

## Supplementary Information

### **MarmoDetector: A Novel 3D Automated System for the Quantitative Assessment of Marmoset Behaviour**

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Supplementary figure Legends.

Supplementary Figure S1.

The screen coordinate was composed of a horizontal X-axis and a vertical Y-axis. The origin (0, 0) was in the upper-left corner of the screen. The resolution of the screen was 512 pixels along the X-axis and 424 pixels along the Y-axis.

Supplementary Figure S2.

Convert depth data to data of three-dimensional point group.

Line AC was parallel to the X-axis. Point P represented a position of marmoset on the screen. Point B was the origin of the depth. Distance between the depth sensor and the screen was 100 cm. The depth sensor horizontal angle was 70 degrees. The horizontal size of the screen was 140.0 cm ( $2 \times 100 \times \tan 35^\circ$  cm). Similarly, the vertical size of the screen was 115.5 cm ( $2 \times 100 \times \tan 30^\circ$  cm). The X-Y position of the marmoset was determined based on its screen coordinates, and the pixels were converted to distance. The depth of the marmoset was equal to the distance between the depth sensor and the point on the line connecting the depth sensor to the two-dimensional centre of gravity of the marmoset.

Supplementary Figure S3

- (a) MarmoDetector measured a dome-like object movement. The object turned around on the board for six minutes.
- (b) XY plane cumulative trajectories of the ball turning around on the board at the upper left, upper right, lower left, lower right, and the back center was shown. The origin (0, 0) was in the upper-left corner of the screen. They all showed circular movements.
- (c) The expected values and the observed measurements are shown. We also calculated

the error values of the expected values versus the observed measurements.

#### Supplementary Figure S4.

The general patterns of the X-axis, the Y-axis and the depth movement of three male marmosets were shown over 120-hour periods. The movement distance of each direction was quantified every 30 minutes.

#### Supplementary Figure S5.

MarmoDetector can detect where marmosets spent time during the daytime and the night-time in the cage. The space of the cage was equally divided into twelve areas. The Kinect v2 camera was placed in front of the cage. The X, Y, and depth axis show the direction of each axis. The X axis is parallel to the width of the cage. The Y axis is parallel to the height of the cage. The number signifies each area of the cage (a). The graph shows where each marmoset spent time in the area of the cage. Each marmoset tends to sleep on the specific area at night (b).

#### Supplementary Figure S6.

MarmoDetector can detect accurately sleeping or resting time during the daytime.

A representative example of the marmoset movement over 120 hour periods was shown (left). The movement distance was occasionally decreased during the daytime. We magnified the first day of measurement (right). It showed that the movement distance suddenly decreased (red arrow).

(b) Video recording showed sleeping or resting of the marmoset the time when MarmoDetector detected decreased levels in moving distance during the daytime.

#### Supplementary Figure S7.

Alcohol injected marmosets tend to move lower part, but not upper part of the cage, compared to saline injected marmosets.

The graph showed time spent in the upper or lower parts of the cage.

#### Supplementary Figure S8

One-hour 2D (XY plane) cumulative trajectories of marmosets following intraperitoneal saline (a and b) and alcohol administration (c and d). The point (0,0) corresponded to the origin of the screen coordinate of the marmoset (Supplementary Figure S1). The X axis is horizontal one and The Y axis vertical. The X-Y position of the marmoset was determined based on its screen coordinates, and the pixels were converted to the

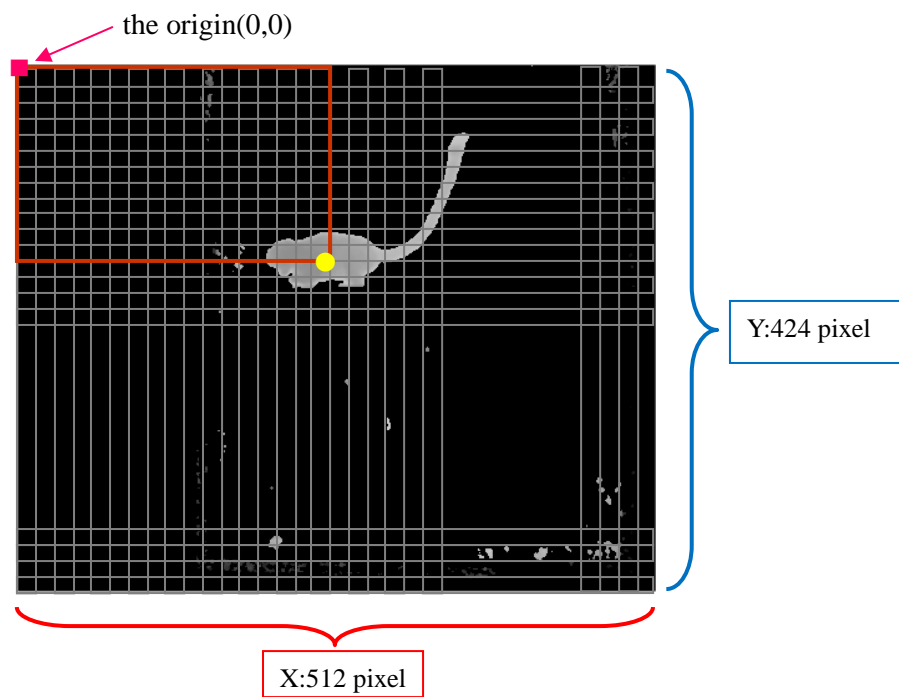
distance. Each plot shows the position of marmoset in the cage in each second. To trace the marmoset movement, we connected each point. 2D analysis could detect only linear movements of the marmoset in the alcohol administration. Quantification of the 2D movement distances in the 1 hour following intraperitoneal alcohol (e and f) and saline administration (g and h). The movement distances were averaged over a 15-minute window (900 recordings /window).

#### Supplementary Figure S9

The First 25 min representative trace of alcohol injected marmosets detects drunken and circular movements. MarmoDetector detects circular movements of the alcohol injected marmoset. Marmosets moved circularly and sometimes back and forth. This movement was also detected by MarmoDetector (red arrows). As time passed, acute effects of alcohol decreased and the marmoset can go to the upper half of the cage.

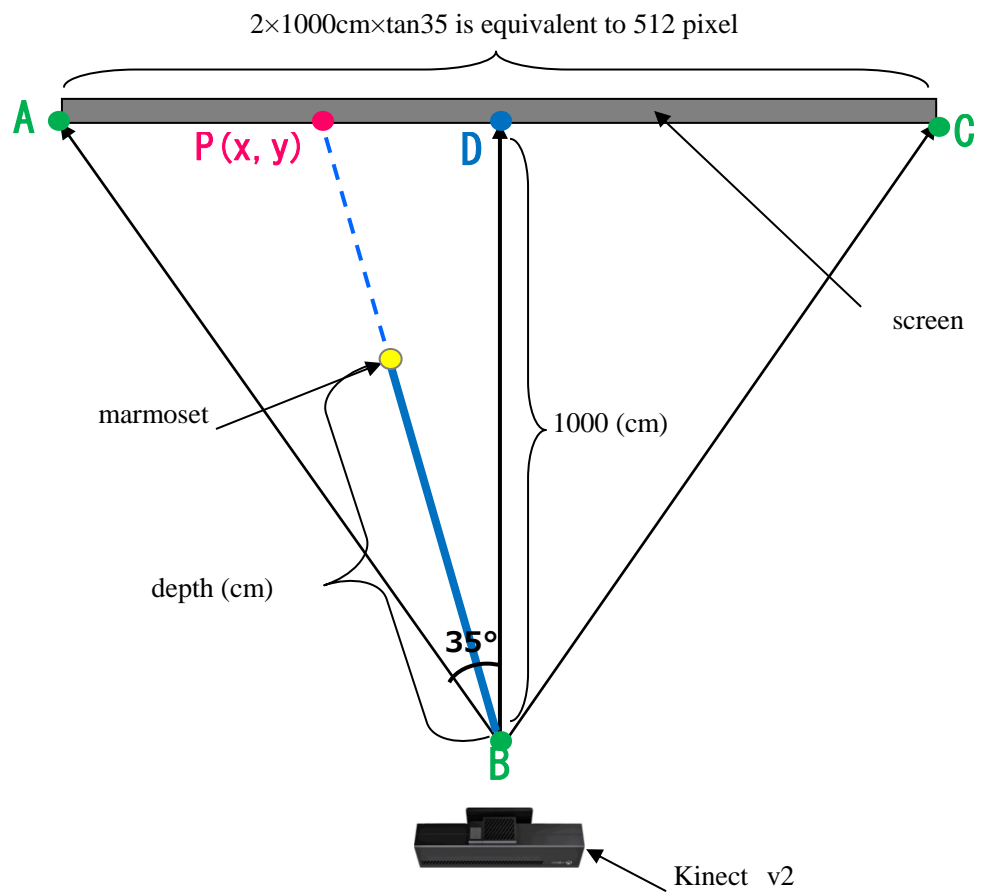
**Supplementary Figure S1.**

**The screen coordinate of the marmoset.**



**Supplementary Figure S2.**

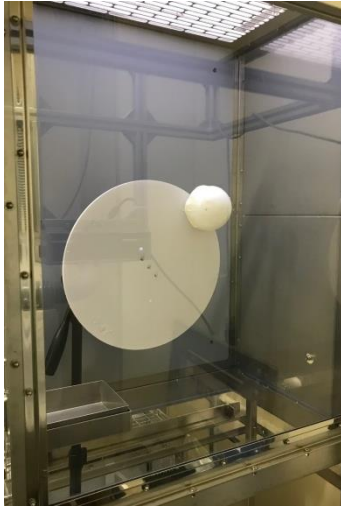
**Convert depth data to data of three-dimensional point group.**



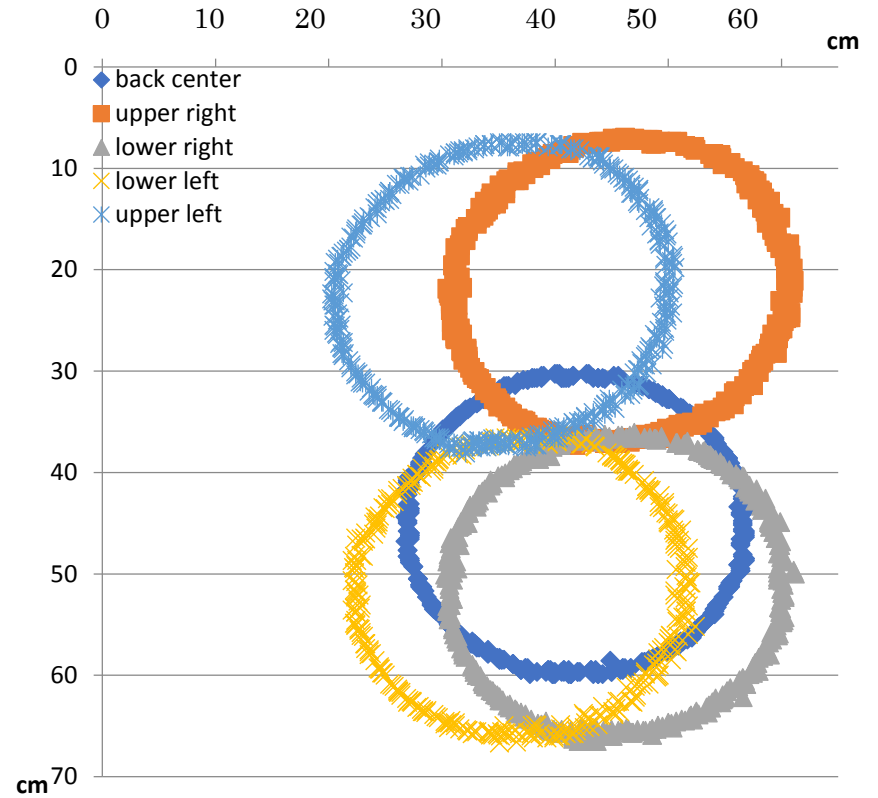
### Supplementary Figure S3

#### Location measurement precision of MarmoDetector.

a)



b)

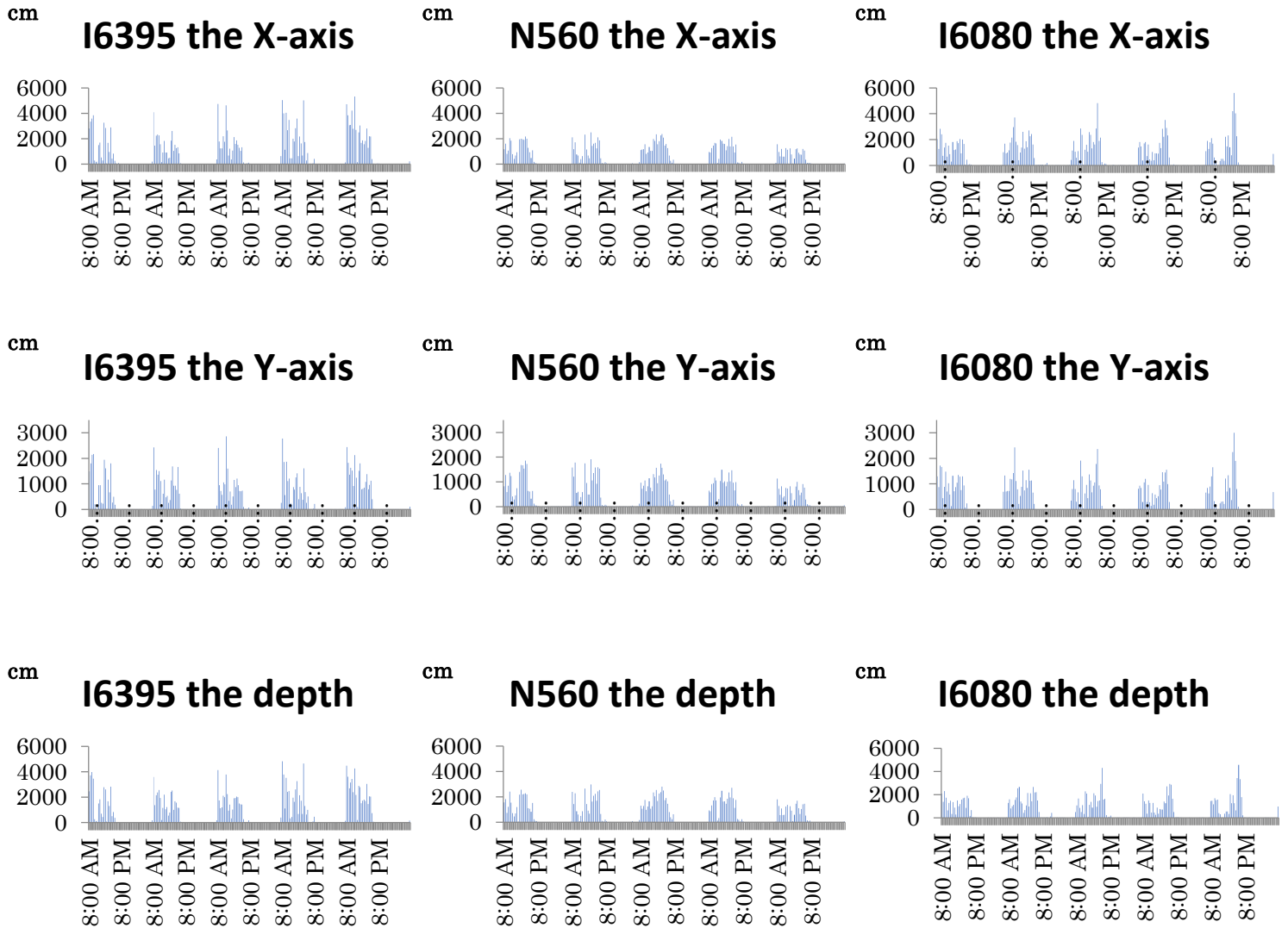


c)

position	expected values			MarmoDetector measurements			error (%)		
	diameter (cm)	movement distance (cm)	mean speed (cm/s)	average diameter (cm)	movement distance (cm)	mean speed (cm/s)	diameter	movement distance	mean speed
upper left	30	4665.3	13.0	30.3	4525.9	12.6	0.8	3.0	3.0
upper right	30	4665.3	13.0	30.5	4622.1	12.8	1.5	0.9	0.9
lower left	30	4665.3	13.0	30.3	4475.7	12.4	1.0	4.1	4.1
lower right	30	4665.3	13.0	30.7	4571.5	12.7	2.2	2.0	2.0
front center	30	4665.3	13.0	30.3	4353.7	12.1	0.8	6.7	6.7
back center	30	4665.3	13.0	29.8	4508.3	12.5	0.7	3.4	3.4
average	30	4665.3	13.0	30.3	4509.5	12.5	1.2	3.3	3.3

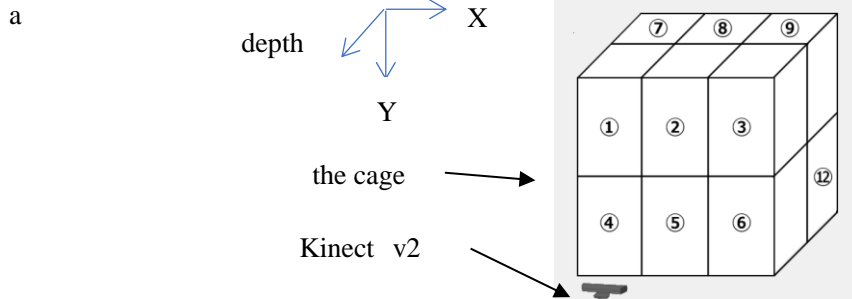
**Supplementary Figure S4.**

**The general patterns of the X-axis, the Y-axis and the depth movement of three male marmosets.**

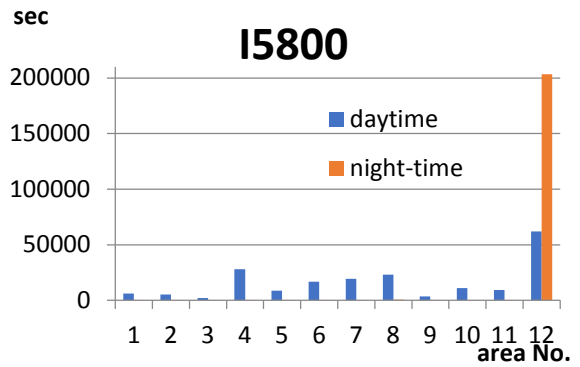
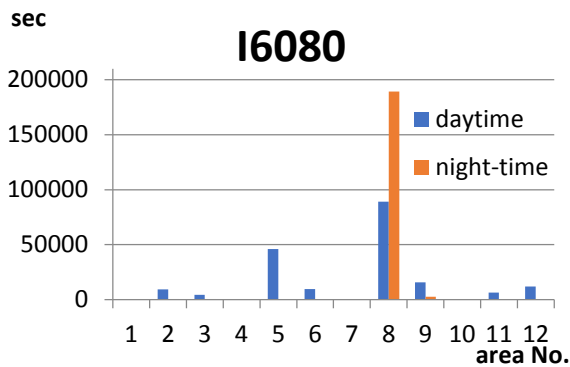
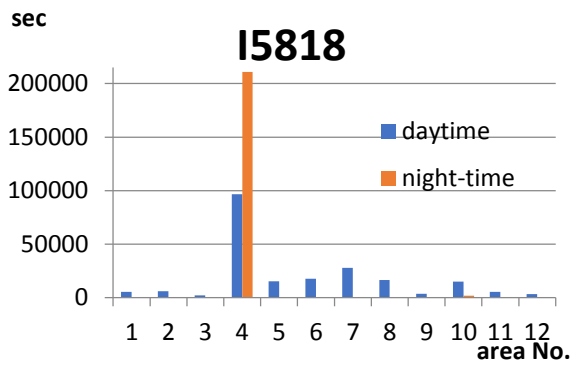
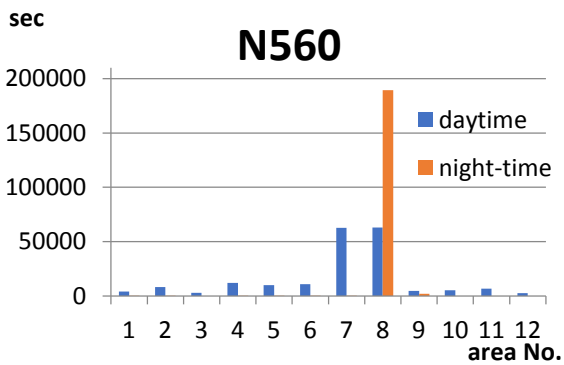
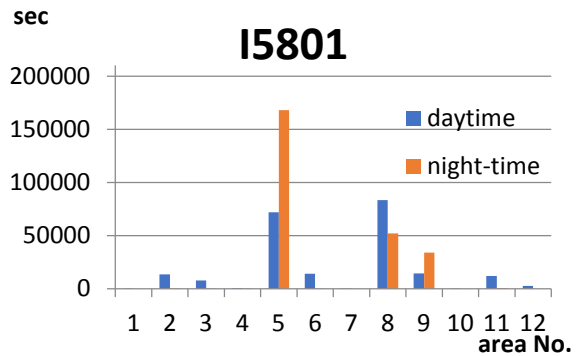
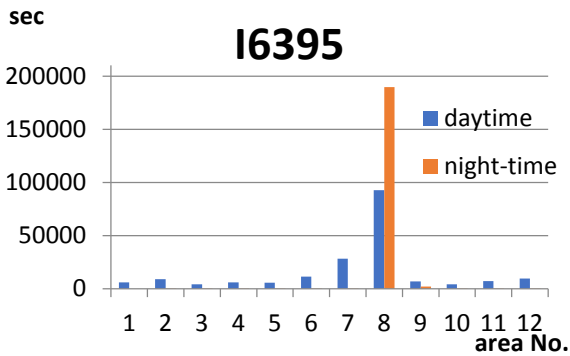


**Supplementary Figure S5.**

**MarmoDetector can detect where marmosets spent time during the daytime and the night-time in the cage.**



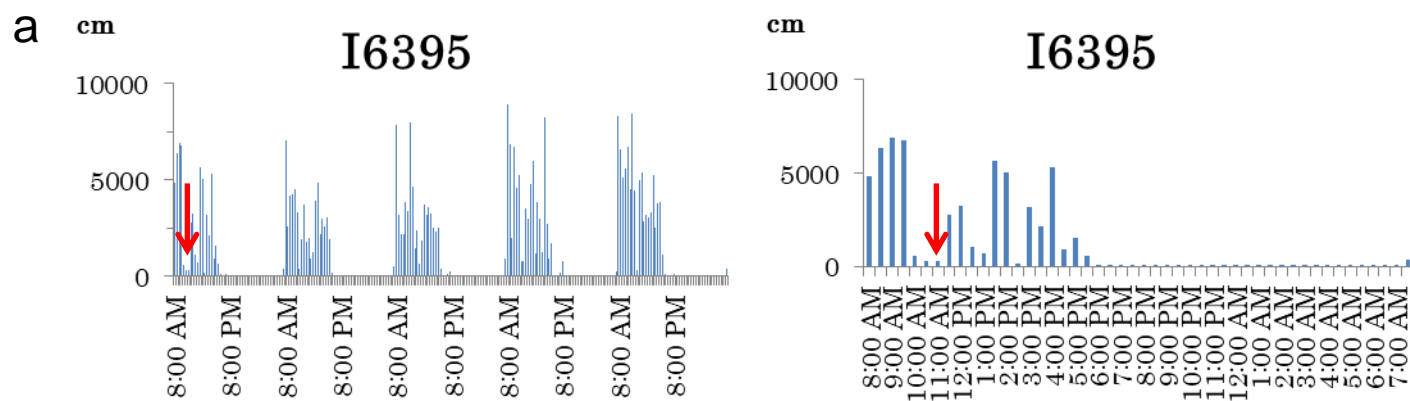
b



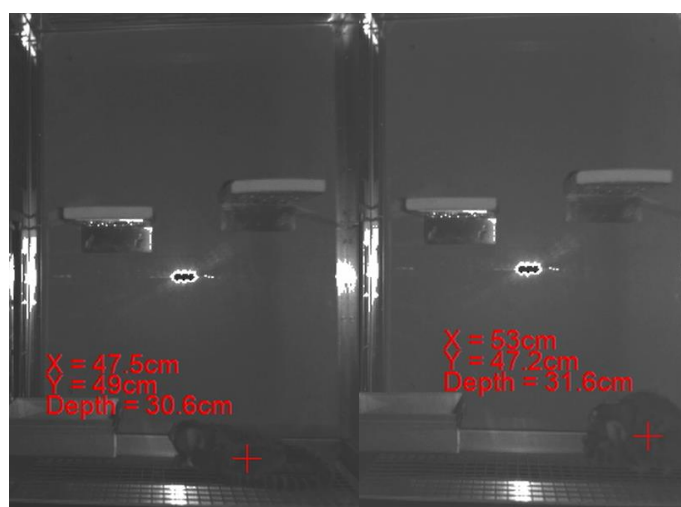


**Supplementary Figure S6.**

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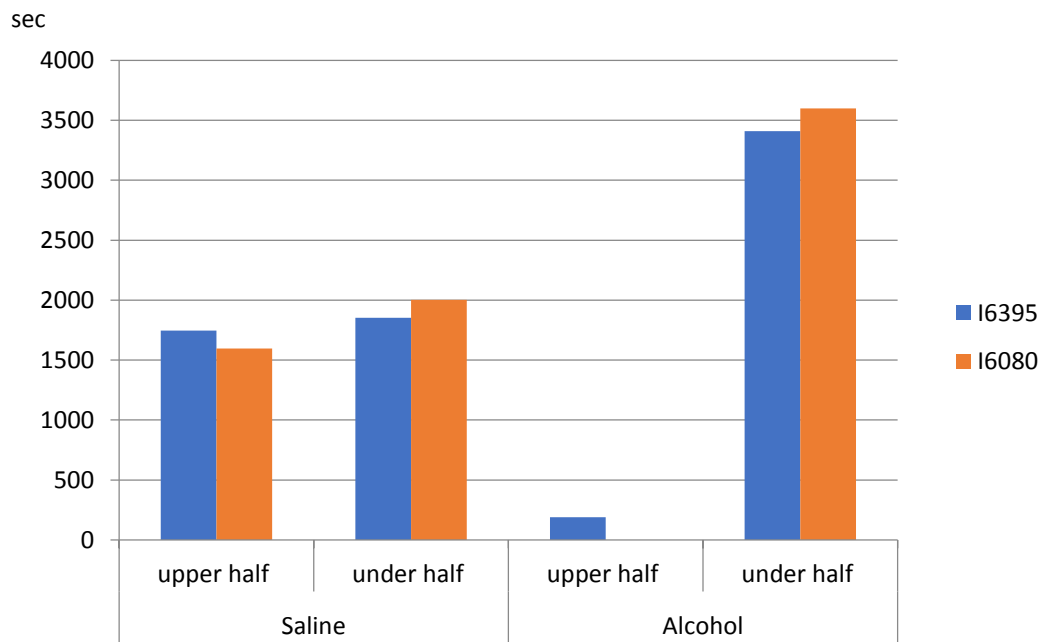


**b**



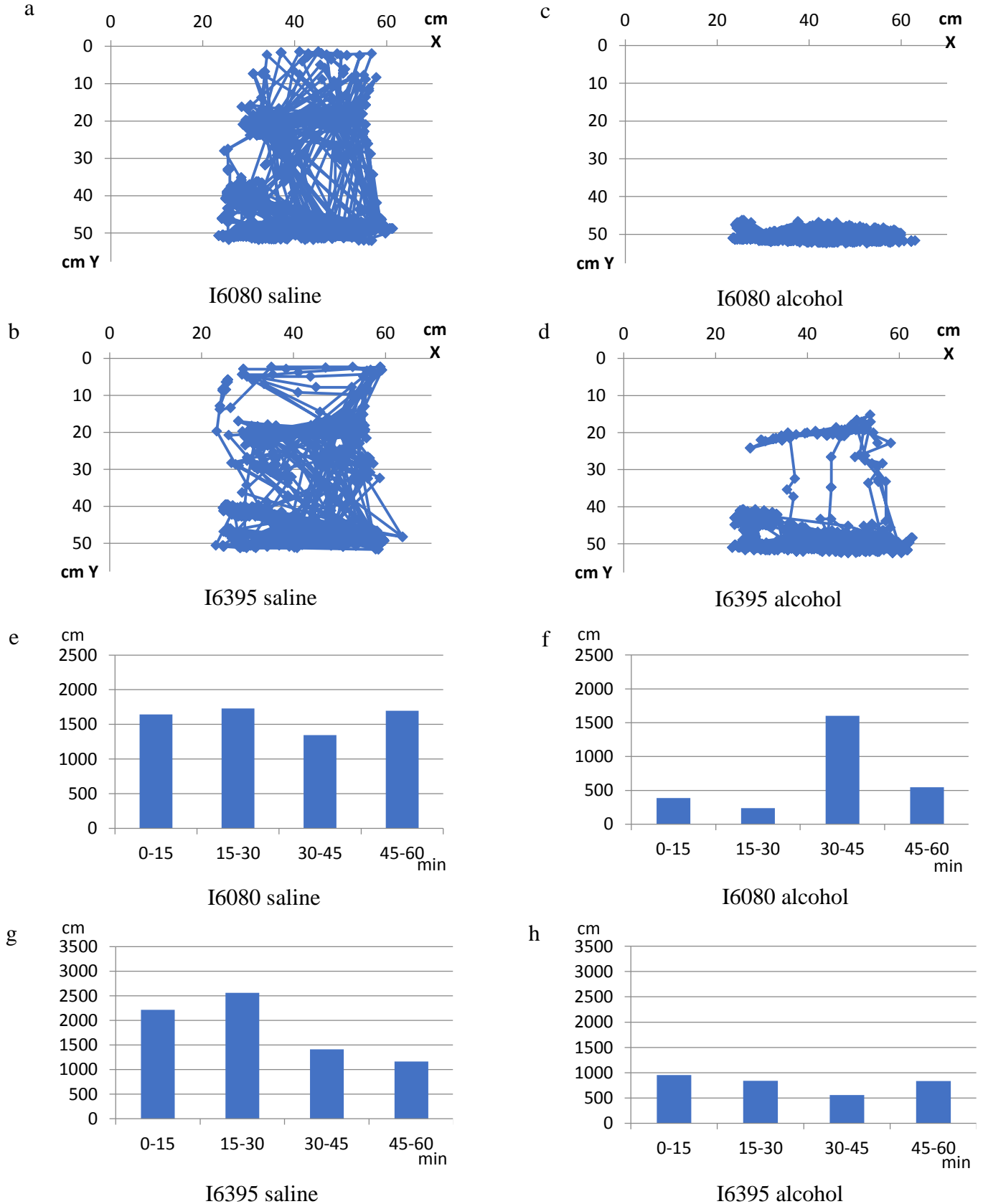
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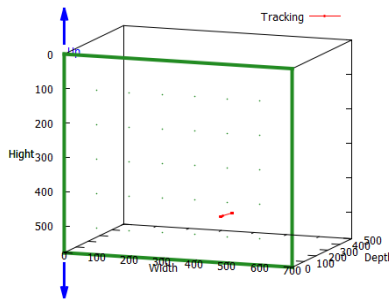
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**One-hour 2D (XY plane) cumulative trajectories of marmosets following intraperitoneal alcohol (a and b) and saline administration (c and d). Quantification of the 2D movement distances following intraperitoneal saline (e and f) and alcohol administration (g and h).**

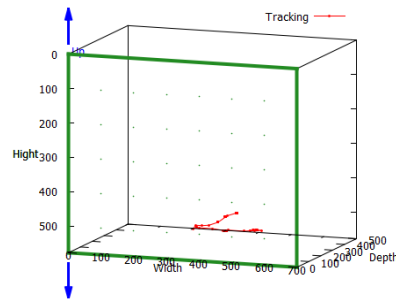


## Supplementary Figure S9

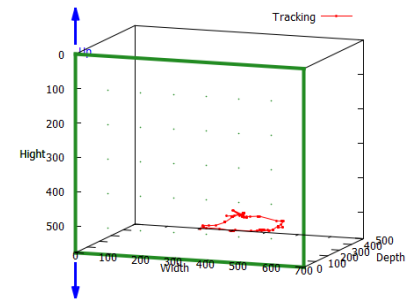
MarmodeDetector detects marmoset complex movements. The First 25 min representative trace of alcohol injected marmosets show drunken and circular movements.



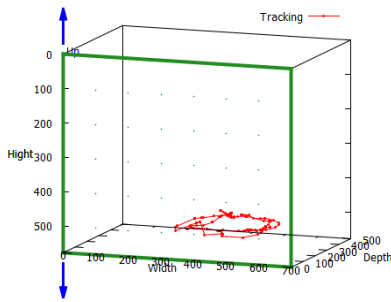
1min



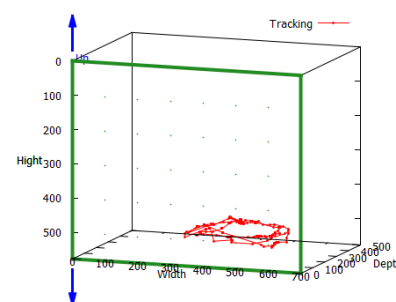
2min



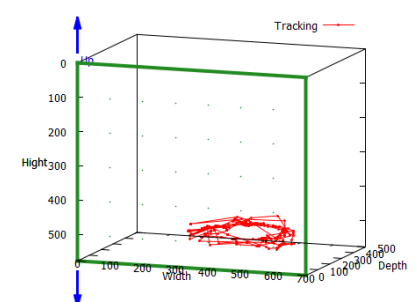
3min



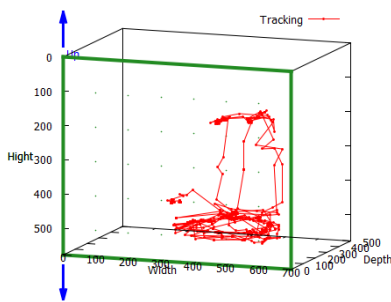
4min



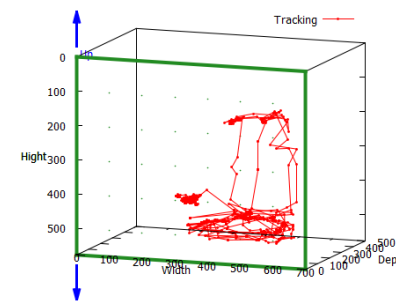
5min



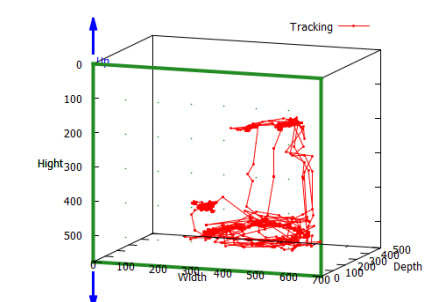
10min



15min



20min



25min