



Sip and Strum: Matcha Intake and a Practice-Reduction Reinforcement Contingency in Beginner Ukulele Skill Acquisition

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Abstract

This study examined differences in beginner ukulele skill acquisition under three combinations of matcha intake and a practice-reduction reinforcement contingency. A quasi-experimental three-group design was employed involving 15 students aged 18–25 years with no prior musical-instrument experience. Participants were assigned to one of three conditions: no matcha with reinforcement, matcha with reinforcement, or matcha without reinforcement. The reinforcement contingency consisted of shortening the remaining practice period when a participant attained at least 85% performance accuracy at the prescribed tempo twice consecutively. Participants completed two structured practice sessions, followed by retention assessments conducted 24–48 hours after learning. Musical performance was evaluated using accuracy, tempo maintenance, criterion attainment, correct chord progressions, and retention scores. Descriptive results showed that the matcha-with-reinforcement group exhibited the strongest overall performance, including more frequent tempo maintenance, higher criterion attainment, and more correct chord progressions. This group also obtained the highest mean retention score. Welch's one-way analysis of variance indicated a statistically significant difference in retention across the three conditions, with the matcha-with-reinforcement group outperforming the matcha-only group. However, the small sample and absence of a no-matcha-without-reinforcement condition preclude separate estimates of the two interventions and any conclusion regarding their interaction. The findings provide preliminary evidence that combining physiological stimulation with a structured practice-reduction contingency may support beginner musical learning, although confirmation through a larger, complete factorial experiment is required.

Keywords: *behavioral reinforcement, matcha intake, musical skill acquisition, practice contingency, retention, ukulele learning*

1. Introduction

Learning to play a musical instrument requires the coordination of attention, memory, perceptual processing, and fine motor movement. Among beginners, the acquisition of even foundational musical skills can be challenging because learners must simultaneously remember chord patterns, position their fingers correctly, maintain rhythmic timing, and transition smoothly between chords. These demands may be particularly difficult during short instructional periods, when learners have limited opportunities to establish automaticity through repeated practice.

Musical skill acquisition also involves concentration, error monitoring, memory consolidation, motivation, and persistence. Structured instruction and consistent practice contribute to instrumental proficiency (Cainoy et al., 2021). Early musical abilities have also been associated with subsequent academic outcomes, although such associations do not establish causality (Janurik & Józsa, 2022).

One potential source of cognitive support is matcha, a powdered green tea containing caffeine, L-theanine, catechins, and other bioactive compounds. Matcha has received attention because caffeine may promote alertness, whereas L-theanine may contribute to a calmer attentional state. Studies have reported possible benefits for attention

and stress-sensitive cognitive performance (Baba et al., 2021; Sakurai et al., 2020). Evidence remains dependent on the population, dosage, task, and research design.

Behavioral contingencies may provide another means of supporting skill development. Negative reinforcement occurs when the removal or avoidance of an undesirable condition increases the likelihood of a target behavior. In this study, the behavioral intervention was operationalized as a reduction in the remaining practice period after a participant achieved a specified level of performance. Because the study did not directly assess whether participants perceived the remaining practice period as aversive, the intervention is described more precisely as a practice-reduction reinforcement contingency (Cherry, 2026).

The present study examined three learning conditions: no matcha with the practice-reduction contingency, matcha with the contingency, and matcha without the contingency. Because the design omitted a no-matcha-without-contingency condition, it cannot independently estimate the main effects of matcha and reinforcement or statistically establish an interaction. Its contribution lies instead in determining whether meaningful performance patterns emerged across the three implemented conditions.

Objectives of the Study

This study aimed to examine beginner ukulele skill acquisition across three combinations of matcha intake and a practice-reduction reinforcement contingency. Specifically, it sought to:

1. describe participants' accuracy, tempo maintenance, criterion attainment, and correct chord progressions across the three learning conditions;
2. determine whether performance changed from the first to the second practice session within each condition;
3. compare short-term retention scores across the three learning conditions; and
4. identify the principal difficulties encountered during beginner ukulele practice.

2. Review of Related Literature

2.1 Matcha Intake and Cognitive Readiness

Matcha is a powdered form of green tea derived from *Camellia sinensis*. Its potential cognitive effects are commonly associated with caffeine and L-theanine. Caffeine generally supports alertness and vigilance, whereas L-theanine has been associated with relaxed attention. Their combination may be relevant to tasks requiring sustained concentration without excessive physiological arousal.

Baba et al. (2021) found that daily matcha consumption helped maintain attentional function following mild acute psychological stress among young adults. Sakurai et al. (2020) also examined matcha and cognitive performance among community-dwelling older adults. These findings suggest cognitive potential but cannot be directly generalized to musical skill acquisition. A systematic review of caffeine and L-theanine likewise identified promising but heterogeneous findings concerning attention, cognition, and inhibitory control (Sohail et al., 2021).

Individual responses may differ according to habitual caffeine consumption, health status, timing, and sensitivity. Cognitive stimulation does not invariably result in better learning performance. Investigations in educational settings should therefore use controlled administration, screen participants for health risks, and avoid treating matcha as a substitute for adequate rest, nutrition, and instruction.

In an adjacent student-health context, nutrition, lifestyle, and psychological distress were examined as interrelated conditions, reinforcing the need to interpret cognitive readiness within a broader physiological and behavioral context (Quinto et al., 2025).

Similarly, a pilot controlled study of digital sleep-diary self-monitoring indicates that readiness-related states may respond to behavioral routines, although perceived sleep quality remains distinct from objectively measured learning performance (San Juan et al., 2026).

2.2 Reinforcement Contingencies and Learning Behavior

Negative reinforcement refers to an increase in behavior resulting from the removal or avoidance of an aversive condition. It differs from punishment, which is intended to reduce behavior. In structured learning, reinforcement contingencies can clarify expectations and provide immediate consequences for successful performance (Cherry, 2026).

Participants under the contingency in this study were permitted to shorten their remaining practice time after meeting an accuracy and tempo standard twice consecutively. The arrangement qualifies as negative reinforcement only when the remaining practice time is experienced as undesirable and its removal strengthens the target behavior. Because this perception was not measured, the more conservative term practice-reduction reinforcement contingency is used.

Related behavioral research suggests that performance-relevant self-regulation may involve self-efficacy, self-control, and delayed gratification, although these constructs differ from an immediate practice-reduction contingency (Rui, 2026; Wang, 2026).

In skill-oriented education, endogenous and exogenous motivation also show differentiated relationships with commitment and learning behavior, emphasizing that an external consequence should not automatically be equated with intrinsic engagement (Yan, 2026).

2.3 Musical Skill Acquisition and Retention

Musical skill acquisition integrates cognitive, perceptual, motor, and affective processes. Beginners must identify chord patterns, recall instructions, position the fingers accurately, maintain tempo, and monitor errors while performing. Structured music instruction and systematic assessment can support developing performance (Cainoy et al., 2021).

A Philippine within-subjects quasi-experiment on desk organization and puzzle completion offers a methodological parallel, demonstrating how a bounded contextual condition can be evaluated through objective task-efficiency indicators (Manio et al., 2026).

Beyond immediate practice conditions, growth mindset, personal-social competencies, and adversity-related resilience offer adjacent perspectives on persistence and effective performance, although none constitutes direct evidence concerning musical learning (Adame, 2026; Aguilar, 2026; Balut et al., 2026).

Accuracy and tempo maintenance capture complementary aspects of early instrumental learning. Retention is also necessary because improvement during practice may reflect immediate instruction or repetition rather than stable learning. Longitudinal evidence linking early musical abilities with later academic achievement further demonstrates the educational relevance of musical development, while not proving causal transfer (Janurik & Józsa, 2022).

2.4 Synthesis and Literature Gaps

The literature identifies cognitive readiness, behavioral feedback, structured practice, and retention as relevant components of skill acquisition. Matcha may influence attention through its caffeine and L-theanine content, while reinforcement contingencies may organize task behavior by linking successful performance to an immediate consequence (Baba et al., 2021; Cherry, 2026; Sakurai et al., 2020; Sohail et al., 2021). Relatively limited evidence

addresses their concurrent use during beginner instrumental learning. The present exploratory comparison responds to this gap, although its incomplete factorial structure prevents isolation of main and interaction effects.

Educational research on artificial-intelligence adoption similarly distinguishes perceived effectiveness from demonstrated outcomes, reinforcing the importance of separating subjective helpfulness from retained performance (Rao et al., 2025).

Broader studies also indicate that performance may reflect the interaction of individual resources and environmental support (Espelita & Atento, 2026), while an integrative review of contemporary education challenges situates motivation, competence, and curriculum-practice alignment within an interdependent learning system (Bermido et al., 2025).

3. Methodology

3.1 Research Design

The study employed an exploratory quasi-experimental design involving three parallel conditions: no matcha with the practice-reduction contingency, matcha with the contingency, and matcha without the contingency. The absence of a no-matcha-without-contingency condition prevented a complete 2×2 factorial analysis. Analysis was therefore limited to within-condition changes and comparisons among the three implemented conditions.

3.2 Participants

Participants were 15 students aged 18–25 years from a community in Caloocan City, Philippines, with five participants in each condition. Eligibility was restricted to students reporting no prior experience playing the ukulele or another musical instrument. Participants assigned to the matcha conditions were regular matcha consumers and were screened for cardiovascular disease, hypertension, pregnancy, severe anxiety, caffeine sensitivity, and other relevant contraindications.

3.3 Learning Conditions and Measures

For the matcha conditions, ceremonial-grade matcha was dissolved in approximately 70–100 mL of hot water and consumed 30–45 minutes before practice. The source protocol reports approximately 2 g for female participants and 3 g for male participants; these amounts are reported as implemented and are not presented as validated sex-specific recommendations. Under the contingency, three minutes were deducted from the remaining practice period after at least 85% accuracy at the prescribed tempo was achieved twice consecutively.

All participants used the same ukulele and standardized beginner-level instructional material. Recorded indicators included average accuracy, tempo maintenance, criterion attainment, correct chord progressions within three minutes, retention score, and reported difficulties involving strumming, chord switching, and finger placement. The study-specific rubric had no reported validation or inter-rater reliability evidence.

3.4 Procedure

Participants provided written informed consent, completed health screening, and were instructed to avoid other stimulants for at least 12 hours before each session. Each completed two sessions over two weeks, comprising approximately 10 minutes of guided instruction and 20 minutes of practice and assessment. A three- to five-minute retention assessment was conducted 24–48 hours after learning.

3.5 Data Analysis

Means, standard deviations, and frequencies summarized performance. Exact two-sided Sign Tests evaluated paired changes because each condition contained only five observations. Retention scores were compared through

Welch's one-way analysis of variance and Games–Howell pairwise comparisons. A significance level of .05 was used, and all findings were interpreted cautiously because of the small sample.

3.6 Ethical Considerations

Participation was voluntary, and participants could withdraw without penalty. Health screening and monitoring addressed caffeine-related risk. Personal names were removed from the journal manuscript, and only anonymous identifiers and aggregate results were retained.

4. Results and Discussion

4.1 Performance Accuracy Across Sessions

All three conditions recorded higher mean accuracy during the second session. The largest descriptive improvement occurred in the matcha-with-contingency condition, whose mean increased by 10.31 percentage points.

Table 1. Accuracy Scores Across the Two Practice Sessions

Condition	S1 M	S1 SD	S2 M	S2 SD	Change
No matcha + contingency	79.06	2.37	83.13	3.01	4.06
Matcha + contingency	80.31	4.36	90.63	3.13	10.31
Matcha only	78.44	2.57	82.19	3.60	3.75

Note. Each condition included five participants. Values are percentages; change equals Session 2 minus Session 1.

4.2 Tempo, Criterion Attainment, and Chord Progressions

Table 2. Summary of Performance Indicators by Learning Condition

Condition	Tempo n/10	Criterion n/10	Mean progressions	chord
No matcha + contingency	3	1	2.80	
Matcha + contingency	9	6	4.60	
Matcha only	7	1	3.30	

Note. Criterion attainment required at least 85% accuracy at the prescribed tempo.

The combined condition maintained tempo in nine observations, attained the criterion in six, and completed the highest mean number of correct chord progressions. This condition therefore displayed the strongest performance pattern across accuracy, rhythm, and execution, without independently establishing the effect of either intervention.

4.3 Within-Condition Changes in Accuracy

Table 3. Exact Sign Tests for Changes in Accuracy Between Sessions

Condition	Improved	Declined	Exact two-sided p
No matcha + contingency	4	1	.375
Matcha + contingency	5	0	.063
Matcha only	5	0	.063

The source manuscript used a normal approximation and reported significance for both matcha conditions. Exact two-sided tests are more appropriate with only five pairs. None of the changes reached $p < .05$. The uniform direction of improvement in the two matcha conditions remains descriptive rather than confirmatory evidence.

4.4 Retention Across Conditions

Table 4. Retention Scores by Learning Condition

Condition	n	Mean	SD
No matcha + contingency	5	80.80	2.25
Matcha + contingency	5	85.60	3.16
Matcha only	5	80.20	2.74

Welch's one-way analysis indicated a significant difference in retention, $F(2, 7.85) = 4.68$, $p = .046$. Games–Howell comparisons showed that the matcha-with-contingency condition exceeded the matcha-only condition by 5.47 points, $p = .046$. The difference between the no-matcha-with-contingency and combined conditions approached significance, $p = .060$, while the no-matcha and matcha-only conditions did not differ, $p = .918$.

4.5 Reported Learning Difficulties

Strumming accounted for 47.4% of difficulties in the no-matcha-with-contingency condition, followed by chord switching (36.8%) and finger placement (15.8%). In the combined condition, chord switching was most frequent (42.9%), while strumming and finger placement each accounted for 28.6%. In the matcha-only condition, strumming and chord switching each represented 35.3%, followed by finger placement at 29.4%.

4.6 Discussion

The results reveal a consistent descriptive pattern favoring the matcha-with-contingency condition. One possible explanation is that cognitive readiness and behavioral structure complemented one another. Matcha has been examined in relation to attention under stress, and caffeine with L-theanine may support selected aspects of cognitive performance (Baba et al., 2021; Sohail et al., 2021). The practice-reduction contingency simultaneously provided an immediate and clearly defined consequence for satisfying the performance standard.

This explanation remains provisional because the study did not measure attention, caffeine absorption, perceived alertness, motivation, or practice aversion. The findings show differences in outcomes but do not demonstrate the internal processes that produced them. The matcha-only condition improved descriptively but did not demonstrate higher retention than the no-matcha-with-contingency condition.

Chord switching and strumming remained the predominant difficulties, underscoring that beginner instrumental learning requires the integration of memory, timing, and fine motor coordination. Important limitations include the small sample, two-session duration, incomplete factorial structure, uncertain assignment process, unvalidated rubric, and unmeasured differences in caffeine tolerance, sleep, motivation, and musical aptitude.

5. Conclusions, Recommendations, and Implications

5.1 Conclusions

The matcha-with-contingency condition demonstrated the strongest descriptive performance, including the largest increase in accuracy, most frequent tempo maintenance and criterion attainment, highest mean chord progressions, and highest retention. Exact Sign Tests showed that no within-condition accuracy change reached the .05 level. Retention nevertheless differed significantly across conditions, with the combined condition exceeding the matcha-only condition. The findings provide preliminary evidence of a favorable combined-condition pattern but do not establish independent or synergistic effects because the fourth factorial condition was absent.

5.2 Recommendations

- Use clearly defined accuracy and tempo criteria to structure beginner practice while retaining constructive feedback and learner choice.
- Apply practice-reduction contingencies cautiously so that musical learning is not framed as inherently undesirable.
- Devote targeted instruction to chord switching and rhythmic strumming before integrating these components into complete progressions.
- Do not treat matcha as a standard educational intervention; any use should remain voluntary and consider health status and caffeine sensitivity.
- Conduct a larger randomized 2×2 factorial experiment including a no-matcha-without-contingency condition, longer follow-up, validated rubrics, blinded raters, and direct measures of attention, motivation, and perceived aversiveness.

5.3 Implications of the Study

The study contributes to behavioral and social analytics by demonstrating how physiological and behavioral conditions may be examined through observable performance indicators. It also highlights that a consequence qualifies as negative reinforcement only when removal strengthens behavior, and that short-term performance gains should be distinguished from retained learning. Methodologically, the corrected exact tests illustrate the importance of matching statistical procedures and claims to very small samples and incomplete experimental structures.

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