BJMB
Brazilian Journal of Motor Behavior

Special issue on Factors that affect the motor learning process

Whole practice combined with *Kuzushi* preparation enhances learning of *Tai Otoshi* in experienced young judokas

FABIO R. F. GOMES[1] | CASSIO M. MEIRA JR[2] | GO TANI[3]

[1] Universidade Municipal de São Caetano do Sul – Escola de Saúde, São Caetano do Sul, São Paulo, SP, Brazil
[2] Universidade de São Paulo – Escola de Artes, Ciências e Humanidades, São Paulo, SP, Brazil
[3] Universidade de São Paulo – Escola de Educação Física e Esporte, São Paulo, SP, Brazil

Correspondence to: Fabio R. F. Gomes
Rua Santo Antônio, 50 – Centro
São Caetano do Sul – SP – CEP: 09521-160
email: fabio.gomes@online.uscs.edu.br
https://doi.org/10.20338/bjmb.v19i1.510

HIGHLIGHTS

- Whole practice with pre-*kuzushi* enhances *tai otoshi* learning and retention.
- Only whole practice improved actual opponent unbalancing over time.
- Traditional static practice showed limited transfer to functional kuzushi.

ABBREVIATIONS

MTP	Traditional dynamic *kuzushi+tsukuri+kake*
PPP	Progressive parts pre-kuzushi+kuzushi+ tsukuri+kake
STP	Traditional static *kuzushi+tsukuri+kake*
WP	whole pre-*kuzushi+kuzushi+tsukuri+kake*

PUBLICATION DATA
Received 09 09 2025
Accepted 08 12 2025
Published 09 01 2026

BACKGROUND: Traditional judo teaching often relies on static, which may not reflect combat demands. Although movement-based kuzushi improves learning in beginners, evidence is limited regarding how different practice schedules affect acquisition and retention of complex throwing techniques in experienced young judokas.
AIM: This study investigated the effects of different practice schedules - static traditional, dynamic traditional, whole with *kuzushi* preparation, and progressive parts with *kuzushi* - on the acquisition of the *tai otoshi* technique in experienced young judokas.
METHODS: Thirty-two children (8.63 ± 0.99 years), each with at least one year of judo training, were randomly assigned to four groups. The protocol included a pre-test, four practice sessions (totaling 160 trials), a post-test, and a retention test. Performance was evaluated via video analysis using a validated checklist assessing global technique, *kuzushi* movement, and actual opponent unbalancing.
RESULTS: All groups improved in global technique and *kuzushi* movement pattern. However, only the whole practice group showed significant gains in actual *kuzushi* across post-test and retention phases. Intergroup analysis demonstrated that this group outperformed the others in both global technique and opponent unbalancing, particularly in retention.
INTERPRETATION: These findings suggest that whole practice incorporating *pre-kuzushi* strategies promotes more effective learning than traditional or segmented approaches, even among children with prior experience. The study advances the discussion on whole versus part practice, indicating that *tai otoshi*, though moderately complex, benefits from high task organization and continuous execution. It also critiques traditional *uchikomi*, which may neglect realistic fight conditions. Integrating *pre-kuzushi* appears to improve timing, leverage, and opponent destabilization, key components in successful execution. The results reinforce the value of aligning practice methods with combat demands to optimize motor learning in martial arts.

KEYWORDS: Motor skills | Motor learning | Part practice | Martial arts

INTRODUCTION

Judo projection techniques during a match are considered open skills, as they occur within an ever-changing competitive environment [1,2]. In this context, competitors (*judokas*) must continuously process information for their actions to be successful, enabling them to execute various projection techniques, often starting from the same stance or footprint [3–5]. However, this dynamic nature of competition does not seem to be fully addressed by traditional judo teaching methods, as instructors frequently begin teaching projection techniques using *uchikomi*.

Traditional teaching methods initially treat projection techniques as closed skills, gradually introducing environmental variations to transform them into open skills. This progression starts with *uchikomi* (repetitive training in which the throwing motion is practiced up to the execution point but without completing the throw), followed by *uchikomi* with a moving partner without resistance (*kata*), *uchikomi* with motion and resistance, *yakusoku geiko* (pre-arranged sparring with specific goals), *randori* (free sparring), and ultimately competition [6].

This stepwise approach is based on the principle of simplifying the technique to facilitate its initial acquisition. However, this approach may result in a weak correspondence between training conditions and the actual demands of a competitive match.

The phases of a judo projection technique are (1) *kuzushi* (unbalancing - destabilizing the opponent's defensive posture), (2) *tsukuri* (preparation - adjusting one's own position to optimize the throw), and (3) *kake* (execution - completing the throw based on the prior positioning) [7].

To simulate an environment with greater instability than static *uchikomi*, a study demonstrated that participants who practiced movement *kuzushi* (advancing and pushing the opponent) showed better retention and transfer when learning the o *soto gari* technique compared to those who practiced static *kuzushi* [8]. These results are in line with the study's assumption that learning motor skills in fighting contexts improves the execution of techniques in real combat situations [9]. Therefore, initiating the technique by moving the opponent away from a static position is crucial for the successful execution of the subsequent phases of the projection technique [10]. Furthermore, an experiment focused on *kuzushi* in learning *soto gari*, analyzing both the *kuzushi* movement pattern performed by *tori* (the person applying the technique) and the actual effect of *kuzushi* (the imbalance of *uke*, the opponent). Their findings revealed within-group improvements for the motion group, whose *kuzushi* movement pattern scores were higher on transfer compared to the pre-test. In contrast, some participants in the static group incorrectly executed *tsukuri* before *kuzushi* during retention and transfer. This supports previous evidence that judokas struggle with the temporal coordination of push-pull actions while learning projection techniques [11].

These findings raise the question of which type of practice most effectively promotes learning of the *kuzushi* phase in Judo projection techniques. Beyond merely pulling the opponent into position, it is necessary to apply a deceptive pre-*kuzushi* strategy that facilitates the projection. One effective way to unbalance the opponent is by shifting their weight to create misleading stimuli, such as "pull and push," "push and pull," "up and down," "down and up," "right and left," or "left and right". Using this pre-*kuzushi* strategy of alternating directions, the tori gains an advantage over the *uke* to execute the *tsukuri* effectively. Mastering this pre-*kuzushi* strategy effectively adds a new component to the technique sequence: pre-*kuzushi*, *kuzushi*, *tsukuri*, and *kake*.

When a skill consists of multiple phases, it can be practiced either in parts or as a whole. This raises the classical debate between part and whole practice in motor learning. Whole practice tends to be more suitable for skills with low complexity (fewer components) and high organization (strong interaction between components), whereas part practice is more appropriate for skills with high complexity and low organization [12]. This question was investigated in a study with children with no prior Judo experience, that participants learned the Judo technique o *soto gari* with or without motion during *kuzushi*, using either whole or part practice. Four experimental groups completed a pre-test, acquisition, post-test, and retention: (1) static *kuzushi+tsukuri+kake*, (2) dynamic *kuzushi+tsukuri+kake*, (3) whole pre-*kuzushi+kuzushi+tsukuri+kake*, and (4) progressive parts pre-*kuzushi+kuzushi+tsukuri+kake* (starting with pre-*kuzushi* and sequentially adding *kuzushi*, *tsukuri*, and *kake*). All groups improved in overall (global) technique performance. However, only the groups that incorporated pre-*kuzushi* and the dynamic *kuzushi* group showed significant improvements in *kuzushi* execution, both in movement patterns and actual *kuzushi*. These results suggest that beginner judokas can handle the added complexity of dynamic *kuzushi* and, more critically, benefit from the inclusion of a pre-*kuzushi* component in the technique [1].

The present study seeks to extend the contribution of Gomes et al. [1] by examining the learning of a more advanced technique in children with previous Judo experience, with specific attention to the components of pre-*kuzushi*, *kuzushi*, and the global execution of the technique. We selected *tai otoshi* as the experimental task because (1) it is more complex than o *soto gari*, involving a spinning motion where the *uke* is projected over the *tori*'s leg using an arm-generated lever [13], and (2) it is typically learned at a more advanced stage in Judo training [14]. Therefore, our sample consisted of experienced children, assigned to the same four groups as in Gomes et al. [1]: traditional static *kuzushi+tsukuri+kake* (STP), traditional dynamic *kuzushi+tsukuri+kake* (MTP), whole pre-*kuzushi+kuzushi+tsukuri+kake* (WP), and progressive parts pre-*kuzushi+kuzushi+tsukuri+kake* (PPP). The aim of this study was to investigate the effects of different practice schedules - static traditional, dynamic traditional, whole with *kuzushi* preparation, and progressive parts with *kuzushi* - on the acquisition of the *tai otoshi* technique in experienced young judokas. We expected that the whole practice group would outperform the others in the retention phase.

METHODS

Participants

Thirty-two children (26 boys and 6 girls), aged 8.6 ± 1 years, volunteered to take part in the study. They had at least one year of systematic practice (twice a week) in a Judo academy, ensuring sufficient experience in several basic techniques. None of the participants had prior experience with the *tai otoshi* technique. Informed consent was obtained from all participants and their parents after they read and signed the consent form. The study was approved by the University Ethics Committee (CAAE 0006.0.241.000-10).

Participants were randomly assigned to one of four groups based on their pre-test scores to ensure homogeneity among groups: STP (6 boys, 2 girls), MTP (7 boys, 1 girl), WP (6 boys, 2 girls), and PPP (7 boys, 1 girl).

Task

The target skill in this study was the *tai otoshi* (Figure 1). *Tai* means "body", and *otoshi* means "fall". It is classified as a *te waza*

(hand technique), with a right-sided *kumi kata* (grip). The *kuzushi* occurs diagonally forward and to the right of the *uke*. The *tori* destabilizes the *uke* by pulling back their left leg while simultaneously pulling forward with the right-side hand. In response, the *uke* counters by stepping forward with the right leg and shifting body weight onto it. During *tsukuri* and *kake*, the *tori* pivots, positioning their left foot beside the *uke*'s left leg while stepping the right leg in front of the *uke*'s right leg. The right foot is placed externally, slightly to the right of the *uke*'s foot. The calf is positioned under the *uke*'s shin, the knee faces forward, and the body weight is balanced between both legs. In this stance, the *tori* applies force with the right hand toward the projection direction while lifting and pulling the left hand upward and forward to execute the throw [7]. Notably, *tai otoshi* does not involve carrying the *uke* on the *tori*'s back.

Two types of preparation, or pre-*kuzushi*, involving multidirectional motion are commonly used for the *kuzushi* phase of *tai otoshi*: (1) the *tori* steps forward with the right leg and pushes backward on the *uke*'s collar, forcing the *uke* to step back while slightly extending the torso. This shifts the *uke*'s body weight predominantly onto the left leg. In response, the *uke* bends the torso forward to rebalance, shifting weight onto the right foot placed forward. At this precise moment, the *tori* executes the kuzushi; (2) when the *uke* steps forward and places weight on the right foot, the *tori* pulls the sleeve forward and to the right with a slight trunk rotation, causing the *uke*'s torso to incline forward. The *uke* does not resist the pull and begins moving the left leg forward to regain balance. At this instant, the *tori* performs another forward pull, which constitutes the *kuzushi* for the *tai otoshi* (Figure 1).

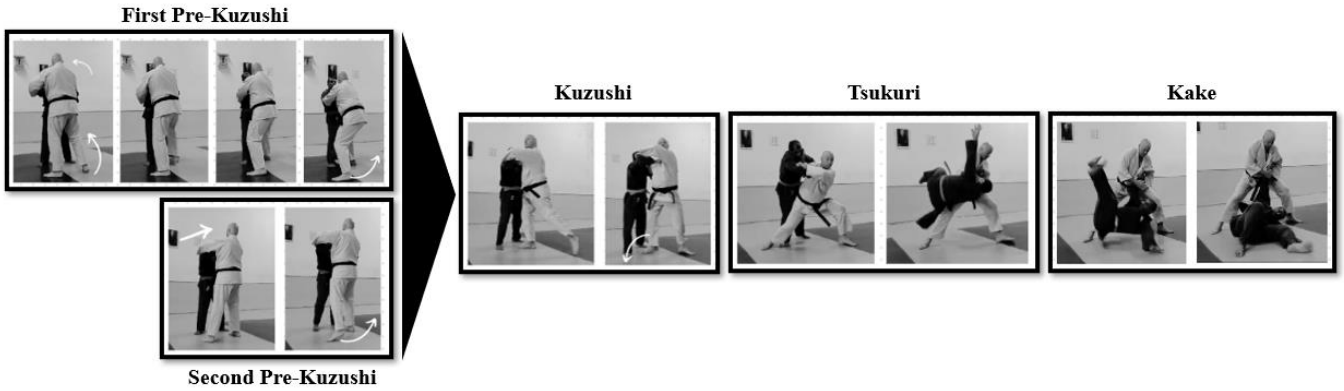

Figure 1. Throwing technique *tai otoshi* with two types of preparation for *kuzushi* (pre-*kuzushi*).

Design and procedure

Six experimental sessions were conducted during regular Judo classes: a pre-test (3 trials), four practice sessions (160 total trials), a post-test (3 trials at the end of the fourth practice session), and a retention test (3 trials one week after the final practice). The pre-test was conducted in week 1 to obtain individual scores for the formation of homogeneous groups. Prior to the pre-test, participants were informed of the technique to be performed, followed by a demonstration that included the projection of the *uke*. The retention was conducted in week 4, with no verbal instruction or demonstration. No feedback was provided during the pre-test or retention.

Practice sessions were held twice weekly, on Tuesdays and Thursdays, during weeks 2 and 3. Each child was individually brought to a designated area for data collection. Forty trials were performed at each session. Before the first trial and after every 10 trials, verbal instructions detailing the skill and a live demonstration were provided.

Verbal instruction included the following points: (a) rotate to face away from the opponent and position the feet in an "L" shape; (b) simultaneously pull the opponent's sleeve while drawing the leg back into the "L" position to generate leverage; (c) cause the opponent's torso to lean forward with weight on the ball of the right foot (for right-handed execution); (d) place the right leg in front of the opponent's legs; (e) ensure the right leg does not touch the opponent's right leg prior to the projection, maintaining space between them; and (f) execute the projection over the leg, not over the hip.

To avoid cognitive overload, three instructions were provided after each set of 10 trials, ensuring that the full set was completed by the end of the session. The first demonstration included the *uke*'s projection. The second (after 10 trials) and third (after 20 trials) demonstrations were performed without projection but reinforced the verbal instructions. The fourth demonstration (after 30 trials) involved the *uke*'s projection but did not include verbal instruction.

Participants in the WP group received additional verbal instructions followed by a demonstration of the preparation phase (*kuzushi*) displacement before the first and the 10th trials. Before the 20th and 30th trials, they received only a demonstration of the *kuzushi*, without verbal instruction. To ensure equal exposure to the two types of pre-*kuzushi*, half of the WP group received displacement 1 before the first and 10th trials and displacement 2 before the 20th and 30th trials; the other half received the same information in the reverse order. This order was counterbalanced across sessions.

Participants in the PP group received a demonstration of the *kuzushi* at the start of the experiment. As practice progressed, a demonstration was provided each time a new movement was introduced, with verbal instructions delivered at a rate of three items per demonstration. During the session in which the technique was practiced in full, instructions and demonstrations were provided in the

same manner as in the WP group. No feedback was provided to any of the groups throughout the experiment. The practice regimes of the groups during the acquisition phase are presented in Figure 2.

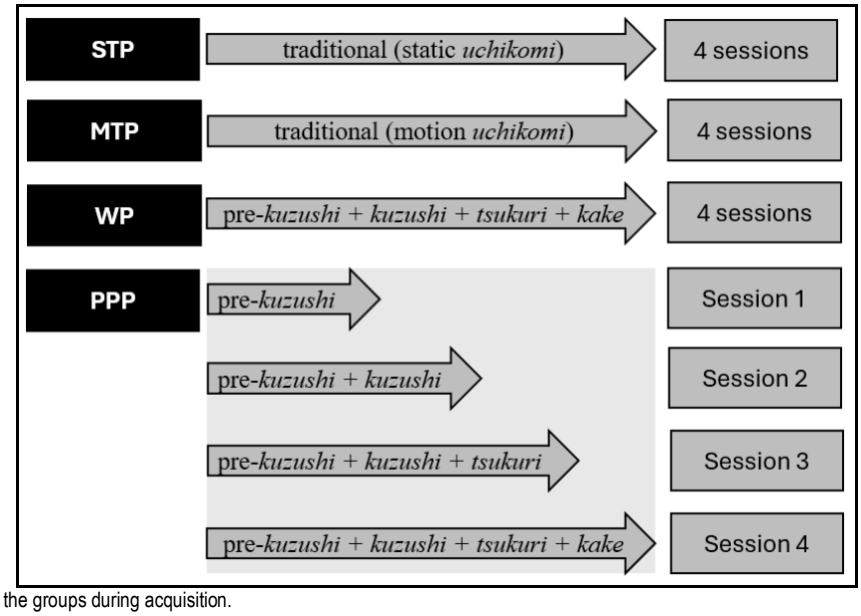

Figure 2. Practice regimes of the groups during acquisition.

Measures

Tai otoshi performance was evaluated using a validated checklist [15], comprising three components: (1) the *tori*'s global technique (subdivided into *kuzushi* and *tsukuri*), (2) *kuzushi* movement pattern (*tori*), and (3) actual *kuzushi* (*uke*'s unbalance). The checklist was designed for the right *kumi-kata* (grip); if the trial was performed with the left grip, the right and left designations in the checklist were reversed.

The task was recorded using a video camera and subsequently evaluated by a Judo specialist with a second-degree black belt who was trained in a validated protocol [15]. To establish baseline reliability for the experiment, an intra-rater assessment was conducted during the initial trials. A set of trials was randomly selected and re-evaluated one week later. The intra-rater reliability was estimated using the intraclass correlation coefficient (ICC), derived from a repeated-measures ANOVA framework. The resulting ICC was 0.89, indicating a high level of consistency between the two evaluations.

To evaluate the *tori*'s global technique, the following criteria were considered:

A) *Kuzushi*

1. BAD: No rotational movement characterizing *kuzushi* occurs, or the *tori* moves excessively toward the *uke*, reducing the distance between them. Consequently, the *uke*'s torso does not lean forward, and there is no sleeve pulling action by the *tori*.
2. REGULAR:
   - 2a: The *tori* rotates around the vertical axis to move the *uke*, keeping the sleeve-holding hand below an imaginary horizontal line beneath the chest throughout the turn. The *uke* remains upright with both feet on the ground. This posture may lead to a *harai goshi* instead of *tai otoshi*.
   - 2b: The *tori* pulls the uke forward and downward, but the arm movement is delayed relative to the body (*tsukuri* precedes *kuzushi*). Both 2a and 2b are scored as 2 (regular) without distinction during scoring.
3. GOOD: The *tori* rotates on the vertical axis while maintaining the sleeve hand below an imaginary chest-level line, possibly near their own abdomen. The *uke*'s torso leans forward, sometimes supported on the tip of the right foot. The forward tilt should occur as the *tori* approaches placing the right leg during the turn.
4. TOP: The *tori* completes the turn with the sleeve-holding hand detached from the body at chest height. The *uke*'s weight is solely on the tip of the right foot. The *tori*'s sleeve only lowers as the *uke* crosses over the right leg.

B) Tsukuri

1. BAD: The *tori* does not complete an approximately 180º turn (around the vertical axis). Without this, the projection may not occur.
2. REGULAR: The *tori* turns very close to the *uke*, causing interference from the *uke*'s leg or hip. This proximity can lead to executing *harai goshi* instead of *tai otoshi*.

3. GOOD: The *uke* is positioned behind the *tori*'s back and is projected over the hips rather than over the leg, which is incorrect for *tai otoshi*.

4. TOP: The *uke* is correctly projected over the *tori*'s right leg, with a clear gap between their legs.

For *kuzushi* evaluation, the following criteria were used:

A) *Kuzushi* movement pattern (*tori*)

• Occurrence: The sleeve is pulled at chest height until the left foot contacts the ground after the throw; hips and shoulders are aligned.

• Absence: The sleeve is pulled below chest level, and hips and shoulders are misaligned.

B) Actual *kuzushi* (*uke*'s unbalance)

• Occurrence: The *uke*'s torso leans forward, with weight on the toes or specifically on the tip of the right foot.

• Absence: The *uke*'s torso does not lean forward when the *tori* finishes the turn to face the *uke*.

Data analysis

The global technique of the *tori* was calculated as the sum of the scores from three attempts, resulting in scores ranging from 6 to 24 points. The *kuzushi* analysis was divided into two components: *kuzushi* movement pattern and actual *kuzushi* pattern. For each component, a score of 1 was assigned when the behavior occurred and 0 when it did not. Therefore, the total score for each component across the three attempts ranged from 0 to 3 points.

Two sets of comparisons were performed for both global technique and *kuzushi*: (1) STP vs. MTP vs. WP, and (2) WP vs. PPP. Between-group analyses for STP, MTP, and WP were conducted using the Kruskal-Wallis test due to the ordinal nature of the data. When significant differences were detected, the Mann-Whitney U-test was applied for pairwise comparisons to determine the source of the difference. Comparisons between WP and PPP were performed using the Mann-Whitney U-test.

For within-group (intra-group) analyses, the Friedman ANOVA test was applied, and when significant, Wilcoxon signed-rank tests were used for post hoc comparisons. The significance level was set at 5% for all analyses.

RESULTS

Table 1 and Figure 3 present the statistical values for each group (STP, MTP, WP, and PPP) across the global technique, *kuzushi* movement pattern, and actual *kuzushi* pattern, reported at the pre-test, post-test, and retention phases.

Pre-test

No significant differences were found for the three variables, indicating that the groups began the experiment with comparable performance levels: global technique of the *tori* [H (2, N = 24) = 3.635; p = 0.162]; *kuzushi* movement pattern [H (2, N = 24) = 0.015; p = 0.992]; actual *kuzushi* pattern [H (2, N = 24) = 2.277; p = 0.320].

Intra-group comparisons

Global technique - Significant differences were detected for: STP [x^2 (N = 8, df = 2) = 11.185; p = 0.00373], from pre-test to post-test (p = 0.018; effect size = 0.399) and from pre-test to retention (p = 0.018; effect size = 0.399); MTP [x^2 (N = 8, df = 2) = 9.307; p = 0.00955], from pre-test to post-test (p = 0.018; effect size = 0.399) and from pre-test to retention (p = 0.0465; effect size = 0.399); WP [x^2 (N = 8, df = 2) = 13.066; p = 0.00145], from pre-test to post-test (p = 0.012; effect size = 0.377) and from pre-test to retention (p = 0.012; effect size = 0.377); PPP [x^2 (N = 8, df = 2) = 6.000; p = 0.0498], from pre-test to post-test (p = 0.028; effect size = 0.399) and from pre-test to retention (p = 0.0465; effect size = 0.425).

Kuzushi movement pattern - Significant differences were found for: STP [x^2 (N = 8, df = 2) = 9.750; p = 0.008], from pre-test to post-test (p = 0.028; effect size = 0.425), and from pre-test to retention (p = 0.028; effect size = 0.425); MTP [x^2 (N = 8, df = 2) = 13.000; p = 0.02] from pre-test to post-test (p = 0.018; effect size = 0.399) and from pre-test to retention (p = 0.018; effect size = 0.399); WP [x^2 (N = 8, df = 2) = 13.000; p = 0.02] from pre-test to post-test (p = 0.028; effect size = 0.425) and from pre-test to retention (p = 0.012; effect size not applied because the pre-test variance was equal to zero); PPP [x^2 (N = 8, df = 2) = 10.211; p = 0.0061] from pre-test to post-test (p = 0.028; effect size = 0.399) and from pre-test to retention (p = 0.044; effect size = 0.458).

Actual *kuzushi* pattern – There were significant differences for: MTP [x^2 (N = 8, df = 2) = 8.588; p = 0.014] from the pre-test to the post-test (p = 0.045; effect size not applied because the pre-test variance was equal to zero); WP [x^2 (N = 8, df = 2) = 14.296; p = 0.001] from the pre-test to the post-test (p = 0.012; effect size = 0.377) and from the pre-test to the retention (p = 0.012; effect size = 0.377); for PPP [x^2 (N = 8, df = 2) = 7.462; p = 0.024] from the pre-test to the post-test (p = 0.028; effect size = 0.425). The analysis revealed no differences for STP [x^2 (N = 8, df = 2) = 2.600; p = 0.273; effect size not applied because the pre-test variance was equal to zero].

Table 1. Means, medians, and standard deviations for STP, MTP, WP, and PPP across the global technique, *kuzushi* movement pattern, and actual *kuzushi* pattern at the pre-test, post-test (final test), and retention phases.

Phase	Groups											
Global Technique												
	STP			MTP			WP			PPP		
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
Pre-test	7.1	6	2.2	7.5	7.5	1.6	8.4	9	1.2	8.8	8.5	2.3
Post-test	14.3	13.5	5	14.4	14	4.7	19.8	20.5	3.5	15.4	17.5	6.6
Retention	13.6	14	3.8	12.8	13	5	19.9	20.5	2.1	13.8	14.5	4.7
Kuzushi Movement Pattern												
	STP			MTP			WP			PPP		
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
Pre-test	0.4	0	1.1	0.3	0	0.7	0.1	0	0.4	0.8	0	1.2
Post-test	2	2.5	1.2	2.6	3	1.1	2.3	3	1.4	2.1	3	1.4
Retention	2.4	3	1.2	2.1	2.5	1.1	3	3	0	2.1	3	1.4
Actual *Kuzushi* Pattern												
	STP			MTP			WP			PPP		
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
Pre-test	0.1	0	0.4	0	0	0	0.4	0	0.7	0.6	0.5	0.7
Post-test	0.8	0	1.4	1.4	1.5	1.4	2.4	3	0.9	2.3	3	1.4
Retention	0.5	0	1	0.8	0.5	0.9	2.8	3	0.5	1	1	0.9

Inter-group comparisons

Global technique - the analysis revealed a statistical difference in the post-test [H (2, N = 24) = 7.021; p = 0.03], with WP showing superior performance when compared to STP (z = 2.257; p = 0.024) and MTP (z = 2.257; p = 0.024). On retention, there was a difference [H (2, N = 24) = 11.493; p = 0.0033], also with superiority of the WP in comparison to STP (z = 3.045; p = 0.0024) and MTP (z = 2.730; p = 0.0064).

Kuzushi movement pattern - No significant differences were found in the comparison between the WP and PPP in any of the phases of the experiment (z = 2.250; p = 0.945).

Actual *kuzushi* pattern - The analysis revealed significant differences on post-test test [H (2, N = 8) = 6.254; p < 0.044], with the WP group showing superiority over the STP group (z = 2.205; p < 0.028). In the retention test, a difference was found [H (2, N = 8) = 15.244; p < 0.001], with WP being superior to both the STP group (z = 3.150; p < 0.002), and the MTP group (z = 3.15; p < 0.0017) and the PPP group (z = 3,04; p < 0,0024).

The boxplots presented in Figure 3 visually support the statistical results, illustrating the performance differences across tests

and groups. It is possible to note a consistent improvement in the WP group, particularly in the global technique and actual *kuzushi* dimensions. Notably, the WP group not only achieved the highest median scores in the retention phase but also exhibited lower variability, indicating more consistent performance among participants. In contrast, the STP group maintained lower scores across all measures, especially in actual *kuzushi*, supporting the interpretation that static practice without movement or preparatory elements is less effective in promoting functional skill transfer in judo techniques.

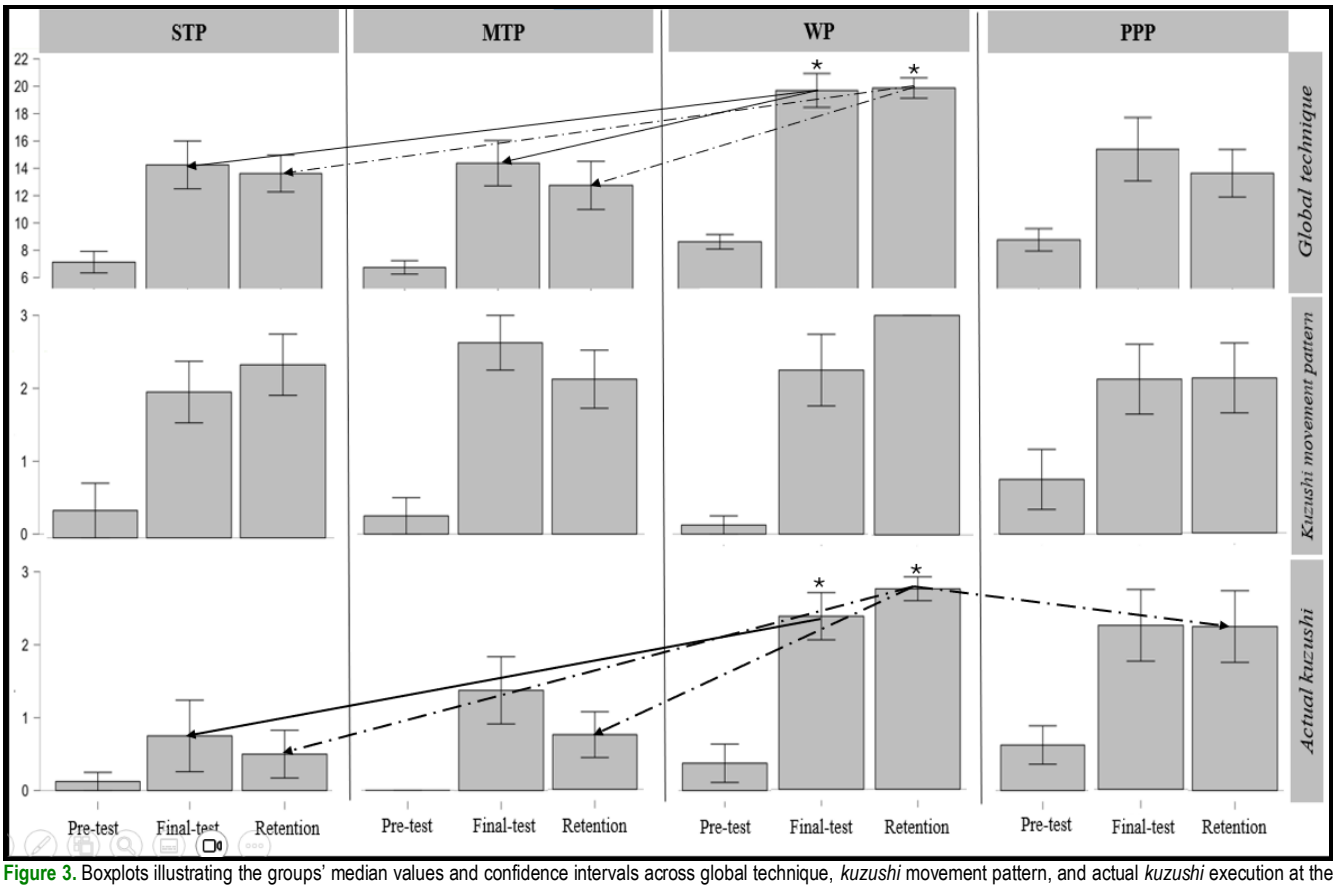

Figure 3. Boxplots illustrating the groups' median values and confidence intervals across global technique, *kuzushi* movement pattern, and actual *kuzushi* execution at the pre-test, post-test (final test), and retention phases (statistically significant differences between time points and/or groups are indicated by asterisks and arrows).

DISCUSSION

This study investigated the effects of different practice schedules - static traditional, dynamic traditional, whole with *kuzushi* preparation, and progressive parts with *kuzushi* - on the acquisition of the *tai otoshi* technique in experienced young judokas. It is important to note that participants were already familiar with basic Judo fundamentals, such as gripping, movement, and posture. Another distinguishing factor of this study is the task itself - *tai otoshi* - a twisting Judo skill involving a direction of unbalance common to many other Judo techniques. Our first specific aim (specificity) was to compare traditional practice schedules (STP: static *kuzushi+tsukuri+kake*; MTP: dynamic *kuzushi+tsukuri+kake*) with an alternative whole practice schedule (WP: whole pre-*kuzushi+kuzushi+tsukuri+kake*). For our second aim (whole/part), we compared whole practice (WP) to a progressive parts practice (PPP: progressive parts pre-*kuzushi+kuzushi+tsukuri+kake*).

Our intra-group results suggest that learning occurred as a result of practice, as all four groups demonstrated significant improvements in both global technique and *kuzushi* movement pattern from pre-test to post-test and retention. Therefore, both traditional and alternative practice schedules appear effective in producing general (global pattern) and specific (*kuzushi* pattern) improvements in the *tori*'s movements. However, regarding the effect exerted by the *tori* on the *uke* (actual *kuzushi*), only the WP group showed significant improvements in both the post-test and retention compared to the pre-test, while MTP and PPP groups improved only from pre-test to post-test. The STP group showed no improvement.

The inter-group analysis showed that the global technique score was higher in the WP group compared to the other three groups during retention, and higher than STP and MTP in the post-test. Additionally, WP demonstrated superior performance in actual *kuzushi* compared to STP in both post-test and retention, and compared to MTP and PPP during retention. No significant group

differences were found for the *kuzushi* movement pattern. These results were more pronounced than those reported by Gomes et al. [1], as our experienced children appeared to benefit more from practicing *tai otoshi* as a whole, especially with the addition of a pre-*kuzushi* phase at the start of the skill. Not only was the whole practice more effective than the traditional groups - which practiced only three components without pre-*kuzushi* - but the whole practice group also outperformed the progressive parts practice group, which learned the skill in segments, adding parts progressively until the full skill was completed. This advantage for the whole practice group may be due to the consistent execution of the entire skill in every trial, particularly with the inclusion of the pre-*kuzushi* phase. Gomes et al. [1] found no significant differences between whole and part practice in learning o *soto gari* among inexperienced children. Therefore, the findings of the present study appear robust and may be explained by the participants' skill level and/or the specific Judo technique studied.

We can argue that the skill level of our participants, while not advanced, was at least intermediate. In this regard, the associative stage of learning Fitts e Posner [16] likely characterizes their performance level. At this stage, learners begin to associate specific environmental cues with the corresponding movements needed to achieve the task goal. As the basic fundamentals and mechanics of the skill have already been acquired, the number of errors typically decreases, and learners become capable of detecting and correcting their own mistakes. This refinement phase allows them to focus on executing the skill more successfully and consistently. The specific movement termed pre-*kuzushi* demands more precise gripping actions from the *tori* - an action often viewed as an error when performing traditional static *uchikomi* [16] - but in this context, it contributes to improving the *tori*'s positioning relative to the *uke*. One could speculate that the ability to execute pre-*kuzushi* within Judo throwing techniques may be an indicator of a strengthened associative learning stage.

The nature of the Judo technique can also be analyzed through the lens of the classical hypothesis proposed, which suggests that whole practice is more suitable for skills with low complexity (i.e., a small number of components) and high organization (i.e., strong interdependence between components), whereas part practice is more appropriate for skills with high complexity and low organization [12]. Considering that *tai otoshi* is characterized by medium complexity but high organization - and given that it was practiced using three components in the STP and MTP groups and four components in the WP and PPP groups - the technique exhibits such a high degree of structural interdependence that no part-practice strategy other than progressive addition is feasible. This is because each component depends functionally on the subsequent one during execution, making alternative segmentation approaches impractical. This hypothesis could be extended as follows: whole practice may also be effective when a skill has medium complexity combined with high organization. In the case of Judo techniques, the incorporation of the pre-*kuzushi* phase - even when practiced within a whole-task framework - appears to enhance learning, likely due to the inherently serial nature of these techniques, in which each component is strongly dependent on the preceding one for successful execution.

Our findings highlight a key limitation of traditional *uchikomi*, where the technique is practiced outside the actual fighting context, with an emphasis primarily on the movement pattern or form. Even for less complex Judo techniques, the omission of *kuzushi* can compromise the subsequent phases of the throw, forcing the *tori* to expend greater effort to unbalance a well-positioned and reactive opponent [1,10,16,17]. Thus, we emphasize the importance of not neglecting the functional aspects inherent to combat situations - particularly the role of unbalancing the *uke* through preparatory movements, such as pre-*kuzushi*. This element is closely linked to the appropriate timing of pushing and pulling actions while managing the opponent during a Judo drill or fight [11].

In the present study, practice sessions were conducted individually, allowing each participant to receive the instructor's full attention. This contrasts with the study by Gomes et al. [1], in which instruction and practice were delivered in groups of five children. Consequently, the level of attentional focus during task execution likely differed between the two studies - being more distributed in Gomes et al. [1] and more concentrated in the present study. Similar to Gomes et al. [1], our participants who did not perform the projection of the *uke* had limited time to process feedback, given the short interval between trials [18]. In contrast, executing the projection not only better simulates the fight context Gomes et al. [8] but also affords learners more time to process and assimilate feedback between attempts. This interpretation aligns with previous Judo research emphasizing the importance of both augmented and intrinsic feedback to facilitate error correction [10,16]. As noted by Gomes et al. [1], although the inter-trial interval was not formally controlled, participants in the STP group likely had less opportunity to process feedback compared to those in the MTP group - who executed the projection only once every ten trials - and the WP group - who performed the projection on every trial. Nevertheless, one could argue that the limited inter-trial interval did not negatively impact learning of the actual *kuzushi*, as evidenced by the lack of improvement in the STP group over time. Instead, the movement involved in MTP (specifically, walking - *suri ashi*) appears to be a strong candidate to explain the superior learning of the actual *kuzushi* in this group compared to STP, which did not incorporate any movement during *kuzushi* [1,8].

Our findings also prompt reflection on the appropriateness of practicing *uchikomi* for both experienced and novice practitioners. In current Judo teaching practice, *uchikomi* is widely employed for beginner children as well as for adult athletes. For more experienced practitioners, *uchikomi* often functions as a means to maintain technical proficiency or as a warm-up routine. In contrast, for beginners, *uchikomi* serves a more foundational purpose, providing meaning to repetitive practice by fostering an understanding of key preparatory elements - particularly pre-*kuzushi* - that are essential for effective unbalancing. Additionally, practicing *uchikomi* in this manner helps simulate specific scenarios encountered during sparring and enhances the learner's ability to transition into different techniques from a common starting position and grip configuration.

In summary, despite some limitations - such as the small sample size, the absence of *uke* resistance during testing, and the fact that only one evaluator conducted all movement analyses - another aspect that could be incorporated into future studies is the use of a force platform to correlate the assigned questionnaire scores with the mass displacement of the person receiving the projection

technique. Even with these limitations, the present study underscores the importance of incorporating a pre-*kuzushi* phase and adopting whole-practice methods to enhance the learning of Judo throwing techniques among practitioners with prior experience.

CONCLUSION

The findings of the present study support the notion that traditional *uchikomi* may overlook the most critical component of Judo techniques - *kuzushi*, the act of unbalancing the opponent - which is essential for the tori to generate effective leverage. While our data do not allow for a formal test of the Naylor and Briggs model [12] across different levels of task complexity, they do provide evidence that whole practice can be beneficial even when learners perform a technique that involves multiple interdependent components. In our study, the traditional throwing technique consisted of three parts (*kuzushi*, *tsukuri*, and *kake*), whereas the groups trained in an execution-oriented context - the progressive part practice (PPP) and whole practice (WP) groups -performed an additional preparatory movement designed to induce imbalance in the opponent. Thus, rather than extending the Naylor and Briggs model [12] to a broader class of tasks, our findings suggest that when the components of a technique are highly organized and functionally dependent on one another, practice methods that preserve the global structure of the movement (such as whole practice) may offer specific advantages.

REFERENCES

1. Gomes FRF, Bastos FH, Meira Jr C de M, Neiva JF de O, Tani G. Effects of distinct practice conditions on the learning of the o soto gari throwing technique of judo. *J Sports Sci*. 2017;35(6):572-578. doi: 10.1080/02640414.2016.1180418
2. Miarka B, Branco BH, Vecchio FB, Camey S, Franchini E. Development and validation of a time-motion judo combat model based on the Markovian Processes. *Int J Perform Anal Sport*. 2015;15(1):315-331. doi:10.1080/24748668.2015.11868795
3. Calmet M, Ahmaidi S. Survey of advantages obtained by judoka in competition by level of practice. *Percept Mot Skills*. 2004;99(1):284-290. doi:10.2466/pms.99.1.284-290
4. Calmet M, Trezel N, Ahmaidi S. Survey of system of attacks by judoka in regional and interregional matches. *Percept Mot Skills*. 2006;103(3):835-840. doi: 10.2466/pms.103.3.835-840
5. Franchini E, Sterkowicz S, Meira Jr CM, Gomes FRF, Tani G. Technical variation in a sample of high level judo players. *Percept Mot Skills*. 2008;106(3):859-869. doi: 10.2466/pms.106.3.859-869
6. Adams N, Carter CA. Olympic judo: preparation training. *No Title*. Published online 1988.
7. Yamashita Y, Isogai H, Nagaoka S, et al. *Kodokan Judo: The Essential Guide to Judo by Its Founder Jigoro Kano*. Reprint edition. Kodansha USA; 2013.
8. Gomes FR, Franchini E, Meira Jr CM, Tani G. Specificity of practice in acquisition of the technique of o-soto-gari in judo. *Percept Mot Skills*. 2002;95(3_suppl):1248-1250. doi: 10.2466/pms.2002.95.3f.1248
9. Kozub FM, Kozub ML. Teaching Combative Sports through Tactics. *J Phys Educ Recreat Dance*. 2004;75(8):16-21. doi:10.1080/07303084.2004.10607284
10. Gutierrez-Santiago A, Prieto I, Camerino O, Anguera T. The temporal structure of judo bouts in visually impaired men and women. *J Sports Sci*. 2011;29(13):1443-1451. doi: 10.1080/02640414.2011.603156
11. Garcia JMG, Deval VC, Sterkowicz S, Molina RE. A study of the diffi culties involved in introducing young children to judo techniques: A proposed teaching programme. *Arch Budo*. 2009;5:121-126.
12. Naylor JC, Briggs GE. Effects of task complexity and task organization on the relative efficiency of part and whole training methods. *J Exp Psychol*. 1963;65:217-224. doi: 10.1037/h0041060
13. Lage IP, Guttiérrez-Santiago A, Lage MÁP. The teaching-learning process of judo techniques improved using knowledge of errors. Tai-otoshi as a case study. *Int J Perform Anal Sport*. 2014;14(3):841-851. doi: 10.1080/24748668.2014.11868762
14. Adnet J. Judô: luta dos fortes. *Brasília DF Ed FTD*. Published online 1993.
15. Gomes FRF, Junior C, Shimoda WK, Tani G. Validação de uma lista de checagem para análise qualitativa do padrão de movimento do golpe de judô Tai Otoshi. *Rev Eletrônica Fia Acad*. 2007;4:12-27.
16. Lage IP, Guttiérrez-Santiago A, Lage MÁP. The teaching-learning process of judo techniques improved using knowledge of errors. Tai-otoshi as a case study. *Int J Perform Anal Sport*. 2014;14(3):841-851. doi: 10.1080/24748668.2014.11868762
17. Imamura RT, Hreljac A, Escamilla RF, Edwards WB. A Three-Dimensional Analysis Of The Center Of Mass For Three Different Judo Throwing Techniques. *J Sports Sci Med*. 2006;5(CSSI):122-131.
18. Schmidt RA, Lee TD. *Motor Learning and Performance 6th Edition with Web Study Guide-Loose-Leaf Edition: From Principles to Application*. Human Kinetics Publishers; 2019

ACKNOWLEDGMENTS

Agradecemos à equipe de professores e Estudantes do Laboratório de Comportamento Motor (LACOM) e as escolas que disponibilizaram seu espaço para realização do estudo, tal qual às crianças e responsáveis que participaram voluntariamente do estudo.

Citation: Gomes FRF, Meira Jr CM, Tani G. (2025). Whole Practice Combined with Kuzushi Preparation Enhances Learning of Tai Otoshi in Experienced Young Judokas. *Brazilian Journal of Motor Behavior*, 19(1):e510.
Editor-in-chief: Dr Fabio Augusto Barbieri - São Paulo State University (UNESP), Bauru, SP, Brazil.
Associate editors: Dr José Angelo Barela - São Paulo State University (UNESP), Rio Claro, SP, Brazil; Dr Natalia Madalena Rinaldi - Federal University of Espírito Santo (UFES), Vitória, ES, Brazil; Dr Renato de Moraes – University of São Paulo (USP), Ribeirão Preto, SP, Brazil.

Funding: This work was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo [05/53302-8].
Competing interests: The authors have declared that no competing interests exist.
DOI: https://doi.org/10.20338/bjmb.v19i1.510