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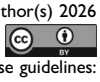

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Skateboarding's Olympic debut: A comparative analysis describing the men's and women's street competition

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Abstract

The aim of this study was to describe aspects of performance in the Tokyo 2020 Olympic street skateboarding competition and compare the men's (M) and women's (W) divisions. Trick attempts (TA = 1118) were extracted from broadcast footage of the semi-finals and finals using notational analysis. Descriptive analyses were adopted to characterise performance, with robust linear mixed-effects models comparing attempt scores (run [RUN] and best-trick [BT]) between divisions. Men's RUN (β = 1.71 [1.43, 1.99]) and BT (β = 1.85 [1.55, 2.15]) scores were higher and more variable than the women. Overall, there was more trick variety during BTs, but less obstacle variability compared to RUNs. Skaters bailed a greater proportion of BT TAs (54.6%) than RUN TAs (14.3%). Men demonstrated greater variety than women by diversifying take-off (M = 28.2% vs. W = 3.3% non-regular) and landing (M = 25.7% vs. W = 6.2% non-regular) stances, attempting more unique tricks (M = 122 vs. W = 74), and using larger feature obstacles (M = 40.7% vs. W = 33.9% of TAs). Alternatively, women demonstrated wider course use during BTs (M = 15% vs. W = 32.1% of all obstacles), corresponding to less feature obstacle use; perhaps indicating a barrier to engagement due to developing physical qualities. Future research should explore men's and women's divisions respectively to understand key factors for success.

Keywords

Action sport, freestyle, obstacles, take-off stance, trick classification

Introduction

Street skateboarding debuted at the Tokyo 2020 Olympic games and its approval for Paris 2024, Los Angeles 2028, and beyond suggests that sporting governing bodies have developed a standardised and adaptable foundation by which competition can sustainably evolve.[1] With this in mind, for athletes to succeed on the competitive stage, and coaches to support development and team selection, they need a clear understanding of performance.[2] However, little is known regarding tactical demands of competition nor the physical or technical determinants.[3] A first step to support street skaters in competition is the objective definition and measurement of performance and understanding how athletes score in their competitive environment.

In Olympic street skateboarding, skaters must navigate a course containing a range of small and feature obstacles, the latter of which are larger, mimicking the urban street environment (e.g., rails, stairs, ledges, etc.). Specifically, competition consists of two attempt formats: Run (RUN) attempts, in which skaters link together a sequence of trick attempts (TA) around the park, and best-trick attempts (BT), in which skaters attempt single, isolated tricks (TA) typically of the highest difficulty. Success is determined by judges who utilise World Skate criteria to award an overall impression score for each BT and RUN attempt, by which to rank the skaters' performance in that competition round.[4] These standardised criteria purportedly encompass subjective and objective aspects of trick and obstacle variety, difficulty, and style.[5] Nonetheless,

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anecdotally the inherent subjectivity of skateboarding performance renders it complicated to objectively determine what distinguishes and constitutes success. No research exists in the area, and how judges apply the criteria and their relative weighting towards scoring is unknown.

In the Tokyo Olympic competition, a "2/5/4" format was utilised, where the top "4" attempt scores from "2" RUNs and "5" BTs were added together to form a skater's total round score. All RUN and BT attempts were judged on a point scale from 0.00 to 10.00. Athletes who did not land (bailed) their BT attempt automatically scored a 0.00 for that trick. In a RUN, an athlete who bailed a trick could continue to score during the allotted time limit.[6] Thus, a single overall impression score was awarded, encompassing all TAs, landed or bailed, within a RUN. Whilst aspects like this complicate the direct allocation of scores to specific TA performance, objectively measuring what skaters do in Olympic street skateboarding competitions is a crucial next step to understand RUN and BT performances and how underlying aspects relate to overall impression scores. Following approaches of similar freestyle board sports,[7] notational analysis (NA) would provide a means of feasibly quantifying and exploring these factors.

Both Olympic men (M) and women (W) street skaters compete on the same course, and the divisions are judged utilising the same criteria.[8] Moreover, at the Tokyo Olympics, it appeared that judges utilised the same scale across divisions to score attempts, evidenced by a much higher average round score for the men's medal winners (36.23 ± 0.92), compared to the women (14.8 ± 0.41).[9] However since, the sport has evolved, and at the 2024 Paris Olympics, division scores converged ($M = 280.52 \pm 0.99$, $W = 264.02 \pm 9.83$)[10] under a new "2/5/3" format, scoring attempts from 0.00 to 100.00. Whether the convergence is due to scaling, underlying performances, or both, is unclear. Nonetheless, the standardised approach to judging at the Tokyo Olympics provides a unique opportunity to explore sex-based performance differences, in addition to the underlying reasons associated with RUN and BT attempt scores.

The development of new and reliable NA approaches[11] and broadly accessible high-quality footage provides a unique avenue for analysing and subsequently enhancing the understanding of skateboarding performance in elite athletes. Utilising this approach, the aim of this study was to characterise elite street skateboarding by comparing judge-awarded scores of men's and women's RUN and BT attempts from the Tokyo Olympics and to conduct exploratory analyses to describe any differences.

Materials and methods

Research design

In this study, a customised NA framework and application[12] was utilised to quantify, describe, and subsequently compare performance aspects of elite men's and women's street skateboarding, using footage from the 2020 Tokyo Olympics.

Participants

The participants in this study were street skaters who competed at the 2020 Tokyo Olympics. Demographics and skating characteristics of each skater were retrieved from the World Skate official website (https://www.worldskate.org/skateboarding.html, access date: 05 March 2022). A total of 40 athletes (20 M, 20 W) representing 18 countries (M = 12 nationalities, W = 13 nationalities) skated at the Games. Skaters were regular (11 M, 8 W) and goofy-stanced (9 M, 12 W) with an average age of 22.9 ± 5.2 years ($M = 24.2 \pm 4.3$, $W = 21.5 \pm 5.7$). Since the underlying footage was publicly available, no explicit consent from participants nor ethical approval was required from the university ethics board.

Procedures

Data collection. For this project, publicly available video footage of the 2020 Tokyo Olympics men's and women's street skateboarding competition was leveraged, including semi-final and final rounds (https://olympics.com/, access date: 05 March 2022). Videos were high quality (~1080p, 60 frames per second) and formatted for broadcast (e.g., varying camera angles and zoom compiled into a single stream). A total of 392 attempts were analysed from the competition, consisting of 112 RUN and 280 BT attempts. Both the men's and women's divisions respectively completed 56 RUN attempts (40 in the semi-finals, 16 in the finals) and 140 BT attempts (100 in the semi-finals, 40 in the finals).

Notational analysis. NA on footage was conducted in accordance with the methods presented by Diewald, Noth.[12] Briefly, the custom NA application and associated tagging process was conducted on individual TAs during skater RUN and BT attempts. Each TA encompassed three phases: take-off (TO), event/interaction (IA), and landing (LD). Trick classification, including common nomenclature trick names, was conducted independently by two authors, who were experienced in classifying skateboarding tricks, skaters themselves (>5 years), and familiar with skating terminology. Any disagreements in trick classification or TA outcome (e.g., whether hand drag during RUN TA was landed or bailed) were discussed together and final decisions were presented in the discussion, if applicable.

All TAs and associated coded NA attributes were exported (as a .csv file, each TA as a row, with position, action, and outcome attributes as columns) and imported into R Statistical Software (RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/) to derive features (e.g., trick type grouping features) and calculate overall performance measures. Definitions of all coded and derived features during the NA process were also provided

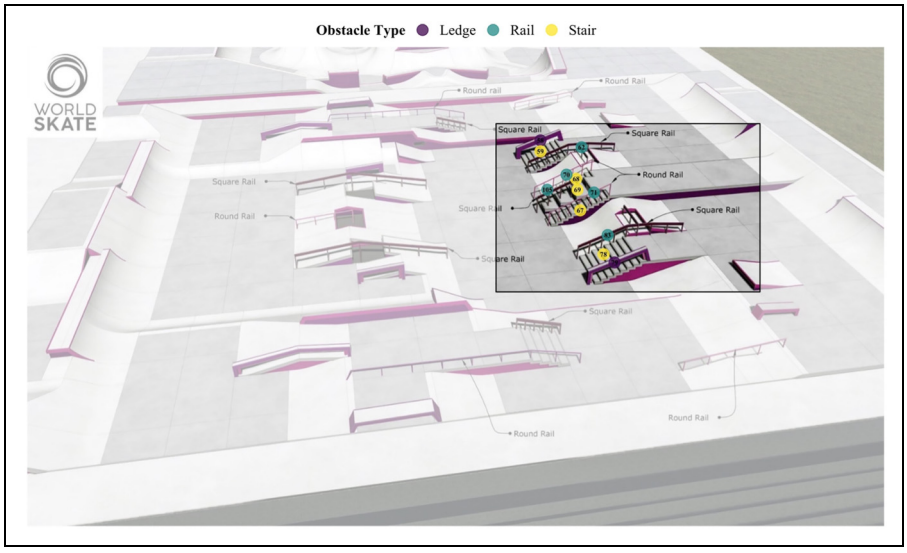

Figure 1. Feature obstacles at the Ariake Urban Sports Skatepark, including ledges (#79-#58), rails (#83-#62, #71-#70, #105), and stairs (#78-#59, #67-#68, #69). Underlying image was accessed and modified from https://www.skateboarding.worldskate.org/news/1478-tokyo-2020-course-designs.html.

in Diewald, Noth,[12] whilst calculated performance metrics compared in this study are described below.

Performance measures

Measures were calculated to describe performance of elite street skaters in competition and were selected to encompass a range of World Skate judging criteria: repetition, difficulty and variety of tricks (obstacle selection, trick selection, originality and innovation), use of course and feature obstacles (number of tricks, variety of obstacles, connecting in line), and run flow/consistency.[6] Quality of execution/landing, style, fluidity, power, aggression, and speed were not directly quantified in this study. Performance measures were grouped by attempt type (RUN, BT) and division (M, W) to explore any differences between the formats and sex. Execution metrics, not 'quality of execution' as per World Skate judging criteria, provided an overview of landed TAs compared to attempted TAs and associated scoring. All other trick and obstacle metrics include both landed and bailed TAs (all attempts). Execution was quantified in two ways: 1) number of landed and bailed TAs and 2) judge-awarded attempt scores.

'Trick selection', encompassing difficulty and variety, was quantified on whether a TA includes a flip, grind, and/or slide, whether it was a 'combination' of multiple tricks, and if so, whether the combination involved a flip into or out of the IA phase. 'Unique tricks' were calculated by counting the number of different TA trick names, across stances (e.g., kickflip and switch kickflip would both be classified under the same unique trick; kickflip). Although TAs performed in different stances were unique in the sense that difficulty levels likely vary,[13] it was assumed this would be captured by other metrics, such as take-off ($stance_{TO}$) and landing stance ($stance_{LD}$), to avoid any additional collinearity. To this effect, counts and proportions of TAs by $stance_{TO}$ (regular, fakie, nollie, OR switch) and $stance_{LD}$ (regular OR fakie/switch) were calculated. Further derived $stance_{TO}$ features captured which foot popped the board ($stance_{TO-DOM}$: dominant = regular OR fakie, non-dominant = switch OR nollie) and the direction in relation to the approaching obstacle ($stance_{TO-DIR}$: front foot = closest to obstacle, back foot = further from obstacle).

Course usage was quantified by the number of different unique obstacles interacted with, the number of unique mirrored obstacles (same obstacles on opposite sides of the course to account for goofy and regular stance riders) interacted with, and by obstacle types. Usage of feature obstacles included TAs interacting with the largest course elements (Figure 1). A total of 131 unique obstacles were predefined,[12] with 100% course usage indicating interaction with all 131 obstacles. Notably, this predefined list of obstacles was based on specific definitions used in our analysis, though interpretations of what constituted an obstacle would likely vary between individuals or contexts.

Prior to statistical analysis, redirection tricks were removed: 'Acid Drops' (M = 1, W = 1 TA) and 'Kick-turns' (M = 24, W = 22 TAs). Unless otherwise noted, potential other redirection tricks such as coping tricks (e.g., 'Backside (BS) 50-50 stall') were included.[12]

Statistical analysis

Statistical analyses were performed using R, primarily with the following packages: *tidyverse* for data wrangling,[14] *lme4* (lmer)[15] and *robustlmm* (rlmer) for modelling,[16]

performance for assessing model fits and assumptions,[17] and *moments* for distributional characteristics.[18]

To address the aim of determining whether scores differed by division, several linear mixed-effects models were applied. These were deemed preferable given the multiple observations (attempts) for skaters. Separate models were fit for RUN (Model 1) and BT attempts (Model 2), each with division as a fixed effect and skater ID as a random intercept. All bailed BT TAs (n = 153) were removed before fitting models. Prior to interpreting model outputs, assumptions were assessed using various approaches (e.g., Q-Q and other residual plots to ensure approximate residual normality and heteroscedasticity, via 'check_model()' from the *performance* package). In multiple cases, violations of normality were observed, primarily due to outliers. In lieu of removal, we adopted robust models, which typically exhibited better fit and decreased error (judged via marginal R^2 and RMSE, respectively). From each model, standardised coefficients and 95% confidence intervals (CI), raw unstandardised coefficients and 95% non-parametric CIs using 1000 bootstrapped samples were reported. Marginal R^2 and conditional R^2 were presented as indices of model fit and to describe the proportion of variance explained by division and skater, respectively. The alpha level for all tests was set at $a = 0.05$.

Exploratory frequency analysis (mean ± standard deviation [SD]) was used to describe and compare what happened in the Olympic competition, with semi-finals and finals combined for all analyses. Performance measures are presented as overall counts (TAs, skaters) and percentages of groups (division and attempt type [RUN, BT]). Various measures describing the distribution of attempt scores were performed, including centrality (mean, median), spread (SD, interquartile range [IQR]), skewness, and kurtosis [with associated kernel density plots and quantile-quantile plots]).

Results

After removing 48 redirection TAs, 1118 TAs (M = 602, W = 516 TAs) remained; including 838 RUN TAs (M = 462, W = 376 TAs) and 280 BT TAs (M = W = 140 TAs).

Scores

Distribution characteristics of attempt scores are displayed in Figure 2, with model summaries in Table 1. Fixed effect of division explained up to 91.9% of the variation in score. Overall, BT attempts (5.43 ± 3.01) were scored higher than RUN attempts (4.39 ± 2.74). On average, men scored 4.23 points higher in RUN attempts (M = 6.59 ± 2.07, W = 2.19 ± 1.02) and 5.37 points higher in BT attempts (M = 8.22 ± 1.33, W = 2.85 ± 1.37). Median scores followed a similar pattern, with men achieving higher medians (BT = 8.65, RUN=7.12) than women (BT = 2.95, RUN = 2.22). Men's scores were more variable in RUN attempts as indicated by a higher SD (M = 2.07, W = 1.02) and IQR (M = 2.39, W = 1.70). Women's scores were more variable in BT attempts (SD: M = 1.33, W = 1.37, IQR: M = 1.06, W = 2.34). Men's score distributions were left skewed and peaked, particularly for BT attempts (−2.33 skewness, 9.74 kurtosis), and RUN attempts (−1.18 skewness, 3.67 kurtosis). In contrast, distributions for women's scores were roughly normal in BT (−0.06 skewness, 1.95 kurtosis) and RUN (0.04 skewness, 2.17 kurtosis) attempts.

Performance measures

Overall summary. A summary of trick selection performance measures are provided in Table 2. Of all TAs, 24.4% (273) were bailed; of which 58.6% (160) occurred during LD, 35.2% (96) during obstacle IA phase, and 6.2% (17) at TO. Skaters attempted 159 (14.2%) unique tricks (excluding obstacle details), resulting in 27 different trick types (https://osf.io/n9bjy/). When stratified by attempt type, skaters attempted 116 unique tricks in RUN TAs (13.8%) and 90 unique tricks in BT TAs (32.1%).

TAs were attempted and landed in all stances. All 40 competitors popped tricks in regular stance (RUN = 40, BT = 32 skaters), 15 in fakie (RUN = 13, BT = 9 skaters), 12 in switch (RUN = 11, BT = 6 skaters), and 11 in nollie (RUN = 8, BT = 5 skaters). Only three skaters (all men) attempted a trick in every stance. Most TAs (83.1%) were landed in regular stance (85.8% of RUN TAs, 75% of BT TAs), compared to fakie/switch (16.7%) (14.2% of RUN TAs, 24.3% of BT TAs). Overall, slides represented the greatest proportion of TAs, followed by grinds and flips. Combination tricks made up a larger proportion of BT TAs compared to RUN TAs (21.0%); 62.6% of which were flipped into and/or out.

Skaters interacted with 105 out of the 131 obstacles (80.2%); including 100% of ledges, 87.5% of rails (14/16), and 71.4% of stairs (5/7). During RUN attempts, skaters interacted with the same proportion of ledges (100%) and rails (87.5%), but only 3 of the 7 possible stair sets (42.9%). During BT attempts, skaters interacted with a smaller proportion of the course; 50% of ledges, 62.5% of rails, and 57.1% of stairs. Feature obstacles were used in a greater portion of BT TAs (84.3%, 236) compared to RUN TAs (22.0%, 654). A detailed summary of performance measures is presented in Table 3.

Overall, the most attempted tricks were the 'Kickflip' (62 TAs, 10 M, 17 W)[19] and 'Frontside (FS) Boardslide' (37 TAs, 1 M, 13 W).[20] The trick the most men attempted was the '360 Flip' (32 TAs, 10 M, 2 W). Women attempted the 'Backside (BS) Boardslide' (34 TAs, 2 M, 14 W)[21] and 'FS Boardslide'[20] the most. In addition, the most attempted combination trick was the 'BS Bigspin + FS Boardslide' (25 TAs, 7 M, 2 W).[22] Comparatively, there were 11 tricks that three or more women attempted (e.g., eight women attempted the 'BS Boardslide').

Execution. Combining RUN and BT TAs, men bailed less (21.6%, 130 TAs) than the women (27.7%, 143 TAs),

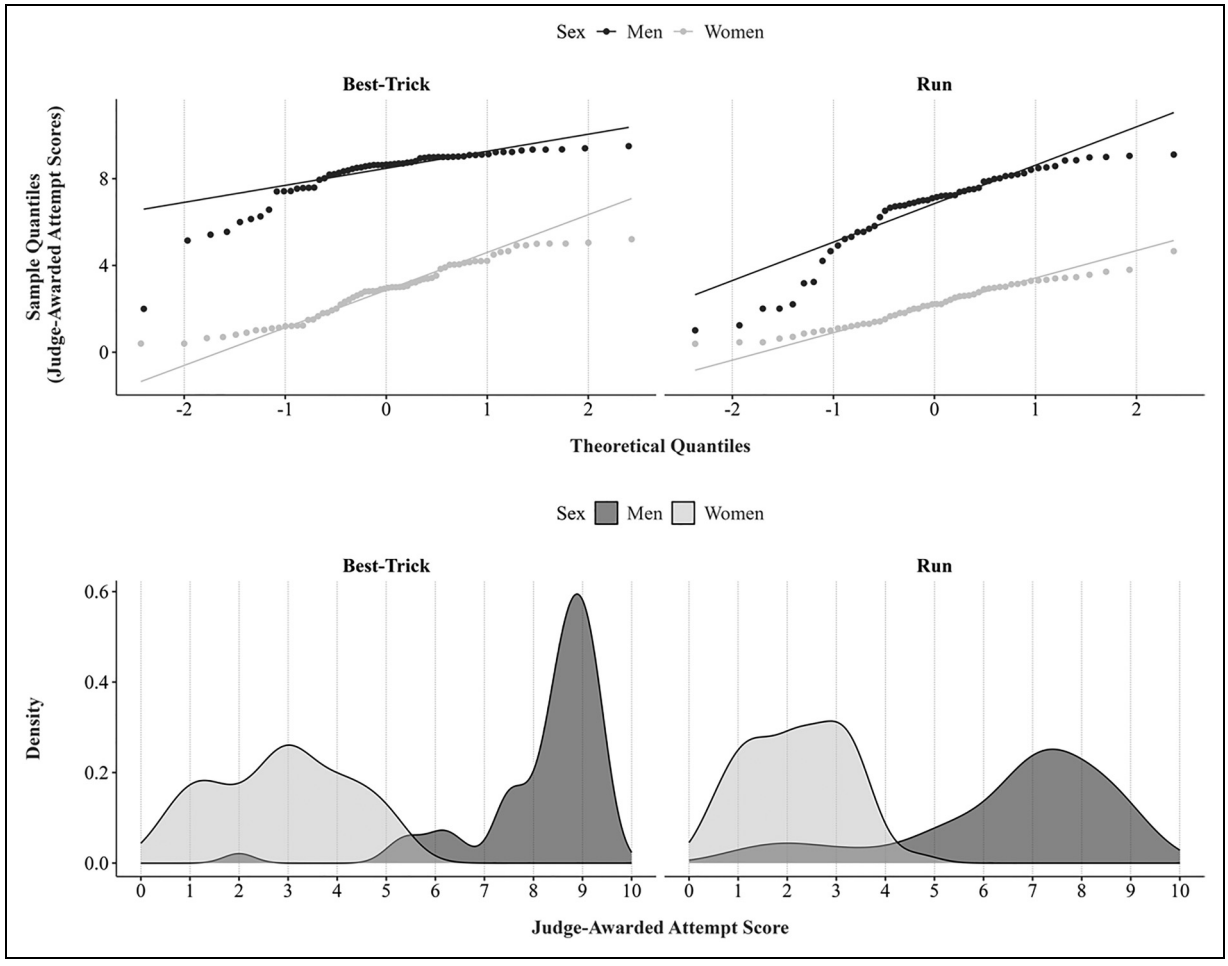

Figure 2. Distribution characteristics of judge-awarded attempt scores for best-trick and run attempts by division. The top panel displays quantile-quantile plots comparing the sample quantiles of score to theoretical normal quantiles for men and women. Note: Bailed best-trick attempts were removed and thus, the density plot presented does not reflect the 153 bails that resulted in a score of 0.

however landed a smaller proportion of their BT TAs (Table 3). TA execution was higher during RUNs (14.3% bailed) than BTs (54.6% bailed). More TAs were bailed during the LD phase of RUN TAs (70%) than IA (25.0%) and TO (5.0%) phases. BT TAs were also bailed most during LD (49.7%) and IA (43.1%) phases.

Trick selection. One in every 4.92 TAs by the men were unique (112 unique TAs). One in every 6.97 TAs by the women were unique, encompassing 74 unique tricks. The men attempted a greater proportion of unique tricks than women in BT TAs (M = 1 in 2.30, W = 1 in 3.68 TAs) and RUN TAs (M = 1 in 5.13, W = 1 in 6.27 TAs).

Men attempted 19 different trick types, 17 in RUNs and 11 in BTs. Women also attempted 19 trick types, 14 in RUNs and 13 in BTs. TAs in the men's division were slides (47.8%), flips (40.2%), and grinds (21.9%). Overall, TAs in the women's division mostly encompassed grinds (39.5%), slides (31.4%), and flips (21.5%). Only 10.5% of the women's TAs were combination tricks, attempted by 12 skaters. A full breakdown by trick type is available in the online material (https://osf.io/n9bjy/).

All 20 skaters in the men's division attempted a combination trick, representing 45.7% of all TAs. Moreover, 27.7% of the men's TAs were flipped into or out of the obstacle IA phase (by 18 men), compared to 7.6% of the women's TAs (by 8 women). Figures 3 and 4 show all the men's and women's TAs by trick name.

TAs were popped in all stances: stance_{TO} = regular (71.8% M, 96.7% W), fakie (9.6% M, 2.1% W), nollie (9.8% M, 0.6% W), and switch (8.6% W, 0.6% W) (1 men's TA was undetermined) (Table 4). Compared to 17 men, only seven women skaters popped their board in a stance other than regular. Only one skater in the women's division (vs. 11 men) attempted a switch trick, and two women (vs. 9 men) attempted a nollie trick.

Men popped off their front foot more in BT TAs (36.4%) and their back foot in RUN TAs (85.7%). Women popped off their back foot in 97.3% (502) of TAs (M = 80.6%, 485). Women only popped off the front foot in 14 TAs

Table 1. Run and best-trick robust linear mixed-effects model fit statistics for judge-awarded attempt scores from the men's and women's street skateboarding Olympic debut.

	Judge-awarded attempt scores	
	Model 1: Run Attempts	Model 2: Best Trick Attempts[b]
(Intercept)	**2.07 [1.86, 2.32][a]**	**2.55 [2.32, 2.88][a]**
Standardised Coefficient (β)	−0.85 [−1.04, −0.65]	−0.96 [−1.16, −0.75]
Division (Men)	**4.69 [4.19, 5.10][a]**	**5.57 [5.14, 5.92][a]**
Standardised Coefficient (β)	1.71 [1.43, 1.99]	1.85 [1.55, 2.15]
Number of Attempts	112	127
Number of Skaters	40	38
Var: Skater (Intercept)	1.12	1.33
Var: Residual	0.715	0.55
Conditional R^2	0.93	0.969
Marginal R^2	0.758	0.919
ICC	0.711	0.853
RMSE	0.913	0.63

CI confidence interval; β standardised coefficient.
[a]Non-parametric 95% CIs were calculated using bootstrapping (1000 samples).
[b]All bailed best trick attempts (where score was zero) were removed prior to fitting the models.

Table 2. Overall frequency analysis of trick selection performance measures from the men's and women's street skateboarding Olympic debut.

	Number of trick attempts[b] (% of Overall)		
Total Trick Attempts	Overall 1118	Run Attempts 838	Best Trick Attempts 280
Grind Trick	336 (30.1%)	230 (27.4%)	106 (37.9%)
Slide Trick	450 (40.3%)	299 (35.7%)	151 (53.9%)
Flip Trick	353 (31.6%)	225 (26.8%)	128 (45.7%)
Flip In/Out Trick[c]	206 (18.4%)	97 (11.6%)	109 (38.9%)
Combination Trick	329 (29.4%)	176 (21.0%)	153 (54.6%)

[a]Each measure *is not* mutually exclusive, and trick attempts can fall under multiple categories.
[b]Includes semi-finals and finals round trick attempts.
[c]A specific variation of a combination trick where skater flips their board into and/or out of another trick, usually a grind or slide.

(2.7%) (5 BT TAs, 9 RUN TAs). Men popped off their board with their non-dominant foot in 18.4% (111) of TAs and more during BTs (32.1%, 45) than RUNs (14.3%, 66). Conversely, women used their non-dominant foot in 1.2% (6) of TAs, all occurring in RUNs.

Including bails, most TAs were attempted to be landed in regular stance (73.9% M, 93.8% W) as opposed to fakie/switch (25.7% M, 6.2% W). Compared to all but one skater in the men's division (95%), 11 skaters in the women's division (55%) attempted to land TAs in fakie/switch; of which only 2 skaters attempted during a BT.

Regarding specific unique tricks (exclusive of stance), in RUN attempts, skaters in the women's division attempted the 'Kickflip' the most (32 TAs by 9 skaters), followed by the 'FS Boardslide' (30 TAs by 13 skaters). More than 11% of all men's RUN TAs were '360 Flips' (27 TAs by 10 skaters)[23] or 'Kickflips' (26 TAs by 8 skaters). In the men's RUNs, 48 tricks were used by only one skater (regardless of the number of attempts by an individual skater), compared with 33 unique tricks in the women's division. In RUNs, both the men's and women's divisions featured 15 unique tricks (e.g., 'Bigger Flip + FS Boardslide') that were each attempted only once by a single skater.

In men's BT attempts, no more than three skaters attempted the same trick; 'Full Caballerial (Cab) + BS Lipslide'[24]; the only occurrence. A total of 50 tricks were unique to a single skater in the men's division. Only 9 of the 61 unique tricks attempted in the men's BT section were also attempted in the women's BT section. During the women's BT attempts, the 'BS Crooked Grind'[25] was attempted most, by 5 different skaters (11 TAs), although the 'BS Boardslide' was attempted by 8 different skaters in 8 TAs. The second most attempted women's BT was the 'Kickflip + BS Boardslide'[26] (9 TAs), by 3 skaters. A full

Table 3. Division and attempt type frequency analysis of trick selection and execution performance measures from the men's and women's street skateboarding Olympic debut.

	Number of trick attempts (% of Overall)			
	Run Attempts		Best Trick Attempts	
	Women	Men	Women	Men
Execution				
Total Trick Attempts[b]	**376**	**462**	**140**	**140**
Landed	307 (81.6%)	411 (89.0%)	66 (47.1%)	61 (43.6%)
Bailed	69 (18.4%)	51 (11.0%)	74 (52.9%)	79 (56.4%)
Trick Selection[c]				
Unique Tricks	60 (16.0%)	90 (19.5%)	38 (27.1%)	61 (43.6%)
Grind Trick	137 (36.4%)	93 (20.1%)	67 (47.9%)	39 (27.9%)
Slide Trick	102 (27.1)	197 (42.6%)	60 (42.9%)	91 (65.0%)
Flip Trick	70 (18.6%)	155 (33.5%)	41 (29.3%)	87 (62.1%)
Flip In/Out Trick	9 (2.4%)	88 (19.0%)	30 (21.4%)	79 (56.4%)
Combination Trick	16 (4.3%)	160 (34.6%)	38 (27.1%)	115 (82.1%)
Stance$_{TO}$[b]				
Regular	364 (96.8%)	363 (78.6%)	135 (96.4%)	69 (49.3%)
Fakie	6 (1.6%)	33 (7.1%)	5 (3.6%)	25 (17.9%)
Nollie	3 (0.8%)	33 (7.1%)	0 (0.0%)	26 (18.6%)
Switch	3 (0.8%)	33 (7.1%)	0 (0.0%)	19 (13.6%)
Stance$_{TO-DIR}$[b]				
Back	367 (97.6%)	396 (85.7%)	135 (96.4%)	89 (63.6%)
Front	9 (2.4%)	66 (14.3%)	5 (3.6%)	51 (36.4%)
Stance$_{TO-DOM}$[b]				
Dominant	370 (98.4%)	396 (85.7%)	140 (100%)	95 (67.9%)
Non-Dominant	6 (1.6%)	66 (14.3%)	0 (0.0%)	45 (32.1%)
Stance$_{LD}$[b]				
Regular	352 (93.6%)	367 (79.4%)	132 (94.3%)	78 (55.7%)
Fakie/Switch	24 (6.4%)	95 (20.6%)	8 (5.7%)	60 (42.9%)
Undetermined	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.4%)
Use of Course and Feature Obstacles				
Feature[a] IA Obstacle	74 (19.7%)	110 (23.8%)	101 (72.1%)	135 (96.4%)

IA event/interaction; *TO* take-off; *LD* landing; *DIR* direction; *DOM* dominance;
Measures were defined using World Skate judging criteria[8] (execution, use of course and featured obstacles, and difficulty and variety of tricks). Values were presented as overall counts of trick attempts and proportions of overall counts (% of trick attempts) within each respective descriptive measure. Performance measures were grouped by division and attempt type, Run or Best Trick. Encompasses both semi-finals and finals round trick attempts.
[a]Feature obstacles were the largest obstacles in the skate park and included gaps, stairs, rails, and ledges (Total of 12 different obstacles and 7 unique obstacles when accounting for mirroring).
[b]Each measure *is* mutually exclusive, and trick attempts can only fall under one category.
[c]Each measure *is not* mutually exclusive, and trick attempts can fall under multiple categories.

breakdown of RUN and BT TA counts and trick names for the men and women are provided in Figures 3 and 4. Moreover, additional figures are available in the OSF repository.

Use of course and feature obstacles. Men and women interacted with 73.3% (96) and 69.5% (91) of the 131 labelled obstacles in the skatepark. Specifically with regards to obstacle type, women utilised between 70–75% of ledges (9/12), rails (12/16), and stair sets (5/7). Men utilised more than 80% of rails (14/16) and ledges (10/12), but only 1 of the 7 stair sets.

During BT TAs, men used 16.0% (21/131) of the labelled obstacles, compared to 32.1% by women (42/131). During RUN BTs, men used 72.5% (95/131) of labelled obstacles, compared to women (67.2%, 88/131). Men interacted with a feature obstacle in 40.7% of all TAs, slightly more than the women (33.9% of all TAs). Both skaters in the men's and women's divisions utilised feature obstacles in greater proportion during BTs than RUNs, overall.

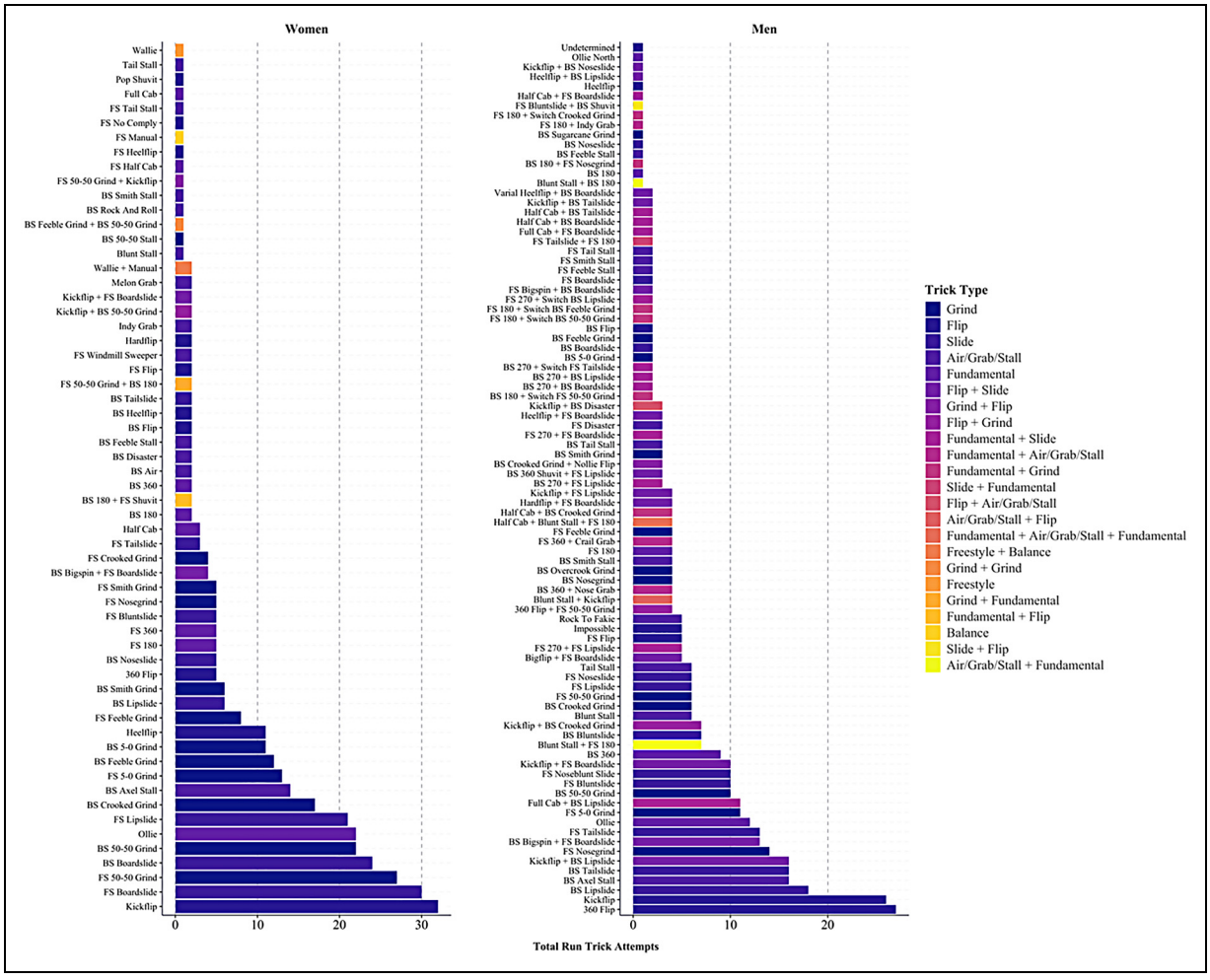

Figure 3. Distribution of *run* trick attempts (both landed and bailed) in the men's and women's division at the Tokyo 2020 Olympics (semi-finals and finals rounds combined).

When accounting for mirrored obstacles, the most used obstacle during the IA phase varied by division. Among the men's division, the most used obstacles were square rails in RUNs ('#83-#62' feature square rails – 49 TAs, 10.6%) and BTs (#105 feature square rail – 58 TAs, 41.4%); all of which are feature obstacles (Figure 1), apart from '#47-#40' round rails; which ran both flat and then inclined parallel to the respective 5-stair, stair set. Among the women's division, round rails were the most interacted with in RUNs ('#47-#40' round rails – 45 TAs, 12%) and BTs ('#71-#70' feature round rails – 30 TAs, 21.4%). Additional visualisations of course usage by division and attempt type are available in the OSF repository.

Discussion

The aim of this study was to explore aspects of performance in the Olympic street skateboarding competition during the 2020 Tokyo Games. RUN and BT scores were higher and descriptively more variable in the men's compared to the women's division, with the latter tending to bail more frequently. Skaters in the men's division demonstrated varied trick selection; skaters in the women's division displayed mostly regular stance grind tricks, notably in RUNs.

Although men's and women's scores in the analysed Olympic competition were presumably judged on the same scale, performance measures varied between divisions. There was a statistically significant difference between the men's and women's scores, with men scoring 4.7 points higher during RUN, and 5.6 points higher during BT attempts. Men's RUN scores were more variable compared to women's, whereas the opposite was true for BTs (men's BT scores were less variable). This suggests a broader perceived range of skill in the women's BT TAs compared to men's, highlighted by the greater IQR and supported by the degree of trick repetition within this format. One possible explanation for this might be attributable to the relative newness of skateboarding as a sport for women. Alternatively, it is possible that even if there was a broader skill range in the men's division, the skaters have identified

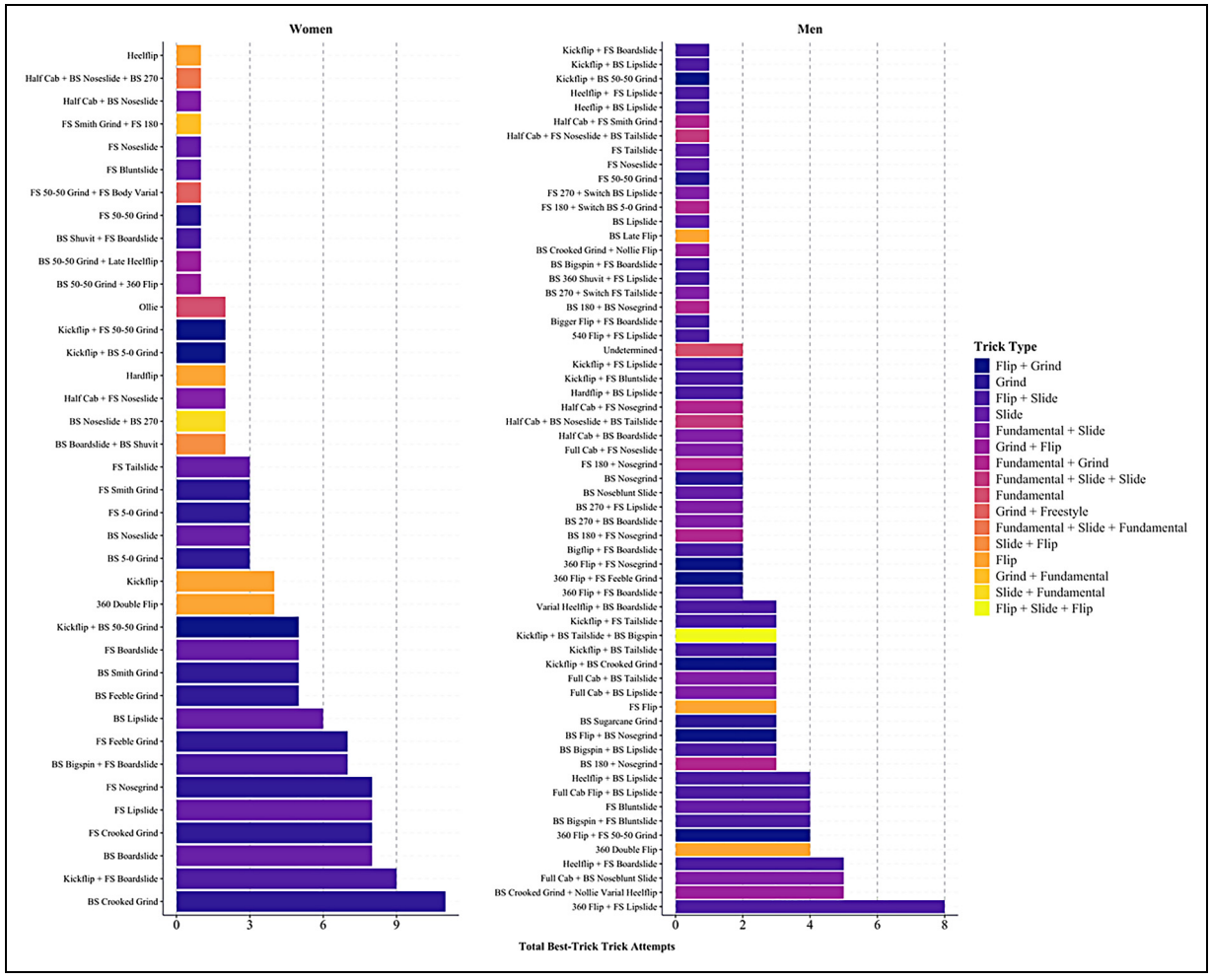

Figure 4. Distribution of *best-trick* trick attempts (both landed and bailed) in the men's and women's division at the Tokyo 2020 Olympics (semi-finals and finals rounds combined).

Table 4. Take-off stance breakdown of trick attempts from the men's and women's street skateboarding Olympic debut.

		Number of skaters[a] (% of Division)[b]			
Trick Attempts	$Stance_{TO}$ $Stance_{TO-DIR}$ $Stance_{TO-DOM}$	Regular Back Dominant	Fakie Front Dominant	Nollie Front Non-Dominant	Switch Back Non-Dominant
All	**Women**	20 (100%)	5 (25%)	2 (10%)	1 (5%)
	Men	20 (100%)	10 (50%)	9 (45%)	11 (55%)
Run	**Women**	20 (100%)	3 (15%)	2 (10%)	1 (5%)
	Men	20 (100%)	10 (50%)	6 (30%)	10 (50%)
Best Trick	**Women**	20 (100%)	2 (10%)	0	0
	Men	12 (60%)	7 (35%)	5 (25%)	6 (30%)

TO take-off; *DIR* direction; *DOM* dominance;
[a]Includes semi-finals and finals round trick attempts.
[b]Percentages represent the proportion out of the 20 skaters in each division, respectively.

better scoring strategies, potentially from greater experience in this competition format.

The "2/5/4" format of competition used at the Olympics was designed such that skaters attempted their most difficult (riskiest), highest scoring potential tricks in the BT section; the greater number of allowed BT attempts suggests that bails were expected and encouraged. Moreover, skaters were more consistent during RUNs, whilst bailing almost a quarter of BT TAs. RUN format highlights a skater's ability to link stylish tricks together, aesthetically flowing through the skatepark. Accordingly, greater trick variety, through changes in board and skater movement, was observed during BT attempts; however, obstacle variability was lower than in RUNs. This likely reflects the relative ramification of bailing in a BT (automatic zero) versus RUN attempt. The harsher penalty in the BT section heightens the risk, encouraging skaters to balance potential high scores against total point loss. Insights into what trick characteristics relate to better scores would enable athletes and coaches to assess the relative risk of more difficult attempts.

The greater variability and higher scoring in men's RUNs likely stems from more diverse take-off/landing stances, more trick types (e.g., combination tricks), and broader use of the large feature obstacles on the course. In contrast, women's wider BT variability coincided with greater course coverage but less reliance on feature obstacles, possibly reflecting lower speeds from a younger and probably less experienced cohort (3 years younger, on average). The men attempted presumably more technically demanding tricks, which likely relied on greater height and speed, whilst the women tended to bail proportionally more, even despite fewer overall RUN TAs by the women. These patterns suggest that differences in trick selection, encompassing variety and difficulty, reflect a combination of physical and technical factors, which may be shaped by experience and maturity rather than inherent skill gaps. As this format of competitive skateboarding gains traction, these distinctions may evolve, offering a chance to reassess how such factors influence performance in future competitions. Moreover, if the risk-reward relationship of BT and RUN attempts is to be understood, more analysis is needed.

Although a small number of skaters in the women's division varied their stance and attempted combination tricks, overall the women showed greater performance spread, likely driving higher trick repetition. One possible explanation is the more recent uptake of female skateboarders in the community.[27] To that effect, it was hypothesised that judges may place greater emphasis on novelty only once certain criteria have been met, such as utilising feature obstacles or performing combination tricks. For example, a skater in the women's division executing a 'simpler' trick on a larger obstacle might have been rewarded more heavily for its uniqueness relative to competitors. In contrast, a skater in the men's division may have relied on alternative strategies, such as varied take-off and landing stances and trick types to distinguish themselves. So, despite competing on the same course and presumably judged on the same criteria, men's and women's street skateboarding are likely better viewed as separate, individual competitions, whereby performances and strategies may be reflected uniquely within scoring. Consequently, judges' preferences, relative weighting of criteria, and resulting outcomes should be explored independently of division and format.

To provide an overall picture of competitive performance to effectively determine training priorities, tactical strategies and competition level outcomes (final round scores and rank) could also be explored. However, scoring has changed since the Olympic debut of skateboarding.[4] The men's and women's divisions are no longer judged on the same scale and scoring is relative to that specific round-division (e.g., men's semi-finals). Therefore, if comparisons between division in future competitions is of interest, methods of standardising scores should be implemented.

Limitations, practical applications, and future recommendations

Olympic street skateboarding is in its infancy, requiring fast adapting training techniques to keep up with varying levels of performance and changing competition formats and judging modalities. One limitation within this study is the evolving structure of competitions, as demonstrated by the Paris Qualifiers and subsequent Olympics.[5] These changes in format and scoring may influence performance measures and competition outcomes. A standardised approach as described above would help alleviate these challenges. Additionally, this study only captures a select number of quantifiable performance criteria at the group level. Skater-level metrics, such as the number of tricks per RUN, or whether a skater landed their first and last trick of a RUN, would add more context to understanding competitive skateboarding performance. Also of note, quality of execution metrics, such as style, were not captured despite their likely importance to success.[11] Tactical strategies, such as when to try the most difficult trick, are also likely related to Olympic exposure and a skater's ability to perform under pressure. These factors are difficult to quantify and outside of scope. However, researchers could explore tactical strategies across multiple competitions, like an entire Olympic qualification cycle, to obtain the sample size required to capture the influence of individual skater style, whilst achieving desired power. Moreover, the performance measures used in this study were mostly reduced to either describe trick or obstacle factors, independently. Consequently, trick difficulty could not be directly assessed. Future researchers should look to implement a more ecologically valid approach by aligning with judging practices and exploring metrics that integrate trick and

obstacle details together to better reflect the overall performance of each TA. This would be facilitated by the aggregation of future competitions to explore if findings are relevant over time. In doing so, the time-consuming NA process would most certainly necessitate multiple skilled raters, and due to the inherent subjectivity in skateboarding trick naming,[12] a formal inter-rater reliability analysis could be beneficial.

Conclusion

Street skateboarding debuted at the Tokyo Olympic Games and the men's and women's divisions were judged on the same scoring scale, presenting an opportune moment to explore and compare performances. There were key differences in performance and scoring between the divisions, with men typically scoring higher. As the sport evolves, there is a clear need for performance analysis approaches that allow practitioners to implement standardised methods of comparing attempt and overall scores. More to that effect, how these differences are reflected in judge preferences and overall competition outcome; and accordingly, what coaches and athletes should prioritise in training, remains unclear across both cohorts.

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Data availability statement

Data is available in the online OSF repository (https://osf.io/n9bjy/).

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