

If You Drum It You Feel IT! : The Rebound of Drumsticks

by: **Sebastian** and **Morgan**

Grade 5, Dr EW Coffin School

Logbook

<https://docs.google.com/document/d/1XlebEgTV6Fi-ujUzMxafFDP8oqvSe7jLgJ7wTqguJlw/edit>

We chose this topic because we both love drumming. Sebastian has been drumming since he was 5 years old, Morgan has been drumming since he was 7 years old.

We feel that drummers who get injuries in their wrists a lot will be attracted to our research. We were coming up with ideas on how drummers can get fewer wrist injuries and were thinking about types of drumsticks and how that may affect their wrists.



Problem

Injuries in drummer's arms and wrists are related to the amount of rebound in their drumstick. If they use too little rebound or too much elbow force it can cause strain on the tendons and muscles in the arms.

Since injuries to drummers wrists and arms are related to the amount of rebound in their drumsticks, what material of drumstick has the most rebound so drummers can prevent injury?

Hypothesis

We are looking at 5 materials of 5A size drumsticks. We hypothesize that maple drumsticks will have more rebound because they are lightweight sticks and oak will have the least amount of rebound because they are heavier sticks.

We think that the heavier drumstick will rebound less because the gravitational forces are more on a heavier drumstick which will prevent it from rebounding higher.

Background Research

How common are injuries in drummers?

-A research study done in 2022 (*Injury Prevention Considerations for Drum Kit Performance*) showed that 68% of professional drummers have had “Playing-related musculoskeletal disorders”.

-This impacts their ability to play their instrument but also to do day to day tasks like washing the dishes, playing video games and texting.

Background Research

What injuries do drummers get?

-The 2 most common injuries are tendonitis and carpal tunnel syndrome (CTS).

-Tendonitis is the inflammation of the thick fibrous cords (tendons) that attach your muscles to your bones. Tendonitis usually appears in your wrists, shoulders and elbows.

-CTS is when the median nerve, which runs from your forearm, through your wrist, into the palm of your hand, becomes pressed or squeezed at the wrist. This causes pain, numbness and weakness in the hand. Some conditions that increase the chances of developing CTS are repetitive and forceful grasping with the hands and repetitive bending of the wrist.

Background Research

What types of drumstick materials are there?

- Maple drumsticks are lightweight
- Hickory drumsticks are medium weight
- Oak drumsticks are heavy
- Plastic drumsticks are light, durable and tend to make a brighter sound than wood ones
- Other types include: Birch, Mallet, Hornbeam, Metal, Nylon, Polyurethane and Rods

Background Research

What do the letters and numbers on drumsticks mean?

-There is always one letter and one number on a drumstick. The most common sizes of drumsticks are 5A, 5B and 2B.

-The numbers represent the lengths of the different sticks.

What length is a 5?

-The possible letters on a drumstick can be A, B, S and D. A stands for orchestra, B stands for band, S stands for street and D stands for dance.

-The possible numbers on a drumstick are numbers 1, 2, 3, 5, 7, 8, and 9.

- Number 1 sticks are usually 16.75" to 17.25" long
- Number 2 are 16.00" to 16.50" long
- Number 3 drum sticks are 15.50" to 17.00" long
- Number 5 sticks are 16.00" long
- Number 7 are 15.00" to 15.75" long
- Number 8 are 16.00" to 16.50" long
- Number 9 are 16.00" to 16.50" long

-Based on the information above 5A drumsticks are 16.00" long and meant for orchestra.

-To prevent error in our experiment we chose 5A drumsticks because they are the most readily available and popular size of sticks.

Background Research

What is rebound?

-Rebound is the elasticity in a collision with an inanimate object.

-An elastic collision is a collision with little or no loss of kinetic energy and an inelastic collision is a collision with absorption of kinetic energy.

What creates rebound in a drumstick?

-The material, weight of the drumstick and how much elasticity the drumstick contains are the factors that create rebound in a drumstick.

Background Research

What are the different types of rebound in drum strokes?

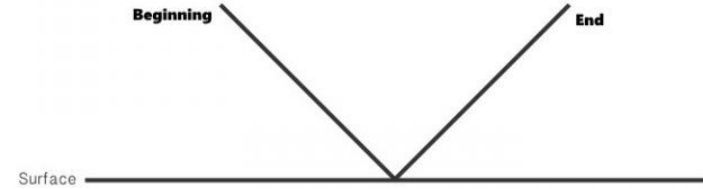
There are three types of rebound.

1. Full rebound: used most frequently and is when the bead of the stick begins and ends the stroke at the same height.

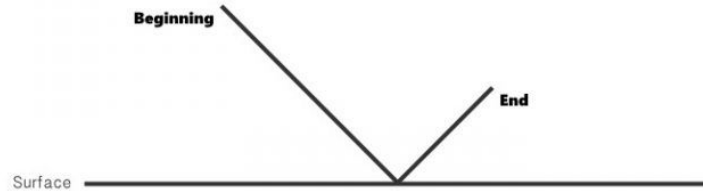
2. Partial rebound: important when playing accents and decrescendos. A partial rebound is when the bead of the stick starts at one height and rebounds to a lower height.

3. Extended rebound: when the bead starts at a lower height and rebounds to a higher height.

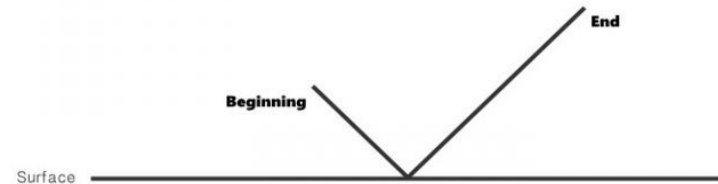
Full Rebound



Partial Rebound



Extended Rebound



Background Research

Why does rebound matter?

- Rebound keeps the stick in constant motion and creates a natural flow in your drumming. It allows your wrist to stay more relaxed so it does not tense up and make you have more chance of injury.
- If you take advantage of the rebound of a drumstick you can play for longer periods of time and faster beats per minute without getting as tired.
- If you aren't as tired and you're using less energy in your stroke then it puts less strain on your body.

Background Research

Are arm and wrist injuries in drummers related to the amount of rebound in their drumsticks?

-Injuries in drummer's arms and wrists are related to the amount of rebound in their drumstick because if they are using too little rebound or too much elbow force it can cause strain on the tendons and muscles in the arms. There is barely any research on this question which is another reason why our research is important.

Interview with an Expert: Ben Montgomery

Ben is our drum instructor and is a professional drummer. He is currently performing in the Rock The Nation show at the National Music Centre.



Interview with Ben

-Ben has avoided injuries from drumming by stretching his wrists, forearms and ankles.

-He does not think that injuries in drummers wrist are related to the rebound that is in their drumsticks. He thinks it is the consecutive motion of the wrist instead. He said that because it is the same motion of the wrist you will end up with more injuries but if you do different motions with your wrist you won't get as many injuries.

-Ben knows people that have had injuries in their wrists from excessive movement and not warming up before shows and cooling down after shows. He also knows people that have had Injuries in their knees from hitting the kick drum very aggressively and at the same tempo every beat. He said that he knows people who have had back pain from bad posture at the drum kit and lifting equipment wrong.

-Ben says that rebound is essential for your drumming capabilities. Without rebound you would get tired very quickly. With rebound you get much better technique, you use less energy and you can play smoother and more musically.

Variables: Manipulated

Material of the drumstick

- Maple

- Oak

- Hickory

- Plastic

- Multi-rod

Variables: Controlled

- length of stick (5A)
- width of stick (5A)
- height of stand to hold the drumstick, type of stand holding the drumstick
- camera angle
- type of drum head
- how the stand releases the drumstick
- ruler position on the drum/height of ruler
- temperature of the room
- where there drumstick head hits the drum
- where on the drumstick head the height of rebound was measured
- always measured highest point of first rebound

Variables: Responding

-Height of the drumstick bead on first rebound against the drumhead.

Procedure

1. Weigh each drumstick individually using weight scale and add to table.
2. Take the beads off the snare drum because that can be a source of error.
3. Build a mount and pivot out of lego to hold the lego drumstick holder. See photos for close up of this.
4. Tape the mount to an ironing board top to keep the mount at the same height every trial.
5. Place drumstick in the removal pivoting portion of the mount, then add that to the mount.
6. Use elastic band around the end of the drumstick to ensure the drumstick does not move in the pivot and stays securely placed at the back of the pivot.
7. Keep the snare drum at the same height every trial.
8. Tape a metal ruler to a piece of graph paper mounted on cardboard.
9. Tape this to a wooden paint stir stick and tape entire measuring device to the outside of the snare drum.
10. Ensure the ruler zero cm is at the surface of the drum head.
11. Use a level to ensure that the ruler is perpendicular to the drum head.
12. Mark the center of the drum for the drumstick to hit (measure centre by measuring distance between the opposite screws) with a pencil and ruler.
13. Move the drum so that the drumstick will hit the dot in the middle of the drum.
14. Mount the phone camera on a gorillapod.
15. Mount the gorillapod to a chair that will not move during the experiment.
16. Test the approximate height the stick will rebound to know how high the camera should be.
17. Take a test video to see what angle the camera has to be at to ensure the trial will be captured.
18. To conduct a trial: Hold the drumstick at the top end of the pivot (where it stops in the holder). Turn camera to slo-mo mode and record video. Release the drumstick from the top of the mount, allow it to hit the drum. Press stop on recording when drumstick has stopped moving.
19. Repeat each trial 5 times for each drumstick.
20. Transfer videos to computer. Use Quicktime Player to play the slow-mo recording and pause the video when the tip of the drumstick is at its highest point.
21. Take a screenshot of the drumstick at its highest point. Measure the centre of the tip of the drumstick against the ruler.
22. Enter the data from measuring onto a table, calculate the mean, then graph the data.

Materials

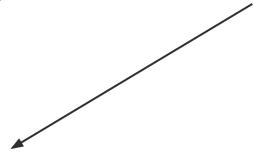
- Snare drum (with beads removed)
- 5 types of drumsticks (Hickory, Maple, oak, plastic and Multi-rod)
- Drumstick holder and pivot - made of Lego & elastic band
- Elastic bands
- Ruler
- Wooden paint stick
- Tape
- Cymbal stand
- Iphone with slow-mo camera
- Gorillapod phone holder
- Piano bench
- Ironing board
- Graph paper
- Cardboard
- Level
- Computer with quicktime
- Small weight scale



Experiment
setup



Drumstick
holder out of
pivot



Drumstick
in the
holder

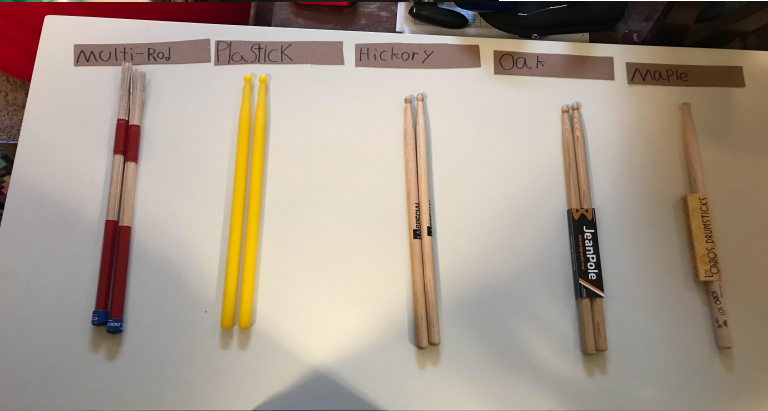




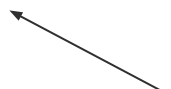
Drumstick holder in pivot at the highest it can be at



Level on ruler to ensure it is perpendicular to the drum head



All the types of drumsticks we used





Trial in progress



Measuring the rebound on computer



example of one of the trials



Results

Subjective Results

-We noticed that different drumsticks made different types of sounds when hitting the drumhead.

-This could influence a drummer's choice of which drumstick to use in a performance.

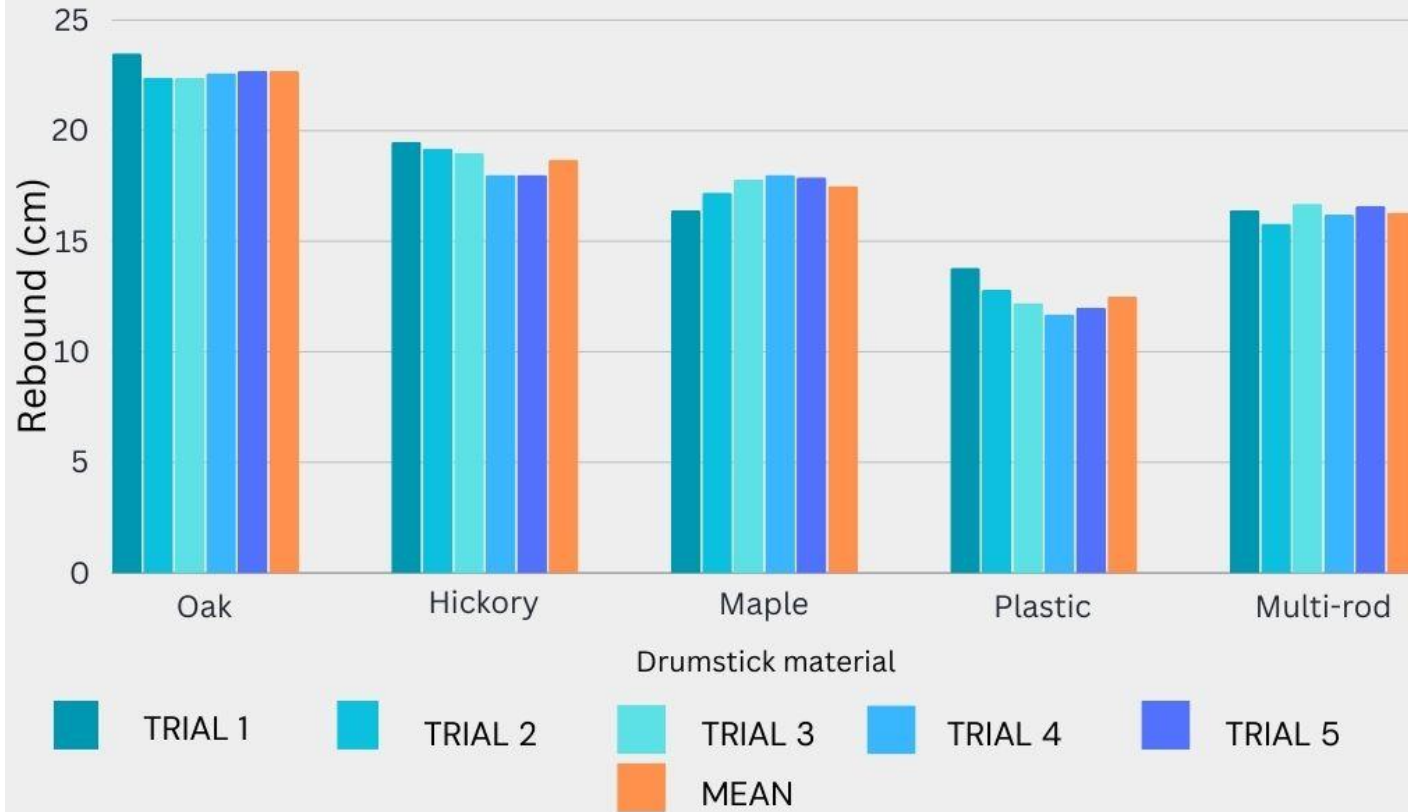
-We added the multi-rod because we were curious about this unique drumstick style, but we know that it can't be directly compared to the other materials because of its different shape and lack of a tip.

DATA: Rebound height of drumstick and weight of drumstick

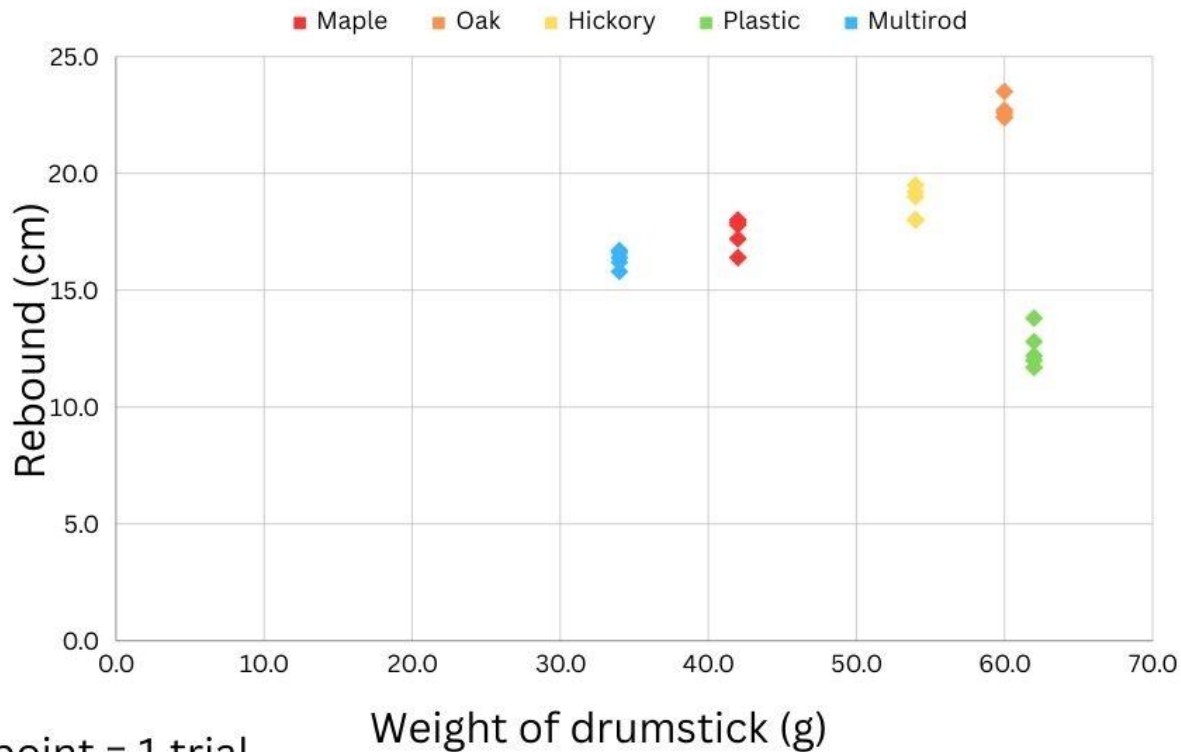
Objective Results

	Maple	Oak	Hickory	Plastic	Multi-Rod
Trial 1	16.4cm	23.5cm	19.5cm	13.8cm	16.4cm
Trial 2	17.2cm	22.4cm	19.2cm	12.8cm	15.8cm
Trial 3	17.8cm	22.4cm	19cm	12.2cm	16.7cm
Trial 4	18cm	22.6cm	18cm	11.7cm	16.2cm
Trial 5	17.9cm	22.7cm	18cm	12cm	16.6cm
MEAN	17.5cm	22.7cm	18.7cm	12.5cm	16.3cm
Weight (grams)	42	60	54	62	34

DRUMSTICK REBOUND BY MATERIAL



Drumstick Rebound by Weight



1 data point = 1 trial

Conclusion

-Based on the data we collected the oak drumstick rebounded highest, hickory rebounded second highest, maple rebounded third highest and plastic had the least rebound.

-Within the wooden drumsticks group, the heaviest one (oak) rebounded the highest, and the lightest one (multi-rod) rebounded the lowest. Plastic was the heaviest of all the drumsticks tested but rebounded the lowest.

-Our hypothesis was incorrect because we predicted that the lightest drumstick would rebound the highest.

Conclusion

-Our results can be explained with 2 factors: the gravitational force on the object and the elasticity of the drumstick material.

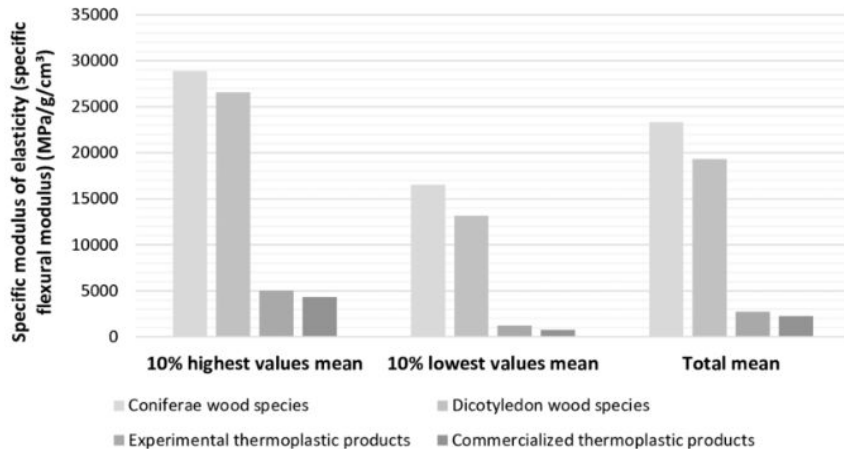
1. Gravitational force

-Within the wooden group of drumsticks, the heaviest one rebounded the highest. This is because the gravitational force is stronger on an object that is heavier and weaker on an object that is lighter. The collision of the drumstick and the drumhead is an elastic collision so a stronger downward force transfers to a stronger upward force. This means that the heavier drumstick rebounds higher.

-The drumhead also has elasticity in it so that will also create rebound for the drumstick.

Conclusion

2. Elasticity - Since we know that rebound is the elasticity in a collision with an inanimate object, the more elasticity the less loss of kinetic energy and the higher the rebound.



Specific modulus of elasticity of various wood species and thermoplastic products

https://www.researchgate.net/figure/Specific-modulus-of-elasticity-of-various-wood-species-and-thermoplastic-products_fig2_317286107

Wood has much higher elasticity than plastic, as we learned in this study we found comparing the elasticity of types of wood versus types of plastic.

Wood drumsticks therefore have more elasticity in them and lose less kinetic energy so they rebound more than plastic ones.

Sources of Error

- The snare drum beads would be a source of error which is why we removed them to do the experiment accurately.
- We measured the centre of the drumhead but if the bead of the drumstick didn't hit the centre of the drum every time this would change the rebound of the stick. The rebound of the stick would be less if it did not strike the exact centre because the point of maximal rebound is the centre.
- If the drum head is tighter it makes more rebound, so it is possible that through the trials the drum head could have loosened slightly which would affect the rebound height in later trials.
- We used our eye to see where the highest point was on the slow-mo video. This could have been incorrect by a millimeter or 2.
- On the video we took for a test trial we noticed we could not see the ruler because of the glare coming from the lights. We changed the lighting so that we could see the ruler so we removed this source of error.
- When doing a test trial we noticed that depending on the arc of the drumstick based on its rebound, the tip of it might not center on the ruler which would mean our measurements might not be accurate. We decided to mount graph paper behind the ruler so we could follow the tip of the drumstick to the ruler on the grid.
- On the multi-rod there was no tip on the end which could lead to errors in measurement, so we decided to measure the centre of the end of the drumstick.
- We released the drumstick from the top end of the pivot but maybe it wasn't perfectly at the top when we released it. We could create a machine to hold and release the drumstick instead of a person so that it is more consistent each time.
- The outliers in our data could be explained by any of the above variables.

Applications

- This study is important because injuries in drummers are very common. If we can identify ways to prevent injuries then that will help to keep drummers drumming.
- It is also important to inform newer drummers which drumsticks will help prevent their injuries. We would recommend oak drumsticks because they rebound the most. More rebound means that you will get tired less easily, develop better technique and play smoother and more musically.

Future Ideas

-A future idea is to try to invent a new type of drumstick material that will rebound well, but have a nice quality to the sound.

-We found a research study that was testing a new type of polymer for drumsticks. They looked at the amount of vibration of the polymer drumstick compared with wooden drumsticks, and the polymer vibrated less. They were going to do future studies to see if this changed the rate of injury.

(https://www.researchgate.net/publication/286867013_Beating_Injury_with_a_Different_Drumstick_A_Pilot_Study)

-We also did research on other factors causing injuries and vibration through the drumstick is another factor. This is an interesting idea regarding vibration which we could explore in future studies.

For next year, we would like to extend our research on rebound to see if the amount of rebound is linked to how much exertion is required to drum with it. We could measure a drummer's heart rate to measure their exertion level.

Thank you

Thank you to our drum instructor Ben Montgomery.

Thank you to Mrs Saunders for signing our school up for CYSF.

Thank you to our parents for helping us with materials for the project.

Thank you to my brother Leander for helping us hold the labels for our project

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