The Effects of Archery Practice on Sustained and Selective Attentional Processes
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Abstract

As children mature, the focus shifts toward extracurricular activities that optimize the development of the body and mind. A passion for archery inspired this study to explore the potential advantages it has for young people. The hypothesis proposed that practicing archery would enhance one's sustained and selective attention, commonly known as concentration. The 16 participants (between ages 14-17) in this study were tested on their concentration through a mobile self-administered online test called Re: collect. The test was used to see whether or not practicing archery, a concentration-intensive sport, would increase their ability to focus on a single task compared to a person who does not engage in the sport. The UCancelation test was split into two types, with one being centered around pictures while the other centered around letters. Participants who did archery were shown to do better on the test centered around letters compared to participants who did not. The test centered around pictures did not particularly favor either side. The results suggest that archery can potentially improve an adolescent's concentration in letter-focused tasks, including reading books or studying texts. Thus, regular participation in archery can give children benefits in concentration abilities in addition to the athletic and social advantages of engaging in archery.

Introduction

Concentration is defined as the ability to focus on a single task while filtering out irrelevant stimuli (Sörqvist et al., 2016). It is a crucial skill in various aspects of life, from academic achievement to athletic performance. Physical activity has been seen to influence concentration (Reigal 2020), and archery, which requires a high degree of focus to achieve its use of cognitive and fine motor skills, is a prime example of an activity requiring concentration. While concentration is crucial for complex tasks like learning new material from textbooks and taking tests, it's also essential for routine daily activities such as driving to work, engaging in conversations, and completing chores.

When preparing to release an arrow, an archer must be able to focus on various factors that combine the body and mind. When drawing the arrow, one must have full control of the muscles in their arms, shoulders, and core while simultaneously tuning out any unnecessary stimuli surrounding them that could hinder their focus on the target. Although simple in theory, understanding wind strength to adjust the sight position while maintaining a stable posture requires an extraordinary amount of focus. The hours spent on the archery range in preparation for competitions and tournaments not only refine physical technique but also train the mind. Prolonged practice forces the archer to maintain an intense concentration for an extended time,

which helps build mental stamina and enables the archer to sustain focus under pressure. This level of concentration is what sets archery apart from many other sports.

Recollect is a mobile application designed to assess selective attention and concentration. It is a digitized version of traditional paper-based cancellation tasks, which makes it a practical tool for researchers. Recollect emulates standard cancellation tasks, which are based on a user's ability to filter out distractor stimuli while searching for the target stimuli. The Recollect test centered around letters is based on the d2 Test of Attention (Brickenkamp & Zillmer, 1980). The test consists of multiple lines of characters, each being either a "p" or a "d" with varying dashes around it. The participant's task is to quickly scan each line and cross out all "d" characters with exactly two dashes. The number of correctly identified and crossed-out "d" characters, along with the number of errors, are used to calculate a score. The picture-centered test is also designed similarly, showing a row of dogs and monkeys with similar colors and requiring the user to select the correct coloration of the target animal correctly. The performance on the picture and letter-centered tests is automatically scored on the application based on speed and accuracy.

The main purpose of this study is to investigate the potential relationship between archery practice and enhanced concentration. Given archery's demanding cognitive requirement and its need to challenge one's mind for extended periods, the hypothesis was that those who participate in archery practice will have a higher concentration, reflected as a higher score on the Recollect test, than those who do not.

After concluding the test with 14 participants, results showed that those who practiced archery performed better on the letter-centered test compared to those who did not. The picture-centered test did not show any favorability for either side. The results suggest that doing archery can improve adolescents' concentration in letter-focused tasks such as reading books or studying text. This heightened concentration can be applied in many portions of people's daily lives, particularly in academics, which will allow one to see not only the physical benefits but also the mental benefits of archery.

Background

During the initial brainstorming of the paper, the d2 test of Attention was considered, but due to its restrictions of being limited to professional use in established labs, this was not a realistic consideration. Through additional research, the method of UCancelation came up. Unlike other previous studies done on the intersections of concentration and archery, this study uniquely uses a more widely accessible tool, available through any mobile device on iOS or Android. UCancelation is based on the structure of the d2 test of attention where the participants have to do various cancelation tasks to gauge their level of concentration on tasks. UCancelation, similar to the d2 Test of attention measures sustained and selective attention

Elite archers possess more efficient attention networks compared to novice or non-archers, enabling them to be more aware of environmental information and suppress distractions more effectively (Marlize, 2024). The repeated precise motion of shooting an arrow results in enhanced cognitive ability and functional connectivity in the brain. Consistent practice over time can lead to an increase in neural efficiency in parts of the brain associated with motor control, visual processing, and attention (Berti et al., 2019).

Methods

This study is based on a mobile test application called UCCancellation developed by students at the University of California, Irvine, and the University of California, Riverside. This self-administrable mobile online test measures concentration by presenting participants with visual stimuli (letters and pictures) and challenging them to identify specific targets while ignoring others. Data was gathered on the comparative concentration ability of archers and non-archers using this accessible and objective tool. The self-administrable test, UCancelation, is available on the app store under the name "Recollect the Study," which will simply be referred to as "Recollect" going forward.

The study involved 16 participants, evenly divided into two groups: active archers and individuals with no prior archery experience. Each participant completed four runs on the Re:collect app for the 2 variations (Pictures and Letters).

The app "Recollect the Study" was downloaded from the app store onto the participant's phone. Participants opened the application and created a new user account by selecting "new user" on the opening screen. Users then entered one of the two server codes and created a username. Putting the server code "PIC" would bring the user to a test with pictures where the user would be requested to pick all the animals that are right side up with the correct color palette. If the server code "LET" was inputted, it would bring them to a test with marks around letters and ask them to choose the letter with the number of marks they were assigned. Once they finished the test (which can range from 1 minute and 10 seconds and 3 minutes and 30 seconds for each test, respectively), they would see a screen that displays the number of answers they got correct compared to the number of questions they were given. After 2 runs of either test, the platform would give the user a 12-hour wait period until they can continue for the remaining 6 tests (4 runs of 2 different tests).

Results

Independent Samples T-Test

		Statistic	df	p
Average PIC results	Student's t	1.52	12.0	0.154
Average LET results	Student's t	2.44	12.0	0.031

Note. $H_a\ \mu_{Archer} \neq \mu_{Non-Archer}$

Figure 1. T-Test for the independent samples of the average PIC and LET results (figure produced by Jamovi)

A t-test was done to assess the impact of archery experience on the average LET and PIC scores. Results indicated a statistically significant difference in LET performance between groups (p = 0.031), suggesting that archery experience positively influenced participants' abilities to maintain sustained concentration and selective attention. Conversely, no significant difference was found in PIC performance between groups (p = 0.154), indicating that archery experience did not impact one's ability to perform the PIC tasks.

Descriptives

	Archery Experience	Average PIC results	Average LET results
N	Archer	6	6
	Non–Archer	8	8
Missing	Archer	0	0
	Non–Archer	0	0
Mean	Archer	0.903	0.908
	Non–Archer	0.859	0.846
Median	Archer	0.908	0.900
	Non–Archer	0.856	0.841
Standard deviation	Archer	0.0291	0.0442
	Non–Archer	0.0655	0.0482
Minimum	Archer	0.860	0.863
	Non–Archer	0.743	0.757
Maximum	Archer	0.933	0.977
	Non–Archer	0.947	0.900

Figure 2. Table presents descriptive statistics for the Average PIC and LET results based on participants' archery experience (figure produced by Jamovi)

For the Average PIC results, archers (N = 6) had a mean score of 0.903, with a standard deviation of 0.0291. Non-archers (N = 8) had a slightly lower mean of 0.859, with a larger standard deviation of 0.0655. The median scores were similar to the means, with archers at

0.908 and non-archers at 0.856. The range of scores for archers was between 0.860 and 0.933, while non-archers had a wider range from 0.743 to 0.947.

For the Average LET results, archers also outperformed non-archers, with a mean score of 0.908 compared to 0.846 for non-archers. The standard deviation was 0.0442 for archers and 0.0482 for non-archers, indicating slightly more variability in the non-archer group. The median scores were 0.900 for archers and 0.841 for non-archers. The range of LET results was slightly narrower for archers (0.863 to 0.977) compared to non-archers (0.757 to 0.900).
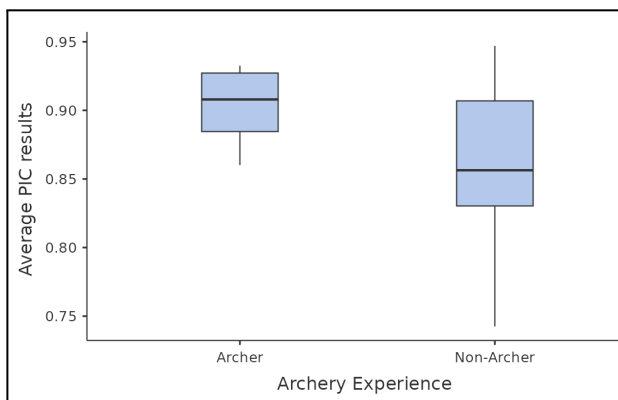

Figure 3. Cat and whisker plot comparison of average PIC results between archers and non-archers (figure produced by Jamovi)

Archers consistently score in the higher range of PIC results, clustering around 0.90 and 0.95. In contrast, the non-archers exhibit a wider distribution of PIC scores, ranging from 0.75 to 0.95, with a noticeable spread across the lower and middle ranges.

This suggests that while archery experience may not directly influence improvements in concentration and selective attention (as indicated by the p-value analysis), individuals with archery experience tend to achieve more consistent and higher PIC scores compared to non-archers. The consistency in higher PIC scores among archers may reflect an enhanced baseline of concentration and selective attention, although it does not imply a significant overall improvement directly attributable to archery. This greater variability suggests that non-archers have more diverse levels of concentration and selective attention, with some performing as well as archers but others performing significantly worse. The wide range observed in non-archers further supports the earlier conclusion that archery experience does not universally improve concentration and selective attention.
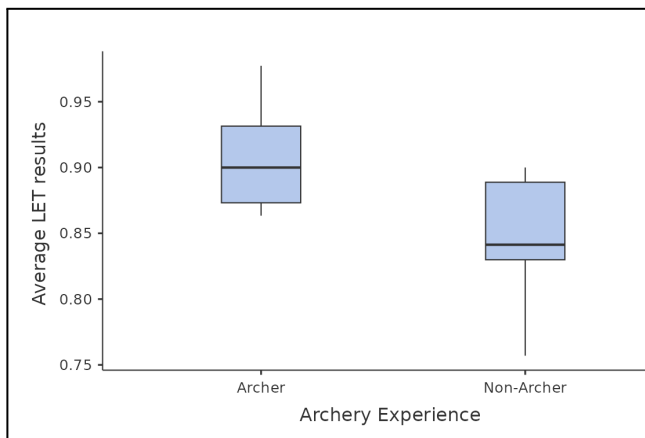
Figure 4. Cat and whisker plot comparison of average LET results between archers and non-archers (figure produced by Jamovi)

The archers predominantly score between 0.85 and 0.95, with a noticeable concentration around 0.90. This suggests that those with archery experience generally achieve higher and more consistent LET scores. On the other hand, the non-archers exhibit a broader distribution of LET scores, ranging from 0.75 to 0.90, with no scores reaching above 0.90. This indicates a wider variability in performance, with non-archers generally scoring lower than archers.
The bottom plot further highlights these differences with a box plot analysis. Archers have a median LET score of approximately 0.90, with most of their scores falling within a narrow interquartile range, suggesting consistency in their performance. The upper quartile extends close to 0.95, with the lower quartile around 0.85, indicating that most archers perform well.
In contrast, non-archers have a median LET score closer to 0.85, with a broader interquartile range extending from about 0.80 to 0.90. The wider spread of the non-archers' scores, including lower minimum values, reinforces the observation that non-archers not only tend to score lower but also show more variability in their performance.
The preliminary data points show the archers outperforming their non-archery counterparts, further supporting our hypothesis on the connection between archery practice and improved concentration in adolescents. However, it is crucial to acknowledge the limitations of this study, including its small sample size and lack of a controlled environment.

Conclusion

This research aimed to explore the impact of archery experience on concentration and selective attention, as measured by the mobile test Recollect, which evaluated these aspects using the LET and PIC tests. The data analysis, including both T-tests and graphical representations, reveals significant insights into how archery experience influences these cognitive and perceptual abilities.
The results concluded that individuals with archery experience consistently achieved higher and

more uniform scores in both PIC and LET tests compared to non-archers. Specifically, archers demonstrated a narrower range and higher median scores, indicating enhanced focus and selective attention. The T-test for LET results confirmed the statistical significance of this observation, with a p-value of 0.031, affirming the relevance of the findings.

In contrast, the PIC results had a lower p-value of 0.154, suggesting a statistically insignificant difference. The broader distribution of scores among non-archers indicates that archery experience does not uniformly enhance concentration and selective attention. Non-archers exhibited greater variability in their performance, with some individuals achieving scores comparable to archers while others scored significantly lower.

Overall, the findings suggest that while archery experience is associated with better performance in letter-based tasks and more consistent concentration levels, it does not necessarily guarantee improved concentration and selective attention across all individuals in the picture-based task. The precision and focus developed through archery may contribute to these enhanced cognitive and perceptual skills, but other factors likely also play a role. Further research could explore the underlying mechanisms contributing to these differences and investigate whether similar patterns are observed in other precision-based sports or activities. This study contributes to the understanding of how specialized skills like archery can influence broader cognitive functions, offering potential applications in fields that require high levels of focus and perceptual accuracy.

Limitations of the Study

In this study, the participant sample size and geographical representation were limited. The students represented in this study all reside in California, with the majority being in the Bay Area. Due to this being an individual study, the sample size was also limited, resulting in a low power, so it may be difficult to generalize this to the whole population. The calculated significance in the LET test was 0.59 (NC3Rs, n.d.). Since the testing application showed the participants their results right after they finished one round, it could have created a bias. Additionally, the environment in which the test was taken wasn't controlled, which may have affected how much attention the participants were able to give to this activity. The time the participants took the test could have also affected their scores.

Discussion

By using the self-administered mobile selective attention and concentration test UCancellation on the platform Recollect, 6 archers and 8 non-archers finished 4 runs of the 2 tests. One test was centered around letters, while the other was centered around pictures. Analysis of the data from these tests revealed that archers performed more favorably on the letter-centered test. The P value for the average LET result for the study for archers was 0.031, therefore suggesting that

practicing archery increases one's selective attention and concentration. On the other hand, the P value for the average PIC results was shown to be insignificant, with a value of 0.154. The P values were calculated for other factors, such as gender and grade, but no significance was found.

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Future experiments could explore the correlation between weekly archery practice hours and performance outcomes, focusing on identifying the optimal practice duration for maximizing selective attention and concentration. To address this curiosity in a future experiment, participants could take the Recollect test once a week on a consistent day to observe how their scores vary on weeks with longer or shorter practice durations. However, this process would likely be time-consuming, as testing the practice hours multiple times would be necessary to ensure that external factors do not introduce inaccuracies in the data.

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