Rhythm and Stress: Genre-Specific Autonomic Responses During Drumming Practice

A 27-month single-subject heart rate variability study in an expert drummer aged 68–71

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Replaces version 2 (January 2026). All results in this version come from a re-analysis of the beat-to-beat (RR interval) data; see the note on revision at the end of the document.

Abstract

Background

Drumming combines motor, timing and attentional demands, yet little is known about how these register physiologically across musical styles, particularly in later adulthood and during solo practice. This exploratory longitudinal single-subject study examined whether autonomic responses during drumming differ by musical genre in an expert drummer aged 68–71 during data collection.

Methods

Electrocardiographic (ECG) data were recorded with a Hexoskin ECG shirt during structured practice sessions comprising four consecutive 15-minute blocks (Rock, Fusion, Jazz, Latin). Genre order was randomised by die roll and recorded in a practice diary. Playing was accompanied by genre-matched recorded music; tempo was not controlled. A measure-by-measure hand-switching technique was used in all four genres. RR intervals were analysed in Kubios HRV Scientific 4.3. Per block, mean heart rate (HR) was computed from the RR intervals and the SNS and PNS indices were averaged from Kubios time-varying values, excluding 90 s at each block boundary. Sessions with more than 5% corrected beats were excluded (1 of 33). Genres were compared within sessions (Wilcoxon signed-rank test) and with a regression model including session and playing position.

Results

Across 32 sessions (March 2023 – June 2025), mean HR during Latin blocks exceeded the average of the other three genres in 30 sessions (mean difference +4.5 bpm, 95% CI 3.5 to 5.5; Wilcoxon $p < 0.001$), and Latin was the highest-HR genre in 27. Each later block in a session added about 1.1 bpm regardless of genre. After adjusting for playing position, Latin HR was 3.4 to 5.7 bpm above each other genre (all $p < 0.001$). The SNS index was higher and the PNS index lower during Latin blocks. Jazz was consistently the lowest-HR genre. In all five sessions where Latin was not the highest-HR genre, the higher genre was played later in the session.

Conclusions

These observations suggest that, for this player, Latin grooves are associated with a consistently higher cardiac and sympathetic load than Rock, Fusion or Jazz. Because hand-switching was used in every genre, it does not by itself account for the Latin difference; differences in groove structure, physical workload and the tempo of the accompanying music remain candidate explanations. Single-subject findings are hypothesis-generating. A second phase adds 32-channel EEG to examine neural correlates of these demands.

Keywords: heart rate variability; drumming; musical genre; autonomic nervous system; single-subject design; older musicians; music practice

1. Introduction

1.1 Music-making, health and the older musician

Making music, particularly in groups, has been associated with a range of wellbeing benefits, including relaxation, social connection and community participation (Tsugawa, 2009; Daykin et al., 2017; Barbeau and Cosette, 2019; Helton, 2019). Long-term studies suggest that playing a musical instrument may be associated with a lower risk of cognitive decline and dementia in later life (Balbag, Pedersen and Gatz, 2014), and a meta-analysis points toward benefits of musical practice for executive function and working memory in healthy ageing (Roman-Caballero et al., 2018).

Much less is known about what happens in the body during individual practice, which is where most instrumental time is spent. Research on practice has concentrated on younger classical musicians and conservatory settings (Talbot-Honeck and Orlick, 1999; Johansen and Nielsen, 2019; Taylor, 2019), leaving older musicians who practise independently largely unstudied. At the same time, practice carries physical risk: musicians report high rates of playing-related health problems, and music education often lacks health and safety training (Wijsman and Ackermann, 2018). Objective, continuous measures of the physiological load of practice could help musicians balance challenge and recovery.

1.2 Stress, arousal and learning

Physiological stress responses are not uniformly harmful. Brief, moderate activation of the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis supports alertness and can facilitate learning and memory, whereas prolonged elevation of stress hormones is associated with adverse effects on the brain and body (Sapolsky, Romero and Munck, 2000; Sapolsky, 2004). Practice that is demanding but brief and self-paced may fall on the beneficial side of this distinction, but this has rarely been measured during real practice.

1.3 Heart rate variability as a window on autonomic load

Heart rate variability (HRV), the beat-to-beat variation in the interval between heartbeats, reflects the balance between sympathetic and parasympathetic influences on the heart and is widely used as a non-invasive marker of autonomic state and psychophysiological load (Shaffer and Ginsberg, 2017; Jarczok et al., 2019). Kubios HRV software provides standardised time-domain, frequency-domain and nonlinear measures, together with composite sympathetic (SNS) and parasympathetic (PNS) indices and Baevsky’s Stress Index (Tarvainen et al., 2014; Baevsky and Chernikova, 2017). Wearable ECG garments such as the Hexoskin shirt make it feasible to record RR intervals during movement in natural settings (Elliot, Hamlin and Lizamore, 2019).

An important caveat is that during physical activity, HR and HRV are shaped by metabolic demand as well as by cognitive or emotional load. Drumming is physical work. Any difference between musical conditions therefore needs to be interpreted with the physical intensity of playing in mind.

1.4 Why genre might matter

Musical genres differ in tempo, rhythmic density, limb coordination and the degree of independence required between limbs. Professional drummers show greater microstructural integrity of the corpus callosum and more efficient motor-cortex activation than non-musicians, consistent with the unusual demands of independent limb control (Schlaffke et al., 2020), and rock improvisation recruits

language-related frontal regions associated with spontaneous creativity (Tachibana et al., 2024). If genres impose different motor and attentional demands, they may also produce different autonomic profiles. Studies of music and health, however, have generally treated “music” as a single category, and systematic comparisons of genres during active playing are scarce.

1.5 Aim of this study

This study used an intensive single-subject longitudinal design to ask whether autonomic responses during drumming practice differ between four genres (Rock, Fusion, Jazz and Latin) played within the same session. A within-session, randomised-order design allows each genre to be compared with the others under the same daily conditions (sleep, room, equipment, time of day), which removes much of the day-to-day variation that would otherwise swamp genre effects. The study is exploratory. Its purpose is to generate specific, testable hypotheses for group studies and for a second phase that adds EEG.

Two questions guided the analysis: (1) Does any genre show a consistently different HR or autonomic profile within sessions? (2) Does any such difference survive adjustment for the position of the block within the session?

2. Methods

2.1 Design

Single-subject, longitudinal, within-session comparison of four musical genres during routine drumming practice. The analysed dataset spans 27 months (March 2023 – June 2025) and comprises every session in this period for which (a) a complete ECG recording of the four genre blocks was available and (b) the genre order was recorded in the practice diary. This yielded 33 sessions, of which 32 met the data-quality criterion (Section 2.6).

2.2 Participant

The participant is the author: a male expert drummer aged 68–71 during data collection, with formal training at the Royal Academy of Music, London, and decades of playing experience, including advanced independence and polyrhythmic studies. The participant was both investigator and subject (see Section 2.9 and Limitations).

2.3 Session structure and genres

Practice sessions lasted about 2.5 hours and were recorded continuously. Within each session the groove section consisted of four consecutive 15-minute blocks, one per genre. In most sessions the groove section ran from 1:30:05 to 2:30:05 into the recording; in some early sessions it ran from 0:30 to 1:30, and in one session from 1:00:39 to 2:00:39.

- **Rock:** straight and progressive rock grooves, occasionally in odd time signatures.
- **Fusion:** complex, often polyrhythmic grooves with limb independence.
- **Jazz:** swing and bebop time-keeping patterns.
- **Latin:** Salsa, Songo and Guaguancó patterns built on clave, including cascara patterns and left-foot independence.

In all four genres the participant used a deliberate hand-switching technique, exchanging the roles of the two hands every measure (for example, cascara in the right hand and the song pattern in the left, then the reverse). Because this technique was common to all genres, it is held constant in the within-session comparisons.

Each block was played along to genre-matched recorded music (Spotify playlists or albums by artists on file). Tempo therefore varied across and within sessions and was not logged.

2.4 Randomisation of genre order

Genre order was determined by a die roll at the start of every session and recorded in a practice diary, which the participant has kept since 2018. One diary entry was corrected after cross-checking (2 May 2023: Fusion, Jazz, Latin, Rock). The genre order used in the analysis matches the diary for all 33 sessions. Because a die roll does not guarantee balance over a modest number of sessions, the distribution of Latin across playing positions is reported and adjusted for (Section 3.4).

2.5 Recording and HRV processing

ECG was recorded with a Hexoskin ProShirt (Carré Technologies Inc., Montréal, Canada; ECG sampled at 256 Hz). RR intervals were analysed in Kubios HRV Scientific 4.3 (Kubios Oy, Kuopio, Finland; Tarvainen et al., 2014) with automatic beat correction. For each session, one Kubios export was produced containing the time-varying results (60-second analysis window, computed on a 1-second grid) and all RR intervals.

Each session's groove section was split into its four genre blocks by script, using the diary order. To exclude changeovers between genres, 90 s were trimmed at each block edge, leaving 12 minutes per block. For each block:

- **Mean HR** and **RMSSD** were computed directly from the RR intervals within the block; **peak HR** was taken as the highest value in the time-varying HR series.
- **SNS index, PNS index, Stress Index, breathing rate, DFA α1** and **percentage of corrected beats** were averaged from the Kubios time-varying values within the block.

The SNS index combines mean HR, Baevsky's Stress Index and the Poincaré SD2 measure; the PNS index combines mean RR, RMSSD and SD1 (Kubios Oy, n.d.). Neither uses frequency-domain power. Because the SNS and PNS indices include mean HR or mean RR as components, they are not independent of the HR outcome and are reported as supporting rather than independent measures.

2.6 Data quality

A session was excluded if more than 5% of beats were corrected in its blocks. One session (29 October 2024) was excluded: 6–9% of beats were corrected in every block, and the diary also noted the recording as noisy. In the 32 included sessions, the percentage of corrected beats averaged 0.75% per block (maximum 2.9%). One included session (11 March 2025) was noted as "quite noisy" in the diary, but its correction rate (1.1–2.5% per block) was below the threshold.

Some blocks showed a combination of high RMSSD (above 30 ms) with low DFA α1 (below 0.55) and implausible breathing-rate estimates. This pattern can arise from sensor noise or from irregular beats, which inflate beat-to-beat variability. Under a rule flagging RMSSD above 30 ms or DFA α1

below 0.55, 43 of 128 blocks (in 15 sessions) were flagged. These blocks were retained for HR analyses, which are robust to occasional irregular beats, but RMSSD, breathing rate and DFA α1 from them are not interpreted. A sensitivity analysis excluding every session with a flagged block is reported.

2.7 Outcomes

The primary outcome was block mean HR. Secondary outcomes were the SNS index, the PNS index and peak HR. RMSSD is reported descriptively for unflagged blocks only. Stress Index, breathing rate and DFA α1 were extracted but are not used for inference, because the Stress Index is derived from the same RR intervals as HR, and breathing and α1 estimates were unreliable in the flagged blocks.

2.8 Statistical analysis

Within-session contrast. For each session, the Latin block value was compared with the mean of the other three genres (Latin minus the others' average). The 32 session-level differences were tested against zero with the Wilcoxon signed-rank test; the matched-pairs rank-biserial correlation is reported as the effect size, with a t-based 95% confidence interval for the mean difference. The number of sessions in which each genre had the highest (and lowest) mean HR was counted. An omnibus Friedman test across the four genres is also reported.

Adjusting for playing position. Because HR tends to rise across a long session, genre comparisons were repeated in an ordinary least-squares regression of block mean HR on genre (Latin as reference), session (as a fixed factor, absorbing all between-session differences) and block position (1–4, as a linear term). The same model was fitted for the SNS index, PNS index and peak HR. As a check on the linear assumption, the model was refitted with position as a categorical factor.

Sensitivity analyses. (a) Including the excluded session; (b) excluding all sessions containing a flagged block; (c) a position-adjusted within-session contrast, in which each session's Latin difference was corrected for the expected position effect.

Change over time. The association between the Latin HR difference and session date was assessed with Spearman's correlation.

Analyses were run in Python 3 using SciPy 1.18 and statsmodels 0.15. All tests are two-sided with $\alpha = 0.05$. With one primary outcome and a small set of prespecified secondary outcomes, no correction for multiple comparisons was applied; all secondary p-values would remain below 0.05 after Bonferroni correction for the four outcomes.

2.9 Ethical considerations

This was a self-experiment by the author during his own routine practice; no other participants were involved and no risk beyond normal practice was introduced. No formal ethical review was sought. Extending the protocol to other participants will require ethical approval and informed consent.

2.10 Video recordings

Practice sessions were also video-recorded. The recordings were not used in the present analysis. They may allow bar-level timing and tempo of each block to be reconstructed in future work.

3. Results

3.1 Data set

Thirty-two sessions (128 genre blocks) were analysed, spanning 31 March 2023 to 10 June 2025. Latin was played first in 6 sessions, second in 5, third in 13 and fourth in 8 (Table 4). Table 1 summarises each genre.

Table 1. Per-genre summary across 32 sessions (one block per genre per session).

Genre	Mean HR, bpm (SD)	HR vs session average, bpm	Peak HR, bpm	SNS index	PNS index	Highest HR (n sessions)	Lowest HR (n sessions)
Latin	93.7 (11.0)	+3.4	100.8	6.38	−1.78	27	1
Fusion	90.2 (11.9)	−0.1	98.4	5.58	−1.56	3	3
Rock	90.0 (11.3)	−0.4	97.3	5.28	−1.57	2	5
Jazz	87.5 (11.5)	−2.9	94.9	4.67	−1.35	0	23

SD of mean HR reflects mainly between-session differences in overall HR level (Section 3.6), which the within-session comparisons remove. “HR vs session average” is the block’s mean HR minus the mean of the four blocks in the same session, averaged across sessions.

3.2 Within-session comparison: Latin versus the other genres

Latin mean HR exceeded the average of the other three genres in 30 of 32 sessions (Figure 1). The mean difference was +4.5 bpm (95% CI 3.5 to 5.5; median +4.4; range −1.2 to +10.6; Wilcoxon $W = 7$, $p < 0.001$; rank-biserial $r = 0.97$). Latin was the single highest-HR genre in 27 of 32 sessions, and the lowest in one. Across all four genres, block HR differed significantly (Friedman $\chi^2(3) = 54.8$, $p < 0.001$).

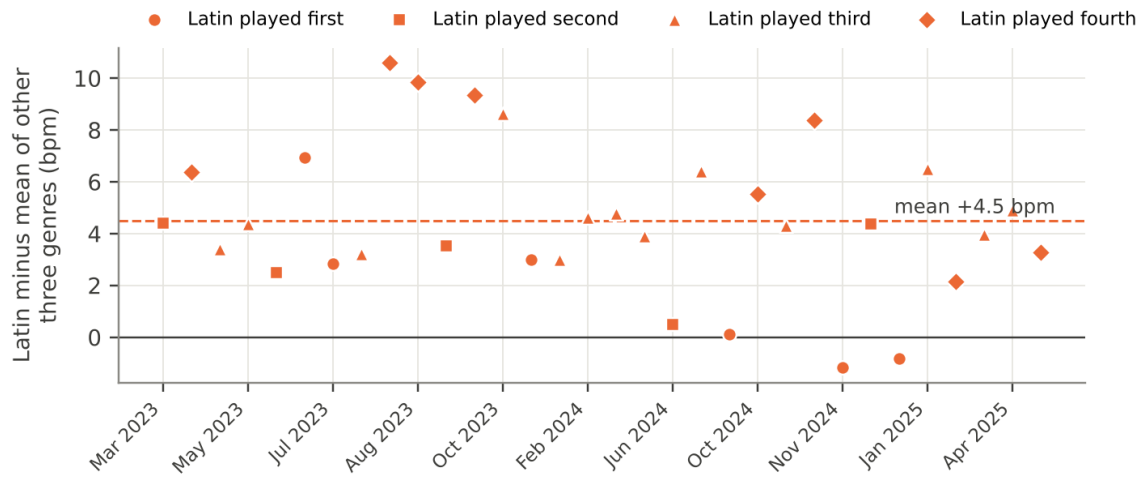


Figure 1. Latin mean HR minus the mean of the other three genres, for each of the 32 sessions in date order. Marker shape shows Latin’s playing position in that session. Dashed line: mean difference (+4.5 bpm). Values below zero occurred in two sessions, both with Latin played first.

The autonomic indices pointed the same way (Table 2). The SNS index during Latin exceeded the others’ average in 30 of 32 sessions (mean +1.20, 95% CI 0.85 to 1.55; $p < 0.001$) and was the highest of the four genres in 24. The PNS index was lower during Latin in 29 of 32 sessions (mean −0.29, 95% CI −0.41 to −0.17; $p < 0.001$). Peak HR during Latin exceeded the others’ average in 27

of 32 sessions (mean +4.0 bpm, 95% CI 2.4 to 5.6; p < 0.001). Because the SNS and PNS indices include HR as a component, their agreement with the HR result is expected and should not be read as independent confirmation.

Table 2. Within-session contrasts: Latin block value minus the mean of the other three genres in the same session (n = 32).

Outcome	Latin minus others, mean (95% CI)	Sessions Latin higher	Wilcoxon W	p	Rank-biserial r
Mean HR (bpm)	+4.49 (3.45 to 5.53)	30 / 32	7	< 0.001	0.97
SNS index	+1.20 (0.85 to 1.55)	30 / 32	21	< 0.001	0.92
PNS index	−0.29 (−0.41 to −0.17)	3 / 32	27	< 0.001	−0.90
Peak HR (bpm)	+3.98 (2.40 to 5.55)	27 / 32	54	< 0.001	0.80

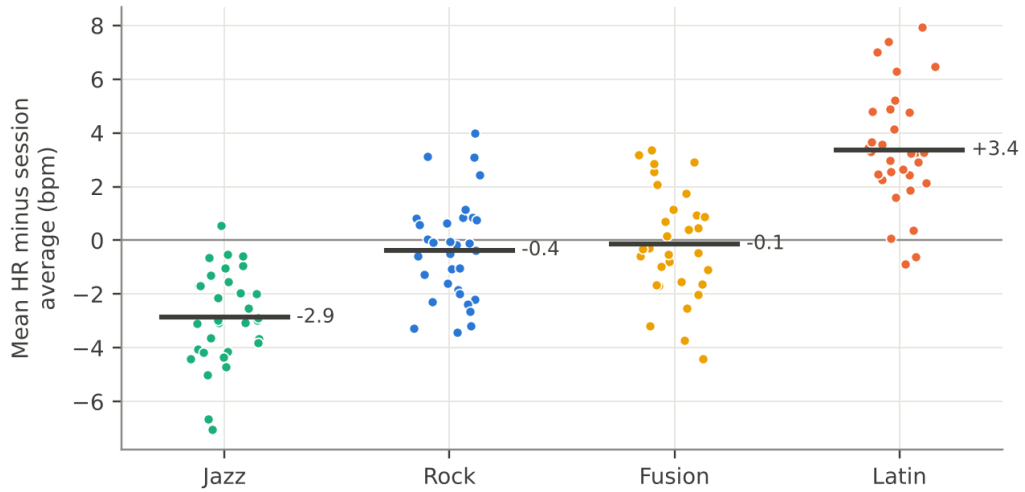


Figure 2. Each genre block's mean HR relative to its own session average (each dot one session). Horizontal bars and labels show the mean across sessions. Jazz sits below the session average in almost every session, Latin above it.

3.3 Jazz

Jazz was the lowest-HR genre in 23 of 32 sessions and never the highest, averaging 2.9 bpm below the session mean (Figure 2). Rock and Fusion lay close to the session average.

3.4 Playing position and the adjusted comparison

HR rose across the session regardless of genre (Figure 3). In the regression model, each later block added 1.15 bpm (95% CI 0.88 to 1.42; p < 0.001). Because the die rolls placed Latin third or fourth in 21 of 32 sessions, part of the raw Latin difference could reflect this drift. The relationship is visible in the data: when Latin was played first or second, it exceeded the others' average in 9 of 11 sessions (mean +2.4 bpm); when played third or fourth, in 21 of 21 (mean +5.6 bpm). Across sessions, Latin's HR difference correlated with its playing position (Spearman ρ = 0.58, p < 0.001).

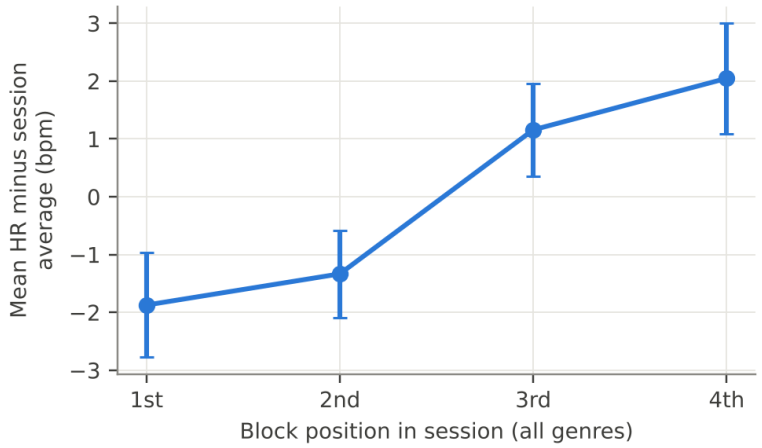


Figure 3. Mean HR relative to the session average by block position, pooled across genres (error bars: 95% CI). HR rises through the groove section, most steeply from the second to the third block.

After adjustment for session and position, Latin HR remained 3.4 to 5.7 bpm above each other genre (Table 3; all $p < 0.001$). Treating position as a categorical factor gave almost identical estimates (Latin above Fusion by 3.4 bpm, Rock by 3.4 bpm and Jazz by 5.7 bpm). The adjusted SNS index was 0.8 to 1.6 units higher for Latin than for each other genre (all $p < 0.001$).

Table 3. Regression estimates (95% CI) with session as a fixed factor and block position as a linear term (128 blocks, 92 residual degrees of freedom).

Outcome	Latin minus Fusion	Latin minus Rock	Latin minus Jazz	Per later block
Mean HR (bpm)	+3.40 (2.54 to 4.25)	+3.41 (2.55 to 4.26)	+5.66 (4.80 to 6.52)	+1.15 (0.88 to 1.42)
SNS index	+0.78 (0.43 to 1.14)	+1.04 (0.68 to 1.40)	+1.61 (1.25 to 1.97)	+0.18 (0.07 to 0.30)
PNS index	−0.22 (−0.33 to −0.10)	−0.20 (−0.31 to −0.09)	−0.40 (−0.51 to −0.29)	−0.07 (−0.11 to −0.04)
Peak HR (bpm)	+2.33 (0.33 to 4.33)	+3.31 (1.30 to 5.32)	+5.50 (3.47 to 7.52)	+0.91 (0.27 to 1.55)

All genre contrasts $p < 0.001$ except peak HR, Latin vs Fusion ($p = 0.023$) and Latin vs Rock ($p = 0.002$). Model R^2 was 0.98 for mean HR; most of this reflects between-session differences absorbed by the session factor.

3.5 The five exceptions

In five sessions, a genre other than Latin had the highest mean HR (Table 4). In every case that genre was played later in the session than Latin, consistent with the upward drift. In four of the five, Latin was played first or second. In the fifth (11 March 2025), Latin was played third and Fusion fourth; Latin still exceeded the others' average by 4.0 bpm, with Fusion 0.2 bpm higher.

Table 4. Sessions in which Latin was not the highest-HR genre.

Session	Genre order (diary)	Latin position	Highest-HR genre (position)	Latin minus others (bpm)
4 Jun 2024	Jazz, Latin, Rock, Fusion	2nd	Fusion (4th)	+0.5
27 Aug 2024	Latin, Fusion, Rock, Jazz	1st	Fusion (2nd)	+0.1
19 Nov 2024	Latin, Jazz, Fusion, Rock	1st	Rock (4th)	−1.2
1 Jan 2025	Latin, Fusion, Rock, Jazz	1st	Rock (3rd)	−0.8
11 Mar 2025	Jazz, Rock, Latin, Fusion	3rd	Fusion (4th)	+4.0

3.6 Sensitivity analyses and change over time

- **Including the excluded session** (29 October 2024): Latin above the others' average in 31 of 33 sessions, mean +4.4 bpm ($p < 0.001$); highest in 28 of 33.
- **Excluding every session with a flagged block** (17 sessions remaining): 16 of 17, mean +3.9 bpm ($p < 0.001$).
- **Position-adjusted within-session contrast:** 31 of 32 sessions positive, mean +4.2 bpm ($p < 0.001$).
- **Over time:** the Latin HR difference showed no clear trend across the 27 months (Spearman $\rho = -0.18$, $p = 0.32$).

Overall HR level changed markedly during the study (Figure 4). Before August 2024, session mean HR varied widely, from 69 to 104 bpm (mean 83.5; 19 sessions). From August 2024 onwards it was consistently high, 93 to 108 bpm (mean 100.4; 13 sessions), with lower RMSSD (median 7.6 ms versus 29.3 ms before). The cause is unknown; candidates include tempo and playlist changes, room conditions, the drum kit used and the shirt's fit. The Latin difference was present in both periods (+5.0 bpm before, +3.7 bpm after). Because each session is compared with itself, this shift does not affect the within-session comparisons.

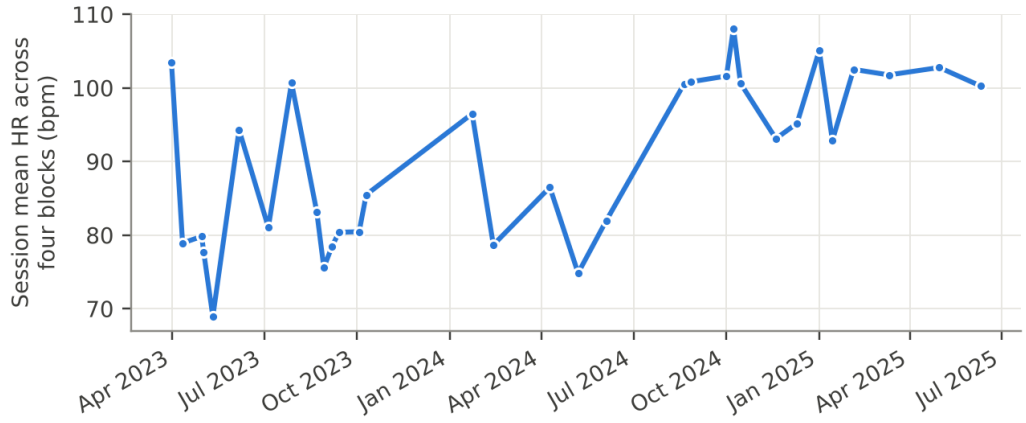


Figure 4. Session mean HR (average of the four genre blocks) across the study. Lines connect consecutive sessions and do not imply measurements in between.

3.7 RMSSD and other measures

In unflagged blocks, median RMSSD was lowest for Latin (7.5 ms) and highest for Jazz (10.5 ms), with Fusion (8.4 ms) and Rock (9.8 ms) in between, consistent with the HR ordering. These values are descriptive only. Earlier, preliminary observations that Latin was associated with faster breathing, or with a distinctive DFA α1 profile, were not supported: the breathing difference came from a single session and did not hold across ten, and Rock showed similarly low α1 values.

4. Discussion

4.1 Principal findings

In 32 sessions over 27 months, Latin grooves were associated with a higher mean HR than the other three genres in almost every session, by about 3.4 to 5.7 bpm after accounting for playing position. Sympathetic and parasympathetic indices moved in the expected directions, and Jazz was consistently the least demanding genre by these measures. The pattern was stable across the study period, across a large shift in overall HR level, and across several sensitivity analyses. These observations suggest a consistent genre-related difference in physiological load for this player.

4.2 What might explain the Latin difference?

The within-session design holds constant everything that varies from day to day, and the hand-switching technique was used in every genre. The Latin difference must therefore come from something that differs between genres within a session. Three candidate explanations, not mutually exclusive, can be distinguished, and none was tested here:

- **Groove structure and coordination demand.** The Latin patterns played (Salsa, Songo, Guaguancó) combine clave-based phrasing, dense cascara patterns and left-foot independence. Hand-switching may be more demanding when the two hand parts are as asymmetric as cascara and song patterns are. This would predict a Latin effect that grows with pattern complexity.
- **Physical workload.** HR during drumming reflects metabolic demand. If the Latin grooves involve more strokes per minute or more limb movement, the higher HR may reflect physical rather than cognitive load. This could be examined with the Hexoskin accelerometer data, which were recorded but not analysed.
- **Tempo and arousal from the music.** Playing along to genre-matched recordings means tempo and the energy of the music differed between genres and were not logged. Faster or more energetic recordings in the Latin playlists could account for some or all of the difference.

The data cannot separate these explanations. The term “autonomic load” is therefore used descriptively: it refers to the measured cardiac and sympathetic response, not to a demonstrated cognitive or emotional stress.

4.3 The upward drift within sessions

HR rose by about 1.1 bpm per block across the one-hour groove section, regardless of genre. This could reflect accumulated fatigue, rising body temperature, or carry-over of arousal from earlier blocks. Its practical consequence for this study is methodological: because the die rolls happened to place Latin late in most sessions, the unadjusted Latin difference somewhat overstates the genre effect. The adjusted estimates (Table 3) are the better guide. Future sessions could use a counterbalanced order (for example, a Latin square) rather than independent die rolls.

4.4 Relation to earlier analyses of these data

Earlier, preliminary analyses of this data set reported correlations between the Stress Index and HR within each genre, and described a distinctive “biphasic” Latin pattern in which the Stress Index tracked maximum HR closely but average HR only weakly. That pattern was traced to a data-entry error, and the analysis has been withdrawn. With the error corrected, the Stress Index–HR

correlation for Latin ($r \approx 0.92$) is similar to the other genres ($r \approx 0.88$–0.95). Such correlations are in any case largely built in, since both measures are derived from the same RR intervals. Earlier zero-filled cells for genres not recorded on a given day had also inflated the correlations. The present analysis replaces those results with direct within-session comparisons of the genres.

A related earlier suggestion was that Latin produces HR spikes at bar boundaries, when the hands switch roles. The present data cannot test this: the Kubios time-varying values use a 60-second window, far longer than one bar (about 2 s), and no bar or track timing was recorded. It remains a hypothesis. Testing it requires beat-level RR data aligned to bar timing, which the video recordings or a click track could provide.

4.5 Implications

For the individual musician, the results indicate that genre choice and playing order measurably affect cardiac load during practice, and that a wearable ECG garment can capture this reliably over years. For research, they point toward genre, and the specific demands within a genre, as a variable worth controlling in studies of music and physiology. Recommendations for practice sequencing, training or therapy would be premature on the basis of one participant.

4.6 Limitations

- **Single participant.** The results describe one expert drummer in his late sixties and early seventies, who was also the investigator. They may not generalise to other players, ages or skill levels. The single-subject design also cannot separate practice effects from other day-to-day changes.
- **Investigator as participant.** Expectations could in principle influence playing intensity. The die-roll order, the objective ECG measures and the consistency of the result over 27 months mitigate but do not remove this concern.
- **Tempo and music not controlled.** Tempo varied across and within sessions and was not logged; it is a plausible confound for the genre difference. Streaming-history data may allow the tracks played, and their tempos, to be reconstructed retrospectively.
- **Physical versus cognitive load.** HR and HRV indices during movement do not distinguish metabolic from cognitive or emotional demand. Accelerometry was not analysed.
- **Measures not independent.** The SNS and PNS indices include HR or RR as components, so they partly restate the HR result.
- **Signal quality.** A sizeable minority of blocks showed signs of noise or irregular beats, which limits the use of RMSSD, breathing and DFA $\alpha 1$. The RR intervals are quantised in steps of about 4 ms, consistent with the 256 Hz ECG sampling rate; this is adequate for HR but coarse for very low RMSSD values.
- **Unexplained level shift.** Overall HR level rose markedly from August 2024, for reasons not identified. It does not affect within-session comparisons but limits interpretation of long-term trends.
- **Order imbalance.** Independent die rolls placed Latin late in most sessions. This was addressed statistically but would be better addressed by design.
- **Exploratory analysis.** The analysis plan was not preregistered, and the focus on Latin emerged from earlier exploration of the same data.

4.7 Future research

- **Phase 2 (EEG).** 32-channel EEG (Emotiv Flex 2) recorded alongside ECG during the same four-genre protocol, to examine neural correlates of the genre differences.
- **Logging.** For each session: dice order, playlist or track list, start time of each genre block and tempo; a click track or synchronised audio recording if bar-level hypotheses are to be tested.
- **Separating the explanations.** Fixed-tempo comparisons across genres (for example, all genres at the same metronome tempo); Latin with and without hand-switching; and accelerometer-based measures of physical intensity.
- **Counterbalanced order** and preregistered analyses.
- **Group studies** across ages and levels of expertise, using the same within-session design as a template.

5. Conclusion

Over 27 months of structured practice, Latin grooves were associated with a consistently higher heart rate and sympathetic index than Rock, Fusion or Jazz in this expert drummer, and Jazz with the lowest. The difference persisted after accounting for the upward drift in HR across each session. Because hand-switching was used in every genre, the Latin difference points toward something specific to the Latin grooves or their accompanying music, such as coordination demand, physical workload or tempo. These single-subject findings are hypothesis-generating. They offer a concrete, testable target for the EEG phase of the project and a template for group studies.

Declarations

Data availability. The per-block data set (128 analysed blocks plus the excluded session) and the diary genre order are available from the author on reasonable request. Video recordings contain identifiable information and are not publicly available.

Competing interests. The author declares no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Note on revision (version 3)

Version 2 of this manuscript (January 2026) reported correlations between the Stress Index and heart rate within each genre, a “biphasic” Latin response, daily-versus-monthly comparisons and lagged cross-genre correlations. Version 3 replaces all of these results. A re-analysis of the beat-to-beat data in November 2026 found that the weak Latin correlation underlying the biphasic pattern resulted from two mis-entered values (18 and 20 January 2023), that zero-filled cells had inflated the remaining correlations, and that Stress Index–HR correlations are largely built in because both measures come from the same RR intervals. Version 2 also described its data set as 144 practice sessions; that figure counted genre records in the spreadsheet rather than sessions. Version 3 analyses 32 complete four-genre sessions using direct within-session comparisons and adjustment for playing order.

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