International Journal of Sports Physiology and Performance, (Ahead of Print)
https://doi.org/10.1123/ijspp.2024-0438

Human Kinetics
ORIGINAL INVESTIGATION

Impact of Auditory Deprivation on Tennis Performance and Perceived Exertion

Jachym Kolar,[1] Pavel Kolar,[1] Martin Modrak,[2] Viktor Veselý,[1] and Alena Kobesova[1]
[1]Department of Rehabilitation and Sports Medicine, Second Faculty of Medicine, Charles University and Motol University Hospital, Prague, Czech Republic;
[2]Department of Bioinformatics, Second Faculty of Medicine, Charles University, Prague, Czech Republic

Purpose: This study aimed to evaluate the impact of auditory deprivation on tennis-stroke accuracy and perceived exertion among tennis players, with a focus on understanding how auditory inputs affect sport performance. ***Methods:*** A total of 77 active tennis players participated in this controlled trial, which involved playing tennis under standard auditory conditions and with auditory deprivation using noise-isolation devices. Data were collected using a Zepp Tennis Smart Sensor 2 to assess hit accuracy, and the Borg Rating-of-Perceived-Exertion (RPE) scale was used to measure exertion levels. ***Results:*** Players demonstrated significantly lower accuracy in hitting the center of the racket under auditory deprivation compared with standard auditory conditions (OR: 0.71, 95% CI, 0.68 to 0.75, $P < .001$). Additionally, auditory deprivation resulted in higher reported exertion levels, with 75% of participants reporting increased RPE compared with standard conditions (95% CI, 64% to 84%, $P < .001$). ***Conclusions:*** Auditory deprivation negatively impacts both the accuracy of tennis strokes and the subjective experience of exertion in players. These findings highlight the importance of auditory cues in sport performance and suggest that integrating sensory feedback can enhance athletic training and performance strategies. This study supports further exploration of sensory inputs' role in sport and their potential in training regimens.

Keywords: sensory feedback, noise isolation, motor skills, exercise tolerance, performance metrics

The integration of sensory information is critical for motor control and athletic performance.[1] Auditory cues, in particular, play an essential role in motor regulation, perception, and reaction time. Previous research has demonstrated the importance of auditory cues in motor control. For example, in a study by Pizzera et al,[2] it was highlighted that athletes produce natural sounds during movement, known as acoustic reafferences, which they perceive and use to regulate their actions. The research team recorded the natural step sounds produced by athletes during hurdling and played these sounds back to the participants before a training intervention, altering the tempo of the sounds. All participants showed an improvement in their hurdling performance in terms of overall running time, with the best performance observed in those who listened to the slowed-down tempo. This study demonstrated that manipulating the tempo of acoustic reafferences can enhance both short- and long-term athletic performance, especially when the tempo is decreased.[2] A study by Camponogara et al[3] has shown that athletes can use auditory information to anticipate opponents' actions thereby enhancing their own performance. The authors suggest that the ability to discern another person's action intentions from sounds is refined through practice.[3] Camponogara et al[4] has also found that the closer a sound is perceived within an individual's peripersonal space, the earlier the initiation of movement, demonstrating a link between the perceived proximity of sound and motor preparation.

A review by Sors et al[5] reports that audio-based interventions have been shown to enhance performance in various sports by providing auditory models and feedback, which improve movement execution and coordination. For example, studies have demonstrated that auditory models can significantly improve golfing performance by standardizing swing timing and duration, and have also been effective in sports like tennis, weightlifting, and skateboarding by promoting better technique and muscle activation patterns. Additionally, sonification of movements, such as in rowing and hurdling has provided real-time feedback that helps athletes refine their skills and optimize performance.[5] Allerdissen et al's[6] research indicated that fencing experts, compared with novices, exhibited superior ability in utilizing auditory information in the absence of visual cues and in disregarding unnecessary auditory information. A significant finding in the field of auditory perception is that hearing enables better determination of the strength of a hit compared to visual perception. This discrimination further sharpens and, most importantly, speeds up the body's reaction. Sors et al[7] observed this advantage of auditory response over visual in kicking a ball and upper limb strikes in volleyball. These findings underscore the potential for auditory cues to influence motor performance in sports.

A smaller body of literature addresses the impact of auditory deprivation on sports performance. Research by Schaffert et al[8] found that auditory deprivation prevented rowers from optimizing their rowing technique. In tennis, auditory deprivation negatively affects players' ability to receive serves.[9] Finally, a study by Ilyicheva and Sirakovskaya[10] found that auditory deprivation during training significantly improves sensory perception and sensorimotor coordination in adolescent tennis players. This method was more effective than visual exercises, indicating its potential as a practical tool for enhancing sports performance.[10] Auditory deprivation may also affect perceived exertion during sports activities. For example, rowers found rowing without the ability to hear to be mentally more demanding than physically demanding.[8] The study by Wooller at al[11] demonstrated that auditory deprivation during green exercise leads to an increase in perceived exertion, as well as an elevation in

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Modrak https://orcid.org/0000-0002-8886-7797
Veselý https://orcid.org/0009-0008-5451-7159
Kobesova (alena.kobesova@lfmotol.cuni.cz) is corresponding author, https://orcid.org/0000-0002-7836-4723

total mood disturbance, characterized by increased fatigue and confusion. These effects were more pronounced when natural sounds were blocked compared to when visual inputs were occluded, indicating that the absence of auditory feedback can significantly influence subjective feelings of exertion and overall mood during physical activity.

In tennis, auditory cues contribute to timing, rhythm, and anticipation particularly in serve reception and stroke execution. Studies have shown that experienced tennis players use sound to predict the ball's trajectory and speed, especially when visual input is limited or delayed.[9,12] Despite this, the specific role of auditory deprivation in tennis performance remains underexplored. To further clarify the impact of auditory perception, this study examines tennis stroke accuracy and the subjective exertion experienced by players under auditory deprivation. The goal is to determine how the absence of auditory cues influences performance and a player's perceived effort. Understanding these effects may have important implications for sports training, as it could inform the development of training methods that enhance athletes' reliance on other sensory modalities when auditory cues are unavailable.

Materials and Methods

This study employed a controlled, nonrandomized crossover design to evaluate the impact of auditory deprivation on tennis stroke accuracy and perceived exertion. The following section details the study participants, experimental setup, data collection procedures, and statistical methods used to analyze the findings.

Participants

In this controlled, nonrandomized crossover study, the target group consisted of 77 active tennis players (35 women and 42 men), aged 11–25 years. All participants were members of a local tennis club and included both competitive and amateur players. The average age of all participants was 17.1 years (SD ± 4.93). The average number of years participants had been actively playing tennis was 10.2 (SD ± 5.79), with a median of 8 years. All participants played tennis at least once a week on a regular basis. The sample included both high-level competitive players and amateur-level players. Amateur players trained at least once per week for a maximum of 1 hour per session, while competitive, and professional players trained almost daily, with sessions lasting between 1 and 2 hours. The inclusion criteria required participants to have regular tennis training at least once per week, no history of subjective hearing difficulties, and no prior surgical interventions on the auditory system. Exclusion criteria included irregular or no prior tennis experience, subjective hearing difficulties, and a history of ear-related surgery. All procedures were performed in accordance with the Declaration of Helsinki and were approved by the institutional ethical committee.

Technology Tools

A Zepp Tennis Smart Sensor 2 (Zepp Health) attached to the players' tennis rackets (Figure 1A) was used to distinguish hits made with the sweet spot from those outside it by analyzing the vibrations generated at the moment of impact. The sensor is equipped with dual accelerometers and gyroscopes that detect the specific vibration patterns produced when the ball contacts different areas of the racket head. The sweet spot, being the most balanced point, generates a distinct vibration profile characterized by minimal shock and maximum control. In contrast, off-center hits produce different vibration patterns, with greater intensity and asymmetry due to uneven distribution of force. The sensor transmits these data to a connected device, such as a smartphone via Bluetooth. The Zepp Tennis app then processes the data and provides immediate feedback on the percentage of hits made on the sweet spot versus other parts of the racket head. This real-time analysis allows for identification and quantification of successful hits based on the unique vibration signatures associated with the sweet spot. The same technology has been utilized in previous research.[13]

Auditory deprivation was accomplished by concurrent use of 2 noise isolation devices. The first device was foam earplugs manufactured by 3M, specifically the E-A-R Soft FX model (Figure 1B), which offers a Sound Noise Reduction (SNR) of 39 decibels (dB) as specified by the manufacturer. The second device was over-ear noise-canceling protectors from Wisent (Figure 1C), providing a manufacturer-specified SNR of 37 dB. Noise isolation levels exceeding 30 dB are considered to provide extreme auditory isolation, suggesting significant effectiveness in environments requiring substantial reduction of external noise.

Procedure

The participants played against a consistent sparring partner from their team, who was matched to their performance level. This sparring partner remained the same throughout all stages of the experiment. Following a standard 10-minute warm-up for overall body activation and familiarization of the player with the tennis

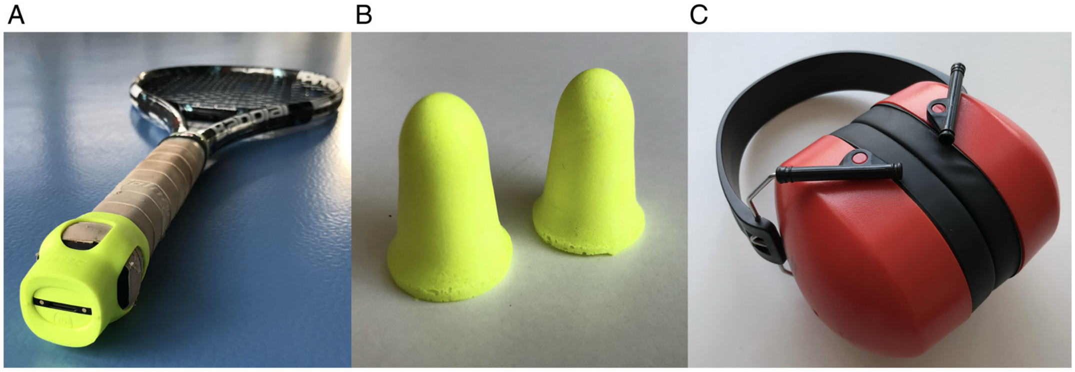

Figure 1 — (A) Zepp sensor attached to a racket, (B) foam earplugs, and (C) ear noise protectors.

court and ball type, the Zepp Tennis 2 sensor was activated for an initial 20-minute session under normal auditory conditions. The second session of measurement 1 (lesson 1) was also conducted over a duration of 20 minutes, but with auditory deprivation achieved using both foam earplugs (SNR 39 dB) and noise-canceling earmuffs (SNR 37 dB). Between the first and second sessions, there was a 5-minute rest period. The instructions for the game were always the same, to practice a tennis drill, that is, to play as well as possible for 20 minutes without a break. During both sessions the percentage of hits on the sweet spot (center of racquet) was recorded.[13] The same setup was replicated 7 days later (lesson 2). In this instance, however, the sequence was reversed: the first session was measured with auditory deprivation, while the second session was conducted without it. This reversal of conditions was implemented to mitigate potential order effects. Since all participants experienced both conditions in both orderings, this design ensured that performance changes were not solely due to sequential familiarity with the testing procedure. Additionally, before the first session, a short familiarization period was provided to allow players to adjust to the testing environment, reducing the likelihood of performance improvements due to increased familiarity rather than the auditory manipulation itself.

To assess physical exertion, the Borg Rating of Perceived Exertion (RPE) scale was used during the first lesson. This is a 15-point verbal scale, beginning at a value of 6 and ending at 20. A value of 6 corresponds to light exertion, while values exceeding 16 indicate very heavy exertion. After each 20-minute session, players were given a paper with a scale ranging from 6 to 20 to determine the subjective exertion they felt. Players were informed that on the scale, 6 indicates the lightest subjective exertion and 20 the heaviest. The RPE scale is a widely used and reliable tool for assessing exercise intensity.[14] It has been shown to correlate well with physiological measures, such as heart rate, and oxygen consumption.[15] RPE was only measured in the first session to standardize the assessment of perceived exertion and avoid variability from prior testing experiences, ensuring consistent baseline data under both auditory conditions.

Statistical Analysis

To compare performance under standard and deprived conditions, we considered each hit as a binary outcome (successfully hit the sweet spot vs other part of the racket) and employed a logistic regression model (generalized linear model with a binomial response and logit link function). We used this model as it respects the binary nature of the data while providing flexibility in modeling. For the overall comparison, the outcome was a successful hit and the sole predictor was the condition. To consider individual differences in performance, we also ran a "within-subject" model where the outcome variable was success in the deprived condition, with the log odds of observed success in the standard condition serving as the sole predictor. For both model variants, we also tested adjustments for sex, age, and years of experience with a likelihood ratio test. For the analysis of perceived exertion, we took the proportion of participants reporting higher exertion in the auditory deprivation condition and performed an exact binomial test. All analyses were conducted using R (version 4.2). Data preprocessing was performed with the dplyr package, and visualizations were created using the ggplot2 package. The complete source code for the analyses, along with the underlying data, is available at Zenodo https://doi.org/10.5281/zenodo.11115776.

Results

In this study, 35 women and 42 men demonstrated significantly lower overall accuracy under auditory deprivation (58.5% hits in the sweet spot) compared with standard auditory conditions (66.4% hits in the sweet spot, difference = −7.9 percentage points, odds ratio: 0.71; 95% CI, 0.68 to 0.75, $P < .001$). The overall trend is mirrored at the individual level—86% of participants recorded lower success rates under deprivation (Table 1, Figure 2). The results were almost identical when adjusting for age, sex, and years of experience (Table 2).

Table 2 demonstrates the summary of model results reported as difference and ratio of success rates as well as odds ratio. The statistical models used work naturally on the odds ratio scale, which is then transformed into success difference, and ratio to aid interpretation. Adjusted models include age, years of experience, and sex as extra predictors. All results are computed for a median female subject (success rate in standard condition: 66%, age 14.5 y, 8 y of playing experience). Success difference is in percentage points and values below zero indicate worse performance under auditory deprivation. Ratios below 1 indicate worse performance under auditory deprivation.

To consider individual differences in performance under standard conditions (within-subject model; see "Methods" section), we observed that the performance decrease is more pronounced among higher performing athletes. Specifically, a 2-fold increase in the odds of a correct hit in the standard condition corresponds, on average, to only a 1.56-fold increase in the odds of a correct hit under auditory deprivation (95% CI, 1.48 to 1.64, $P < .001$; see Figure 3).

These are the concrete examples of the skill dependency: under standard auditory conditions, the median success rate for center strikes was 66%. For an athlete with this success rate, the within-subject model estimates a 95% CI for success rates under auditory deprivation ranging from 57.07% to 58.76%, representing an approximate 8-percentage point decrease or a ratio of 0.88. In contrast, an athlete in the lower decile of success rate (53%) has an expected success under deprivation of 49%, that is, a decrease of roughly 4 percentage points (ratio = 0.93). For an athlete in the

Table 1 Summary of Main Quantitative Results, N = 77 for All Conditions

	Lesson 1		Lesson 2	
	Standard 1st session[a]	Deprivation 2nd session[a]	Deprivation 1st session[a]	Standard 2nd session[a]
Number of hits[b]	88 (44–175)	86 (40–186)	90 (48–187)	90 (40–186)
Percentage of center hits[c]	66 (45–92)	59 (35–85)	58 (39–94)	67 (47–95)
Worse performance under deprivation	67 (87%)		66 (86%)	

[a]Mean (range); n (%). [b]Number of hits during session. [c]Percentage of successful hits using the center of the racket's head.

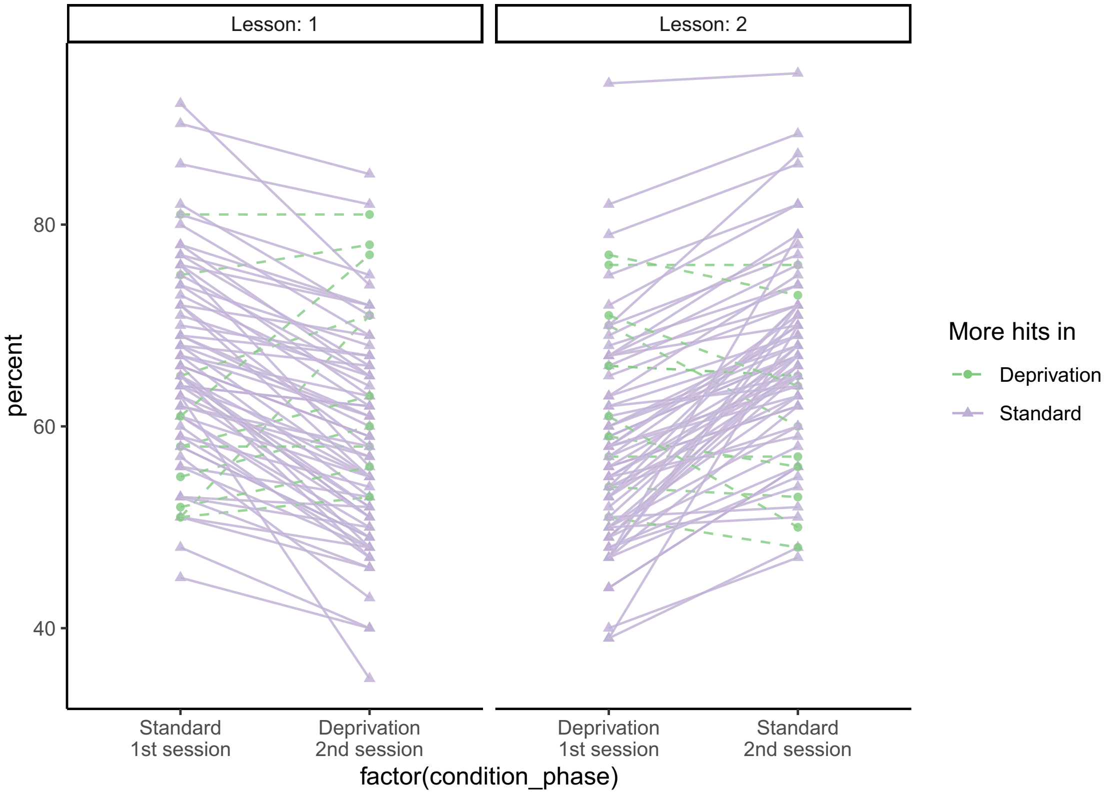

Figure 2 — Distribution of success rates by lesson and condition. Lines connect the measurements for each subject, with color and line style indicating whether the subject achieved higher success in the deprivation or standard condition. The dashed lines with circles represent the deprivation condition; the solid lines with triangles represent the standard condition.

Table 2 Summary of Model Results Reported as Difference and Ratio of Success Rates, as Well as Odds Ratio

Model	Success difference (95% CI)	Success ratio (95% CI)	Odds ratio (95% CI)
Overall	−7.9 (−8.7 to −7)	0.88 (0.87 to 0.89)	0.71 (0.69 to 0.74)
Overall, adjusted	−7.9 (−9.1 to −6.8)	0.88 (0.86 to 0.9)	0.71 (0.68 to 0.75)
Within-subject	−8.1 (−8.9 to −7.2)	0.88 (0.86 to 0.89)	0.71 (0.68 to 0.73)
Within-subject, adjusted	−7.2 (−8.5 to −5.8)	0.89 (0.87 to 0.91)	0.74 (0.7 to 0.78)

upper decile of success rate (78%), the expected success rate under deprivation is 67%, that is, a decrease of roughly 11 percentage points (ratio = 0.86).

Adjusting for age, sex, and years of experience in the within-subject model does not noticeably change the main results. However, there is some evidence that older athletes experience a slightly larger penalty under auditory deprivation (odds ratio per 5 y of age: 0.90; 95% CI, 0.82 to 0.99, $P = .03$). Regarding the other variables, large differences in success rates in the deprivation condition beyond what is already explained by performance in the standard condition and age, can be ruled out. Specifically, the 95% CIs for the odds ratios are 0.98 to 1.15 per 5 years of experience and 0.92 to 1.06 for males.

The design does not let us completely rule out adaptation effects between the 2 lessons, but they could not be very strong as the overall pattern of performance is the same in both lessons (see Figure 2).

In the RPE survey, the majority (75%) of participants reported feeling higher exertion in the auditory-deprived state compared to the standard condition (95% CI, 64% to 84%, $P < .001$). See Figure 4 for more details.

Discussion

In our study, we investigated the effects of auditory deprivation on tennis performance and perceived exertion, utilizing both objective measurements from the Zepp Tennis 2 sensor and subjective ratings from the Borg RPE scale. The results clearly demonstrated that auditory deprivation negatively impacts the accuracy of strokes, specifically reducing the probability of hitting the ball with the center of the racket head. Additionally, players reported significantly higher levels of perceived exertion under auditory-deprived conditions, indicating a greater subjective difficulty associated with playing tennis without auditory cues. The

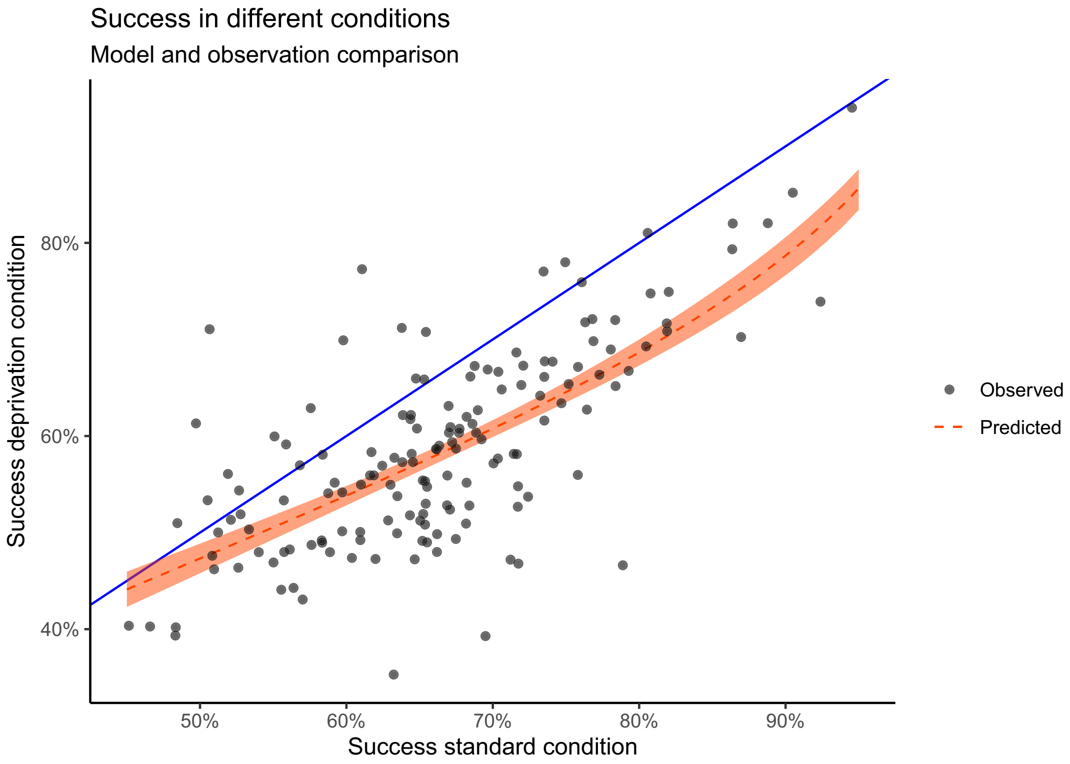

Figure 3 — Relationship between success in the standard condition and the auditory-deprivation condition. Each participant is represented by 2 dots—1 for each lesson. The solid diagonal line indicates equal performance in both conditions. Most data points lie below this line, reflecting lower success under deprivation. The difference in performance (ie, distance from the line) tends to be smaller for athletes with low success rates compared to those with moderate or high success rates. The dashed line shows the trend estimated from the within-subject model, with the lighter shaded area representing the 95% CI.

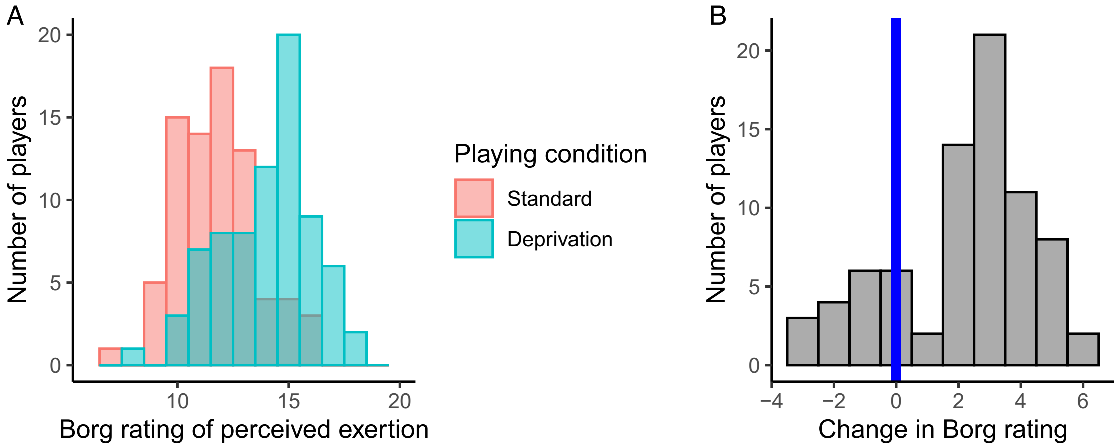

Figure 4 — (A) Histogram of Borg rating of perceived exertion per playing condition (standard vs auditory deprivation). The *x*-axis represents the Borg rating reported by players. (B) Histogram of the differences in Borg rating between auditory-deprivation and standard conditions. The *x*-axis represents the change in perceived exertion, with positive values indicating higher exertion in the deprivation condition. The thick vertical line at the 0 mark indicates no difference. See online article for color version of the figure.

drop in success rate under deprivation increases from 4-percentage point reduction in low-performing athletes to 11-percentage point reduction in high-performing athletes suggesting that skilled tennis players make better use of auditory cues. Figures 2 and 3 visually present this decline in accuracy, comparing performance across conditions.

The role of auditory–motor interactions is an expanding area of interest. Recent studies examining the link between sound and balance have shown mixed results, with evidence suggesting that stationary broadband noise may stabilize balance particularly when played through speakers in challenging conditions.[16] Other studies have highlighted auditory influence on action perception and motor execution.[17,18] Auditory cues, including those that are nonveridical, impact body perception, motor behavior, and emotional valence.[18] Sounds that naturally occur with movements are especially useful for understanding sports movements and may enhance motor rehabilitation protocols.[19] Effenberg and Schmitz[20] assert that the perceptual system, crucially involving multisensory integration, plays a vital role in motor control and learning. They suggest that movement sonification could be a potent tool for subconsciously shaping human movement patterns.

While most studies examine the influence of auditory input on motor activity in relation to other sensory inputs, the specific impact of hearing on movement is still not fully understood. In our study, it is noteworthy that none of the set variables (experience, age, gender, and phase order in the measurement cycle) significantly impacted the individuals' success rates. We expected auditory deprivation to fundamentally influence the gameplay of more experienced players, as these players have established movement patterns over several years. We anticipated that auditory deprivation would significantly disrupt these learned movement patterns, thus worsening their gameplay more than in players who do not have these patterns as deeply ingrained automatically. However, this assumption was not confirmed by our statistical results.

Beyond disrupting learned movement patterns, the decrease in performance under auditory deprivation can also be attributed to the role of auditory cues in spatial localization and anticipation. For example, a study by Cañal-Bruland et al[12] demonstrates that the loudness of the sound produced at the moment of ball-racquet contact significantly influences tennis players' anticipation of the ball's trajectory. Louder sounds led participants to estimate longer trajectories, indicating that auditory cues are crucial for predicting the outcome of strokes, alongside visual information. This underscores the importance of action-related auditory cues in enhancing the ability to spatially locate the ball during play.[12] Additionally, a study by Takeuchi[9] found that experienced tennis players deprived of auditory information by using earplugs lost more games and had decreased ability in receiving serves compared to playing without earplugs. Another study highlights the significant role of early auditory information in predicting the length of volleyball serves.[7] Experiments with expert players demonstrated that auditory cues were more effective than visual cues in anticipating the landing zone of the ball, leading to higher prediction accuracy. This suggests that auditory information, often overshadowed by visual cues in sports research, is crucial for action anticipation. The study recommends further research to explore the interaction between auditory and visual information in real-world sports scenarios.[7] Similarly, a study by Klein-Soetebier et al[21] revealed that the accuracy of shots was significantly reduced in table tennis players without auditory information. Agostini et al[22] claim that auditory information is an essential factor for guiding motor action in hammer throwers, and Schaffert et al[8] report that auditory information is important for movement precision in rowing practice.

All the studies mentioned above confirm the importance of auditory information for sports activities. Our study complements these findings by demonstrating that auditory deprivation worsens stroke accuracy in tennis players. In contrast, the study by Ilyicheva and Sirakovskaya[10] concludes that auditory deprivation significantly enhances sensory perception and motor coordination in skilled tennis players, resulting in improved accuracy, speed, and force of hits. For their evaluation, they also used rackets equipped with integrated sensors to compare the performance of an experimental group trained under auditory deprivation conditions (using earplugs and noise-canceling headphones, similar to our study) with a second group that used visual exercises. They reported that auditory deprivation improved stroke accuracy compared with both visual exercises and natural gameplay without specific stimuli or deprivation. The authors suggest that the absence of auditory stimuli forced players to rely more heavily on visual and proprioceptive inputs, potentially leading to heightened sensory awareness and improved performance. They conclude that auditory deprivation is not only more effective but also a simpler and more practical training method compared with exercises aimed at enhancing visual perception.[10] However, this is the only study we have found that identified improved sports performance under auditory deprivation conditions.

Conway et al[23] propose the concept of "auditory scaffolding," a framework that organisms use to learn how to interpret and process sequential information for temporal and sequential cognitive abilities, with auditory deprivation potentially disrupting these skills. The absence of auditory cues likely increases cognitive load and uncertainty, forcing athletes to rely more heavily on visual and proprioceptive information,[8,24] which can be less immediate and precise. This increased reliance may not fully compensate for the loss of auditory feedback, resulting in decreased performance accuracy and increased cognitive load and perceived exertion.[8,11] The integration of congruent visual and auditory information results in more accurate decision making compared with unimodal information.[25] The effect of music on perceived exertion during physical exercise is also well-known. Boutcher and Trenske[26] discovered that, compared with sensory deprivation and control conditions, music significantly reduced perceived exertion and improved mood during cycling. The effects varied according to the workload, consistent with information processing models that integrate sensory and psychological inputs. The study by Potteiger et al[27] explored how different types of music influence perceived exertion during moderate exercise, finding that music acts as an effective distractor and reduces exertion ratings compared to silence. Our results concerning the perception of subjective exertion (RPE scale) are in line with the previous research.[8,11] The vast majority of the participants reported that playing under auditory deprivation is physically more demanding.

The findings of this study indicate that auditory deprivation affects movement accuracy and worsens subjective perception even in tennis, where vision plays a significant role and hearing is considered a less critical sensory input for the game. Auditory deprivation could potentially serve as a training aid in future applications. Training regimes often aim to artificially enhance perceived difficulty, thereby making actual competitive situations seem less challenging by comparison. The utilization of foam earplugs or noise-canceling headphones may provide a safe method to simulate these enhanced conditions.[10] Future research is required to determine whether such tools can indeed improve sports performance.

This study has several limitations. The experiment's repeated measures design could allow for adaptation effects across lessons. A limitation of the design is that the order was not allocated randomly within lessons so there is a small possibility of an ordering effect biasing the results. However, the order of conditions was switched between lessons, and the observed effect is highly consistent across lessons (Figure 2) so the hypothetical ordering effect would have to change between lessons in a very specific way to produce the data we see. We find such fine-tuned order effect implausible. Furthermore, future measurements might explore how results could differ if the sample were more homogeneous and if testing were conducted exclusively with competitive or amateur players. However, the issue of participant heterogeneity is minimized by the within-subject design of our study, as each participant serves as their own control. Additionally, the observed effect is notably strong, with almost all participants showing worse performance under auditory deprivation. Specifically, 60 participants performed worse in both tasks under deprivation, 13 had mixed results (worse once under deprivation and once under standard conditions), and only 4 participants had better scores under deprivation in both tasks. Another variable could be the influence of the sparring partner. A better-performing opponent could have contributed to their improved game performance and increased accuracy in striking the ball. And finally, our findings, derived from a specific group of young, active tennis players, may not extend to other sports or age demographics.

Practical Applications

Our findings highlight the crucial role of auditory cues in tennis stroke accuracy and perceived exertion. Training with auditory deprivation may enhance sensory adaptability by encouraging players to rely more on visual and proprioceptive feedback, potentially leading to faster motor responses and improved performance. Since auditory cues introduce a slight reaction lag due to sound propagation delay, training under noise-isolated conditions could help players process visual information more efficiently. The participant can move toward the ball more quickly due to faster processing through visual perception and strike the ball in front of their body, which many coaches consider a key factor for an optimal tennis stroke. Coaches may integrate auditory deprivation drills into training to improve spatial awareness and reaction speed, similar to established methods of training under challenging conditions to make real-game scenarios feel easier.[28,29] This aligns with previous studies showing that auditory deprivation initially disrupts movement coordination but can enhance sensory adaptation over time. For instance, research in rowing[8] and tennis[10] has demonstrated that temporary auditory deprivation improves posttraining movement quality and sensory awareness. To integrate these findings into training regimens, coaches can incorporate progressive auditory deprivation drills, starting with brief, controlled sessions to allow players to adapt gradually, followed by more extended training under reduced auditory input to enhance sensory compensation and reaction speed in real-game scenarios. Future studies should explore its long-term impact on motor skills and performance across various sports.

Conclusions

Our study reveals that auditory deprivation negatively impacts tennis performance and increases perceived exertion among young active players. These findings emphasize the critical role of auditory cues in maintaining accuracy and managing effort levels in tennis, highlighting the importance of sensory inputs in sport performance. This research supports the integration of sensory cues, particularly auditory feedback, to enhance athletic training and performance strategies.

Acknowledgments

The authors thank the study participants for their participation.

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