinions of the validity of the investigator's assumption we ask in question three of the importance of a) air sense, and b) vision with respect to the individual gymnast. All the subjects agreed that it was important for a gymnast to have a well developed air sense while no subject indicated that an acute visual sense was important. This is probably a reflection on the individual gymnastic histories of the subjects, as more that one subject responded that it is more reliable or important to orient oneself during a gymnastic move by using air sense rather than vision.

Question four was our attempt to quantify the comparative importance of air sense or vision using units of individual moves where either air sense or vision would be more helpful or essential. All but one of the subjects responded that a larger percentage of their individual moves were more dependent on air sense than vision. Once again this probably reflects on how these gymnasts received their past training with respect to orientation or security during an individual move.
Question five was included to sample if visual input leads to adverse consequences or is an obstacle in gymnastic performance. The responses to this question were quite revealing and focused on a specific aspect of psychological relevance involving gymnastics and vision. All but one of the subjects responded that visual input can be detrimental but more interestingly these subjects exclusively associated visual input with fear. Without consultation these three subjects all felt that visual input restricts or limits the execution of their performance by intensifying negative emotions towards physical harm. From this response alone we can surmise that vision has a greater effect on the psychological set of the gymnast as opposed to the effects on the physical execution of a move.

Question six attempts to expose the subject's previous training techniques in terms of specific examples. The subjects were asked to give an example of a past training technique where visual attention was emphasized and also their opinion on how successful this training technique was. Conversely the second part of question six asked the same of training techniques were vision was not the primary focus of attention.

All the subjects were able to recall an example of a technique where vision was most helpful. From the responses it seems that vision is used as an orientation technique or as a technique to improve the height or fullness of a move. The word "spotting" was used by every subject which required an explanation for the reader.
When a gymnast spots during execution she is directing her focus or awareness to any assigned object in her line of sight usually immediately before or immediately after the actual physical explosion of a move. By spotting an object it is thought that the perception of "horizontal", "vertical", and how the body relates to the horizontal and vertical will be set or locked into the gymnast's cognitive pattern so that during the most intense or concentrated physical effort of the move, where spatial awareness may be warped or thwarted, the gymnast still retains a positive or true conception of bodily orientation. This spotting technique would therefore consume the cognitive processes before the initiation of a move and after the completion of a move to prepare the gymnast for either a subsequent move or perhaps a dismount (landing).

The other was that vision is used as elicited by the responses of the subjects is to contribute to the virtuosity of a move by improving on the height of wholeness of the move. In this technique visual awareness is focused on an arbitrary object or perhaps a spot on wall or ceiling. The gymnast must then strive to align her body or position certain parts of her body in the same direction or at the same height or the arbitrarily assigned spot. Once again there is a setting or locking phenomenon involved. If, first, vision can identify a spot to strive for then direct the body to strive for alignment or orientation with respect of this spot it is felt that superior execution will pursue.

It is interesting to note that one subject was aware of the habitualization of the spotting technique. She noted that the
spotting technique is beneficial when training in one particular gym or area but necessitates readjustment when performing in a foreign or unfamiliar setting.

The responses of the subjects concerning examples of training techniques where vision was not important all seemed to converge on a single concept. All the subjects were able to site examples where the focus of awareness was on "feeling the body performing the move" and agreed that this technique was successful for these examples. The common concept seemed to emerge that the bodily awareness technique was most helpful during moves where the intensity of the physical effort eliminated the possibility of using vision as a guiding of setting phenomenon. There exists certain maneuvers in gymnastics where the body is spinning or twisting at such a velocity or is positioned in such a unique way that no visual input can be assimilated or processed. During these concentrated efforts there exists a potential void of awareness where the gymnast may loose orientation. It is the technique of "listening to body cues" that once again contributes to the gymnast's sense of security, sense of set, or sense of orientation so that the gymnast will not have to wait out this void until re-orientation through vision can once again be employed. All the subjects agreed to the validity of this technique.

The responses to both parts of questions six seem to generate naturally succeeding questions. It is presumed that a gymnast would be better able to execute a superior performance if, to state it loosely, she "knows where she is" at all times during a performance.
There is a need to always have a sense of orientation or to fill a void of awareness to achieve superior performance. Does this not naturally conclude an association of the two techniques responded to in question six? It would seem most beneficial to use vision to set the gymnast with respect to orientation immediately before and after initiation of a move and then switch modes of awareness to bodily cues during the physical effort of the move so that there is never a void during any part of an individual maneuver. This analogy can serve as the cornerblock for which to strive but first there are other questions concerning how this awareness of intrinsic stimuli can be developed or enhanced.

Question seven was a straightforward investigation concerning the benefits of incorporating a training program aimed at developing an air sense. All the subjects agreed it would be beneficial and two of the subjects added supplementations. Subject C remarked that an air sense would be a more universal technique and remarked that an individual participant may be "thrown off" if she relied on visual cues only when performing in an unfamiliar gym or setting. Subject D commented on the benefits of self-evaluation that one can employ by using air sense. If the gymnast can develop an air sense to such a degree that all body parts are monitored, then when performing a move there may be less of a need for an observer to contribute an opinion about the execution. The gymnast could be able to assess the execution of a move by the way it felt to her, providing that she has developed a sense of what superior execution feels like.
From the pre-study survey the investigators learned many psychological and physical ramifications associated with achieving a behavior either with or without the help of the visual sense. A summarization of the investigator's interpretation of the pre-study survey would proceed as follows:

In this specific mode of behavior of gymnastic activities we begin to learn the capabilities of the visual sense and other sensory and perceptual detectors. We also learn how these gymnasts could utilize and would like to utilize many different sensory detectors during their routines. We learn that in the gymnasts' perception of how they use their vision or emphasize their vision is as a setting/locking or as an orienting phenomenon where she abstractly takes a picture of her surrounding and then acts to keep oriented with that picture until another visual picture can be taken. The way these gymnasts use or would like to use their bodily senses such as kinesthetic, vestibular, and other intrinsic senses is as a security hold so that an awareness of "where the body is" or what the body is doing is always present.

We also get suggestions from these gymnasts that visual dependency may act as a detriment in the respect that vision may be unreliable or that vision may enhance negative emotions like fear, apprehension, or anxiety. All the gymnasts felt it was beneficial to have a well developed air sense but not so for vision.

From the pre-study survey we as investigators felt from the responses of the subjects that there is a lack of development of
air sense. Even though the visual sense contributes input for the betterment of the performance it is our interpretation that the weak link is the development of air sense. If we were setting out to make a comprehensive training program aimed at enhancing the input gathering processes of the many sense modalities to achieve gymnastic performance then the enhancement of vision must also be included. However in this study the investigators were particularly intrigued with the weak link, i.e., development of air sense and therefore attempted a method of intrinsic sense awareness by incorporating a training program involving inhibited vision and techniques to make the gymnast more aware of her body through intrinsic senses.
E. METHODS DISCUSSION

There were many ways in which the methods of this study could have been manifest. There however, were also many limitations that the investigators had to contend with during the methods of this study such as time, a facility, number of subjects and motivation of the subjects. We therefore set limits as to where, when, how, and for how long, and proceeded to gather information from there.

We as investigators defined for ourselves only one purpose for the methods study. This purpose was to enhance the gymnast's awareness of bodily senses while the vision inhibiting lenses were worn and therefore begin to develop air sense. For five training sessions we saturated the gymnasts with training techniques involving balance, spatial awareness, and enhancement or monitoring of kinesthetic feelings, while deterring or under emphasizing vision. A more detailed account is included in the methods section. Even in this short study period much was learned from the gymnasts concerning the effects of inhibited vision and the benefits of a well developed air sense. This was learned via the responses of a questionnaire presented to the participants after the five day training program was completed. The responses of this post-study survey follows.
F. POST-STUDY SURVEY DISCUSSION

The post-study survey was constructed not so much as a parallel to the pre-study survey but rather as an extrapolation of it as molded by the methods themselves. The most difficult part in the construction was adhering to a limit on the number of questions used. The investigators had difficulty in focusing and aligning the questions so as not to deviate into tangents or investigate areas not originally designed by this project. But since our thesis is broad enough, we felt any number of questions could be appropriate. Therefore we chose twelve questions that would lighten the burden on the investigators of validating or negating this method of visual inhibition by forcing the participants to answer our questions in lieu of us.

The first six questions directly asked the effect of inhibited vision on certain physical and mental abilities needed for a gymnastic performance. Question one asked of the effect the contact lenses had on the gymnast's ability to concentrate on the particular move they were performing. All the subjects responded that concentration was easier or that the contact lenses necessitated a higher level of concentration. These responses could be interpreted in two ways. Either the inhibited vision truly demanded a keener sense of concentration, a heightened awareness for a need to concentrate, or because of the attention given to the gymnasts by participating in this study. The subjects put in their best effort by adhering to a rigid discipline of highly focused concentration. It is impossible to surmise what the underlying reason was for an awareness
of higher concentration. It is suffice to know that a change in mental concentration was involved along with a change in visual status and coaching technique (attention). Obviously all three are interrelated.

The responses to question two concerning the effect of inhibited vision had on timing and rhythm were split. Half the gymnasts responded that there was no effect while the other half felt their timing and rhythm was thrown off by their blurred visual status. Here we learn that for some individuals a keen visual sense must be related to some internal clock. For these individuals the timing or rhythm mechanism that was learned was probably a response to visual stimuli. A reaction must have been learned that when the environment is seen then the clock can proceed. In this method of visual inhibition the internal rhythm clock must not have been started as the gymnasts felt the maneuvers "came upon" them too fast or too slow leaving the gymnast unprepared to react or set herself for the present maneuver or subsequent maneuvers.

Question three asked of the effects blurred vision had on the ability to inhibit fear. A unanimous response by the subjects was that inhibited vision made them feel fearless. An interpretation of this response could be, "what I don't know or can't see, can't hurt me". Since the gymnasts have had experience on each apparatus they have experienced certain fears and apprehensions particularly concerning falling off the apparatus. However, with blurred vision the subjects must rely on a self-security system where priority is given to feeling the moves. In this way the gymnast
can be set free from apprehension because there is no room or
time to let in negative emotions or think about anything but
the execution of the present maneuver.

The fourth question asked for the effects of inhibited
vision on the subjects' spatial location. Spatial location in a
gymnastic sense would mean how the gymnast can perceive the dis-
tances as well with inhibited vision since the visual sense is
the primary cue for this ability. At first consideration this
may seem a blatant mark against visual inhibition as an aid to
execution but as one gymnast responded, the ability to judge
distances is diminished but this diminution is not necessarily
bad.

If we think about the stand that was made concerning inhibition
of fear we can see that spatial localization and fear inhibition
are related. If the gymnast is less able to judge distances then
her perception of how far it is to the ground will also be affected.
In this way no apprehension or fear may be experienced since no
danger is perceived. Also a keen sense of spatial distances may
not be a priority since with inhibited vision the emphasis is now
on internal execution. If the gymnast can project where the
apparatus is and the relationship of herself to the apparatus
at any given moment then at the moment of contact with the
apparatus she will begin to learn where her execution is lacking.
If she makes contact with the apparatus sooner or later than
what she is expecting then there is a lack of preparedness. If
the gymnast is initiating a move that necessitates making contact
with the apparatus it would be beneficial if she not begin that
move until the instant of contact. If during the transition between
two moves she is overly aggressive or too passive the previous
move or the transition will suffer in execution. But if there is
a diminuation of the ability to judge distances, all the gymnast
can do is dwell on the immediate present being sure that she is
in good position during every instant of time so that each transition
is full and complete until contact is made with the apparatus and
an initiation of the subsequent move can begin. This is a phenomenon
that must be learned. When vision is not inhibited the gymnast
may proceed from one individual move to another using spatial
localization to aim for and segregate each move. But when spatial
localization is diminished the gymnast can do very little but make
every instant a maxim of execution until the next move is upon her.
In this way the entire routine becomes smooth and controlled and
a much more complete presentation.

The effect of inhibited vision on balance was asked in question
five. Half the subjects stated there was little effect while the
other half commented that the effect was detrimental to balance.
This split of opinion can be explained perhaps by examining how
balance is sustained with or without the help of vision. For the
gymnasts who said that the effect on balance was detrimental is
interpreted by the investigators as using vision in a feedback
system. If they see their world tilted or can spot some object in
their environment that should be upright but is not, then these
individuals will register this as off balance. Since with
inhibited vision these clues are no longer reliable the gymnast feels her balance is jeopardized and consequently feels off balance if she can not see how she is orienting herself to her environment. Her balance is therefore environmentally controlled through her visual sense. In contrast the gymnasts who felt there was little or no effect on balance is interpreted by the investigators as meaning that these individual's balance must be monitored by an internal mechanism of feeling certain forces on their body. This would necessitate a strong sense of "mass-center" be established by the gymnast along with a strong concept of bilateral and horizontal axes for her individual body. When there are unequal forces acting on her body either by gravity or by self initiated centrifugal force the gymnast will feel off balance and will adjust whatever body parts need to be adjusted to symmetrize the forces on her body. This method of sustaining balance is independent of vision and can still be employed when or if vision is degraded or unreliable. An example would be when the gymnast finds herself inverted during a move must must still sustain balance. We can label these two method of sustaining balance as egocentric or environmental. It would seem advantageous for the gymnast to balance herself egocentrically since in the peak of a difficult move vision may be suppressed or too degraded to be useful.

The sixth question of the post-study survey asked the effect inhibited vision had on the gymnasts awareness of body parts. All the gymnasts responded that they were more aware of individual
body parts when vision was inhibited. This seems logical since little information could be received via the visual sense. Whether or not the gymnast felt it was beneficial to be more aware of their body parts must go uninvestigated since the subjects were biased in their opinions by the training techniques themselves.

The seventh questions asked the subjects of the awareness they had of the presence of the contact lenses. This was done to investigate how adaptable the gymnasts were to the wearing of corneal lenses while performing gymnastics. Here the investigators were looking to find if the performances that were observed were typical of an average training session or if the actual wearing of corneal lenses effected the behavior of the subjects just by being present. If the gymnasts responded that they were constantly aware of the lenses then certain reservations must be interjected concerning the elicited behavior. However, all the subjects responded that they were able to adapt to the wearing and were able to forget about any discomfort that may have been experienced. Therefore we feel correct in assuming that the behavior that was observed was not influenced by the actual wearing of the contact lenses but only by the visual status change afforded by the doptric powers of the lenses.

Question eight asked of the subjects their ability to monitor body parts to the extent that they were able to assess where the move was lacking in execution. All but one of the subjects responded that they were better able to monitor what body parts
were lacking in execution. The one gymnast who did not respond in this way felt there was no effect on her self-assessment. This exception is remarkable since the five day training session included coaching techniques where the investigators pressed the individual gymnasts to feel what body part was lacking in execution. After an individual move was completed by each gymnast criticism was given concerning what part of her body was lacking in execution. The gymnast would then repeat the move but this time feel the particular body part that did not attain superior execution and attempt to correct this shortcoming by emphasizing correct placement of that particular extremity. This training approach could most likely be executed without any sort of visual detriment and it is the training approach itself that is being evaluated in this question. The investigators felt however that the vision inhibiting contact lenses would screen out much "visual noise" and place the gymnast in a circumstance affording better evaluation of bodily movement. Therefore it is remarkable to note that through the training sessions three out of the four gymnasts were made to feel they could assess bodily movements better but that this assimilation is an individual phenomenon and not all the subjects were able to learn this new training technique.

Question nine asked the gymnasts if they felt their gymnastic abilities could be improved if enough time were spent in practice sessions similar to the sessions of this study. This question had to be asked because of the limitations manditorily placed on the longevity of this study. We felt it would be impossible to think
a change in practice behavior or training philosophies could be achieved in a mere five day training program. Therefore we asked the subjects to project the outcome of a longer termed training session. All of the gymnasts responded that their abilities could be improved if enough time was devoted to training sessions similar to those experienced in this study. Two of the subjects added qualifications regarding the nature of certain events and certain times. This probably reflects the essence of the training technique where there are times when good vision is mandatory. This training technique would therefore not be beneficial during those times (i.e., dismounts, superior difficulty moves) or more beneficial on one apparatus than another in the opinion of the subjects.

Question ten asked the subjects if they felt this technique involving visual inhibition would be helpful to beginning gymnasts. All the gymnasts felt it would be beneficial to a gymnastic beginner and two of the subjects commented with supplantations. One subject felt it would be beneficial because beginning gymnasts need to be more aware of their form during execution and this technique places priority on control of form. Another subject commented that this technique would be beneficial because beginning gymnasts need to control or suppress apprehension towards a move and this technique is good for learning to inhibit fear. The investigators believe it would be impossible to project how a beginning gymnast would respond to a training program similar to the one designed by this project. We project that a certain amount
of gymnastic maturity in the direction of mechanical execution must first be obtained before an abstract concept like "listening to your body" can be conceived. However, as soon as the proper form of a move is understood by the beginner a training program such as this could be beneficial in our opinion.

Question eleven sampled the opinions of the subjects with respect to certain moves that are so dependent on good vision that proper execution could not be achieved with severely blurred vision. All the subjects, save one, commented that there are certain moves that could not be perfected by this technique of visual inhibition. Examples include superior difficulty moves, moves on the vaulting event or moves attempted by a gymnast who may be out of shape or ill prepared to attempt such moves. These three opinions are shared by investigators. We concede that this technique is not useful or is too riskly in the execution of some superior difficulty moves, dismounts or moves requiring a total release and re-grasp of the apparatus.

Question twelve asked the subjects if they were able to transfer any abilities that they learned with inhibited vision when on the last part of training session number five the contact lenses were removed. All of the subjects commented that the abilities or the mental approach they learned through this project could be utilized either completely or partially without the presence of the contact lenses. One subject commented that when the contact lenses were removed she reverted back to her previous habitual
training style of execution. However, on repeated attempts of the same move she could actively focus her attention in a way consistent with the training technique she had just learned therefore exhibiting an ability to transfer. We were pleased to know that a transfer could be obtained after removal of the contact lenses but believe there must exist an extinguishing phenomenon if the technique of intrinsic awareness is not emphasized or prioritized. As with any learning method, application must co-exist with theory to habituate the behavior.
G. CONCLUSION

The reader is reminded that this study was designed to investigate the role the visual system plays in the first step of gymnastic ability development--the monitoring of all bodily senses. It is the hypothesis of the investigators that if visual input can be inhibited and awareness of all other bodily senses be enhanced, the gymnast will be in a better position to monitor these cues and receive feedback as the where and how she is falling short of superior execution.

For the subjects in this study, we can conclude that visual inhibition helped their concentration, helped inhibit fear, made them more aware of body parts during activity and gave them a better ability to monitor the posture of body parts. In contrast, the subjects felt visual inhibition deterred their sense of spatial localization and were split in opinion as to the effect visual inhibition had on timing/rhythm and balance. Therefore, we have made these four gymnasts more aware of at least four senses that contribute to gymnastic ability development but in the process have deterred one. We feel confident in saying that the technique of visual inhibition can make the gymnast more aware in the confines of our study but many factors must still be investigated as far as utilization of this new awareness.

We do, however, feel that there is a merit to this technique as expressed by the subjects who felt that if enough time were spent with beginning gymnasts, abilities could be shown to improve and be more consistent. However, the subjects felt that visual inhibition could not be substituted as a universal technique since many maneuvers could not be executed by this technique.
A literature search was conducted during the course of our investigation. Hundreds of articles were found in the areas of sports and vision. None of the articles that were found pertained directly to our study. We hope that our study can generate more interest in this same area so that the benefits of visual inhibition as it applies to sports performance can be fully investigated and documented.