SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Scientific Inquiry

Year R-2

Alexander Praino

Pembroke School - Middle School

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Music Movement- Does Playing the Piano Improve Fine Motor Control?

By: Alexander Praino

Pembroke School, Year 2

Questioning and Predicting

Introduction:

Playing the piano is more than just fun – it can have lots of benefits for the person who plays. When you play the piano, you use muscles in your wrists, hands and fingers to move between the keys. Many studies have shown that this can lead to improvements in fine motor skills. For example, playing the piano improves the dexterity of your fingers, since you have to move your fingers to play the different notes. Piano can also improve hand-eye coordination, as you read the music and then play the correct notes.

Besides fine motor skills, piano also has positive effects on your brain, such as improving your memory and ability to learn new things. For example, a study from the University of Wisconsin showed that children who had piano lessons scored 34% higher on tests of maths and science than those who didn't play the piano. An article in *Musiprof* said that playing music is like a full body workout for your brain. This is because lots of different parts of your brain work together when you play music. Practicing piano helps make these areas stronger. Dr. Ellen Winner says that the brains of people who play music are different from people who don't – they are bigger in 5 areas. Piano players might be born this way, or their brains might change from practicing. These brain changes are called neuroplasticity.

Question: Are people who play the piano faster or more accurate at a task that involves fine motor skills?

Hypotheses:

1. People who play the piano will be faster and make fewer errors than people who don't play the piano.
2. People who play the piano will improve more from the first test to the second than people who don't play the piano.

Planning and Conducting

Participants:

- 3 people who play the piano

- 3 people who do not play the piano

Equipment and Materials:

- Mirror drawing task
- Stopwatch
- Pen and paper
- Table and chair

Risks: Be careful when plugging in the task to the power and when lifting the mirror into place. Ask an adult for help if needed!

Reasoning:

The mirror drawing task measures motor learning. When you do this task, you need to use hand control and eye-hand coordination. Since playing the piano involves both, I chose this task for my project.

I wanted to measure equal numbers of people who play the piano and people who don't. This was the variable that differed between groups. It is important that the people in the non-piano group have never played the piano before, as this could impact the results.

The variables that I measured were:

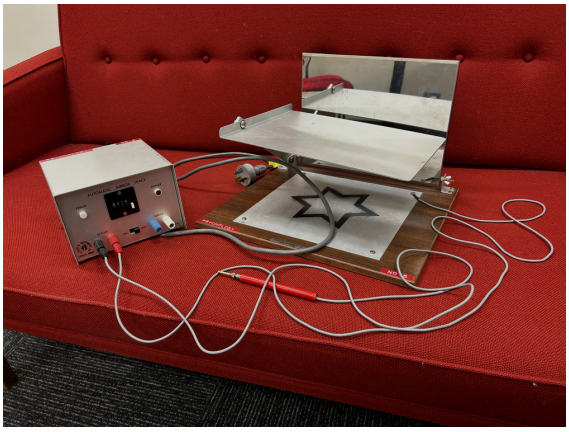
- How fast someone completed the task
- How many mistakes they made

I measured these for the dominant hand and each person completed the task twice.

The test is fair because everyone did the same task in the same environment – only whether they played the piano or not differed between groups.

Method:

1. Setup the mirror drawing task. It needs to be plugged in, the mirror needs to be lifted up and the metal plate needs to be moved into position. It should look like this:



2. Bring each person into the room and give them instructions about what will happen and what they need to do. Ask them to sign the consent form.
3. Each person traces the star using their dominant hand. While they trace the star, you record how long it takes using a stopwatch. Note down how many errors they made (the mirror drawing task box automatically records this).
4. Repeat this again for the dominant hand, as described in Step 3.
5. Thank each person for participating and walk them back to the classroom.

Processing and Analysing Data and Information

Boy/Girl?	**Piano Player?**	**Dominant Hand?**	1st Trial Errors	1st Trial Time (sec)	2nd Right Hand Errors	2nd Right Hand Time (sec)
Girl	Yes	Right	208	178	90	65
Girl	Yes	Left	10	61	6	49
Boy	Yes	Right	43	102	35	91
Boy	No	Right	56	120	63	103
Boy	No	Right	209	277	63	108
Boy	No	Right	80	142	48	63

Piano Players:

Trial 1 Average Errors: (208+10+43)/3=87 errors

Trial 1 Average Time: (178+61+102)/3=114sec

Trial 2 Average Errors: (90+6+35)/3=44 errors

Trial 2 Average Time: (65+49+91)/3=68sec

Improvement from Trial 1 to Trial 2 (Time): 114-68=46 sec faster

Improvement from Trial 1 to Trial 2 (Errors): 87-44=43 fewer errors

Non-piano Players:

Trial 1 Average Errors: (56+209+80)/3=115 errors

Trial 1 Average Time: (120+277+142)/3=180sec

Trial 2 Average Errors: (63+63+48)/3=58 errors

Trial 2 Average Time: (103+108+63)=91sec

Improvement from Trial 1 to Trial 2 (Time): 180-91=89 sec faster

Improvement from Trial 1 to Trial 2 (Errors): 115-58=57 fewer errors

Piano Players vs. Non-Piano Players:

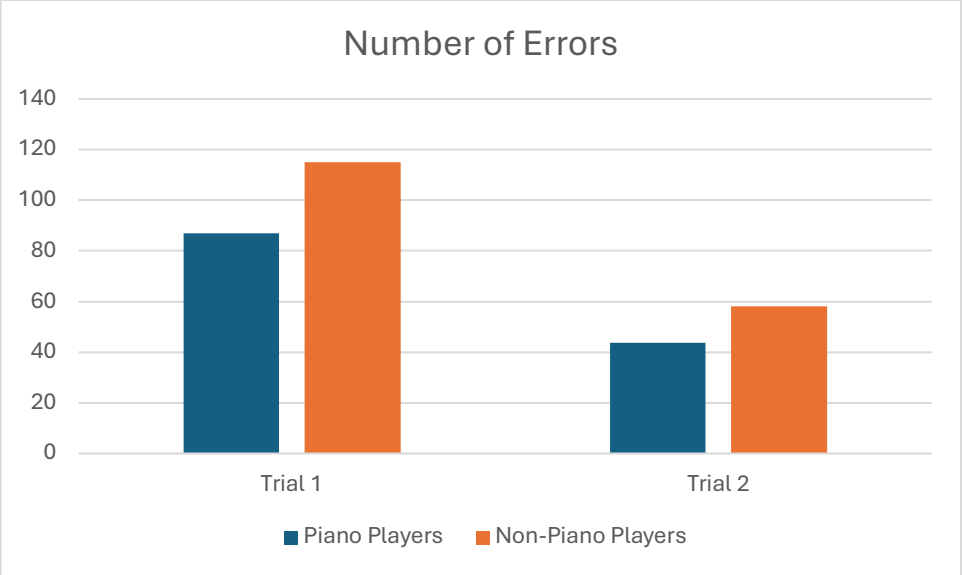
Trial 1 Time: 180sec-114sec= 66 seconds faster

Trial 1 Errors: 115-87= 28 fewer errors

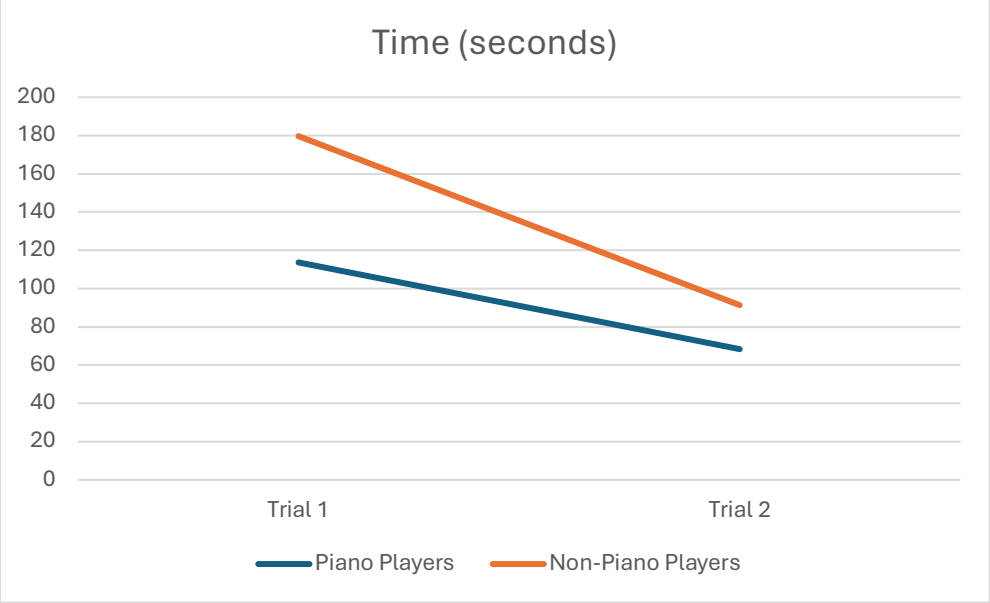
Trial 2 Time: 91sec-68sec= 23 seconds faster

Trial 2 Errors: 58-44= 14 few errors

How many errors did each group make?

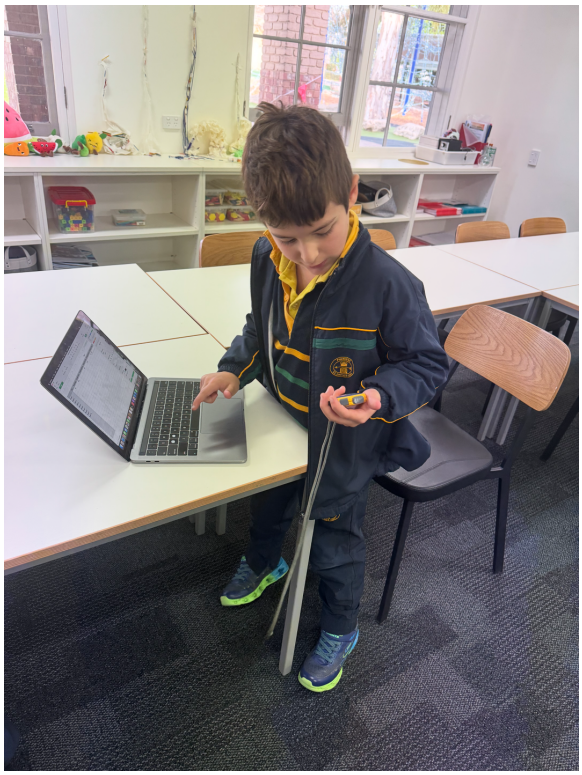


How fast was each group at tracing the star?



Photos of the data collection:

Testing a participant on the mirror drawing task



Recording data from my stopwatch.

Tracing the star in the mirror drawing task.

Evaluating

Piano players were faster and made fewer errors than non-piano players on both trials. On Trial 1, they were 66 seconds faster and made 28 fewer errors. On Trial 2, they were 23 seconds faster and made 14 fewer errors. This supports my hypothesis that piano players would be better at the fine motor task. This might be because playing the piano improves your fine motor skills over time due to practice.

I was surprised that non-piano players improved more than piano players between trials, as this was the opposite of my hypothesis. They were 89 seconds faster and made 57 fewer errors on Trial 2. Piano players were only 46 seconds faster and made 43 fewer errors on Trial 2. This might be because the piano players started off better, so had less room to improve between trials.

Since all of the non-piano players were boys and almost all of the piano players were girls, this could have inmpacted the results, if boys and girls are different in fine motor skills. I would like to test this in the future. I also wanted to test more people and have a more even split between groups, but was not able to because of time.

From my study, I hope that people will learn that they should learn the piano because it can improve their fine motor skills.

Word Count: 985

Acknowledgments and Assistance:

Thank you to Professor Hannah Keage from the University of South Australia for loaning me the mirror drawing task. Thank you to Ms Rechner and Mrs Riley for helping me to identify and schedule participants for my study.

My father helped me to setup the mirror drawing task on my testing day. My mother helped me to type up and proofread my report and showed me how to make the table and graphs and how to put together my reference section.

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Music Movement- Does Playing the Piano Improve Fine Motor Control?

By: Alexander Praino

Pembroke School, Year 2

Tuesday, 1st April

I have been playing the piano since I was 4. To play the piano well, you have to practice a lot and move your fingers up and down the keyboard. Sometimes you have to stretch your fingers a long way between the keys. I think that if you play the piano, you will have better hand movement than someone who doesn't play the piano. I thought about ways that I could test this. I want to look at how fast someone who plays the piano can finish a task, compared to someone who doesn't play the piano.

Wednesday, 2nd April

My teacher, Ms Rechner, said that she would talk to Ms Riley in the music department to see if I can test some Pembroke students who play the piano and some Pembroke students who don't play the piano. I want to give the students a test of their hand movement and compare how they do.

Thursday, 3rd April

I thought about different ways that I could test the participants. I did some searching online about ways that scientists study hand movement. I found a task called the peg board, where you have to time how fast someone can put pegs into holes on a wooden board. You measure both the hand that they write with (which I learned is called their dominant hand) and their other hand (which is called their non-dominant hand). I wasn't sure where to get a peg board and thought about whether I could make my own with my father. Then my mother had an idea to talk to our friend Hannah about my project. She works at UniSA in the Psychology department. She said that she didn't have a peg board, but she said that I could borrow something called the "mirror drawing task."

In this test, you see how fast someone can trace a star while looking at their hand in a mirror. They can't see their hand while they trace the star, so they have to look carefully in the mirror. The machine records how many mistakes they make. You can also time how fast they can trace the star. I thought that this sounded perfect.

Saturday, 26th April

Hannah dropped off the mirror drawing machine. It's so cool! I took a picture so that I could put it in my report.

Saturday, 17th May

I did some reading about different types of muscles and movements. Your hands have small muscles. Tasks that use these muscles are called “fine motor skills.” The opposite of this are tasks that use large muscles, like in your arms and legs. These are called “gross motor skills.” Playing the piano involves fine motor skills. I think that people who play the piano will have better fine motor skills than people who don’t.

Saturday, 24th May

I did some reading about piano playing and fine motor skills. I found some words I didn’t know, like coordination, precision and dexterity. I looked these words up and found definitions from Oxford Languages:

- Coordination: “the ability to use different parts of the body together smoothly and efficiently”
- Precision: “being exact and accurate”
- Dexterity: “skill in performing tasks, especially with the hands”

I read that a lot of different studies have shown that playing the piano helps to improve fine motor skills. This includes:

- Making your hand muscles stronger and your wrists more stable
- Improving hand-eye coordination - your ability to read sheet music and play the correct notes on the keys with your fingers
- Improving finger dexterity and coordination as you play the different notes. To play the music correctly, you have to move your fingers with precision

Saturday, 7th June

I was really interested if things other than fine motor skills might also get better with playing the piano, so I did some more reading. Scientists have looked at lots of different skills and found that piano is good for these too. For example, piano can improve your memory and your ability to learn new things. Learning to play the piano can even raise your IQ (how smart you are) and maybe make you better at subjects like reading and maths.

Scientists are still trying to understand this, but I read an article in *Musiprof* that said that playing music is like a full body workout for your brain. This is because lots of different parts of your brain work together when you play music. Practicing piano helps to make these areas stronger. The article in *Musiprof* also said that playing music increases activity in both sides of the brain and helps messages move faster from one side of the brain to the other.

The *Musiprof* article had a link to a Youtube video by Dr Ellen Winner. I watched this and she said that the brains of people who play music are different from people who don’t – they are bigger in 5 areas. They might be born this way, or their brains might change from practicing. I learned that when your brain changes because of something you do, this is called plasticity. So playing the piano seems to increase how plastic your brain is.

Sunday, 8th June

After my reading, I came up with some ideas about what I would see, based on the questions I am testing. I think that because playing piano can improve fine motor skills and learning and memory, people who play the piano will be faster at the mirror drawing test and make fewer mistakes compared to people who don't play the piano. I also think that people who play the piano will get better at the task faster than people who don't play the piano.

Thursday, 12th June

Today, during music class, I worked with my teacher to pick ten students to participate in my study. 5 of these students play the piano and 5 don't. I planned out when I would be able to have them do the mirror drawing task. I will test them next week.

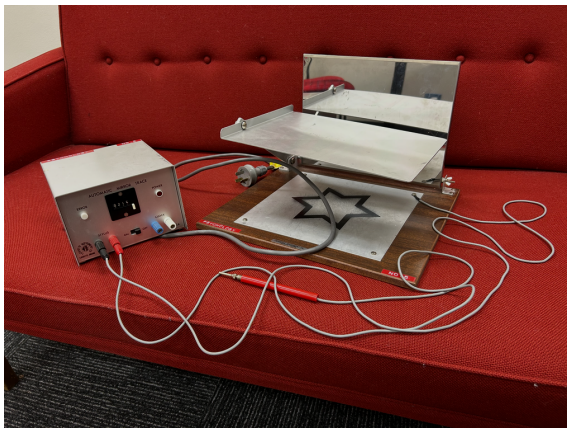
Saturday, 14th June

I did some more reading today about piano playing and hand function so that I would have some more evidence to talk about in my report. I read three articles on this and wrote down the important points to put into the beginning of my report.

Tuesday, 18th June

Tomorrow I am testing my participants, so tonight I worked with my father to help complete my risk assessment and to make a consent form for each participant. This is important because it shows that they understand what the study is about and what they will have to do and that they want to be part of the study. I also gathered all of my materials together and put them in the car:

- Stopwatch for timing how long each person takes to complete the mirror drawing
- Paper and pen for writing down how long it took to complete the task and how many mistakes they made. Each person will do the mirror drawing twice, so I will write these down each time.
- Mirror drawing task. This is made up of the wooden board with the star drawn on a metal plate. There is another metal plate that hangs above the star so that you can't see your hand when you are tracing. There is a mirror in front of this. There are also some wires that connect this to a box that counts the number of mistakes when tracing and to a pen that you use for tracing. It looks like this:



Wednesday, 19th June

I tested all of my participants today. First, I had to setup the mirror drawing machine on a table and put a chair in front of it that students could sit in when tracing. My father helped me to do this, since the mirror drawing task is really delicate. Next, I brought in each student one at a time to do the mirror drawing. I explained to each what they needed to do and asked if they had any questions. Then they signed the consent form. Then they started tracing. Some of them were really nervous, so I tried to make them feel more comfortable. When they made mistakes, they got frustrated. I explained that it was OK to make mistakes because it was supposed to be hard and said that they would do better on the next try. For each participant, I recorded how long it took and how many mistakes they made each time they tried the mirror drawing (see attached).

Because the students were nervous, it took them each a long time to do the mirror drawing. I ran out of time to test all 10 of my participants. I was only able to gather data on 6 people, but I made sure that 3 people played the piano and 3 didn't, so that I could compare even numbers between groups.

Monday, 23rd June

My mother showed me how to put all of the data I wrote down into a table and how to make graphs. She also helped me to find the formula for averaging the data for the two groups. I made a graph showing how fast the groups were on their first try versus their second try. I also made a graph showing how many mistakes the groups made on their first try versus their second try.

Wednesday, 25th June

My mother helped me to type up my report and proofread it. It's exciting to see the results!

Raw Data: Mirror Drawing Task

Participant 1:

- Girl
- Right-handed
- Piano player
- Time trial 1: 178 seconds
- Mistakes trial 1: 208
- Time trial 2: 65 seconds
- Mistakes trial 2: 90

Participant 2:

- Girl
- Left-handed
- Piano player
- Time trial 1: 61 seconds
- Mistakes trial 1: 10
- Time trial 2: 49 seconds
- Mistakes trial 2: 6

Participant 3:

- Boy
- Right-handed
- Piano player
- Time trial 1: 102 seconds
- Mistakes trial 1: 43
- Time trial 2: 91 seconds
- Mistakes trial 2: 35

Participant 4:

- Boy
- Right-handed
- Not a piano player
- Time trial 1: 120 seconds
- Mistakes trial 1: 56
- Time trial 2: 103 seconds
- Mistakes trial 2: 63

Participant 5:

- Boy
- Right-handed
- Not a piano player
- Time trial 1: 277 seconds
- Mistakes trial 1: 209
- Time trial 2: 108 seconds
- Mistakes trial 2: 63

Participant 6:

- Boy
- Right-handed
- Not a piano player
- Time trial 1: 142 seconds
- Mistakes trial 1: 80
- Time trial 2: 63 seconds
- Mistakes trial 2: 48

Participant Consent Form

By signing the sheet below, participants consent to participate in a research project on how playing the piano improves hand abilities.

	Signature	Date
Participant 1	away.	18.06.25
Participant 2	Arella	18.06.25
Participant 3	Cici	18.06.25
Participant 4	Alexandeh	18.06.25
Participant 5		
Participant 6		
Participant 7		
Participant 8	Ashwin	18.06.25
Participant 9	Collin Qu	18.06.25
Participant 10	Rodrigo	18.06.25

Pianists

non piano playing students

OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☑ Scienti ic Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Alexander Arthur Praino_____ ID: 0486-011_____

SCHOOL: _____Pembroke School _____

Activity: Give a brief outline of what you are planning to do.

I will use an instrument called the mirror drawing task to measure how fast students who play the piano can trace a star compared to students who don't play the piano. I will also record how many mistakes they make. Each student will complete the mirror drawing twice.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
- Electrical risk: equipment needs to be connected to a power outlet	An adult will connect the equipment to the power outlet and will supervise its use throughout the data collection
- Other risk: equipment has a mirror	An adult will supervise the use of the equipment to reduce the risk of the mirror breaking and causing injury

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): __Alexander Arthur Praino_____

SIGNATURE(S): Alexander Praino

☑ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Sally Rechner

SIGNATURE: Sally Rechner DATE: 24/06/25