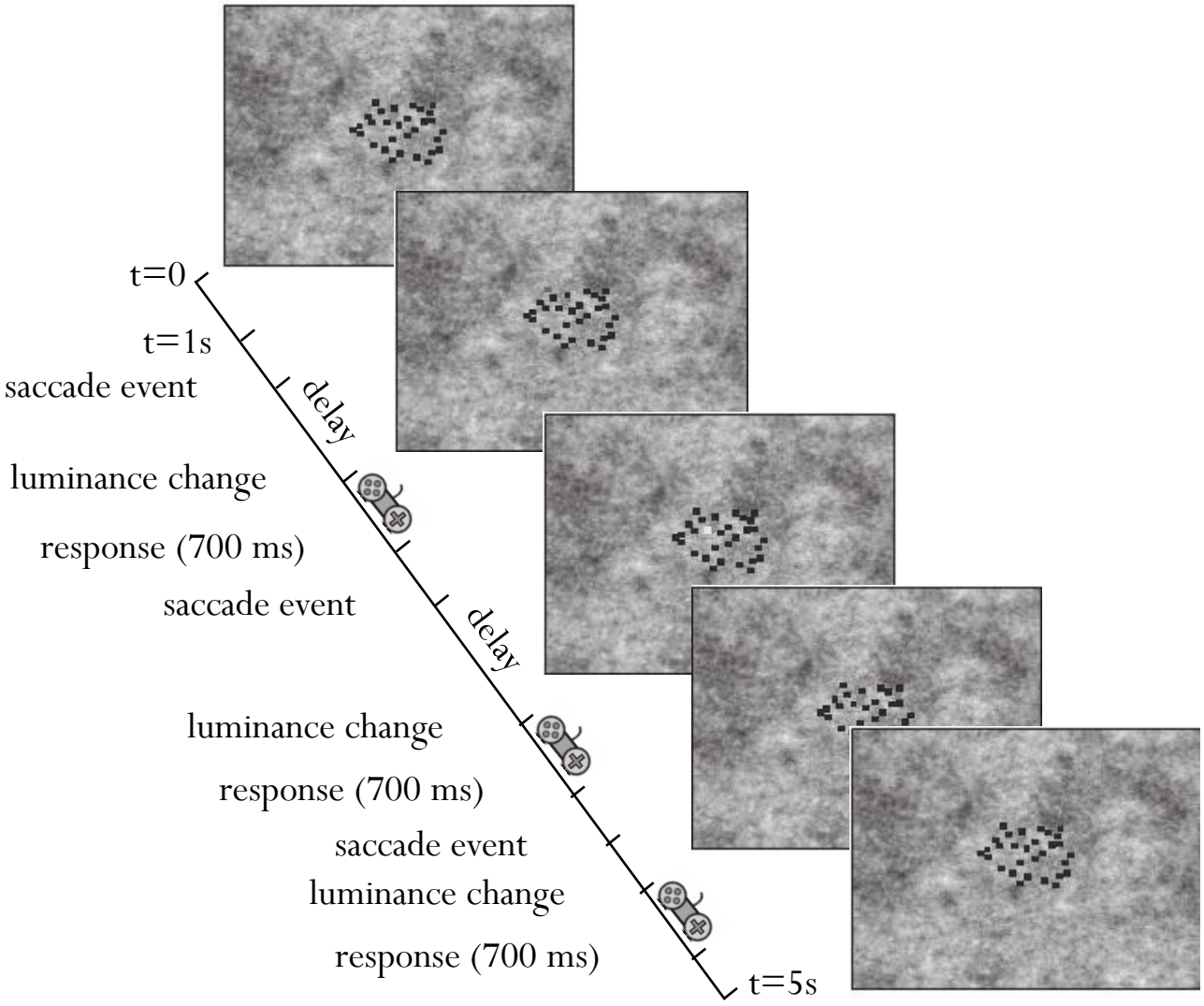
Peri-microsaccadic vision

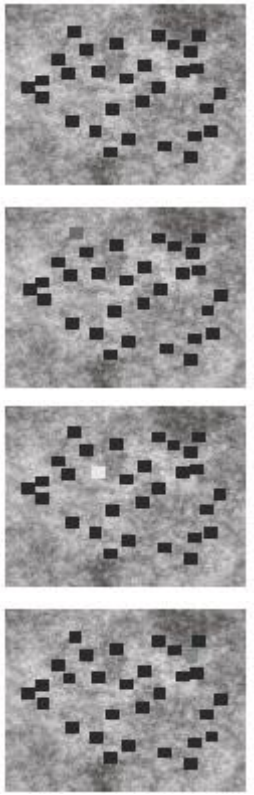
10-30-15

Study objectives:

- Examine the Spatiotemporal profile of peri-microsaccadic contrast sensitivity.
- Examine the homogeneity of contrast sensitivity across the fovea and perifovea.
- Study the dynamics of saccadic suppression phenomena across the fovea and perifovea.

Experimental design





Experiment paradigm

- Each session consists of 5 blocks of 40 trials.
- Objects (squares) are uniformly distributed within 1 deg radius from the center of the screen.
- Upon occurrence of a microsaccade or small saccade (< 1 deg), a luminance change occurs after a delay.
  - The delay varies between 0-400 ms.
- The change occurs at a randomly selected location within ±15 deg from the center of gaze.
- Based on the distance from the center of gaze, the level of change is chosen randomly from 8 values varying between 60-200.
- The duration of change is 10 ms.
- The minimum distance between each two objects is 5 arcmin.
- There is a calibration trial after each trial.

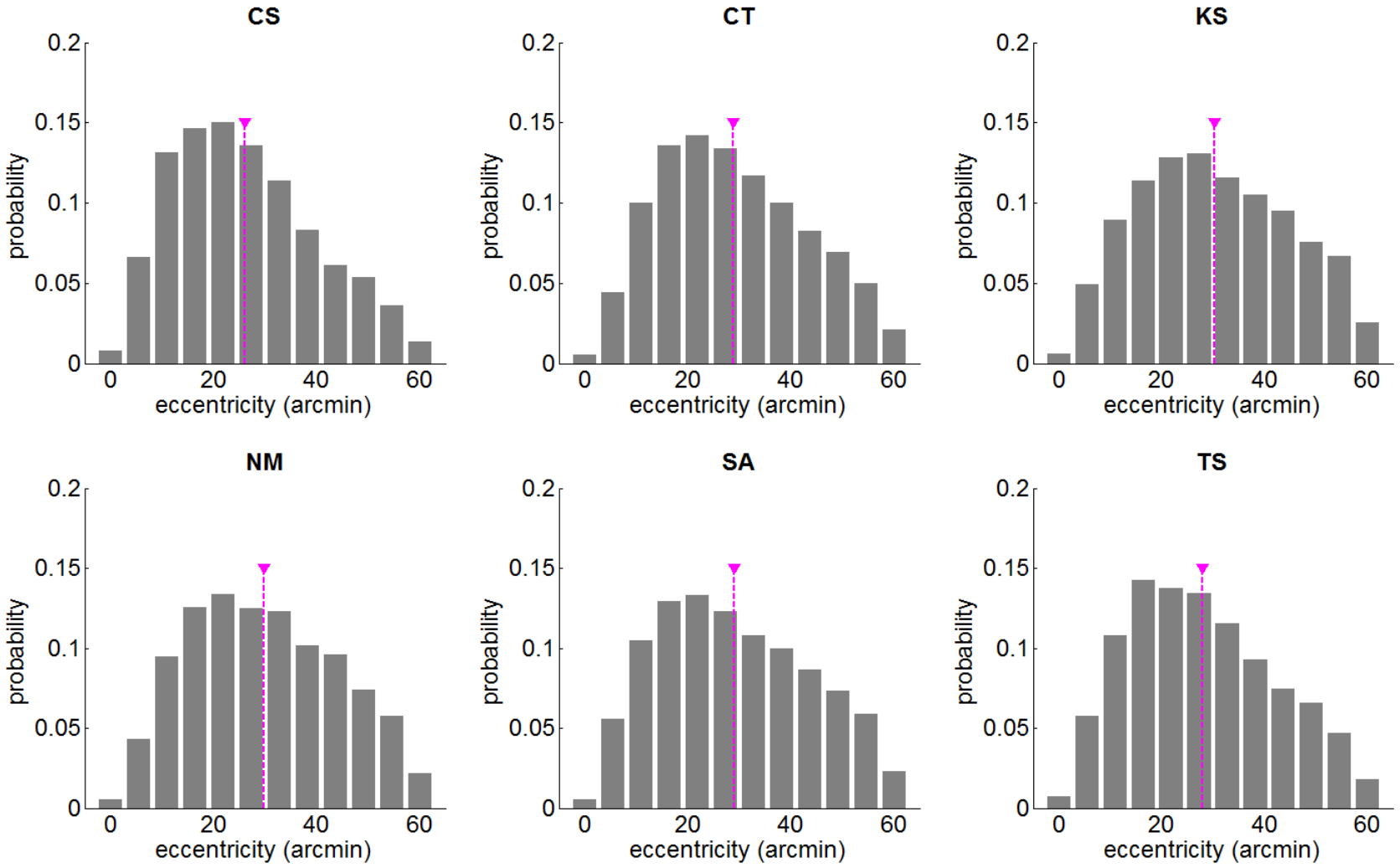
Data summary

Changes within ±45 deg horizontal angel

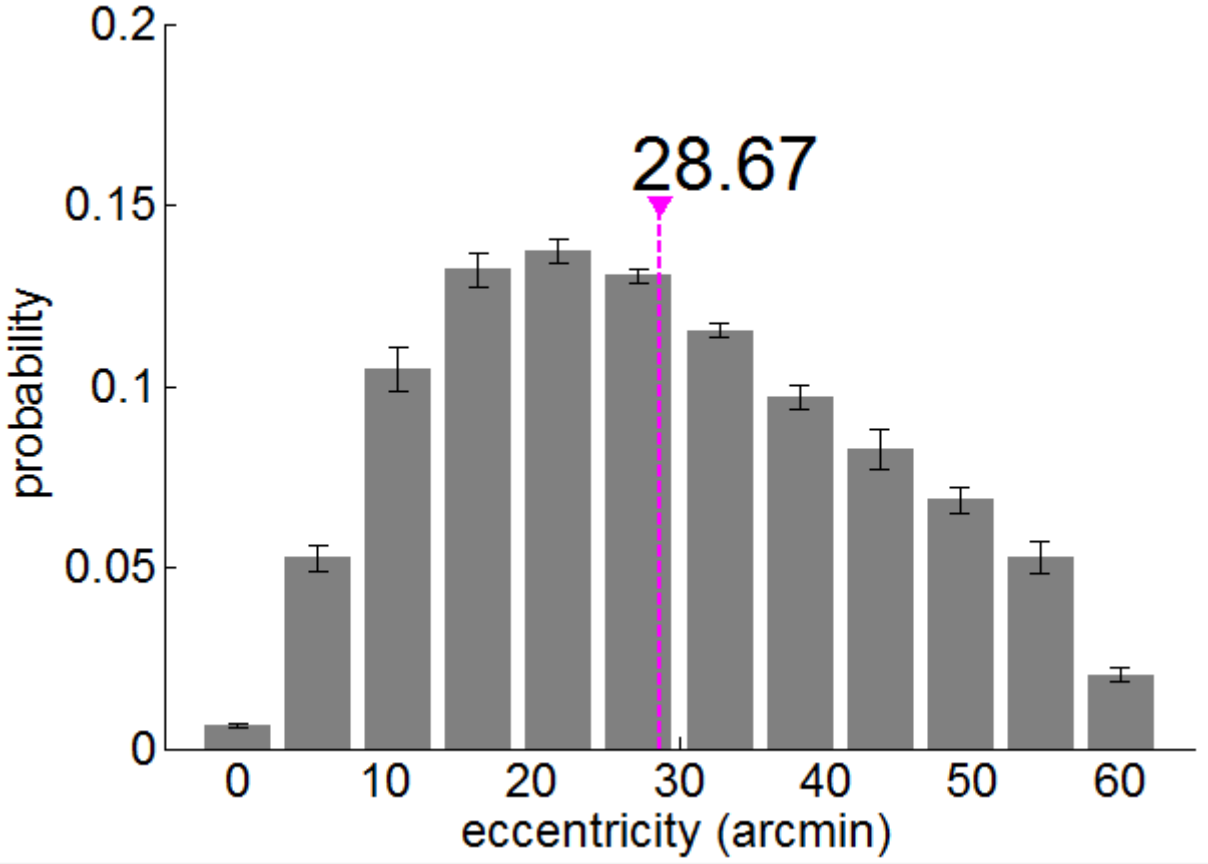
Changes within 1 deg radius from the center of gaze, corresponding only to 1 saccade within ±200ms time window from the change.

	# chng	# hor chng	#used chng		**-200 to -100**	**-100 to -50**	**-50 to -25**	**-25 to 0**	**0 to 25**	**25 to 50**	**50 to 100**	**100 to 200**
CS (17)	10507	10056	7718	**0-15**	66	110	67	65	202	780	349	216
				15-30	175	157	126	162	328	1339	488	296
				30-60	187	145	88	110	255	1373	408	226
CT (23)	13896	13254	10404	**0-15**	42	82	49	72	224	857	361	233
				15-30	145	190	114	132	386	1723	777	445
				30-60	225	165	90	123	389	2158	928	494
KS (27)	16751	16202	11701	**0-15**	110	93	55	59	155	796	458	284
				15-30	203	182	106	95	292	1615	953	591
				30-60	272	173	110	96	331	2485	1352	835
NM (25)	16157	15224	10818	**0-15**	40	51	40	51	314	619	467	275
				15-30	92	90	84	90	548	1364	1052	518
				30-60	131	130	78	97	610	1849	1464	764
SA (21)	11949	11368	7404	**0-15**	83	99	55	50	139	525	282	208
				15-30	181	127	82	90	288	1027	495	351
				30-60	245	145	77	79	296	1383	665	432
TS (20)	10185	9490	6296	**0-15**	79	113	58	39	131	616	210	53
				15-30	197	160	77	71	252	1187	351	103
				30-60	316	150	60	64	213	1354	332	110

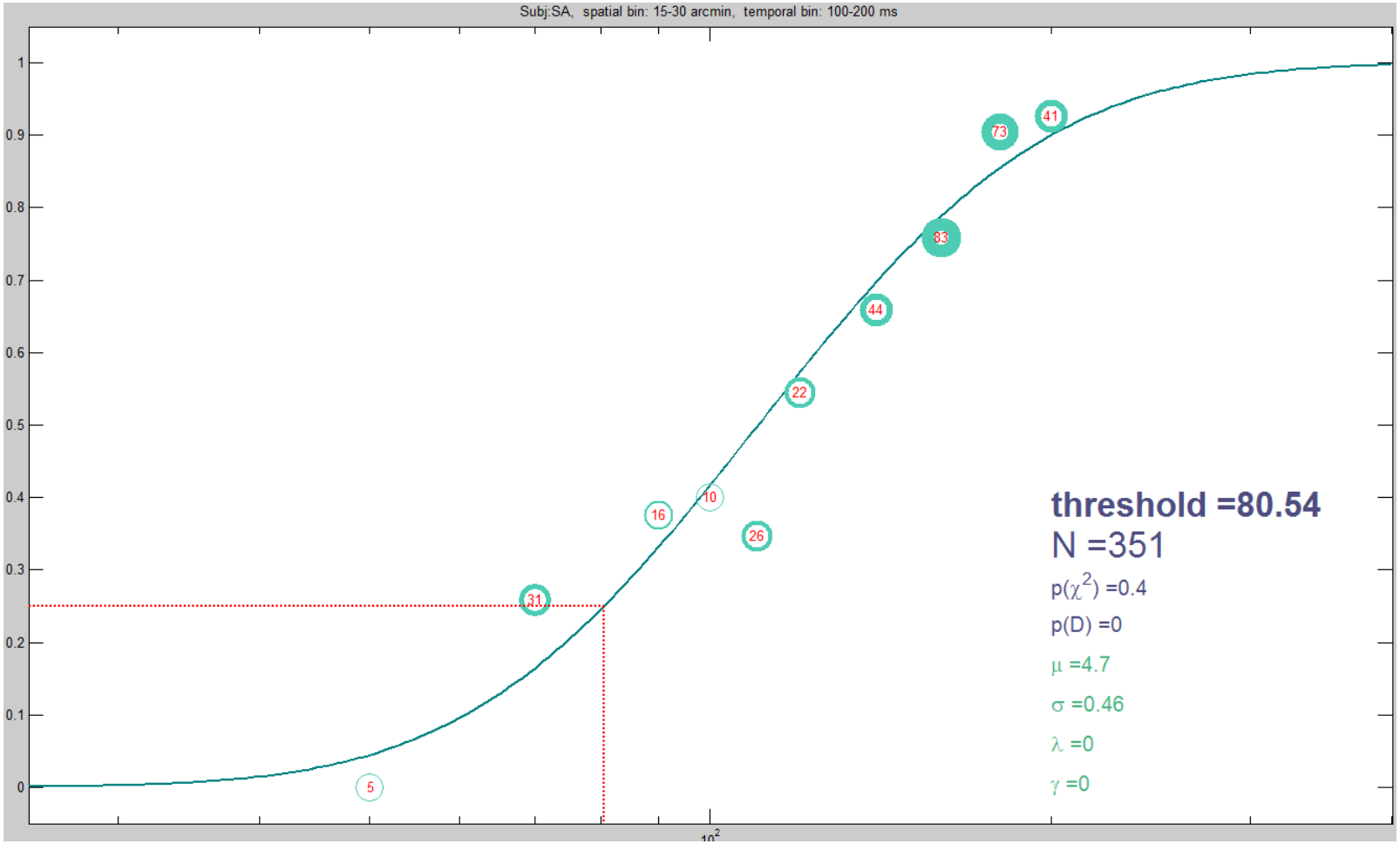
Distribution of change eccentricity



Distribution of change eccentricity

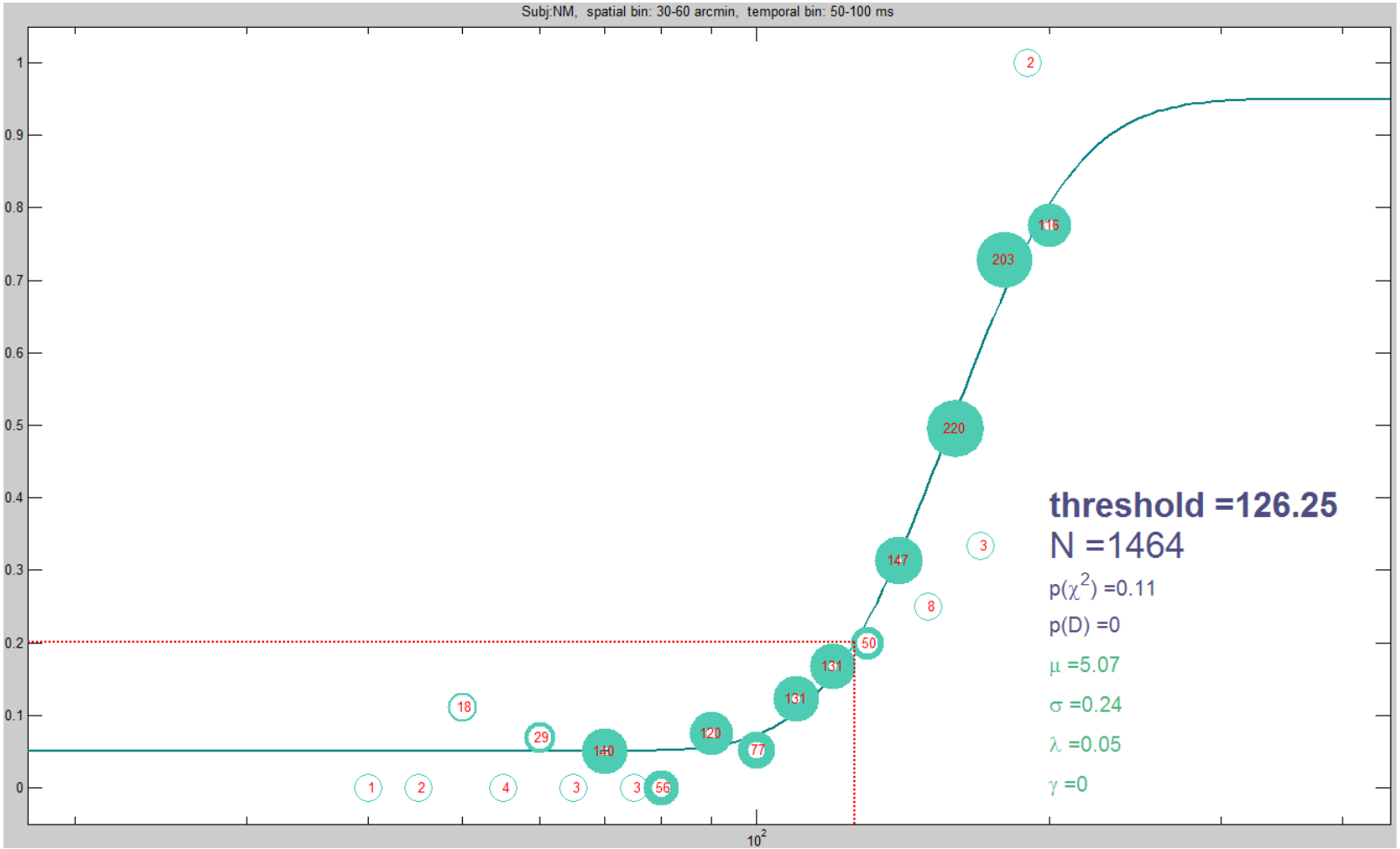


Contrast threshold estimation

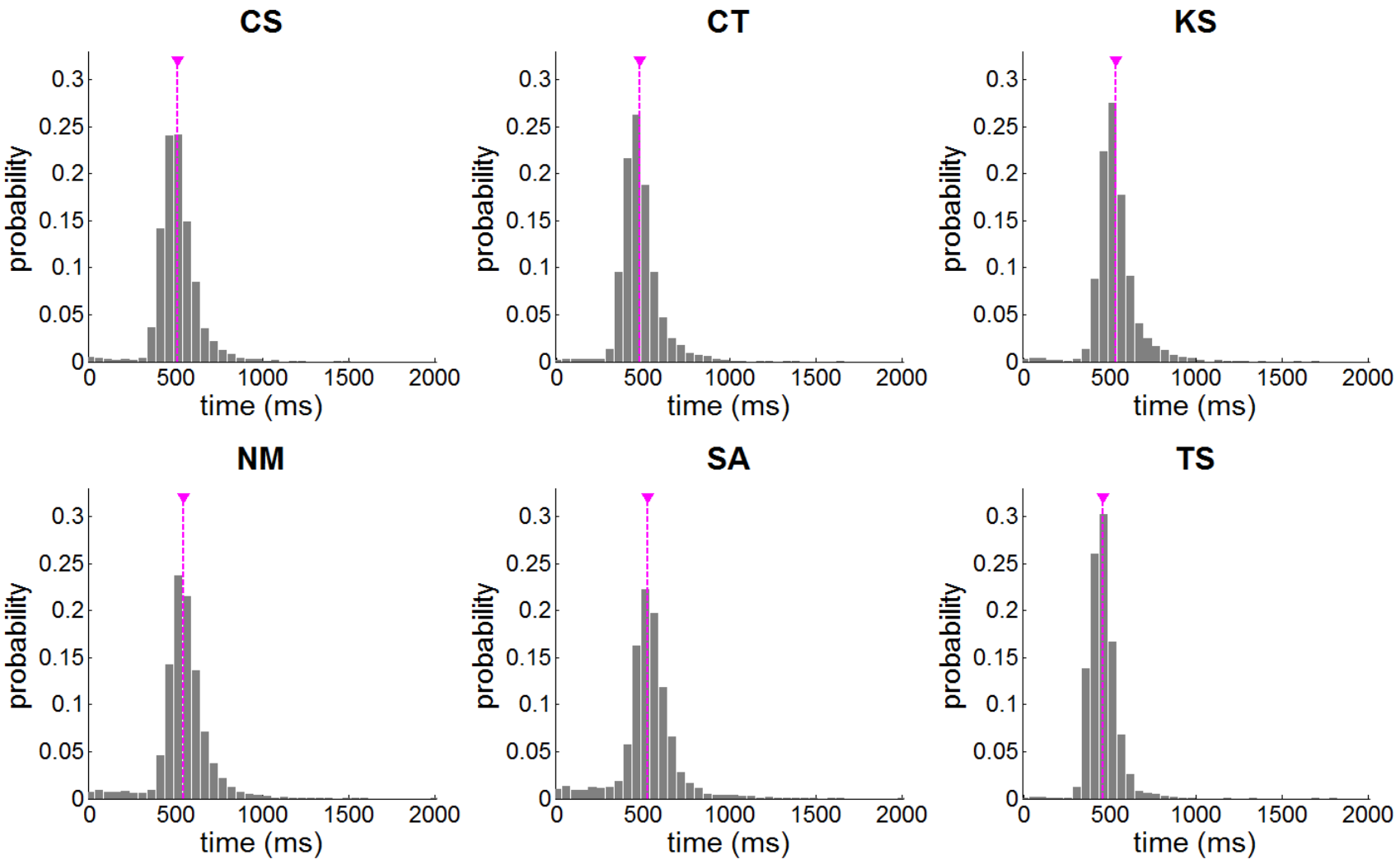


Contrast threshold estimation

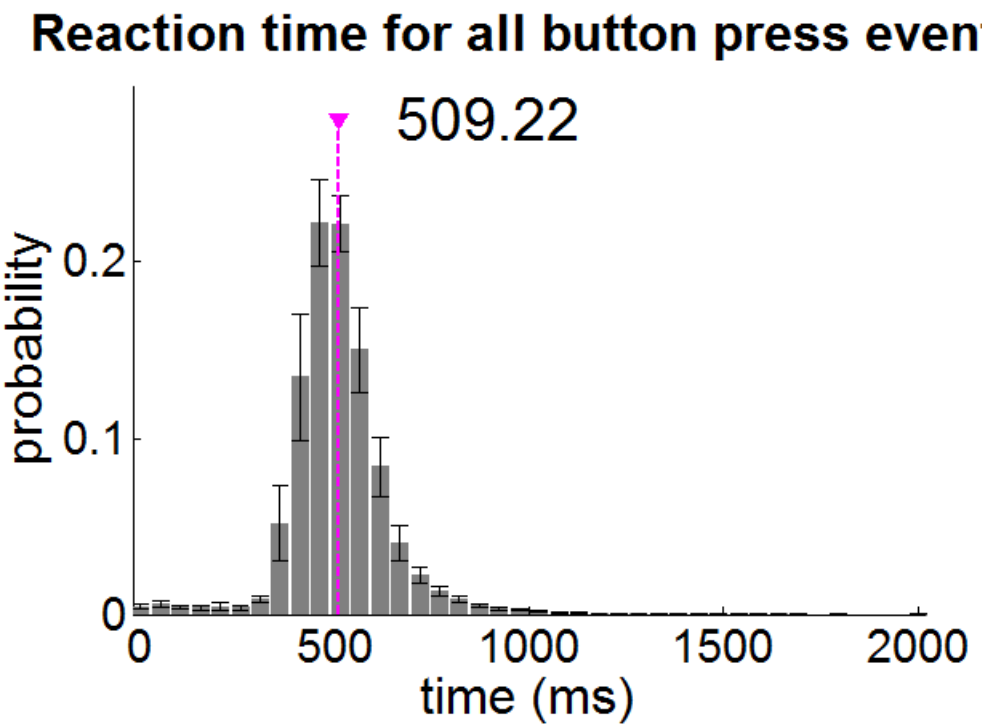
$$n_p = \frac{p - 2\lambda_p}{1 - 2\lambda_p}$$



Distribution of reaction times



Distribution of reaction times

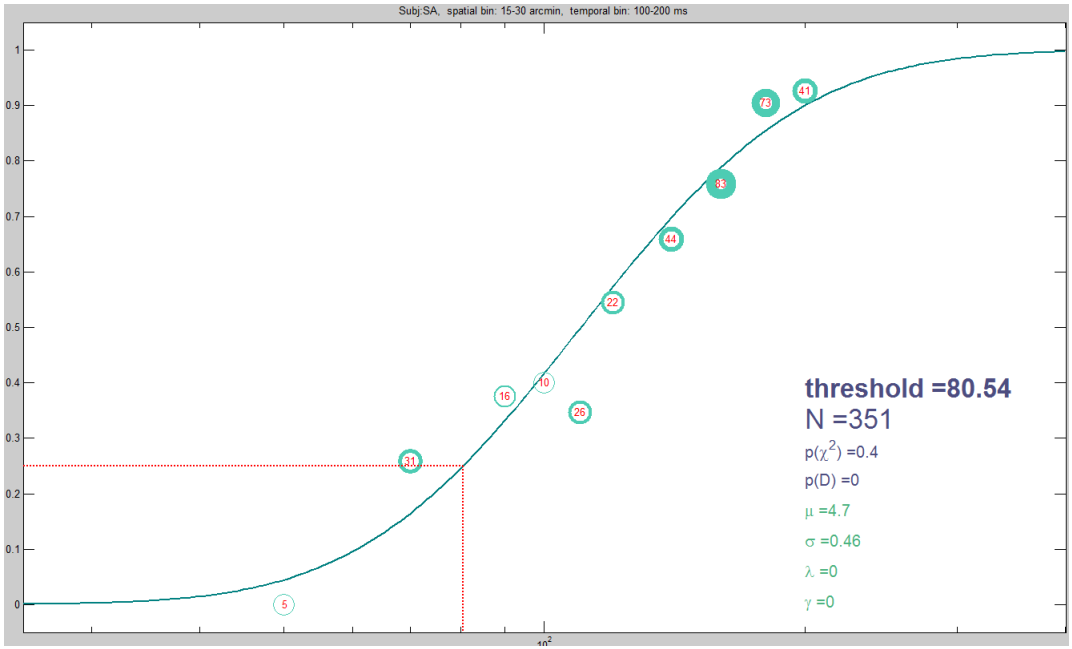


	5 percentile	95 percentile
CS	380.26	699.40
CT	353.96	687.16
KS	406.69	745.02
NM	347.89	757.23
SA	221.75	754.70
TS	351.53	586.42

False alarm rate

Sbj	# Trials	# no-change trials	Average number of changes in change trials	Average number of button presses in no-change trials	False alarm rate
CS	182	23	3.85	1.48	38.44%
CT	189	24	3.70	1.25	33.76%
KS	195	25	3.32	0.76	22.91%
NM	189	24	3.68	1.17	31.71%
SA					
TS	283	39	3.55	2.08	58.45%

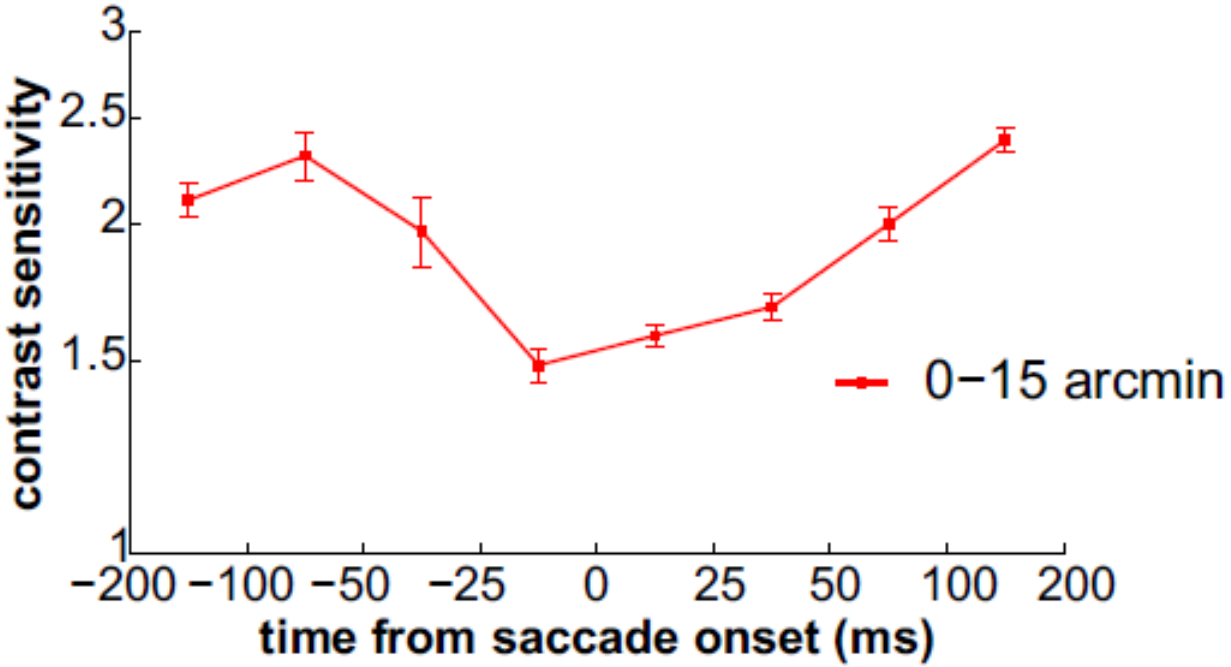
Contrast threshold estimation



Sensitivity = contrast threshold / (contrast threshold + 100)

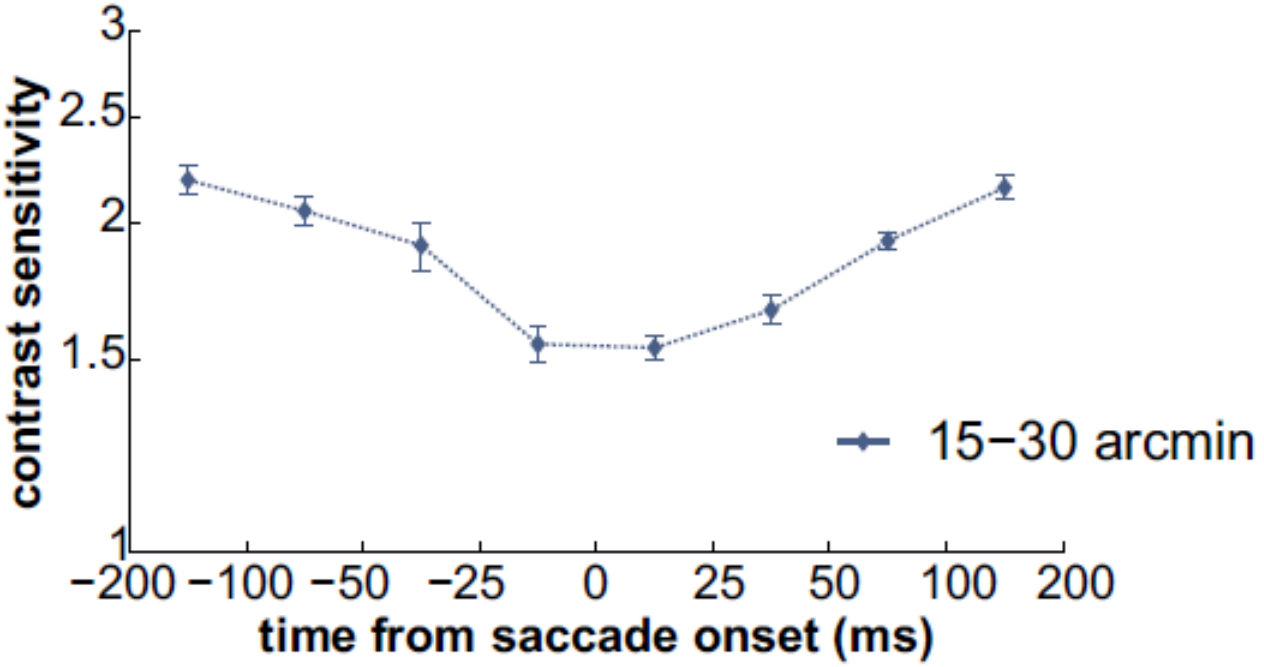
Time course of sensitivity change across the fovea and perifovea

Relative to occurrence of microsaccades and small saccades



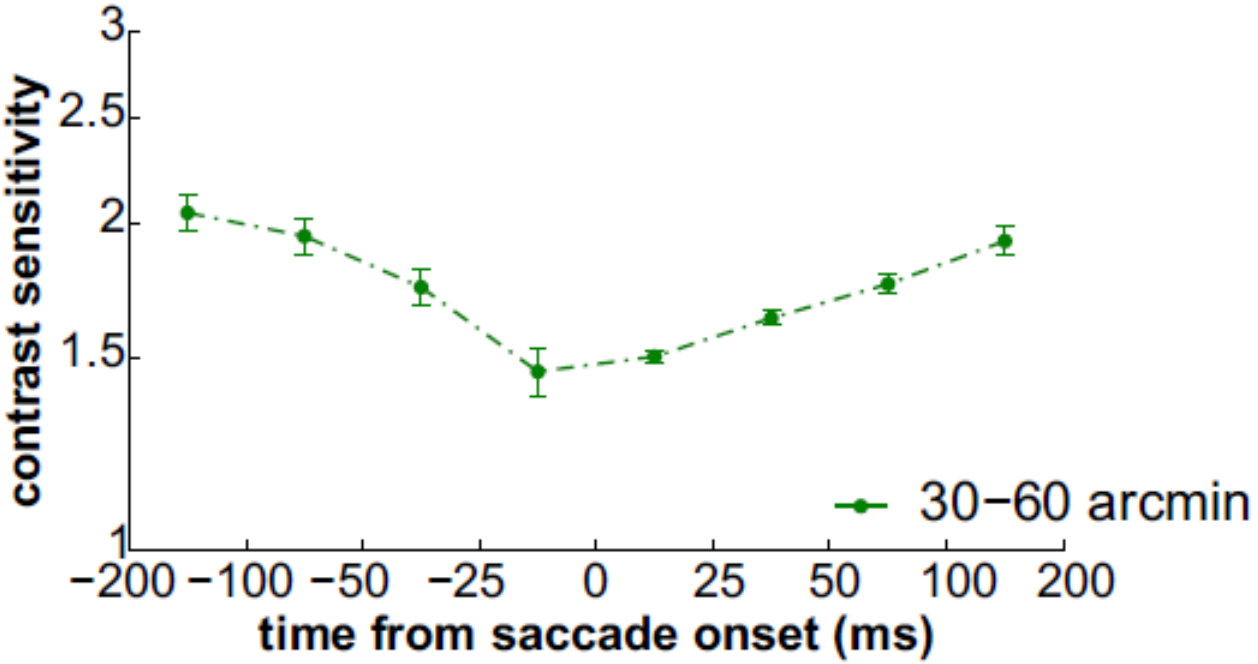
Time course of sensitivity change across the fovea and perifovea

Relative to occurrence of microsaccades and small saccades



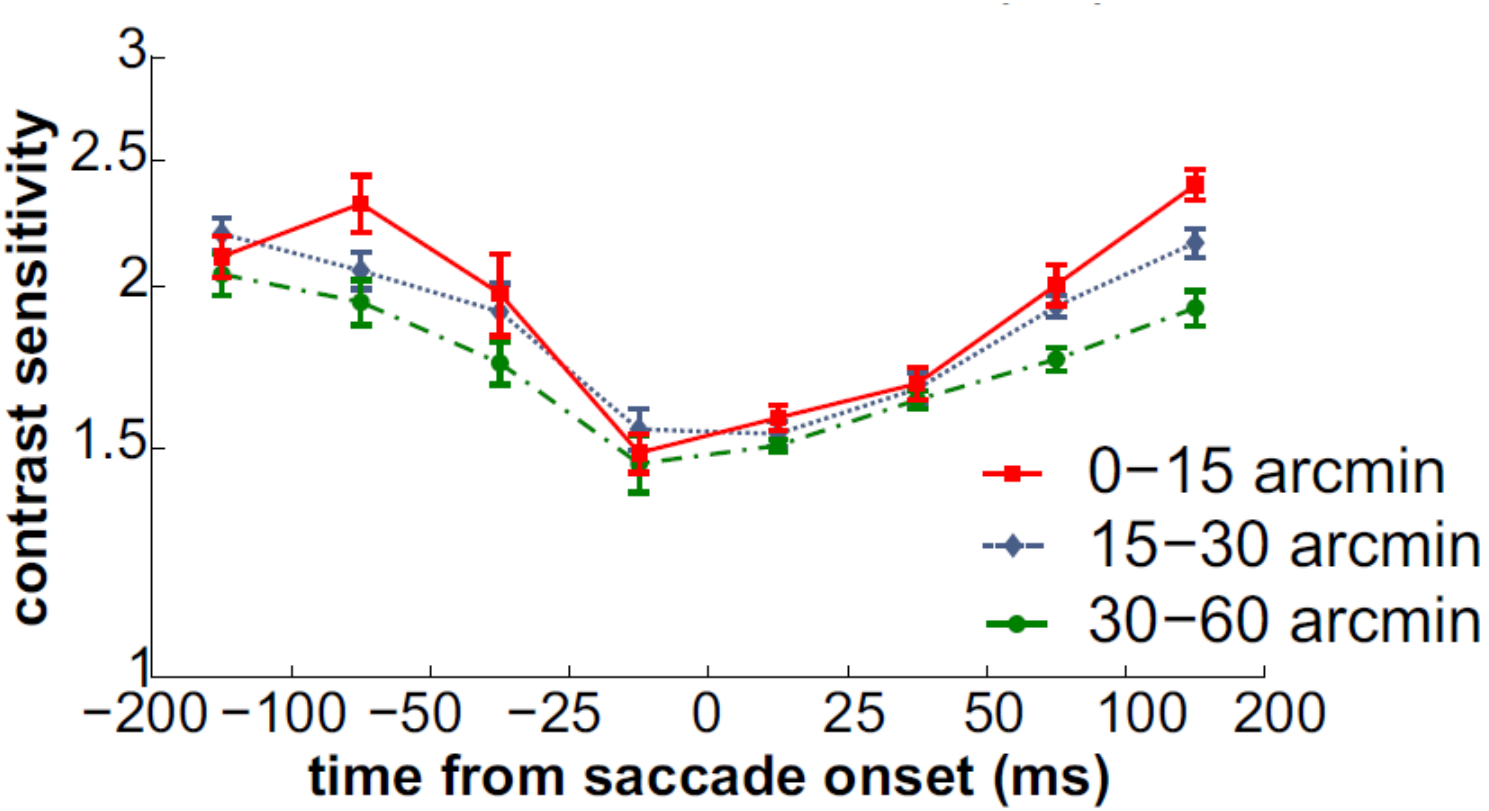
Time course of sensitivity change across the fovea and perifovea

Relative to occurrence of microsaccades and small saccades



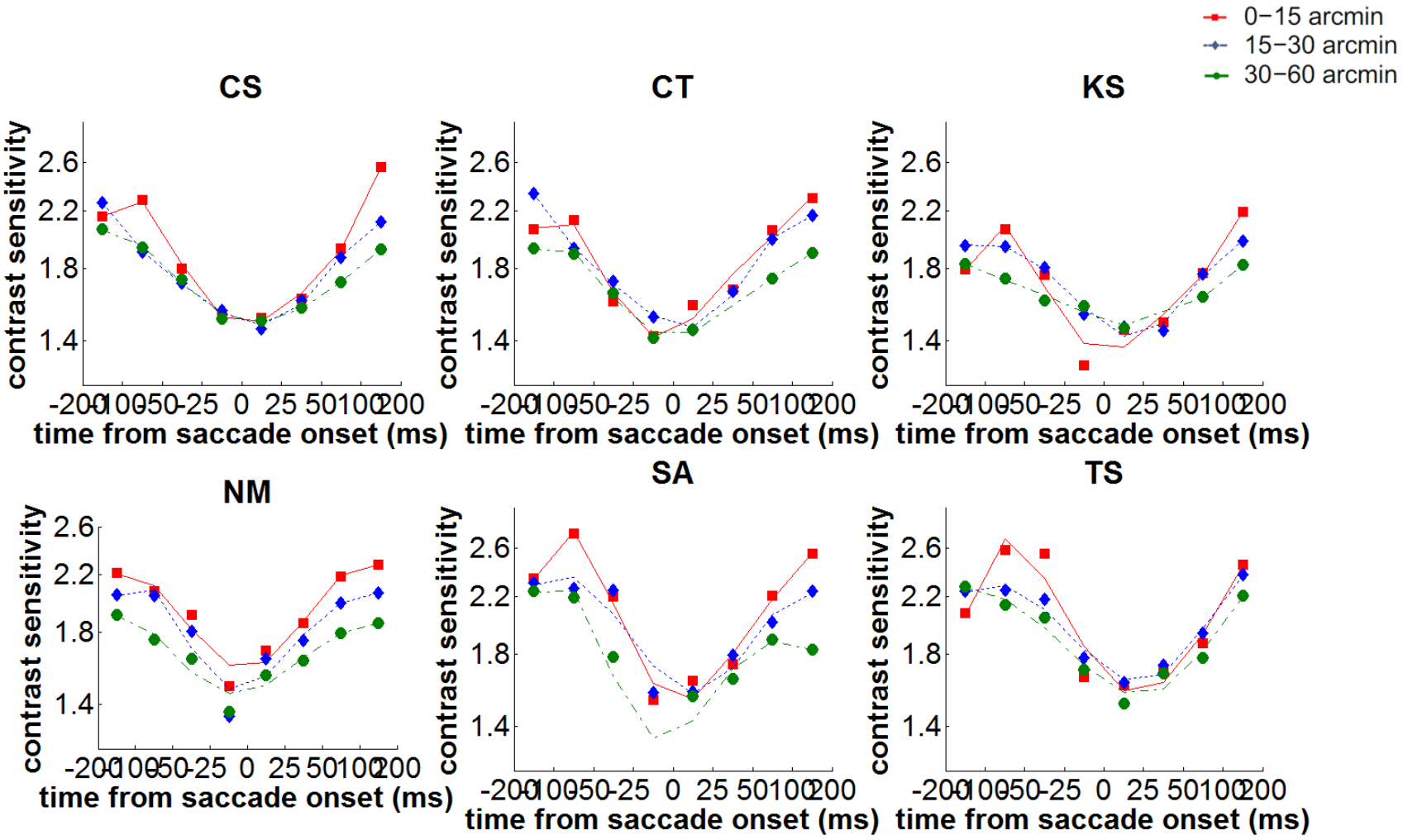
Time course of sensitivity change across the fovea and perifovea

Relative to occurrence of microsaccades and small saccades

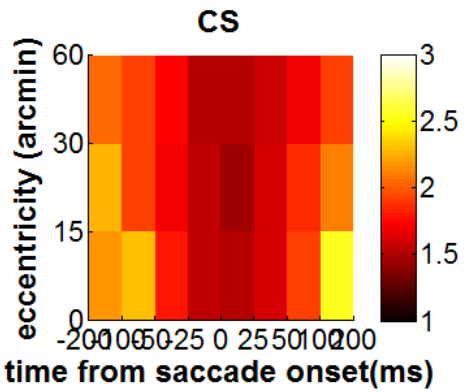


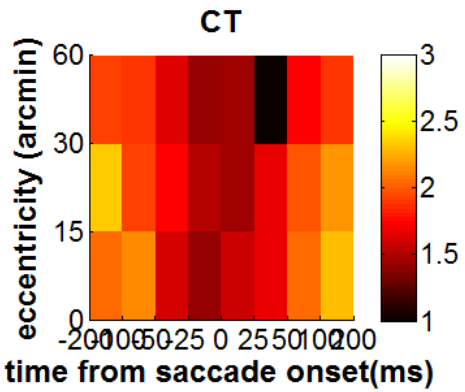
Time course of sensitivity change across the fovea and perifovea

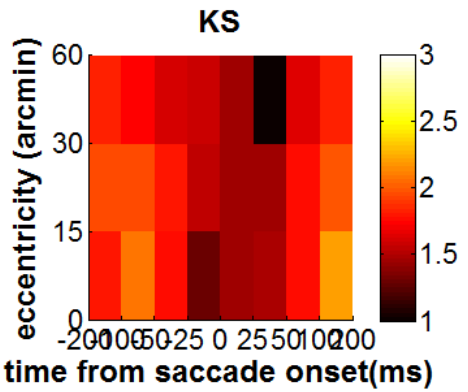
Relative to occurrence of microsaccades and small saccades

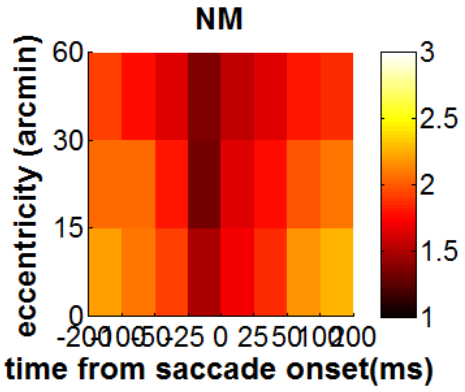


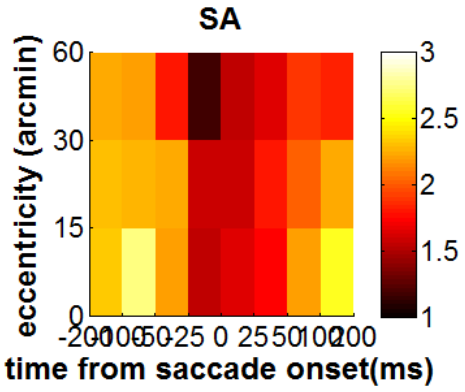
Spatiotemporal contrast sensitivity map.

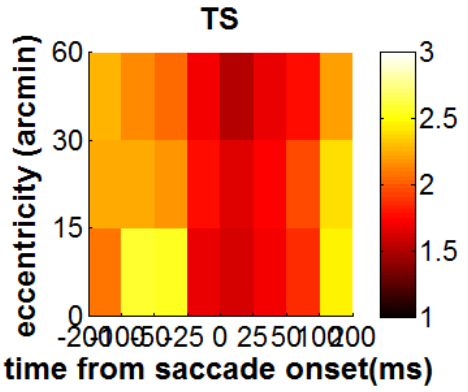






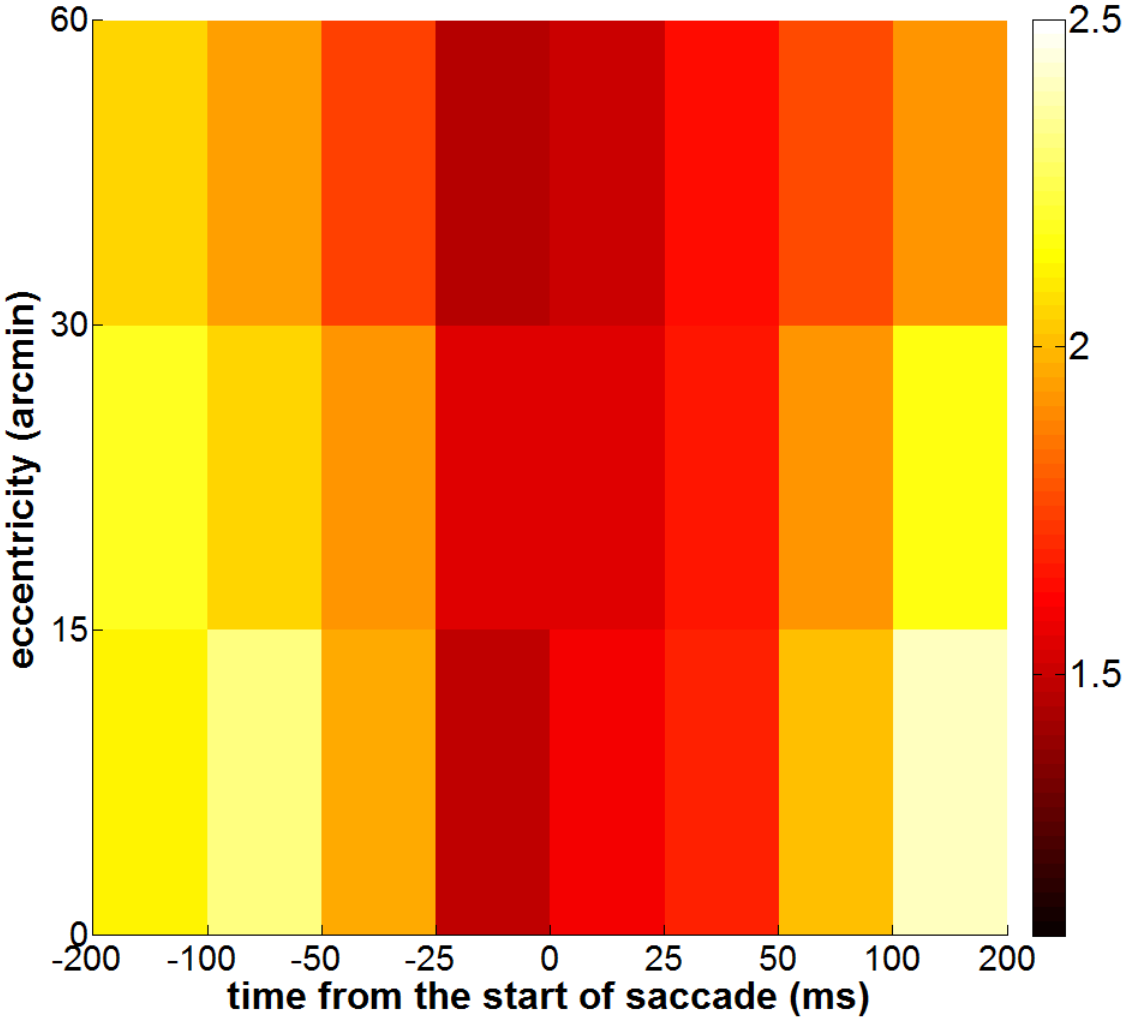






Spatiotemporal contrast sensitivity map.

Relative to occurrence of microsaccades and small saccades



Summary

- Construct the full spatiotemporal map of contrast sensitivity relative to occurrence of microsaccades.
- Contrast sensitivity is not homogenous within the fovea and perifovea and decreases with increasing eccentricity.
- “Microsaccadic suppression” of visual thresholds with similar time course to saccadic suppression phenomena.