Reaction time by stopwatch

FizziQ activity · Middle school · 30 min

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Two hand claps, two stopwatches: the manual timing minus FizziQ's microphone-triggered stopwatch gives a student's reaction time. Middle school, on smartphone.

Learning objectives

- Measure the time between two acoustic events using both a manual stopwatch and an automatic acoustic stopwatch
- Determine personal reaction time by comparing the two measurements
- Investigate how visual conditions (eyes open vs. closed) affect reaction time
- Understand the neural pathway for auditory and visual reflexes
- Develop skills in measurement precision and systematic error analysis

Instruments and sensors

Acoustic stopwatch · Manual stopwatch · Microphone

Materials

- Two smartphones, one running the FizziQ app for the acoustic stopwatch
- Manual stopwatch on the other smartphone
- A calm environment
- A partner to perform the hand claps
- Note: the protocol remains adaptable to any comparable time-measurement tool.

Protocol

1. Set up two smartphones: one with FizziQ's acoustic stopwatch (which starts and stops automatically when it detects a loud sound), and one with a manual stopwatch app.
2. Work with a partner. The partner will make two hand claps, separated by a few seconds.
3. The student holds the manual stopwatch and positions the FizziQ acoustic stopwatch nearby (within 1 meter of the clapping).
4. The partner claps once. The student starts the manual stopwatch at the clap. The FizziQ acoustic stopwatch starts automatically.
5. After 3-5 seconds, the partner claps again. The student stops the manual stopwatch at the second clap. The acoustic stopwatch stops automatically.
6. Record both times: the manual time and the acoustic time. The difference (manual minus acoustic) is approximately your reaction time.
7. Repeat this measurement 10 times with eyes open and calculate the average reaction time.
8. Now repeat 10 times with eyes closed. The student must rely entirely on hearing to react to the claps.
9. Compare the average reaction times for eyes-open and eyes-closed conditions.
10. Create a table of all 20 measurements and calculate the mean and standard deviation for each condition.
11. Discuss: does closing your eyes improve auditory reaction time? What does this tell you about sensory processing?
12. Investigate the effect of fatigue or distraction: repeat while counting backward from 100, or after physical exercise.

Expected results

Typical auditory reaction times (from the manual-acoustic difference) range from 150-300 ms, with an average around 200-250 ms for most students. With eyes open, the reaction time is often slightly longer (by 20-50 ms) because the visual system may partially interfere with auditory processing. With eyes closed, auditory attention may be enhanced, reducing the reaction time by 10-30 ms in some individuals. The standard deviation of reaction times is typically 30-80 ms, reflecting natural variability. Fatigue and distraction increase reaction times by 20-50 ms on average. The acoustic stopwatch should be consistent to within ±1 ms (limited by the phone's audio sampling rate), making it far more precise than the manual measurement.

Questions

- Why is auditory reaction time faster than visual reaction time?
- What are the steps in the neural pathway from hearing a sound to pressing a button?
- Why does the standard deviation of reaction times give useful information about the measurement?
- How do athletes train to minimize their reaction time (e.g., sprinters at the starting blocks)?
- What factors other than the stimulus type can affect reaction time?
- Why is the acoustic stopwatch more precise than a manual stopwatch for this experiment?

Going further

- Compare reaction times between different students and investigate whether age, handedness, or alertness affect the results
- Measure visual reaction time using a partner's hand signal instead of a clap, and compare with auditory reaction time
- Investigate the effect of caffeine on reaction time by measuring before and 30 minutes after consumption
- Test whether reaction time improves with practice by repeating the experiment over several days
- Use a ruler drop test as an independent method to measure visual reaction time and compare results