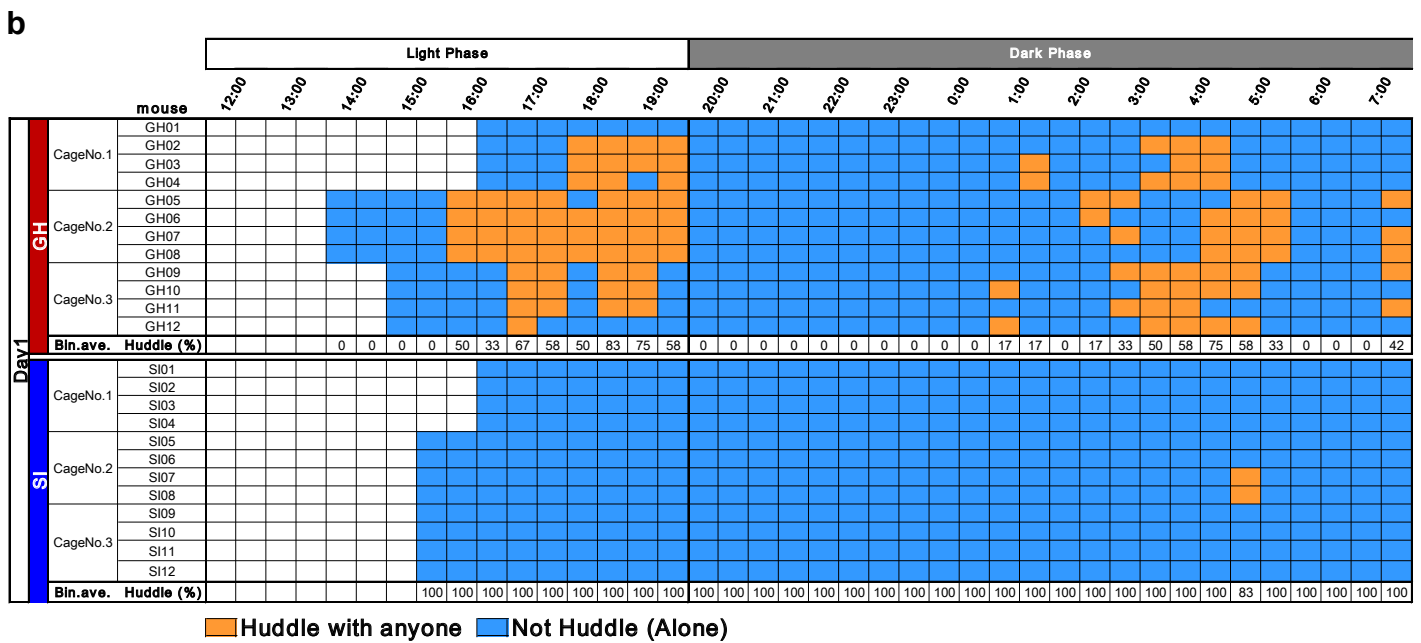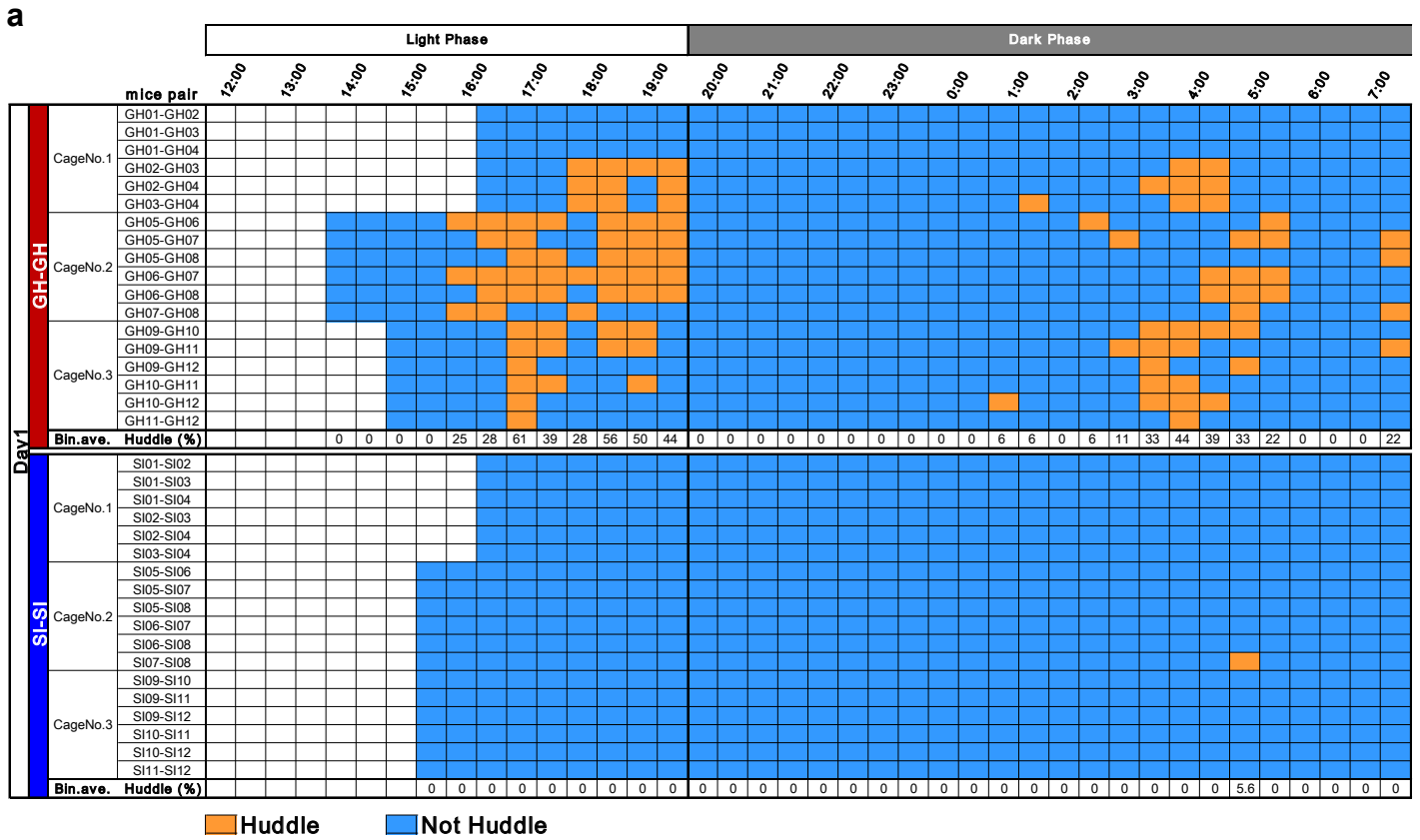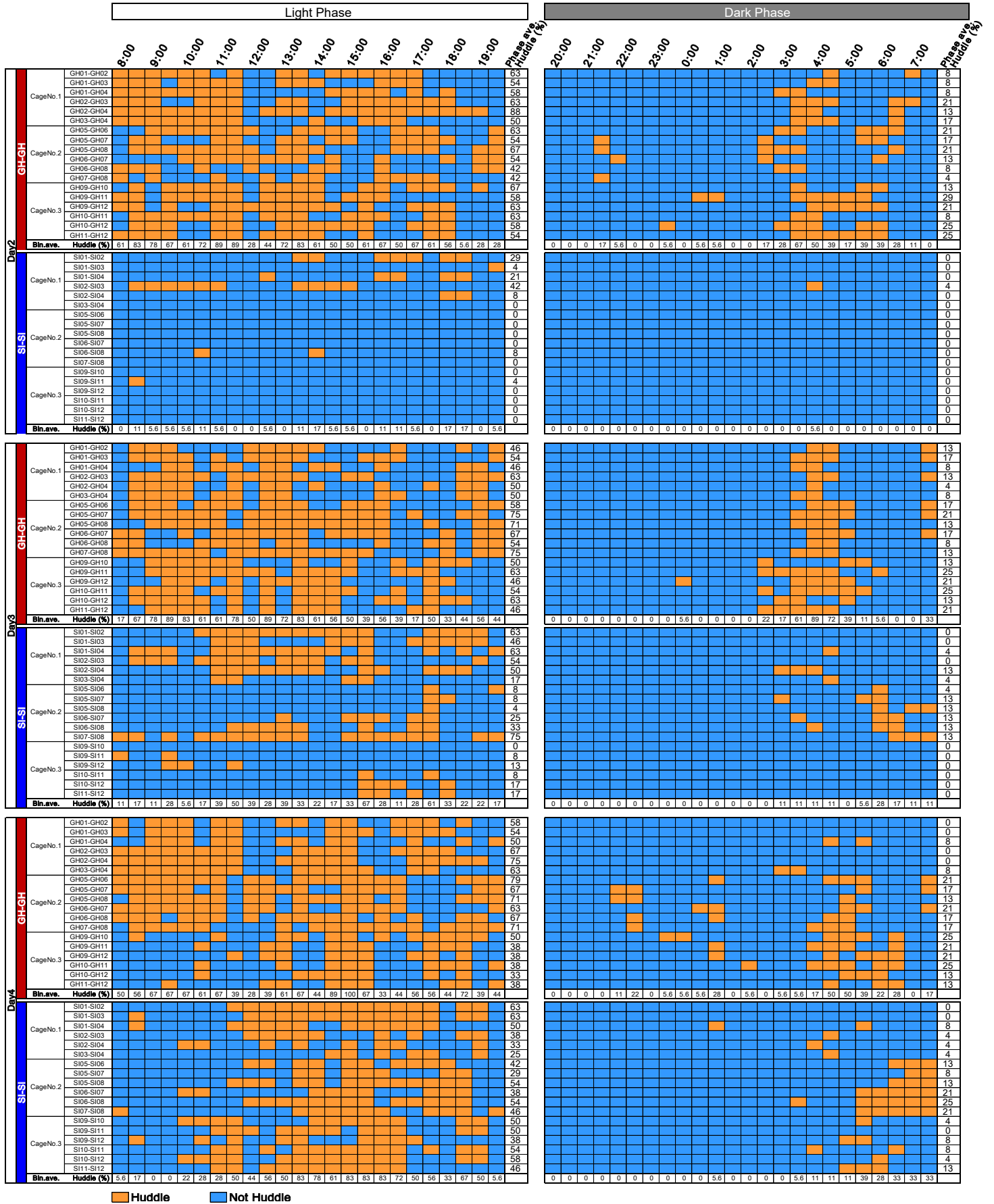**Supplementary Figure 1**

(a) Representative photographs of mouse ID. **(b)** Light and dark boxes taken by visible (left) and infrared light (right). **(c)** Overview and **(d)** photograph of the experimental chamber used in Experiment 2, 3 and 4. **(e, f)** The result of comparing a video analysis data by maps and the experimenter`s manual scoring. The X-Y coordinate of two free-moving mice in a chamber were obtained for 10 minutes, and calculated in locomotor activity **(e)** for ID1(left) and ID2 (right), and inter-individual distance **(f)** as the mean of 1-min bins.
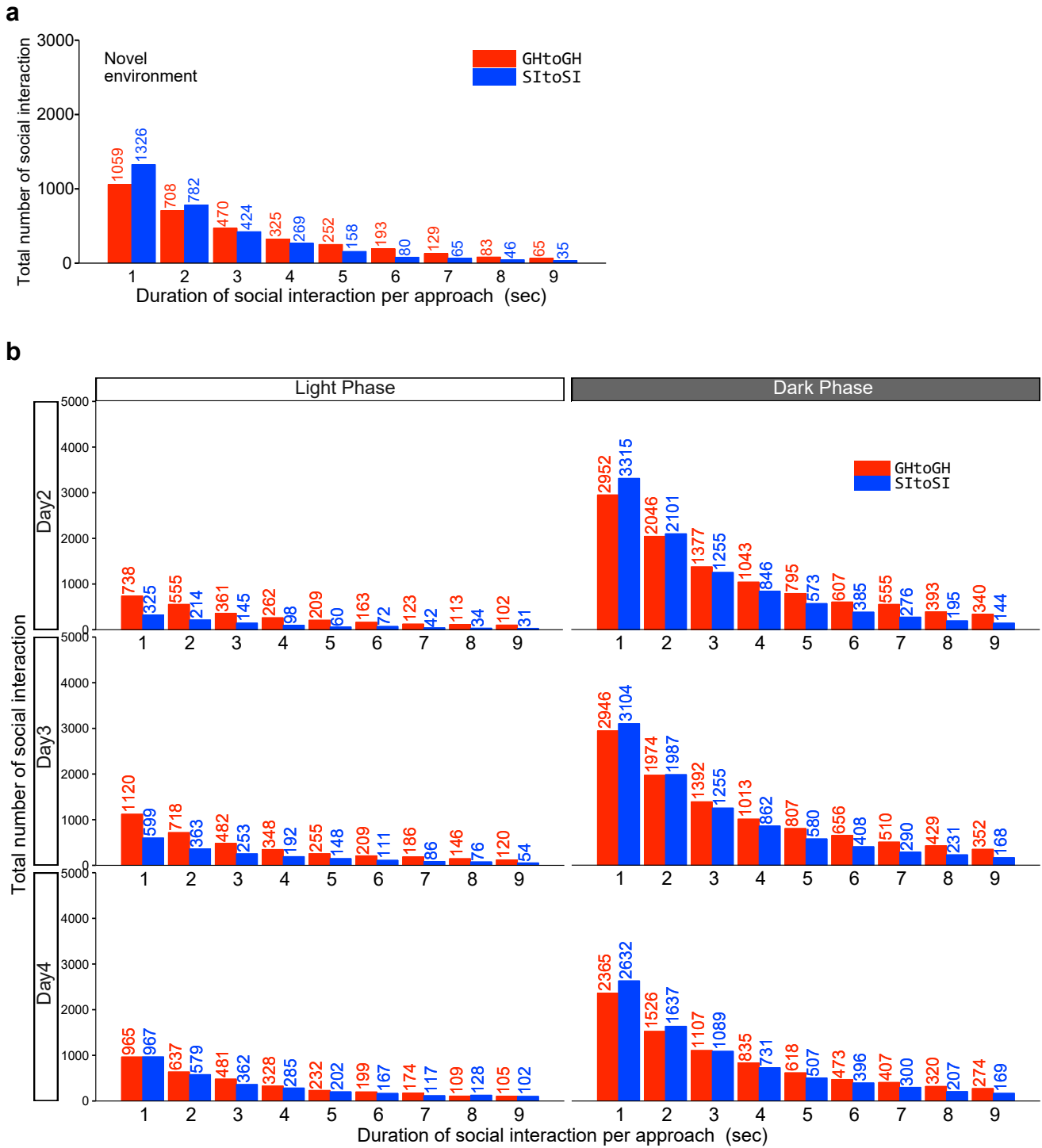
Supplementary Figure 2

Heat maps of "huddling behaviour" status on the Day1 (30 min-bin) in the GH- and SI-only housing condition. **(a)** A heat map showing "huddling behaviour" status of each mice pair. An orange cell; the 30 min-bin that the mice pair exhibited "huddling behaviour", and a blue cell; the 30 min-bin that the mice pair did not exhibited "huddling behaviour". **(b)** A heat map showing huddling with anyone, or alone for each mouse. An orange cell; the 30 min-bin that the mouse exhibited "huddling behaviour" with anyone, and a blue cell; the 30 min-bin that the mouse did not exhibited "huddling behaviour" (= alone).
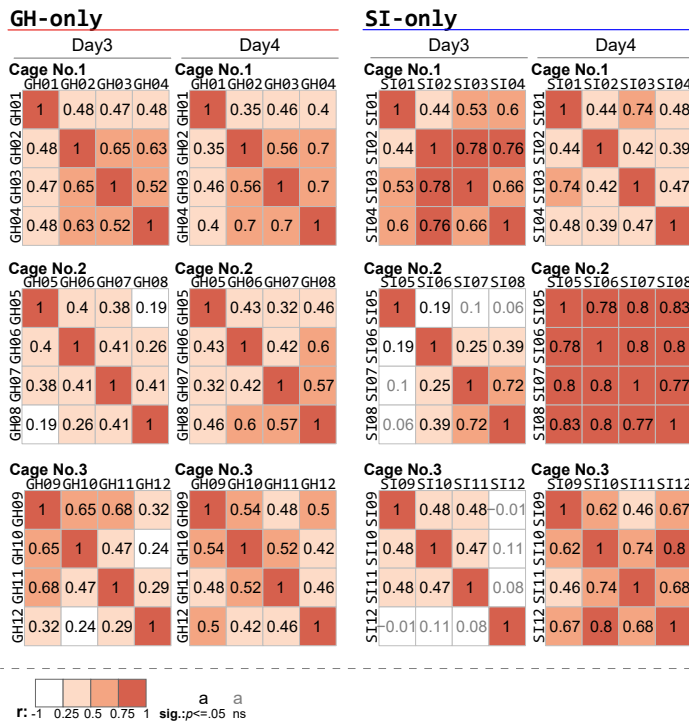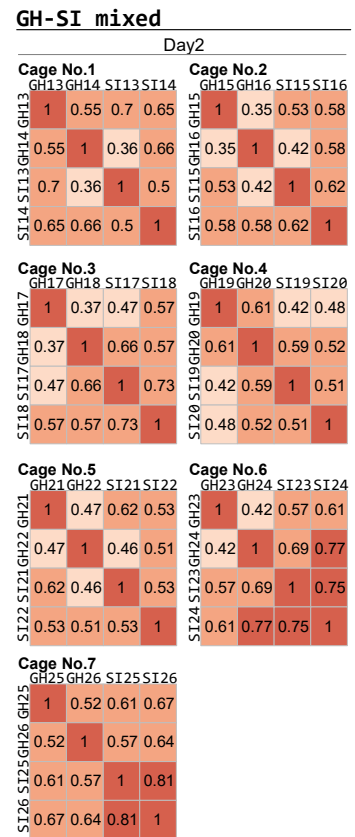
Supplementary Figure 3

A heat map showing "huddling behaviour" status of each mice pair on the Day 2-4 in the GH- and SI-only housing condition. An orange cell; the 30 min-bin that the mice pair exhibited "huddling behaviour", and a blue cell; the 30 min-bin that the mice pair did not exhibited "huddling behaviour".

Supplementary Figure 4

Duration histograms of social interaction (<10 sec) in the **(a)** novel and **(b)** familiar environments in the GH- and SI-only housing condition. Total number of social interaction of each type (n = 36 for each approach direction) for each duration (1 sec-bin) was shown.

Supplementary Figure 5

Heat maps showing representative correlation matrices of the correlations of 5-min periods of activity among mice in the same experimental chamber during the light phase on Days 3 and 4 in the GH-only and SI-only housing conditions **(a)** and on Day 2 between mice in the GH−SI mixed condition**(b)**. The IDs of GH and SI mice are shown as GH 01 to GH 26 and SI 01 to SI 26, respectively. Black colour type indicates p ≤ 0.05, grey colour type indicates ns.

Supplementary Table 1. Percentages of successfully detected frames by MAPS automated analysis.

Group	number of IDs	Light Phase	Dark Phase
SI	8	79. 2 ± 4.2 %	81.4 ± 5.1 %
GH	8	82.3 ± 4.9 %	80.9 ± 3.8 %

*mean ± S.E. (n=8 in each group)

*Data were obtained from Experiment 2 (four mice in a chamber in the GH-only and SI-only housing condition) by MAPS automated analysis and confirmed by experimenters' observation.

*Successfully detected frames were calculated from 60 min. extraction images when mice were relatively active.

Supplementary Table 2. Summary of publications using automated or video-based home cage analysis in group-housed mice.

Reference	Product	Individual identification	Advantages	Disadvantages
Arakawa et al., (2007) Pobbe et al., (2010)	Visible Burrow system. (VBS)	Manual observation of video images		Requires long-term observation and analysis by expert observers.
Galsworthy et al., (2005) Endo et al., (2012) Benner et al., (2014) Ishii et al., (2015) Ujita et al., (2018)	IntelliCage	RFID	Extremely precise and automated identification	Identification restricted in 4 places (entrance of corner chambers).
Bains et al., (2016)	Home Cage Analysis (HCA) system	RFID combined with manual observation of video images	Same as the above. In manual observation, objectivity can be guaranteed by video record.	RFID identification restricted to where the reader allocated. In manual observations, long-term observation and analysis by expert observers are required.
Alexandrov et al., (2015)	PhenoCube system (video analysis combined IntelliCage)	Video analysis combined IntelliCage	Same as IntelliCage in RFID analysis In video analysis, locomotion can be quantified as the total value for all mice in a field.	Same as IntelliCage in RFID analysis Lack of individual data in video analysis Animals must move. Not applicable for heterogeneous housing
Pérez-Escudero et al., (2014)	idTracker	Video analysis (background subtraction) (2 or 4 mice)	High-frame-rate tracking analysis Does not require marking. Excellent achievements, especially in fish studies	Subtraction works only in light conditions. Requires setting up background subtraction parameters.
Endo et al., 2018) (present study)	MAPS	Video analysis (pattern matching of markers)	Identification and tracking of up to 6 mice	Low frame rate Requires marking