Envisioning the Mind:
Children's Representations of Mental Processes

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(ABSTRACT)

Inspired by writings on creativity and by Howard Gardner′s theory of multiple intelligences, I conducted a series of ten ″exercises″—each of them a guided visualization followed by an opportunity to produce art—with nine- and ten-year-old students. The visualizations, which were designed to encourage the students to explore some of the many ways our minds have of knowing and learning, began with a simple relaxation exercise and proceeded to more challenging exercises involving, for instance, kinesthetic learning, sensory awareness, the logical and linguistic mind versus the spatial mind, and intra- and interpersonal intelligence. Following each visualization the students discussed what they had experienced (transcripts of the visualizations and the discussions are included in the thesis). The students responded in visual terms as well: after each visualization, each student created a two- or three-dimensional piece of art from materials such as matboard, construction and origami paper, glue, felt-tip pens, pipe cleaners, and plastic-coated wire. These visual responses have been photographed, described, and scored according to the number of materials used, the number of colors used, and the dimensionality of the piece (photos, descriptions, and scores are included in the ″Gallery″). I found, surprisingly, that the visualizations in which the students were the most imaginatively engaged did not always produce the most interesting art, and that girls were much less likely than boys to create three-dimensional pieces, although girls tended to use more colors and occasionally used relief on otherwise two-dimensional pieces.

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Introduction

0.1 Overview: The Use of Multiple Intelligences in Architecture

For those in any profession, a unique array of skills is essential. Many would argue, for example, that a musician must have a special attentiveness to sound, including a sensitivity to pitch and rhythm. In a musician likely to achieve excellence, that attentiveness to sound might well be accompanied by a keen awareness of others (fellow orchestra members and the audience), or perhaps by a talent for turning that awareness inward when focused intensity is needed. The array of necessary skills might be quite different for a visual artist, a writer, a teacher, or an architect.

For an architect to become successful, in fact, an unusually wide range of skills may be required. The list of skills—or, more accurately, the list of strategies, approaches, or modes of communication—that an architect needs certainly includes:

- Spatial analysis and visualization, with an ability to create visual products that communicate this spatial sense
- Verbal skills for oral and written communication with clients, team members, public officials, and contractors
- Logical and mathematical accuracy

For an architect designing specific types of buildings, the list would almost certainly also include:

- Acoustic and auditory sensitivity
- Kinesthetic feeling for how people will move in the space

The Harvard educator, psychologist, and cognitive scientist Howard Gardner proposed in Frames of Mind (1983) to call these skills, strategies, and approaches "intelligences." I will do so here, setting aside any discomfort I feel about the idea that there are many separately measurable intelligences, in order to fully explore his theory in relation to education and design. At the time, Gardner specified seven intelligences, although he mentioned then that there might well be additional ones. (Since then, and since the time at which I conducted the classroom exercises for this study, Gardner has published an eighth, the "naturalist intelligence," which he describes as an ability to recognize and categorize features of the environment.) According to Gardner's theory, the seven intelligences are:

- **Linguistic intelligence,** which involves using language to accomplish goals, remember information, and express oneself. This has typically been valued in schools and, as I noted above, is also essential to the architect.
- **Logical-mathematical intelligence,** which is the capacity to analyze problems, detect patterns, and reason deductively. Again, this is valued in schools and is essential to the architect.
- **Musical intelligence,** which includes the capacity to recognize pitch, tone, and rhythms as well as the skill to perform and compose. This might be essential to the designer of a symphony hall and is useful for supportive acoustics elsewhere.
- **Bodily-kinesthetic intelligence,** which uses mental abilities to coordinate bodily movements, both large and small. A strength in this kind of intelligence might be essential to architects in creating drawings and models as well as in thinking about how people will move in the space.
- **Spatial intelligence,** which involves recognizing and being able to manipulate various sizes and configurations of space.
- **Interpersonal intelligence,** which allows people to work effectively with others.
- **Intrapersonal intelligence,** which involves having an effective working model of ourselves.

My curiosity was piqued. What if a student arrives at architecture school without some of the requisite intelligences? Can these intelligences be taught or enhanced at that point, or is it too late to help the student acquire or develop them? How do these intelligences interact with creativity, the development of which had seemed to me to be a major goal of architecture school? And finally, as the art teacher of five- to twelve-year-olds in an elementary school, I wondered about my own students′ development. What would help them become creative human beings, and could creativity be measured? I hoped that sharing Gardner′s theory with my students would be useful in stimulating creative responses that could be evaluated. To this end, I designed ten exercises, based on the concept of multiple intelligences, to conduct with them.

Kosslyn′s studies comparing the three-dimensional rotation abilities of adults with those of children of various ages (1980) indicated that my nine- and ten-year-old students should be similar to adults in these abilities Piaget and Inhelder′s work with spatial transformations (1971) provided clues that children of this age would probably be receptive to concepts in this arena. Yet my reading of Bruner (1979) convinced me that there would likely be an order in which Gardner′s intelligences might emerge in a person. It seemed possible to me that my students might not yet have developed certain intelligences to the point that they could grasp information that I planned to present about these ways of knowing. So as not to introduce developmentally inappropriate material early in the sequence, I placed near the beginning the exercises based on ways of knowing and learning that are known to be present even in the very young. Thus the exercises in the study came to have a range of topics inspired by Gardner in an order inspired by Bruner.

0.2 Children and the Creative Mind

Underlying the study was the notion that creativity can be encouraged or invited or taught. Overlapping and sometimes contradictory descriptions of the creative mind by Arnheim (1974), Bruner (1979, 1987), Duckworth (1987), Brittain (1979), Brittain and Lowenfeld (1982), Martin Gardner (1978), and Howard Gardner (1980, 1982) all provided stimulation for this notion. I read that each of us is inherently creative, that we each have the potential to come up with fresh responses to problems, that creativity is as important to the scientist and the mathematician as it is to designers and musicians, that the ability to function creatively is essential both for ourselves as individuals and for society as a whole.

As a teacher, I wanted to be sure that my teaching would bring my students to their own moments of creativity, perhaps identifiable by novelty, abundance, and individuality of expression. Many of the children had been team members in Odyssey of the Mind, a program developed specifically to help children practice creative problem solving. As an Odyssey of the Mind coach, I had seen what astonishingly creative ideas students could come up with if they were relaxed and if they opened their minds to new approaches to problems. Studies referenced by Murdock (1987) have indicated that creativity may be increased by jogging, being in a relaxed frame of mind, or meditating. I hoped during this study to stimulate the creation of artwork that might be measurably more colorful, use materials in a unique way, or otherwise create surprise.

0.3 Guided Visualizations

My use of visualizations for the ten exercises that I conducted with students was inspired by Spinning Inward (Murdock, 1987), which explores the value of guided imagery in helping children with relaxation, creativity, and learning. I had used visualizations from the book in my coaching of Odyssey of the Mind teams with students aged five to thirteen, and had been impressed with the way these sessions seemed to help my teams relax and focus. After a guided visualization session my team members tended to improve specifically in the fluency of their ideas during brainstorming. Following Murdock, I saw the use of guided imagery in the classroom as a way to enhance students′ receptivity to ideas and information that might otherwise seem too difficult to understand. In addition, I was persuaded that guided imagery would enable students to attain a greater level of creativity in expressing their understanding.

Each exercise began with my helping the children to relax their bodies, breathe slowly, and get into a calm state. I handled this process in a variety of ways, depending on the initial state of the group. People often find it easier to achieve full relaxation while

lying down, but the room in which we did the activities was not conducive to lying on the floor, and generally the children sat instead. In a relaxation exercise of this kind, the initial tension is released limb by limb, muscle by muscle. Breathing together, creating spaces to breathe and to pay attention to the breathing amid the instruction, is a crucial part of moving participants toward a calm and receptive state. During the first exercise I allocated more time for bringing the children to a noticeable calmness; later in the series of sessions, the children tended to relax faster, and less time was devoted to this stage. Once the children were relaxed, I introduced the imagery of the exercise. The conclusion brought the children back to an alert state.

Following each guided visualization was a brief discussion during which children described their experience and answered any questions I posed. The guided visualizations and the discussions afterward were taped and transcribed for each of the two classes I worked with; the transcripts can be found in the second and third sections of each exercise.

During the remainder of the forty-five-minute period, the children had a brief period of time in which to make art projects that reflected what they had experienced during the visualization. Generally the time period left for this was between fifteen and twenty minutes. The assortment of materials and tools was constant throughout the study (a list is provided in the Appendix). Each child′s product was photographed, described, and scored (see below for details on the scoring procedure). The works can be seen both in a mini-gallery at the end of each exercise and in a complete gallery, organized alphabetically by student name, immediately following the Appendix.

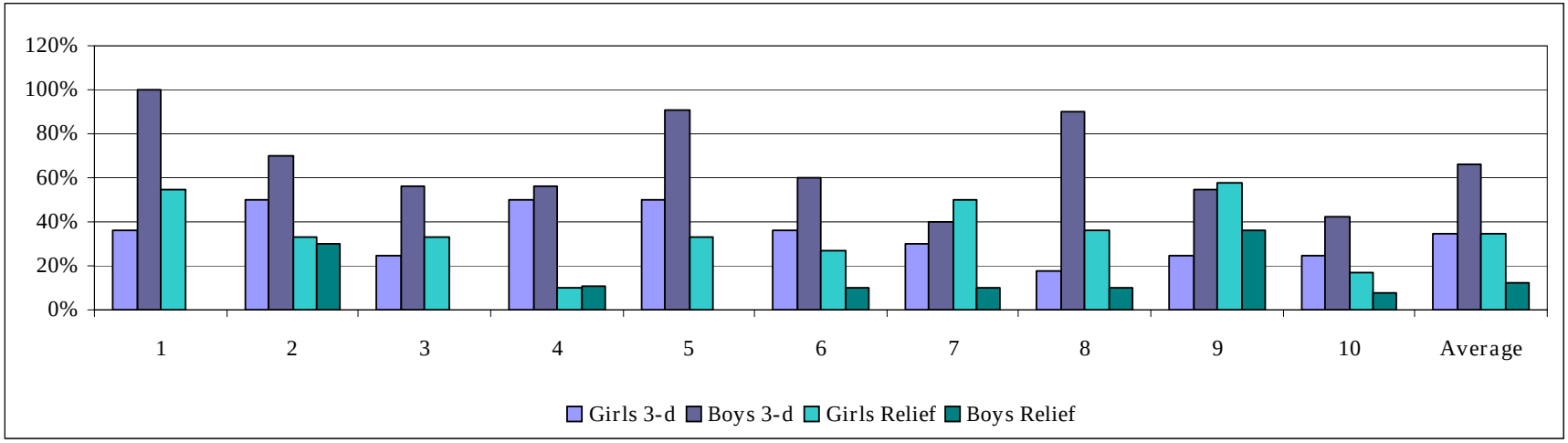
0.4 Discussion of Results

For each exercise, there are two areas of student response that are considered in this study. First, in the discussion following each visualization, the students commented on what they had experienced. These "verbal responses" are included in the transcripts for each exercise (sections 2 and 3), and some of the responses are also quoted in the **Discussion of Results** for that exercise (section 4), particularly in cases where what a student said in the discussion elucidates, or perhaps contrasts with, the piece of art that he or she produced afterward. The verbal responses have not been scored, as they do not provide sufficient evidence regarding the participants′ level of understanding of the material. Second, the students responded in a visual way, each of them producing a piece of art at each session. The "visual responses" to each exercise appear in a mini-gallery following the discussion of that visualization (section 5). In addition, all the visual responses to all the exercises appear together in the Gallery near the back, following the Appendix.

Because of my hypothesis that complexity in a visual response might indicate greater interest, understanding, or creativity on the part of the participant, I scored visual responses in multiple ways. The number of materials used in the production of the piece, the number of colors used, and the dimensionality of the piece were all evaluated.

The materials scores are strictly numerical: a project that used six materials (for instance, railroad board, pipe cleaners, glue, felt-tip pen, origami paper, and string) received a score of 6. The same is true for the colors score: every color was counted, with variations of the same color being counted separately. A project using black construction paper with black pipe cleaners would have been given a score of 2, because the darker black of the pipe cleaner could be readily distinguished from the lighter black of the construction paper.

Dimensionality presented a more difficult scoring problem. A simple (and somewhat simplistic) picture can be gained by looking only at whether a student's product was three-dimensional. Overall, boys made three-dimensional products 66% of the time, with a low score of 40% on one visualization and a high score of 100% on another. Girls made three-dimensional products 35% of the time, with a low score of 18% and a high score of 50%. This difference along gender lines was striking, and there was no reason for it that I could discern. I was interested to notice, however, that many of the two-dimensional pieces had relief. Graph 0.1, below, shows the percentage of three-dimensional projects created by girls versus the percentage created by boys, next to the percentage of projects involving relief for each of the two groups. (In the Discussion of Results within each exercise, a similar graph is shown for easy reference at the top of the section, with the data for that exercise compared to the average data.)

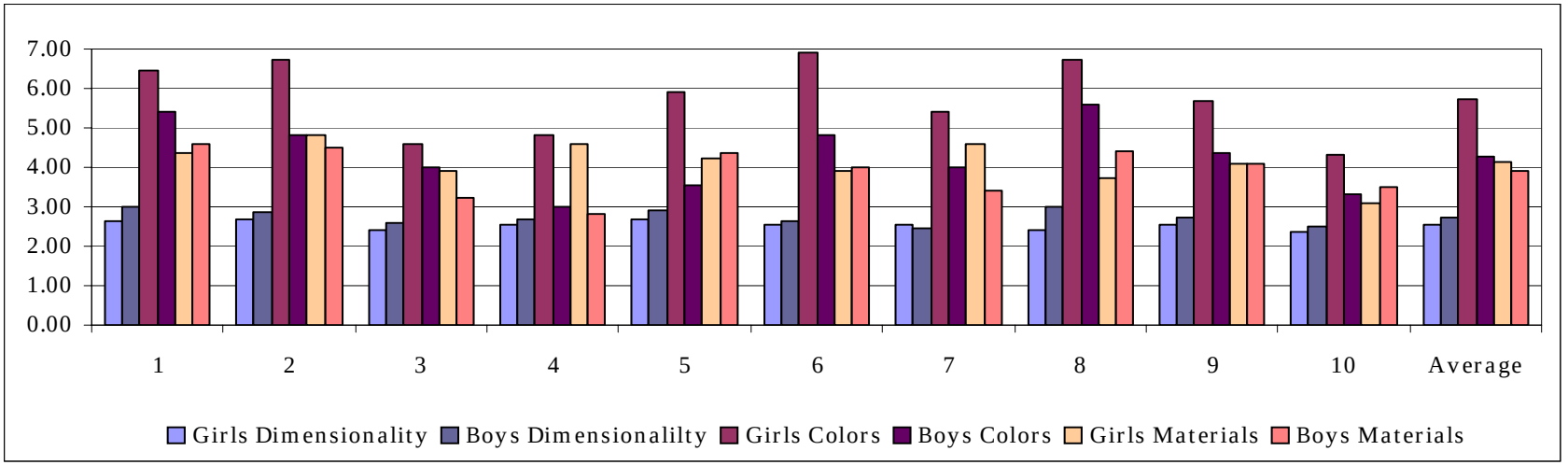


Graph 0.1 Three-dimensions and Relief (Exercises 1 through 10)

Looking for additional insight into the differences between the girls and the boys in their approach to creating art, I felt that it was important to come up with a more complex scoring system for dimensionality, one that reflected other factors. Not only did many of the two-dimensional pieces have relief, but a smaller number of pieces were reversible or had intentionally moving parts. (Note the word "intentionally"—if something wobbled, it was not counted as intentionally moving.) Taking these factors into account led me to give each piece a composite dimensionality score of between 2 and 3.5. A two-dimensional piece received a base score of 2, a three-dimensional piece received a base score of 3, and an extra half point (0.5) was given to a piece that had relief, was reversible, or had intentionally moving parts.

Scores for dimensionality (D), use of materials (M), and use of colors (C) are included in the descriptions that accompany the photographs of the pieces, arranged alphabetically by student name in the Gallery following the Appendix. (The mini-gallery located at the end of each exercise, which is for the reader's convenience in viewing all the pieces made for that exercise only, gives the names of the creators but does not provide descriptions or scores.)

Graph 0.2 shows the results based a more complex scoring system, again from each of the ten exercises, plus the combined average. This more complex scoring adds materials, color, moving parts, and reversibility to the foundation of three-dimensionality and relief. (A similar graph is shown within the Discussion of Results for each exercise.)



Graph 0.2 Dimensionality, Colors and Materials (Exercises 1 through 10)

As Graphs 0.1 and 0.2 indicate, the results from exercise to exercise show neither steady growth nor decline in scores. Possible reasons for the variation of results will be explored in the **Discussion of Results** for each exercise. These reasons include the students' reaction to novelty, their confusion about information I gave within the guided visualization portion of the exercise, their confusion about instructions I gave at the onset of the work period, specific suggestions I made (sometimes unintentionally) in regard to materials, and my mention of the word "model." Despite the variations, there are some patterns as well, especially those having to do with differences between the visual responses produced by boys and the visual responses produced by girls. Simply put, boys were consistently more likely than girls to make three-dimensional products. This difference was surprising to me, in spite of the many studies that would have predicted this result.

0.5 Gallery

The gallery within each exercise contains the visual response of every participant who chose to turn in a project, so that all the visual products from that exercise can be seen at a glance. Descriptions and scoring information are located with the pieces in the **Gallery** at the back (following the **Appendix**). The Gallery is arranged alphabetically by student name; each student's complete collection of pieces, from all ten visualizations, thus appear together.

The caption for each image contains the first name of the student who created it and the number of the exercise. In two cases, students produced two separate responses to the same exercise, so that number is succeeded by (a) and (b). In several cases multiple views are provided; top, bottom, side, and close-up views are indicated.

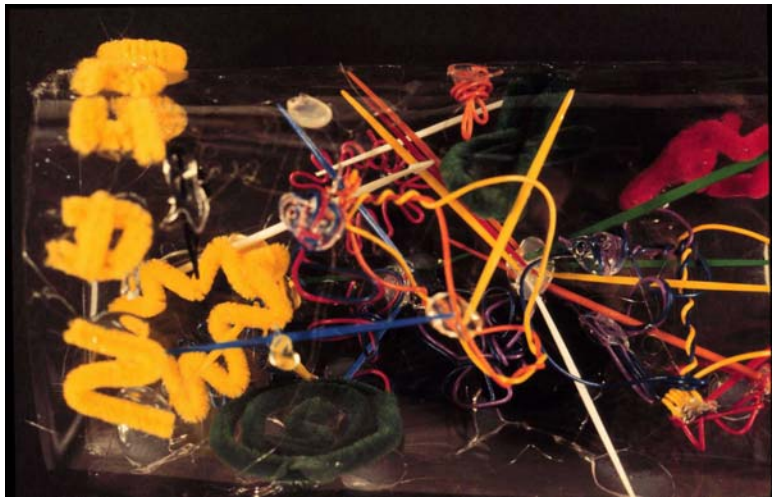


Figure 0.1 **Adrian 1 (Side View)**

Figure 0.2 **Adrian 1 (Bottom View)**

Exercise 1: Relaxation Exercise

1.1 Overview

The first exercise—a modified version of Murdock's "Relaxation Exercise" (Murdock, 1987)—had three purposes:

- Introducing relaxation techniques, including stretching and breathing, to the students.
- Allowing the students to become accustomed to the format of the sessions.
- Familiarizing the students with the materials and tools available for making art after the visualization.

This first visualization shared certain basic characteristics with the later ones. Each exercise began with the children relaxing their bodies, breathing slowly, and getting into a calm state. As the guide, I handled this in a variety of ways, depending on the beginning state of the group. People often find it easier to achieve full relaxation while lying down, but the room in which we did the activities was not conducive to lying on the floor, and generally the children sat instead. In a relaxation exercise of this kind, the initial tension is released limb by limb, muscle by muscle. Breathing together, creating spaces between the instructions to breathe and to pay attention to the breathing, is a crucial part of moving participants toward a calm and receptive state. During this first exercise I allocated more time for bringing the children to a noticeable calmness. Later in the series of sessions, the children tended to relax faster, and less time was devoted to this stage. Once the children were relaxed, I introduced the imagery of the exercise. In this first visualization it consisted of an imaginary trip in on a breath, through their body, to their brain. The conclusion brought the children back to an alert state. (Transcripts of the visualization as it was conducted with each of the two classes are provided in sections 1.2 and 1.3.)

Following each guided visualization was a brief discussion during which children described their experience verbally and answered any questions I posed. For this first exercise I was curious about whether they were able to imagine floating, what they noticed while visiting their brain, and whether they felt especially peaceful or calm at some point during the event. (These discussions were taped and transcribed—see the second half of sections 1.2 and 1.3 for the class discussions about the first visualization.)

During the remainder of the forty-five-minute period, the children had a brief period of time in which to make an art project that reflected what they had experienced during the visualization. Generally the time period left for their art was between fifteen and twenty minutes. The assortment of materials and tools was constant throughout the study. (A list is provided in the Appendix.)

Each child's product was photographed. I have described each one and scored it according to the number of colors used, the number of materials used, and its dimensionality.

For each exercise, in the section following the transcripts I consider the students' verbal and visual responses to the guided visualization (see section 1.4 for a discussion of their responses to the relaxation exercise). The works themselves are presented both in a mini-gallery at the end of each exercise (see section 1.5) and in a complete gallery in the Appendix.

1.2 Transcript of Guided Visualization with Pat's Class

Relaxation Exercise

[Lots of restless behavior; the students take a while to settle on the floor.]

I'm going to tell you a little bit about what we're going to be doing. I'm working on my master's degree in architecture, and for your master's degree you make a book called a thesis. For my thesis, which is really about how to teach people to do design work well, to grow up and be able to think like architects need to think, I started looking at what scientists think about how people think. There are lots of different kinds of scientists who've thought a lot about how minds work, and they're called cognitive scientists. But you can be an anthropologist and also be a cognitive scientist, you can be a psychologist and be a cognitive scientist, you just have to be interested in how minds work. So people have lots of different ideas about it. There's one thing nobody has any disagreements about, and that is: we have bodies and we have brains. [Joking about whether everyone in the class has brains.]

What I'm going to be doing for these ten times we're going to get together is, each time we're going to start with something called a guided visualization or guided imagery, where I'm going to have you shut your eyes and listen to something I'm going to be telling you and try whatever I ask you to do, and it will be different things different times, and after the guided imagery we'll always have an art project where you'll make something pretty fast—not something for weeks and weeks but something in fifteen minutes flat—that shows what you saw, or what you experienced, or what you felt inside your mind while I was taking you through that experience. So you'll make a little model of what you experienced, or a drawing, or you'll write a story, but it would

be especially nice if you'd make a little model. And then I'll use those things that you draw or that you build for illustrations in my book.
So, I want you to sit very comfortably. Today the guided visualization is mostly just a relaxation exercise. We always start visualization by relaxing. And today that's mostly what we're going to do. When we completely relax our bodies, our brains have a chance to work in a different way from the way they work when we're active. Our brain is always sending signals all through our body to tell different parts of us to move. If you want to move your arm, your brain has to tell you to move your arm. It does it very fast and very quietly. Well, if you keep your body very still and very relaxed and you aren't busy thinking about things, it gives your brain a chance to do other kinds of work. (Are you excited by the machine [the tape recorder], Joey? That machine is not as smart as you are.) When we let our brains be calm, our brains have a chance to create lots of images inside of them. I'm hoping, after we finish with this exercise, we have lots of ideas. (Joey, sit back, please.)

All of you, close your eyes. Be very quiet. Feel the weight of your body where it touches the floor. Try to imagine the shape of the part of you that is touching the floor. [Giggling from many students.] Let that part spread out a little bit more. Let your body be still. (Close your eyes, please, and try; I know this is very embarrassing, doing this.) Without moving the outside of your body, tighten all of your toes, see if you can make them tense inside your shoes... OK, and now relax them. Now tighten your whole legs and feet, all the way up... and relax them, letting go of all the tension in them... Now tense your fingers, you can make tight fists if you want to, and tighten your arms all the way up to your shoulders…and let go of them... Now tighten your back and shoulders... and release them... This one you'll like—tense your forehead, scrunch your eyes, and make a terrible, horrible face with your mouth... and relax your face. Keeping your eyes closed, feel your body sitting very still and heavy.

Now breathe quietly, in... and out..., in... and out... Keep feeling your breath. As your breath moves out of your mouth, let other air move into your lungs. While you're breathing in... and out— (You guys are the loudest breathers I've ever heard, can you hear me still? Keep your eyes closed, and I want you to try to imagine something. This is hard. Breathe quietly, and imagine this.) Try to imagine a very, very, very tiny version of yourself, maybe as big as a speck of dust. Try to imagine yourself that little. Let it sort of float around on your breath. Right in front of you. Breathe out and let that little-tiny-speck-of-dust-size-of-you just sort of float on that air. This time, breathe in that air and breathe your self in with it, into your lungs. (A student: Oh, awesome.) In your lungs, imagine that you are in a tiny little boat, that little tiny you, and start traveling through your veins and your arteries. (Can you imagine that? Just feel it. If you're moving your body too much, your brain will have trouble imagining this, so just keep your body still.) Let that little tiny version of yourself keep traveling down your legs, and down your arms, keep breathing, but breathe quietly. Can you let that little boat with you in it drift up to your brain? Your brain is processing more information right now,

even when you are relaxed, than the fastest computers in the whole world. In fact, you are a lot smarter than any computer anyone has ever built. [Giggling and comments.] I'd like you to try to notice the work your brain is doing, just very quietly.

In a minute I will count to six and you will open your eyes. One... two... three... four... five... six...

[Off-topic comments from Jonathan and Joey.]

R: Joey and Jonathan, we've already heard enough from you, I'd like to hear from everyone else about how that was. Real fast, let's go around in a circle. Let's start with Erin.

Erin: That was weird.

R: Could you imagine any of it? Could you let yourself get that tiny? (Joey, interrupting: It makes you smarter.) Was that hard to do?

Erin: No.

R: When you went to your brain, could you see the work it was doing?

Erin: No.

R: You didn't have any kind of imagining about what it was doing? Did any of you have any kind of imagining when you were in your brain?

Joy: One part of each area was full of file cabinets and the other part had a super, super, super smart computer, and each part, one for math, one for dreams one for jokes, so on. They were all full of ideas and they're practically bursting. And the boat I was in was a glass-bottom boat.

Whet: I had a big purple blob, it was my brain working a computer. The boat I imagined was a little rowboat. It ran in the blood. It was brown.

Shannon: I imagined a big thing and I was little and I was in my boat in my blood and my boat was blue, I don't know why it was blue. [Kids giggle about the color.]

R: Your brain does that for you, it's going to make images. I'm not going to say, ever, in any of these visualizations, "Get in a blue boat," or "Get in a brown boat." You can make yourself those things. Your boat is going to look like your idea of a boat. Those ideas that you have in your mind are special, those are unique to you. You are the only person who, when you hear "boat," thinks up a blue rowboat or a glass-bottom boat or... There may be someone else in this room who has a similar boat, but there's no way of predicting it. You can't sit there and guess which people in this room are going to have blue boats, and neither can I.

Jenny: I was in a black boat on a red sea, and I was going to a far-off place. I went looking for it, and I found it in my brain. It was weird.

[Off-topic comments from Jonathan.]

Adrian: I saw me traveling through these roads on my boat, and my boat was like a steamboat. When I got to my brain it was like I saw all these gears working together.

Graham: Not anything really. [He had spent the visualization time wiggling and muttering under his breath.]

Christine: My boat was dark blue and it had these pink polka dots on it. I had a rowboat, I had to row backwards because there was this waterfall the other way. It started getting really windy and I fell in. I swam and got back on it. It was pretty high up, on a mountain type thing. And then when I got up to my brain it was kind of like Adrian's was, it had all these gears working in it.

Joey: My boat was a pulsing blood-cell submarine. It was red. (Another student: Sick!)

Joy: Mine was a glass submarine. (R: Glass-bottom?) It was all glass. (Joey: Bulletproof?)

Jaime: I was in a green boat. It was strange, when I was going through my body there were all these posts, it was like there were these boxes with men in them with walkie-talkies. When I got up to my brain, it was file cabinets. A guy would open the file cabinet, check it over, and start talking through the walkie-talkie.

R: The next thing we need to do, we have twenty minutes, you need to think of something that's very vivid and very fast and get started.

1.2 Transcript of Guided Visualization with Betsy's Class

Relaxation Exercise

You have an extra-short time today, unfortunately. You could come in after you finish your jobs and do a little bit of finishing up. (Evelyn G: I have to go somewhere. R, to Evelyn G: Then just do something really, really fast for your art project. These are supposed to be fast projects anyway, they're not supposed to be sit-and-agonize-over-them projects.)

I'm working on my master's degree in architecture, and when you do that, you write a book about something, usually with lots of pictures in it. What your art projects are going to be are the pictures in my book. I'm not going to use all of them. (Justin: Only the good ones, right?) It's hard to define what a good one is. It's going to be ones that make sense for different parts of it. What we are going to be doing them about is a whole series of guided visualizations.

Have any of you ever meditated? Do any of you have parents who meditate? (Several students: Yeah. Maybe.) We're not going to be doing that. (Ian: Are we going to do those little circle things? Tarot cards?) Tarot cards? No, we're not going to do tarot cards, sorry. In a way we're going to do something a little related to those two things. What happens when you do a guided visualization is that you give your brain a chance to get very, very, very relaxed. When your body is totally relaxed and your brain is relaxed and you don't have stuff that you <u>have</u> to think about, it gives your brain a space to think about other kinds of things in new and creative ways. You know at night when you dream, and your dreams are really bright colors and really exciting, they're really more interesting than the things you can just think up during the day. (Evelyn G, pointing at Lecia: She has a stress card) Are you under stress at the moment? (Lecia: Yeah. Evelyn: I am.) Evelyn is not going to be under stress in a moment because what we're going to do is:

We're going to sit so we're not touching our neighbor, and we're going to close our eyes. As you sit comfortably with your eyes closed, feel the weight of your body where it touches the floor... Try to imagine the shape of you where you touch, where it spreads out a bit. Let yourself spread out a bit more. Without moving the outside of your body, tighten all of your toes... And now relax them. Tighten your legs and feet... and relax them, letting go of all the tension in them... Now tense your fingers into a tight fist...and tense all the way up your arms, up to your shoulders...and relax them... Now tighten your back and shoulders... and

release all the tension in them... Tense your forehead, scrunch your eyes, and make horrible faces with your mouth... And relax your face. Keeping your eyes closed, feel your body sitting very heavy.

Breathe quietly, in... and out... and in... and out... Keep breathing in… and out... Try to imagine a little tiny version of yourself, floating on that breath that you're breathing in and out. Just a little tiny you. About as big as a speck of dust, just floating around on that breath. This time, as you breathe in, breathe in that little speck of you, right into your lungs. Once you are down there in your lungs, get into a little boat. (Ian, close your eyes, please, and relax.) Try to imagine your tiny self in a boat, traveling through your arteries and your veins, that's pretty hard, just picture a little tiny person in a boat. (Evelyn G: I'm not me.) If it needs to be somebody else, but you want to be able to see through those eyes, too. Travel through your body down to your toes, back to your heart… out to your fingers, and back... and now to your brain.

When you get to your brain, notice that your brain is processing information. Even when you are completely relaxed, your brain processes information faster and better than any computer anyone has ever, ever invented. Let yourself notice the work your brain is doing.

I am going to count to six and you will open your eyes. One... two... three... four... five... six...

Who could not even imagine floating? Lecia, was there any piece of it where you could imagine yourself, could you get inside your brain at all?

Lecia: No. (R: Do you feel calm and relaxed, did your body feel pretty heavy and solid to the floor?) No. (R: What does your stress tester say?) It said stressed. (R: At the end, you're still stressed. I guess you didn't relax too well.)

Katie: I would think it would say calm.

Ian: I don't think it works.

Evelyn G: I got calm.

R: Did any of you imagine yourselves in the brain?

Colleen: Yeah, but it was hard.

Brooke: Well, I was imagining a little magic carpet, it was going through this big noodle, and I saw digits going on and answering questions and stuff.

R: Can you think of a way you could show that, in a really fast art project? You'll have seventeen minutes. What would be a really fast way you could show that, maybe not just flat as a picture, but make it 3-d. As you're sitting here, listening to other people talk, start to think about ideas that might work, what you could make the magic carpet out of, whether you would want to write on a piece of paper for the ideas, how you could begin to structure it. We've got wire and pipe cleaners and lots of different colors and types of toothpicks and straws. (A student: Do we have to make us?) You don't have to make you, you could make any part of this. You could show the boat, the trip, how your brain was working, what you saw, or you could show yourself seeing.

Colleen: Mine wasn't really quite a boat, more like a carpet or something.

Evelyn G: Mine was a canoe without any paddles.

Evelyn T: Mine was a sailboat.

Katie: I had wings. I saw the shapes, when you said veins I saw the round side of veins and when I saw my shoes [inaudible] and when I got to my brain it looked like a piece of brain coral, it had all these weird colors.

Evelyn G: My brain looked like little doubles floating around in the air and they had answers to problems.

Justin: It was neat in mine. The first one I didn't get any picture, I was imagining it, but I didn't get any. Then I imagined when I got to my brain it was wire-y.

Ian: My brain looked exactly like a person's brain really does. (Another student: Have you seen a real brain?) Yeah, I've seen a real brain.

Colleen: I was floating on a pencil through my brain. My brain looked more like a picture than a brain.

Evelyn G: Could I do the outside of my brain?
R: If that's how you experienced it, was from outside, then you could do it from outside.

Evelyn G: I went inside. I saw outside, but I went inside.

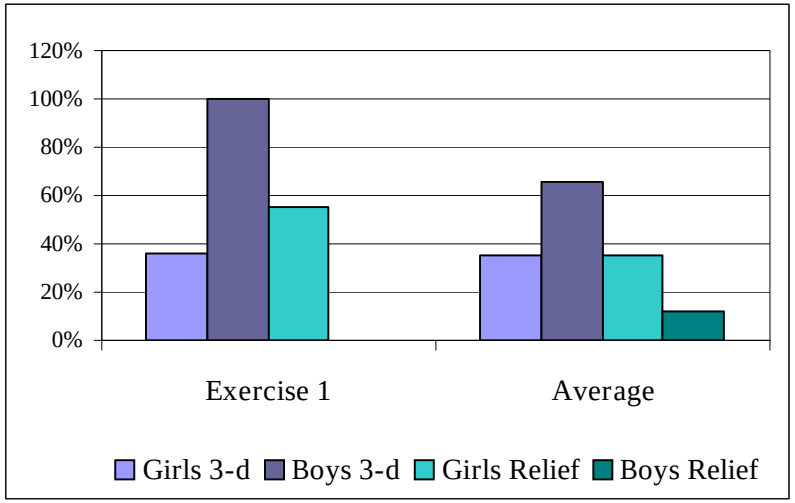
R: Basically what you're going to show here is what you feel is the most important thing for you to show. OK? So that is entirely your decision, I cannot make that for you.

Justin: I'm going to make a model of my brain.

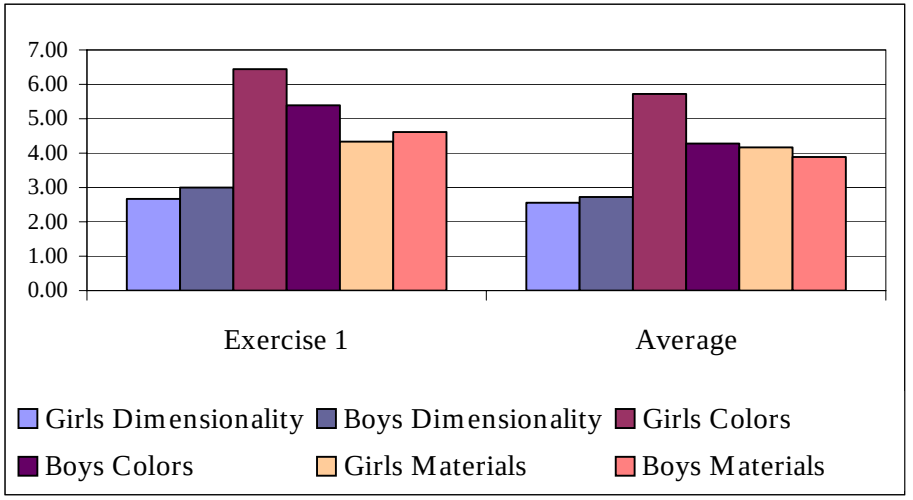
Colleen: Does it have to be in your brain?

R: No, if your main experience was something else, go ahead and do that.

1.4 Discussion of Results



Graph 1.1 Use of Three-dimensions and Relief (Relaxation Exercise)



Graph 1.2 Dimensionality, Colors and Materials (Relaxation Exercise)

Overall, the responses to the Relaxation Exercise were among the most three-dimensional of any set of visualization responses throughout the ten exercises. Every boy made a three-dimensional project, and four of the eleven girls present for this exercise did so. Thanks to the use of relief by six girls, the average dimensionality score for the eleven girls present was 2.64, which was one of their three highest scores during the study. (During the second and fifth exercises, six of the twelve girls present made three-dimensional projects and four of them used relief, resulting in a very slightly higher score.) The average score for the ten boys present for this visualization was 3.00, a level they achieved during only one other exercise. The use of colors and of materials scored very high as well—second place for both overall, with the boys achieving their highest scores and the girls scoring their fourth highest.

It is notable that every girl used paper or cardboard as the base for her work, whether it then became three-dimensional or not (four girls created three-dimensional projects on their flat base). One boy began his three-dimensional project on a shoebox lid, and another based his in a shoebox. All the remaining boys made completely three-dimensional projects.

One pattern that emerges here is the production of similar responses—projects that look quite a bit alike because students have selected the same materials or have reproduced images described in the visualization. For this exercise, three girls in Pat′s class made similar drawings of a river of blood with a small boat (two have relief, one does not) placed in the river. Two projects, made by boys in Betsy′s class, are similar tubular structures made of pipe cleaners (one has a paper boat and figure inside, implying that it may be intended as a blood vessel—neither boy gave any explanation of what he saw or intended). Altogether, of the twenty-one pieces of art made following this visualization, ten show boats and/or rivers, six show brains as blobs or masses of circuitry, and three show brains in a manner that reflects process.

In both classes, children spontaneously noted that the boat they traveled in through their body was of a specific color, material, and type. Their descriptions included a glass-bottom boat, a little brown rowboat, a blue boat, a black boat, a boat ″like a steamboat,″ a pulsing blood-cell submarine, a glass submarine, a canoe without any paddles, and a sailboat. One traveled in her body on ″a little magic carpet,″ one ″had wings,″ and one found herself ″floating on a pencil.″ In examining the art that the children produced in response to the visualization, we see that many of the pieces can be considered literal representations of what the children said they had seen—thus we could describe them fairly as visual descriptions of their mental images. Keep in mind that the children had only fifteen to twenty minutes to work on these projects; they had to work fast in order to share what was in their heads. These are sketches, really, whether in two or in three dimensions.

Several of the responses moved substantially beyond the words used in the exercise or in my instructions to the children. Notable among these are Jaime′s response, which shows little men with walkie-talkies communicating between his brain and ″posts″ in his body, and Adrian′s response, showing ″gears working together″ in his brain. Both of these projects are unusually well crafted and complex, as are the projects of three other boys—Sean′s tubular pipe-cleaner structure with a boat inside, Joey′s pulsing blood-cell submarine, and Graham′s origami boat with a clear acetate floor. Among the girls, only Evelyn T produced work of the quality and complexity that these boys attained.