1 Experiment and Data

Experiment: The designed experiment was a detection task and during each trial the subject had to report whether a stimulus was being displayed on the screen or not. The stimulus in this case was a tilted grating. The tilt of the grating was set at the beginning of each session and did not change during that session. This tilt was either +45 degrees counterclockwise or +135 degrees counterclockwise. These two different tilts will be referred to as right and left, respectively, in the rest of this report. The time course of a stim-on trial (a trial with the stimulus on the screen which constituted 50% of the trials in each session) was divided into two periods: ramp and plateau. The ramp period was the initial 400ms of the trial and during this period the luminance of the screen changed gradually till it reached the contrast level of the stimulus. This level of contrast was kept fixed for an additional 300ms which was the plateau period. Designing with a ramp period prevented abrupt changes that could induce saccade-like effects which was not of our interest in this study. The level of the contrast of the grating used for each subject was changed in order to find the right contrast for that subject (right contrast meant the contrast that resulted in a performance around 75%). A high contrast version of the grating was shown to the subject at the beginning of each sessoin to make sure that the subject was informed about the direction of the grating that was going to be displayed. The direction was also reminded to the subject during the session by showing the same high contrast version of the stimulus each 20 trials. A calibration trial was also done after each 5 trials. Figure 1 shows the timing of the experiment.

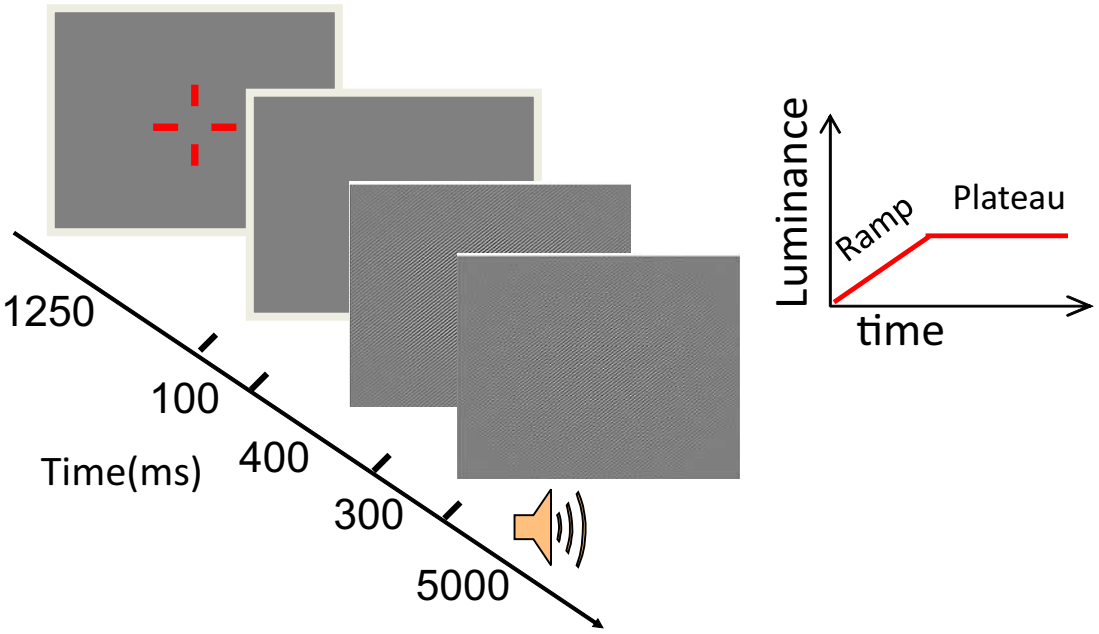

Figure 1: Timing of experiment- First, the subject was asked to look within a small region bounded by a red crosshair for 1250ms, then the crosshair disappeared and there was a 100ms period of blank during which nothing was diplayed on the screen. Then, over a period of 400ms the luminance of the screen was changed gradually to form the stimulus (ramp period) which stayed on for an additional 300ms (plateau period). The stimulus was removed from the screen after this initial 700ms and a beep sound was played to signal the response time to the subject. The subject had to press the right button to report detection of the stimulus and left button to report not detecting any stimuli. A time window of 5000ms was given to the subject to report one's decision, but as soon as the subject gave the response current trial ended and loading image for the next trial started.

Stimulus: The used stimuli were Gabor patches created using *generate_gratings.m* file. Both right and left stimuli had a frequency of 8 cpd and were noise-free. The size was 500*500 pixels. The standard deviation was 150 (to make sure the stimulus was big enough and the movements of the eyes were not performed for localizing the image on the fovea). Parameters used in the generate_grating.m file are as follow:
STIM_SIZE = 500;
MAX_STIM_INTENSITY = 50;
STIM_BACKGROUND = 127;
GRAT_GAUSSIAN_SIZE = 150;
STIM_FREQ = 8;
numStim = 2;
theta = pi/4;
PixelAngle = 1.3513;

Question: The direction of the most informative movement can be assumed to be orthogonal to the direction of the grating because it will expose the observer to the most variations in luminance. Considering that this diretion differs between sessions with "right" and "left" gratings, will the subject use the information they have about the direction of the grating to adapt their eye movements to the situation and show a more optimal movement? If the answer is yes we will expect to find a difference between the eye movements during "right" and "left" sessions.

Data: Four subjects participated in this experiment: Andy, Sara, Ninjin, and Tracy. The whole number of sessions available for these subjects are 33, 14, 25, and 18, respectively. All the data collected for this experiment is accessible from this address:
\\casfsb\APLAB\BACKUPS\Aghajari_Backup\Data\All

Except for the first session (for one subject three first sessions) the experiment was done with a fixed contrast level. In the first session the contrast level was changed using the PEST algorithm to have an estimate of the subject's sensitivity and the contrast that could be used for that subject. The folders containing the trials from these sessions are labeled as "pest".

2 Analysis

First, all sessions were checked for drift-only trials. Drift-only trials included the trials without any blinks and saccades during showing the stimulus. Then, by considering just these trials in each session the following criteria were checked and just the sessions meeting these criteria were selected for further analysis:

1. Performance more than 65%: the total percentage correct (Hits + corret rejections) had to be more than 65%.
2. Hit Proportion: Number of the hits had to be at least twice of number of the misses.
3. Fixed contrast: For each subject, only sessions with the same contrast were selected. This contrast could be different among the subjects, but were the same across sessions chosen for an individual.

After applying these conditions 7, 4, 6, and 10 sessions were selected for Sara, Ninjin, Tracy, and Andy, respectively. The contrast level of the grating for each of these subjects were 6, 2.2, 2.2, and 2.7, repsectively.
The .mat files for the selected sessions are accessible from the following path:

\\casfsb \APLAB \BACKUPS \Aghajari_Backup \Data \Valid

The following tables characterize the selected sessions:

Sara							
session number	17	18	19	21	22	24	25
Selected trials #	54 L	55 R	58 L	53 R	58 L	53 R	57 L
StimOn trials #	27	25	25	31	28	24	24
StimOff trials #	27	30	33	22	30	29	33
Performance %	79.63	81.82	79.31	83.02	89.66	77.36	89.47
Hit %	81.48	76.00	84.00	80.65	89.29	84.21	87.5
Hit #	22	19	21	25	25	16	21
Miss #	5	6	4	6	3	8	3
CorRej #	21	26	25	19	27	25	30
FalseAl #	6	4	8	3	3	4	3

Ninjin				
session number	9	10	11	12
Selected trials #	59 L	63 L	56 L	62 R
StimOn trials #	31	32	21	41
StimOff trials #	28	31	35	21
Performance %	86.44	82.54	80.36	67.74
Hit %	80.65	65.63	66.67	56.10
Hit #	25	21	14	23
Miss #	6	11	7	18
CorRej #	26	31	31	19
FalsAl #	2	0	4	2

Tracy						
session number	2	6	7	9	12	13
Selected trials #	49 R	50 R	47 L	39 L	28 L	39 R
StimOn trials #	25	25	25	16	11	21
StimOff trials #	24	25	22	23	17	18
Performance %	85.96	96	93.62	87.18	96.43	97.44
Hit %	71.43	92	88	68.75	90.91	95.24
Hit #	20	23	22	11	10	20
Miss #	8	2	3	5	1	1
CorRej #	24	25	22	23	17	18
FalsAl #	0	0	0	0	0	0

Andy										
session	6	8	10	11	12	14	17	20	23	24
Selected trials #	25 R	14 R	15 L	24 L	15 R	38 R	23 L	23 R	36 L	38 R
StimOn trials #	12	8	6	9	9	19	12	12	19	20
StimOff trials #	13	6	9	15	6	19	11	11	17	18
Performance %	84	92.86	86.67	87.5	93.33	81.58	95.65	82.61	83.33	86.84
Hit %	66.67	78.5	66.67	77.78	88.89	73.68	91.67	66.67	68.42	80.00
Hit #	8	7	4	7	8	14	11	8	13	16
Miss #	4	1	2	2	1	5	1	4	6	4
CorRej #	13	6	9	14	6	17	11	11	17	17
FalsAl #	0	0	0	1	0	2	0	0	0	1

The mean performance and other characteristics for all the four subjects:

subejct	contrast threshold	mean performance (%)	hits (left,right)	miss (left,right)	correct rej. (left,right)	%hit(mean)
Sara	6	82.90+/-4.90	89,60	15,20	103,70	83.30+/-4.44
Ninjin	2.2	79.27+/-8.09	60,23	24,18	88,19	67.26+/-10.11
Tracy	2.2	92.77+/-4.98	43,57	9,14	62,67	84.39+/-11.35
Andy	2.7	87.40+/-4.94	35,61	11,19	51,70	75.89+/-9.20

For all the reported analysis, the eye movements were filtered with an Sgolay(3,41) and then 50 samples from the beginning and 50 samples from the end were discarded. These 100 discarded samples were discarded from the 700ms long drift performed during showing the stimulus.

3 Results

Right vs. Left: Drifts are separated based on the direction of the grating:

No. drifts	Sara	Ninjin	Tracy	Andy
Left (45 degrees clockwise)	227	178	114	98
Right (45 degrees anti-clockwise)	161	62	138	153

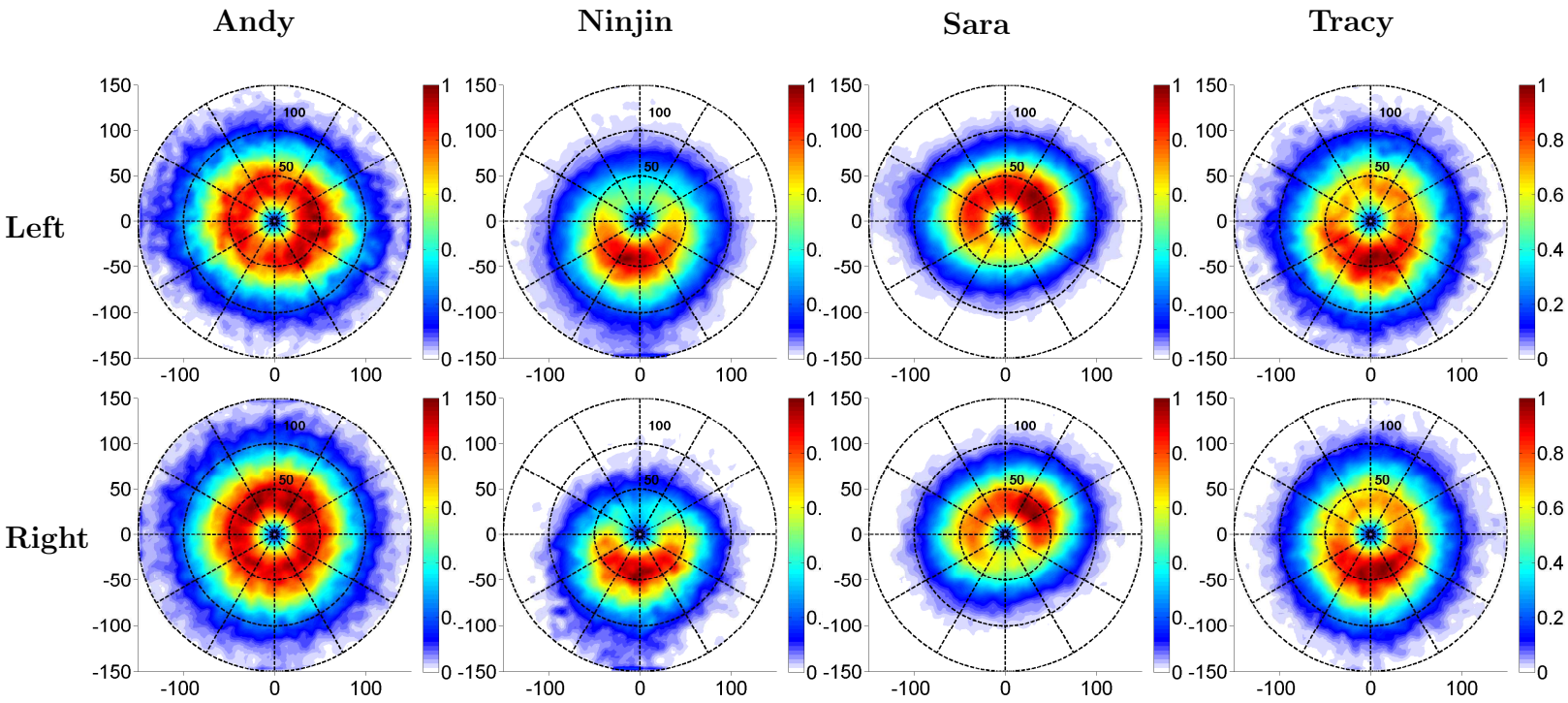

Figure 2: Polar histogram of position

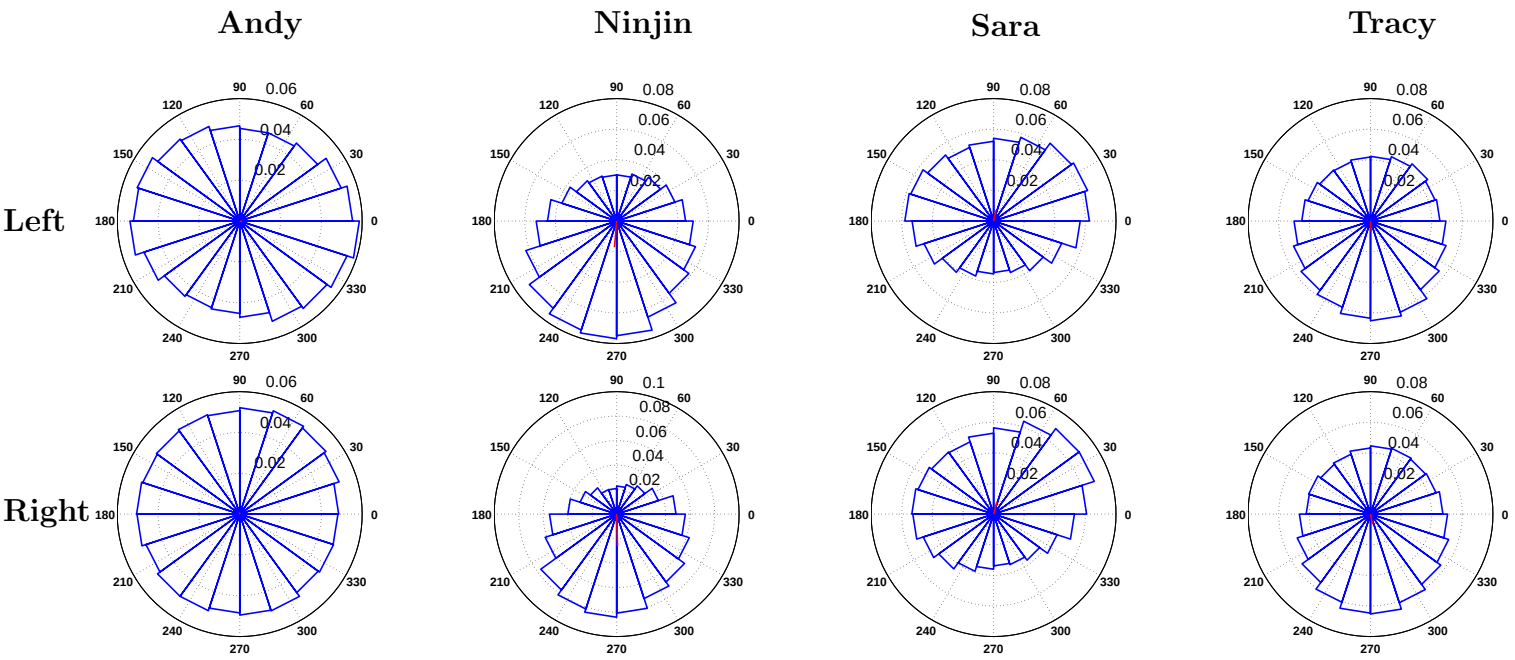

Figure 3: Histogram of the angles of all instantaneous velocity vectors- To find this polar histogram, all the instantaneoud velocity vectors during all the drift period is pulled together.

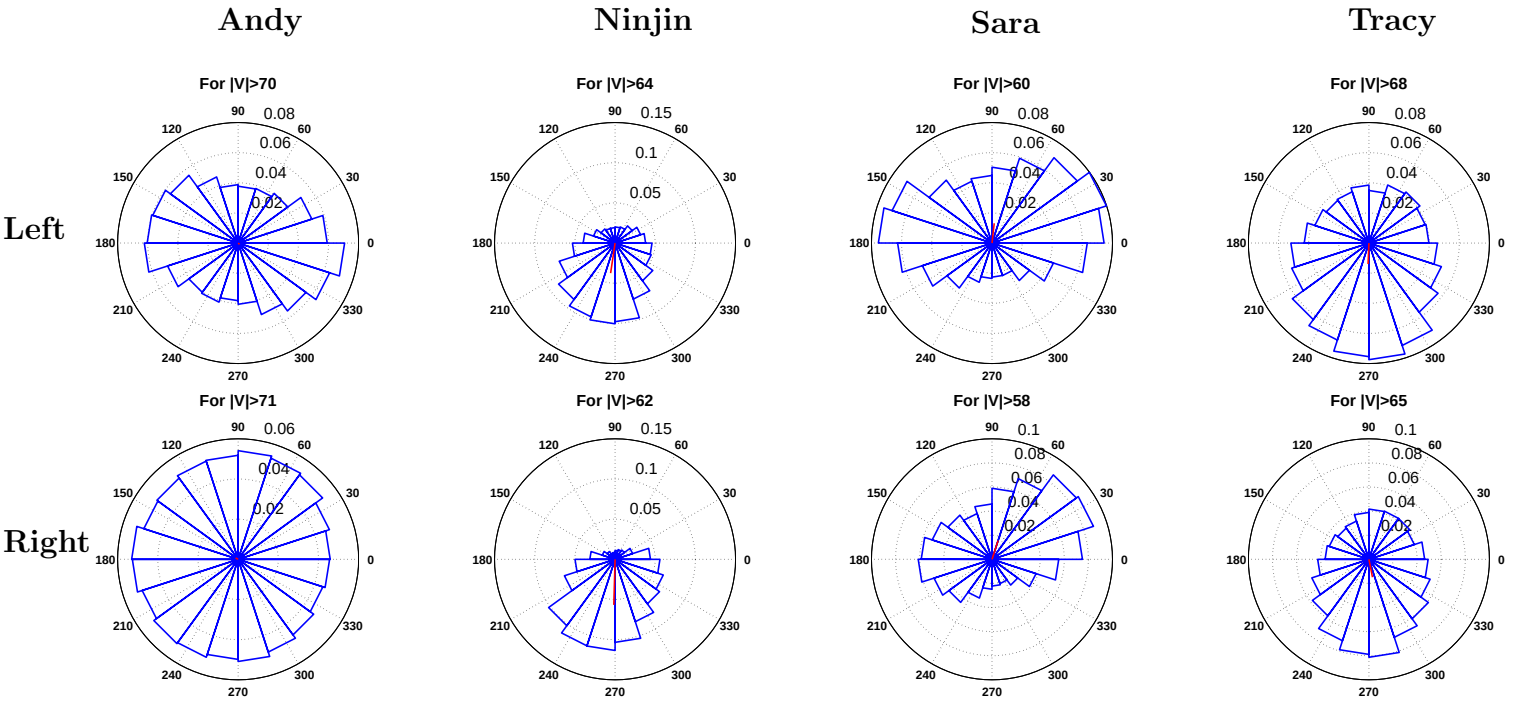

Figure 4: Histogram of the angles of fast velocity vectors (velocity vectors with a modulus in the upper 25% quantile).The value of the threshold set for selecting fast movements were found for each subject separately and was defined as the 75 percentile of all the velocity magnitudes. This threshold value is written on top of the polar histogram for each subject.

	Sara	Ninjin	Tracy	Andy
Left	83.57	-98.33	-92.20	-42.97
Right	71.84	-91.53	-78.68	151.01

Table 1: Mean angle of all velocity vectors

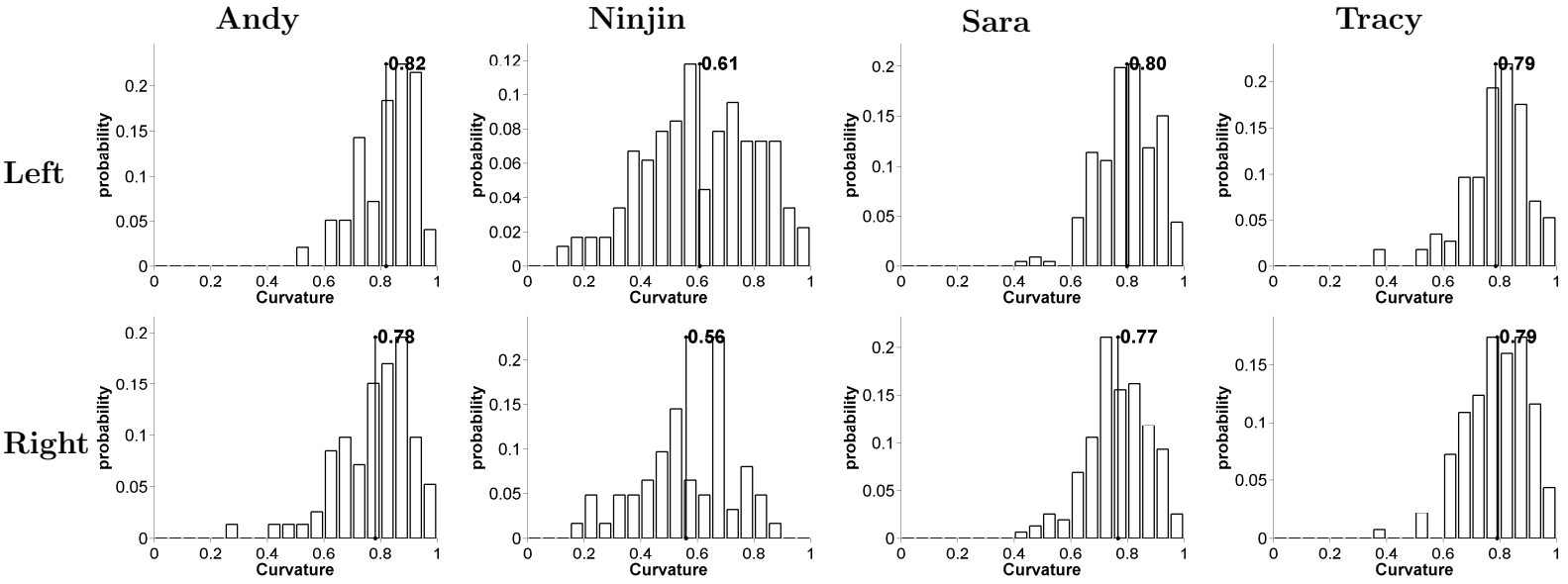

Figure 5: Histogram of curvature of drifts

Sara	Ninjin	Tracy	Andy
0.0035*	0.0857	0.7293	0.0147*

Table 2: P-values for ttest on curvature

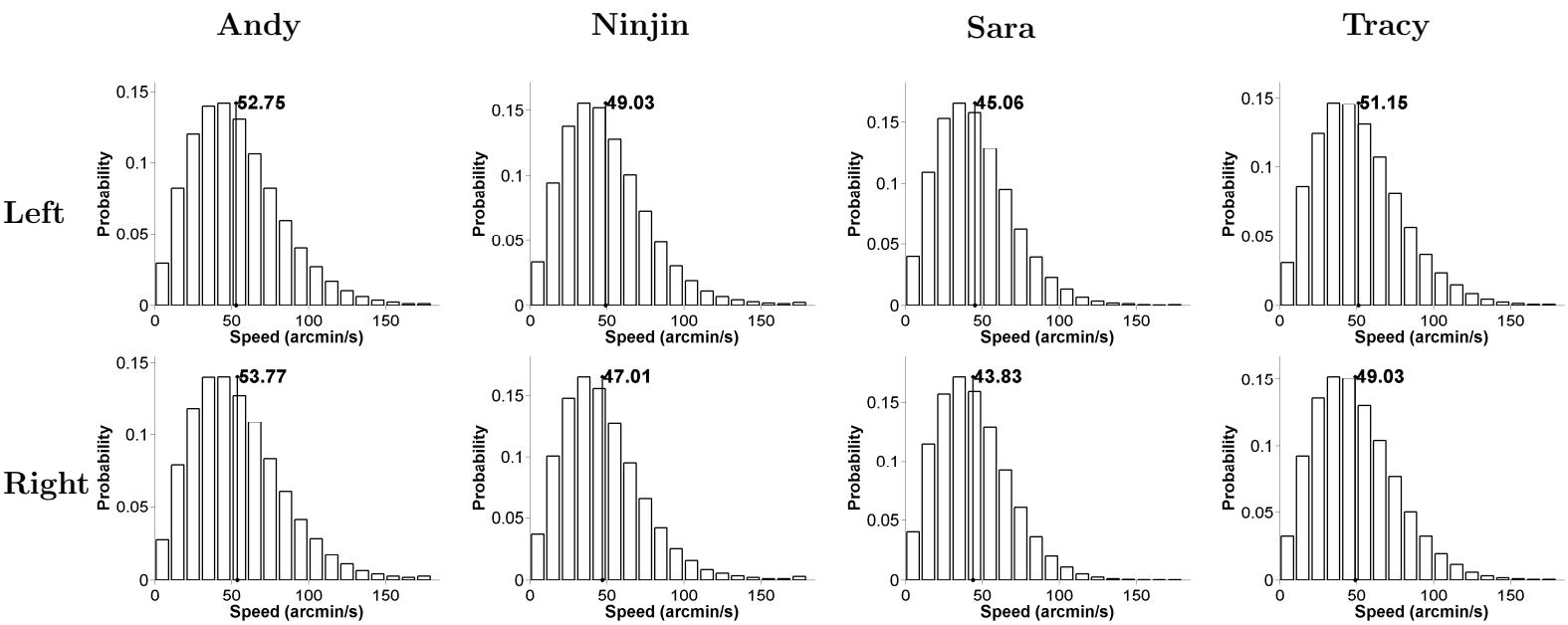

Figure 6: Histogram of speed

Plateau vs. Ramp:

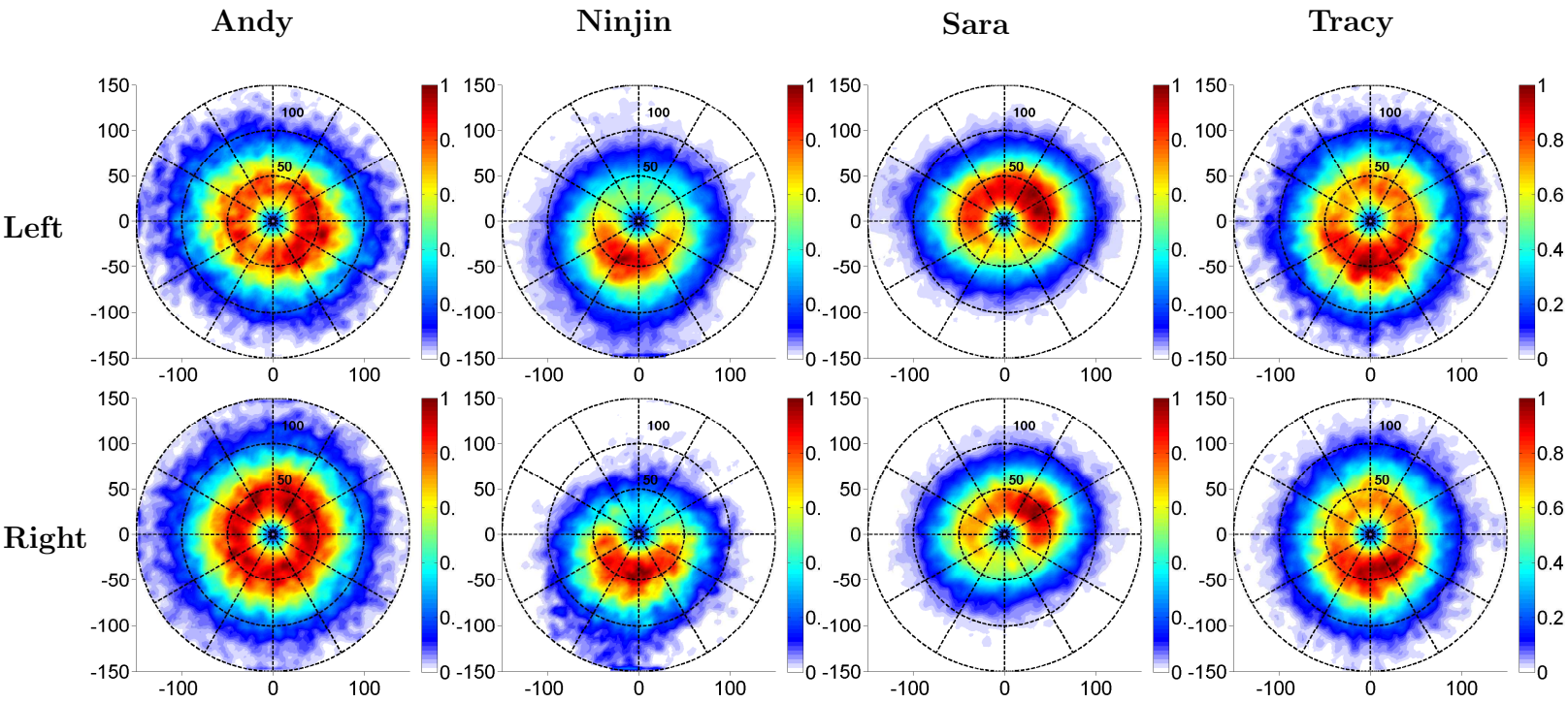

Figure 7: Polar histogram of position for drift segments occuring during **Ramp** period

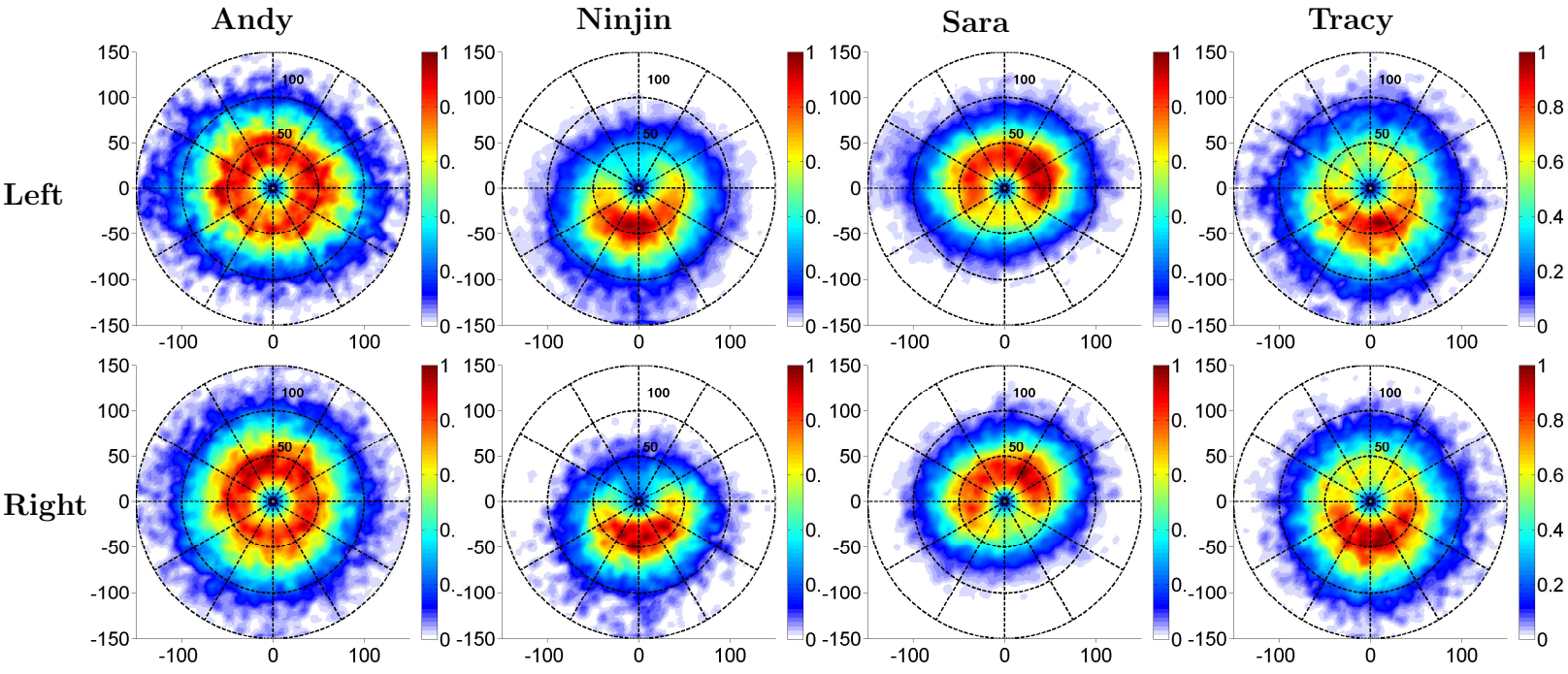

Figure 8: Polar histogram of position for drift segments occuring during **Plateau** period

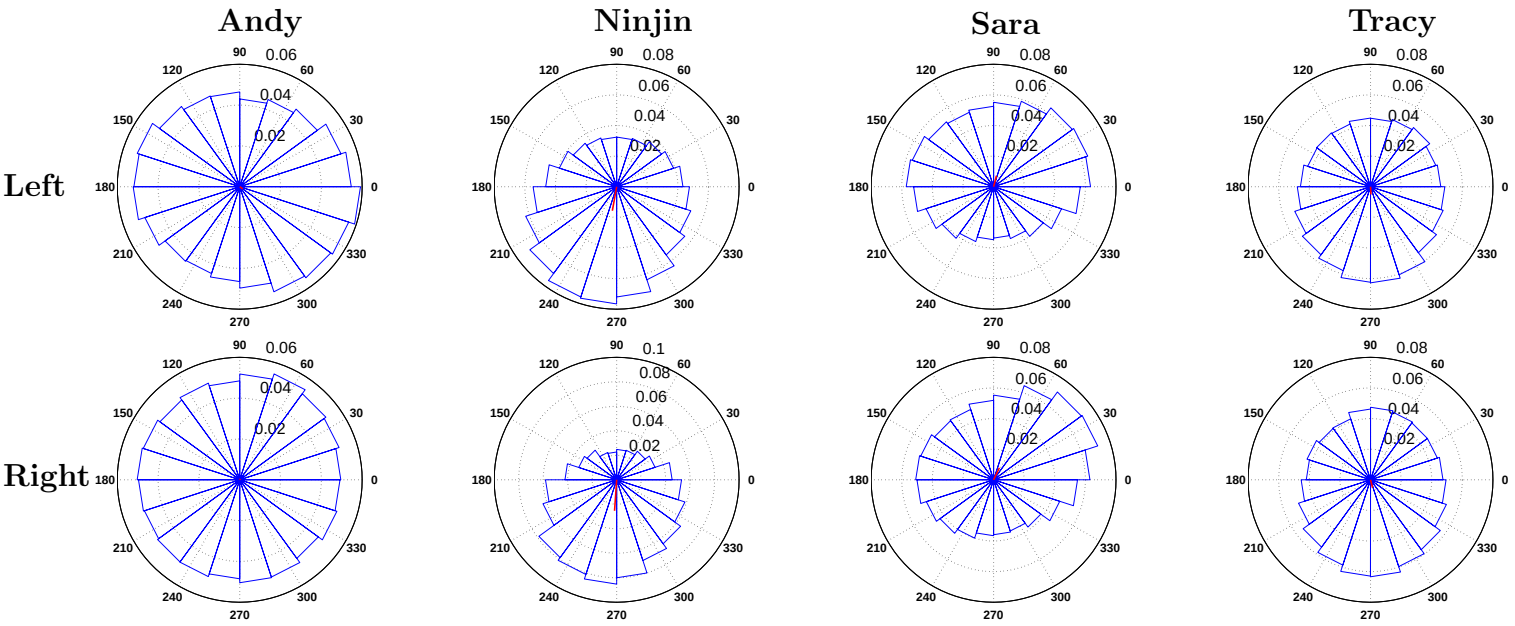

Figure 9: Histogram of angle of instantaneous velocity vector for drift segments occuring during **Ramp** period

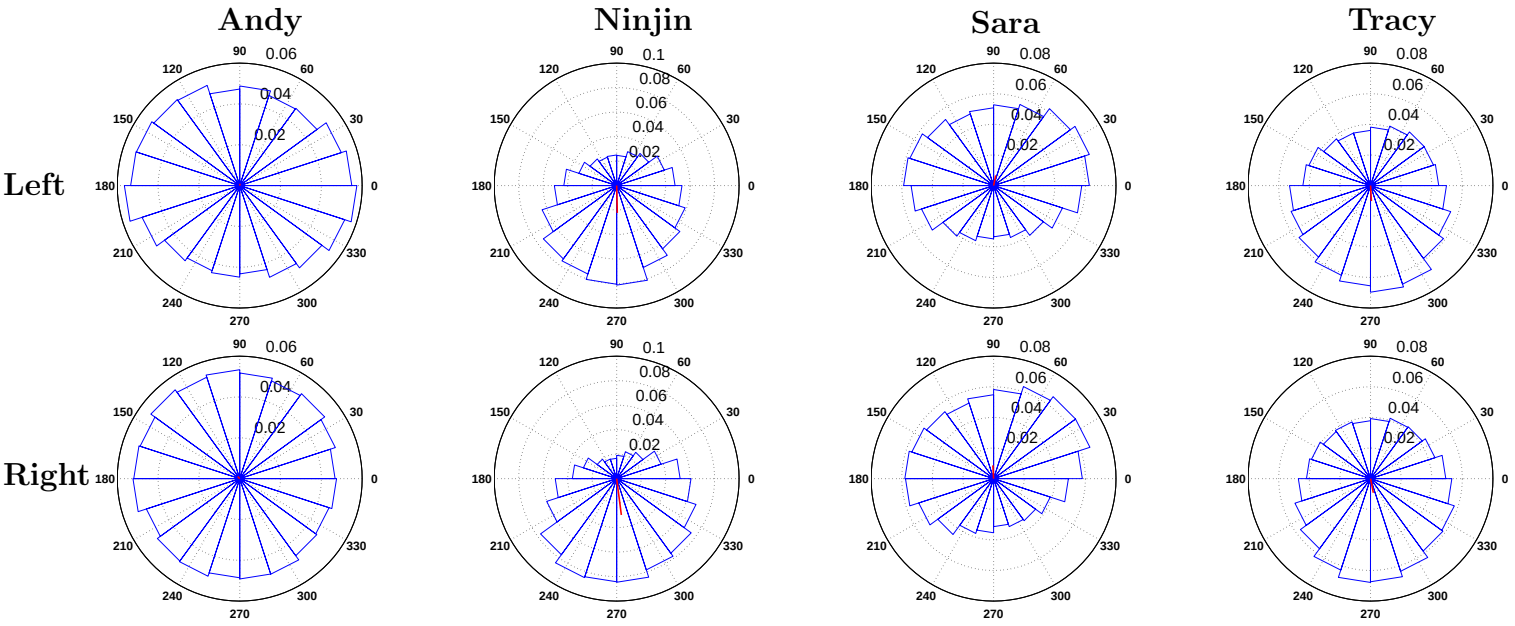

Figure 10: Histogram of angle of instantaneous velocity vector for drift segments occuring during **Plateau** period

Plateau	Sara	Ninjin	Tracy	Andy
Left	78.52	-88.72	-86.72	80.83
Right	93.09	-82.62	-78.75	134.33
Ramp	Sara	Ninjin	Tracy	Andy
Left	75.55	-100.15	-86.36	-35.00
Right	64.1156	-93.88	-75.50	57.75

Table 3: Mean angle of instantaneous velocity vector (all velocities)

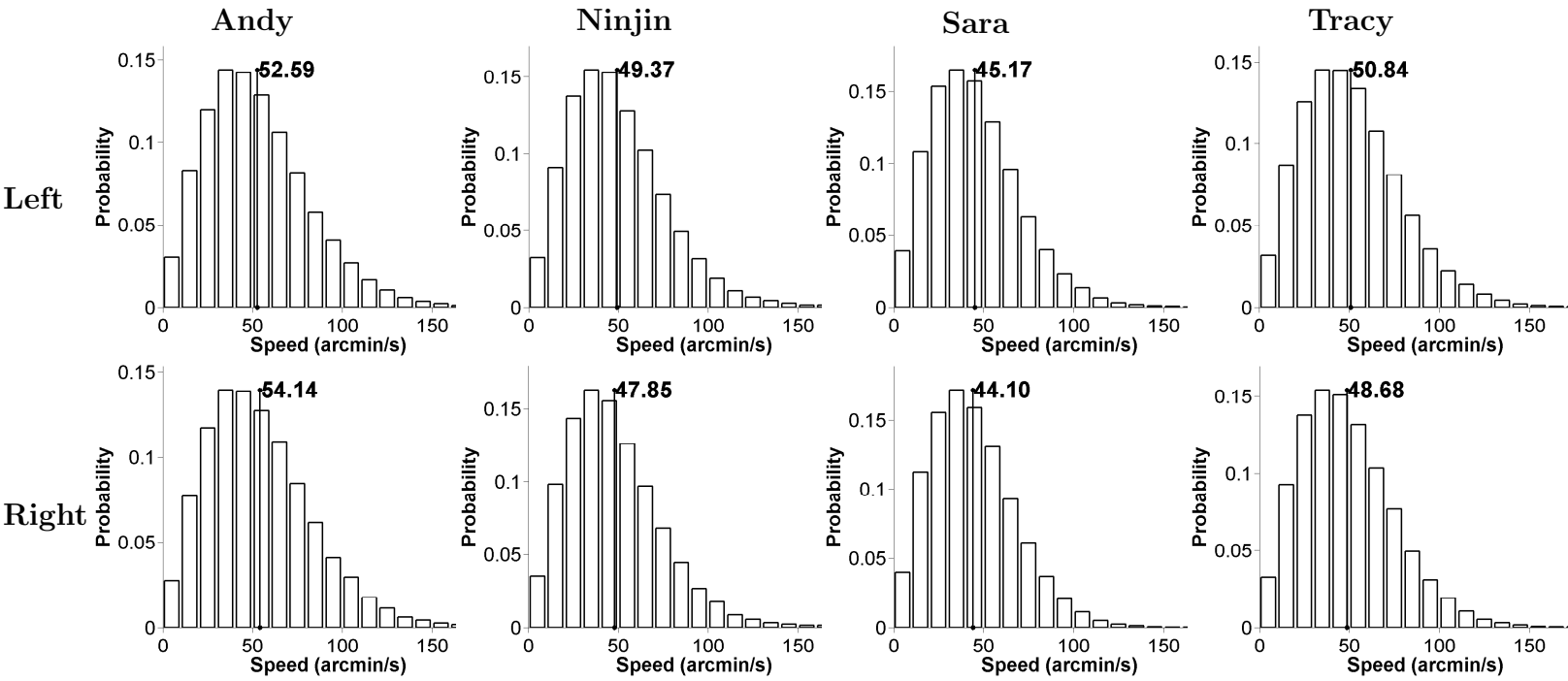

Figure 11: Histogram of speed for drift segments occuring during **Ramp** period- for each drift one value which was the mean of the magnitudes of instantaneous velocity vectors occuring during the ramp period was found. The histogram is plotted by putting all these values together.

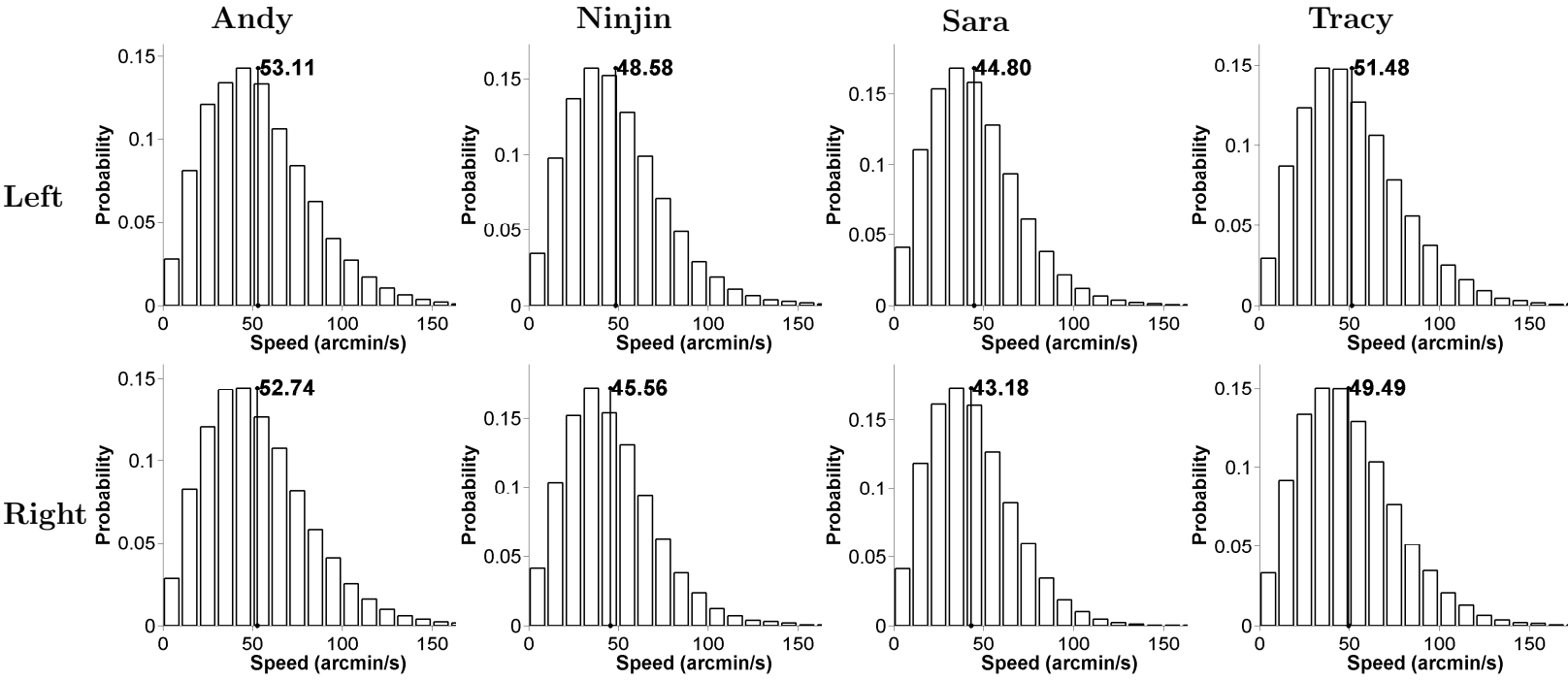

Figure 12: Histogram of speed for drift segments occuring during **Plateau** period- for each drift one value which was the mean of the magnitudes of instantaneous velocity vectors occuring during the ramp period was found. The histogram is plotted by putting all these values together.

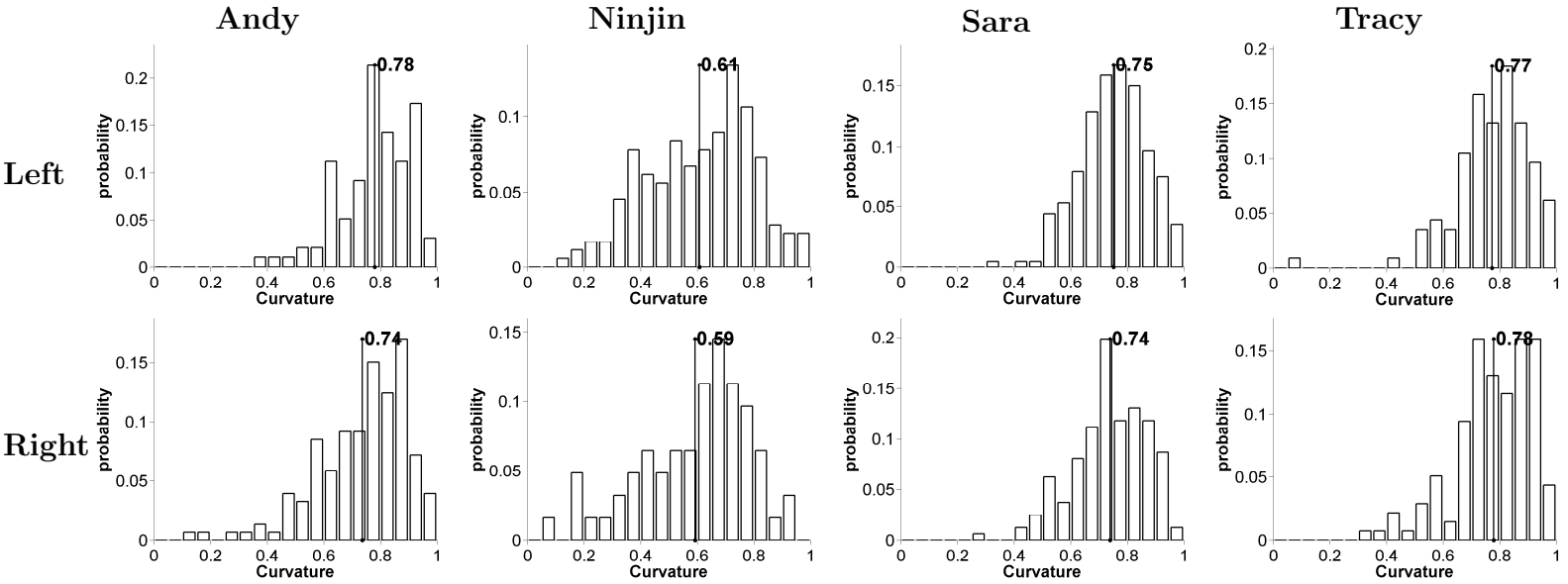

Figure 13: Histogram of curvature for drift segments occuring during **Ramp** period

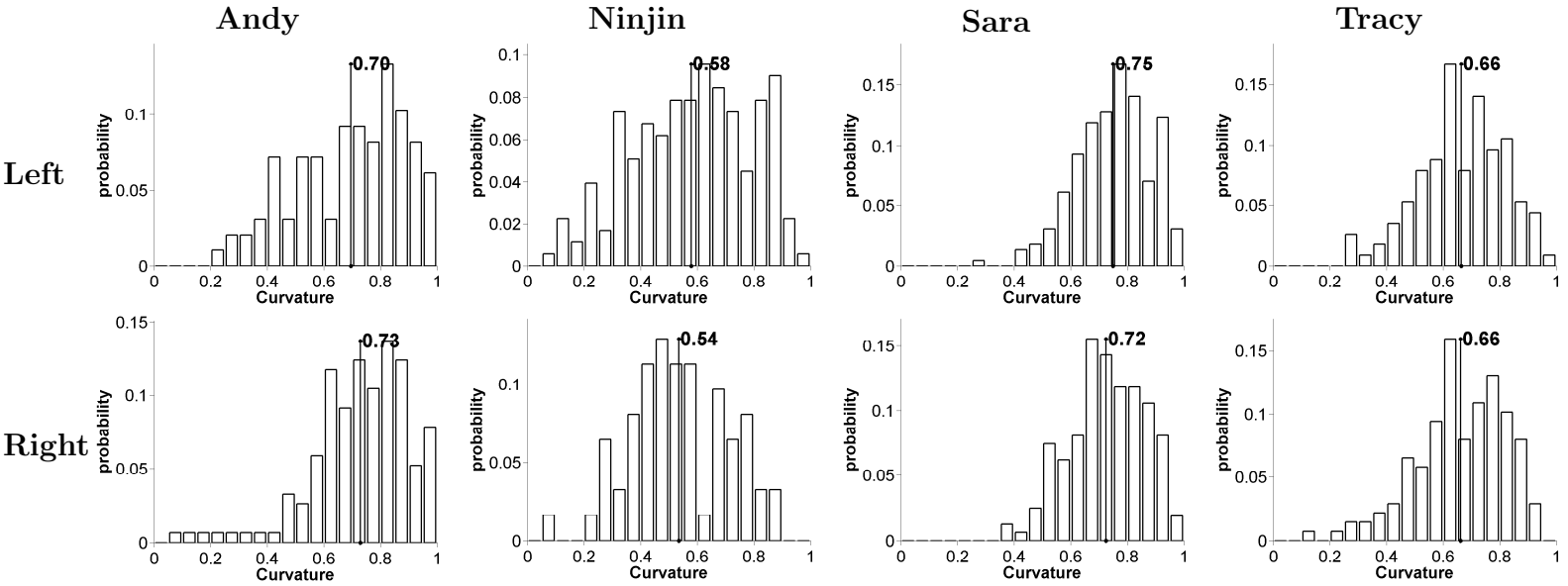

Figure 14: Histogram of curvature for drift segments occuring during **Plateau** period