



## Data paper

## A dataset to study group-housed sows' individual behaviours and production responses to different short-term events

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## ABSTRACT

The relational database SOWELL was created to better understand the behaviour and individual responses of gestating sows facing different short-term events induced: a competitive situation for feed, hot and cold thermal conditions, a sound event, an enrichment (straw, ropes and bags available) and an impoverishment (no straw, no objects) of the pen. The data were collected on 102 crossbred sows equipped with activity sensors, group-housed in video-recorded pens (16–18 sows per pen), with access to automatons. Feeding and drinking behaviours were extracted from the electronic feeders and drinkers' recordings. Social behaviours, physical activities and locations in the pen were recorded thanks to manual video analysis labelling at the individual scale. Accelerometer fixed on the sows' ears also recorded individual physical activities. The physical activity was also determined at a group scale by automatic video analysis using deep learning techniques. BWs, back fat thickness, and body condition (cleanliness, body damages) were recorded weekly during the whole gestation. Last gestation room data regarding environmental conditions (temperature, humidity, noise level) were recorded using automatic sensors. The database can fulfil different research purposes, namely sows' nutrition for example to better calculate the energy requirements regarding environmental factors, or also on welfare or health during gestation by providing indicators.

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## Specification table

|                       |                                                             |
|-----------------------|-------------------------------------------------------------|
| Subject               | Behaviour and Health Management                             |
| Specific subject area | Sow's behaviours in response to different short-term events |
| Type of data          | MariaBD database structured in 18 tables                    |

## How data were acquired

Sows' feeding and drinking behaviours were collected thanks to two electronic feeders and two electronic water suppliers. Physical activities were extracted from accelerometers (individual scale) and automatic video analysis (group scale). Social behaviours and locations in the room were collected thanks to manual video analysis (individual scale). Environmental conditions (temperature, humidity, noise level) were recorded by sensors. Growth performances and body status were registered thanks to a BW scale and a back fat thickness ultrasound portable device. Body conditions (cleanliness, body damages) were collected weekly.

(continued on next page)

Abbreviations: BW, Body Weight.

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|                                |                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data format                    | The folder contains files under two formats: SQL (structure and data of each table) and CSV files (data of each table).                                                                                                                                                                                                                                  |
| Parameters for data collection | A total of 102 group-housed sows were followed during their gestation. Sows faced induced short-term events during their gestation: competitive feeding situations, cold and hot thermal conditions, unexpected sound events, enrichment or impoverishment of the pen. Each event followed a control week that was without any unusual event.            |
| Description of data collection | All data collected by sensors and automatons during the experiment were cleaned (removal of the outliers) and organised as a relational database.                                                                                                                                                                                                        |
| Data source location           | Pig Physiology and Phenotyping Experimental Facility (UE3P, INRAE, <a href="https://doi.org/10.15454/1.5573932732039927E12">https://doi.org/10.15454/1.5573932732039927E12</a> ), Saint-Gilles (35590), France                                                                                                                                           |
| Data accessibility             | Repository name: Recherche Data Gouv, Data INRAE, Pegase<br>Data identification number: <a href="https://doi.org/10.57745/ER4WOJ">https://doi.org/10.57745/ER4WOJ</a>                                                                                                                                                                                    |
| Related research article       | Durand, M., Abarnou, J., Julienne, A., Orsini, C., Dourmad, J.Y., Gaillard, C., 2022. Effect of short-term events on the activity of gestating sows and their nutritional requirements, <i>Animal – Science Proceedings</i> , 13, pp. 445–447, <a href="https://doi.org/10.1016/j.anscip.2022.07.173">https://doi.org/10.1016/j.anscip.2022.07.173</a> . |

## Value of the data

- This data set presents a huge diversity of data collected on gestating sows at an individual scale: feeding and drinking behaviours, social behaviours, physical activities, reproductive performances, health and welfare status, and environmental conditions.
- High number of individual data, mostly time series, can be used by researchers for machine learning approaches or data mining tasks requiring large datasets.
- Different short-term events can be useful for scientists to better understand sow's behaviour and individual variability of response to these different types of events.
- Finally, access to the database is made public to contribute to future research in gestating sows' behaviour, health, nutrition or welfare fields.

## Data description

The dataset is composed of 18 tables structured as a relational database, using SQL standard (Table 1). These tables are organised into three groups (Fig. 1):

- The tables named *Farm*, *Sow*, *Pen*, *Group*, *Exp\_sow*, *Event* are linked to the sow's and experiment characteristics (in red, Fig. 1)
- The tables named *Water\_measure*, *Feed\_measure*, *Sensor*, *Sound\_measure*, *Air\_temperature\_measure*, *Activity\_measure* con-

tain data collected by automatons or sensors at different time scales (in green, Fig. 1)

- The tables named *Farrowing*, *Health\_sow*, *Performances\_sow*, *Sow\_temperature*, *Activity\_video\_measure*, *Video\_analysis* contain other collected data (in blue, Fig. 1).

More precisely, *Farm*, *Sow*, *Pen*, *Group*, *Exp\_sow*, *Event* and *Sensor* tables gather all information regarding, respectively: farms (country, number of sows per band and number of sow per feeder), sows (birth date and farm), gestation rooms (farm), groups (beginning and end date, gestation room), sows during an experiment (sow, artificial insemination date and boar identification dose, body condition at insemination, parity), events (date and kind), and sensors or automatons used (type, room of gestation).

*Water\_measure* and *Feed\_measure* tables describe all visits to the automatons (sow number, automatons used, date and hour of the beginning of the visit and its duration, and the amount eaten or drank). *Sound\_measure*, *Air\_temperature\_measure* and *Activity\_measure* tables gather the recordings of, respectively, the sound level meter (every seconds), the thermometer at group scale (every 5 minutes) and the accelerometers (every 30 minutes) at individual scale (date and hour of the measure, values measured). *Farrowing* table contains the number of piglets and the litter's weight at birth and weaning. *Health\_sow* and *Performances\_sow* tables gather the weekly recording of health problems, and BW and back fat thickness. The rectal and body temperatures are saved in *Sow\_temperature* table including the sow's posture at measurement. *Activity\_video* table gathers the data provided by automatic video analysis at group level (every 30 minutes).

## Experimental design, materials and methods

### Experimental protocol

The experiment took place at Pig Physiology and Phenotyping Experimental Facility (UE3P, INRAE, Rennes, France, <https://doi.org/10.15454/1.5573932732039927E12>). It included 102 cross-bred sows (Landrace × Large White), divided into five groups (approximately 20 sows), monitored throughout their gestation. The sows were group-housed (a few days after their artificial insemination) in a pen with a concrete floor enriched with straw (replaced daily), and the provision of two “playing” chains. After 30 days, the sows not successfully inseminated (identified by echography) were moved out of the pen and of the experiment. The pen dimensions were 7.5 by 8.2 m, for a space allowance of 3.1 m<sup>2</sup>/sow for an initial group of 20 sows. Each sow was equipped with two radio frequency identification tags: one for the two self-locking electronic feeders (Gestal, JYGA Technologies Inc, Québec, Canada), and the other for the two electronic drinkers (Asserva, France). The feed was a blend of two diets (Low and High nutrient content), mixed and delivered daily by the feeder to each individual sow. A gestating sows' nutritional InraPorc model revised by Gaillard et al. (2019) was used to estimate the daily nutrient requirements of each sow. Based on this information, the quantity of feed to supply and the daily proportions of the two diets to blend were calculated for each sow. With this feeding strategy, the quantity of feed to supply was individualised but fixed for each sow during all their gestation, except for a bump feeding of 500 g/d starting at 86 days. Two ceiling-mounted cameras (RS-CCPOE280IR4-DH, Ro-main Inc., Québec, Canada) provided a continuous day and night recording.

### Data acquisition and pretreatment

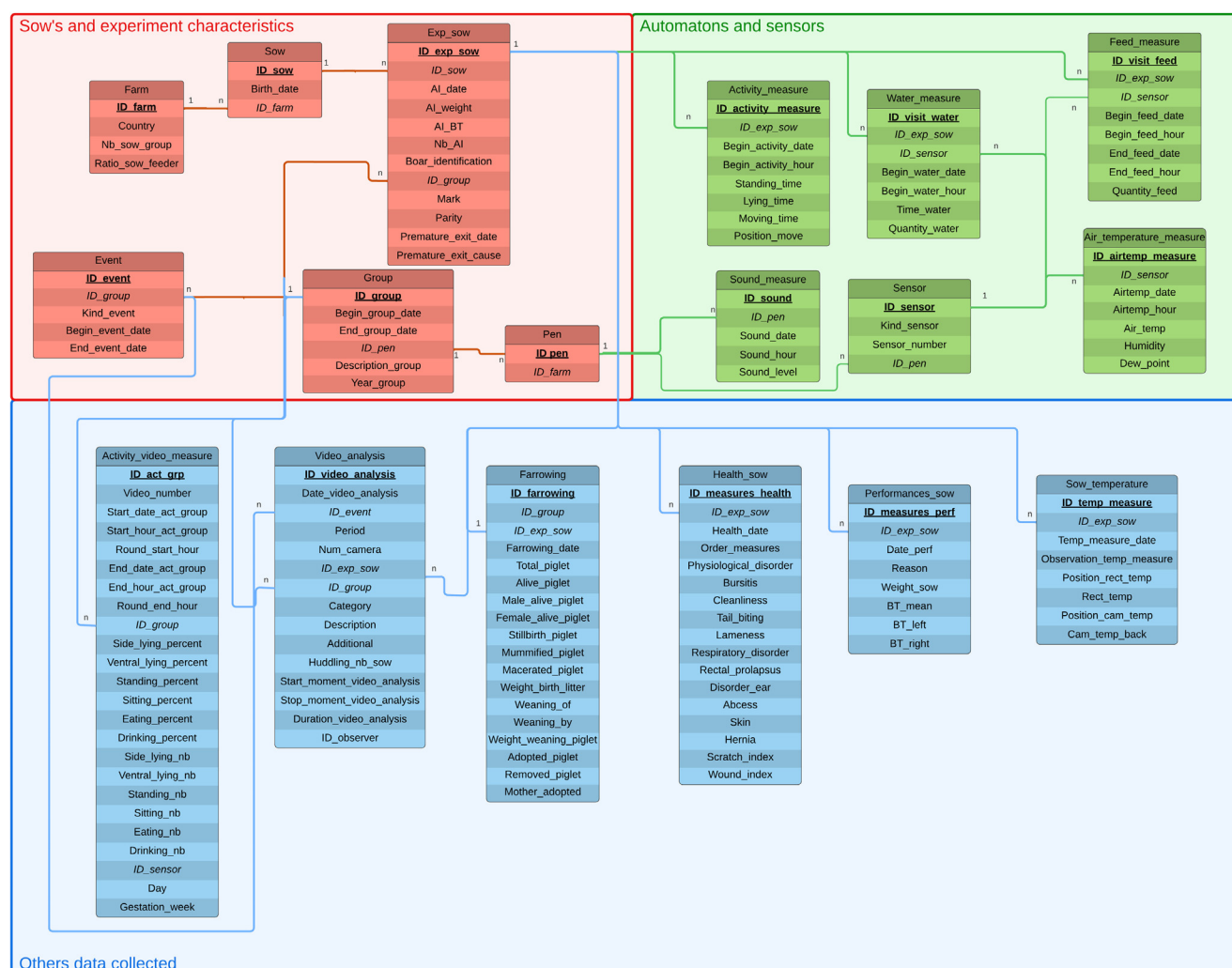
Feeding and drinking behaviours were automatically recorded using automatons (electronic feeders and drinkers). Ambient tem-

**Table 1**

Description of the 18 tables of the relational database: primary and foreign keys, number of columns and rows.

| Table's name                                | Primary Key <sup>1</sup>                                                | Foreign keys <sup>2</sup>      | Col. | Rows      |
|---------------------------------------------|-------------------------------------------------------------------------|--------------------------------|------|-----------|
| <b>Sow's and experiment characteristics</b> |                                                                         |                                |      |           |
| Farm                                        | ID_farm (farm identification code)                                      | none                           | 4    | 3         |
| Sow                                         | ID_sow (sow identification number)                                      | ID_farm                        | 3    | 58        |
| Pen                                         | ID_pen (room identification code)                                       | ID_farm                        | 2    | 2         |
| Group                                       | ID_group (group identification code)                                    | ID_pen                         | 6    | 5         |
| Exp_sow                                     | ID_exp_sow (identification code of the sow in a gestation)              | ID_sow; ID_group               | 12   | 102       |
| Event                                       | ID_event (event identification code)                                    | ID_group                       | 5    | 5         |
| <b>Automatons and sensors</b>               |                                                                         |                                |      |           |
| Water_measure                               | ID_visit_water (drinker visit identification number)                    | ID_exp_sow; ID_sensor          | 7    | 76 911    |
| Feed_measure                                | ID_visit_feed (feeder visit identification number)                      | ID_exp_sow; ID_sensor          | 8    | 43 024    |
| Sensor                                      | ID_sensor (sensor or automaton identification code)                     | ID_pen                         | 4    | 24        |
| Sound_measure                               | ID_sound (sound measure identification code)                            | ID_pen                         | 5    | 2 250 055 |
| Air_temperature_measure                     | ID_airtemp_measure (air measure identification code)                    | ID_sensor                      | 7    | 3 13 978  |
| Activity_measure                            | ID_activity_measure (activity measure identification code)              | ID_exp_sow                     | 8    | 106 408   |
| <b>Others data collected</b>                |                                                                         |                                |      |           |
| Farrowing                                   | ID_farrowing (farrowing identification code)                            | ID_group; ID_exp_sow           | 18   | 85        |
| Health_sow                                  | ID_measures_health (health measure identification number)               | ID_exp_sow                     | 17   | 1 036     |
| Performances_sow                            | ID_performances (performance measure identification number)             | ID_exp_sow                     | 8    | 1 193     |
| Sow_temperature                             | ID_temp_measure (body temperature measure identification number)        | ID_exp_sow                     | 12   | 453       |
| Activity_video_measure                      | ID_act_group (group activity measure identification number)             | ID_group; ID_sensor            | 24   | 29 330    |
| Video_analysis                              | ID_video_analysis (manual video analysis measure identification number) | ID_event; ID_exp_sow; ID_group | 15   | 170 174   |

Col. = Number of columns of the table; Rows = Number of rows of the table.

<sup>1</sup> Primary keys are unique for the table.<sup>2</sup> Foreign keys are used to link data between tables of the database.**Fig. 1.** Schema of the relational database.

perature and humidity were recorded thanks to sensors fixed in the gestation room at 1.8 m high from the ground (Lascar Electronics, United Kingdom, precision  $\pm 0.45\text{ }^{\circ}\text{C}$ ), and the noise level by a sensor near one of the drinkers (Velleman Group, Belgium). Manual video analysis was carried out by trained observers to monitor individual social behaviour, localisation, occupation, and physical activity on defined short periods of 5–36 h. Sows were also equipped with an ear tag accelerometer (RF-Track, Rennes, France) continuously recording their physical activities. Physical activities were also automatically analysed at a group scale from video recordings by a convolutional neural network algorithm (Dilepex, Rennes, France; Durand et al., 2022). Data extracted from automations and sensors were preprocessed to filter the outliers and aggregated daily sensors' files to feed a relational database. Row data from the accelerometers were not included in the database when the cumulated duration per hour was not equal to 60 minutes, and in case of duplicated rows. All the identification codes of automations or sensors were linked to the experiment number of each sow.

Every Monday morning during the gestation, sows were led to a nearby room in order to measure their BW (Schippers, The Netherlands, precision  $\pm 0.5\text{ kg}$ ), and their back fat thickness using an ultrasound portable device (Imago, ECM, France). Body conditions, including skin lesions and potential health problems, were also simultaneously recorded based on the Welfare Quality® Assessment (Dalmau et al., 2009). At the end of the gestation (i.e. one week before parturition), sows were transferred to the farrowing room, after recording their BW and their back fat thickness. During the first 6 hours after farrowing, the BW of the sow and its piglets

were registered, as well as the number of piglets alive or stillbirth. The number of artificial inseminations, the date, and the boar identification dose were also recorded.

Induced short-term events

In addition to the setting up of the hierarchy at the constitution of the group, different perturbations events were induced during the experiment: a competitive feeding situation, cold and hot thermal variations, a sound event, and last, an enrichment and an impoverishment of the pen (Fig. 2). A competitive feeding situation was created by closing one of the two available feeders for five consecutive days and nights. This was performed twice during gestation. The cold thermal condition was induced for three days and nights by increasing the ventilation frequency, opening the windows, and setting the thermostatic control at  $12 \pm 2\text{ }^{\circ}\text{C}$ . Similarly, a hot thermal condition was induced thanks to two heaters, decreased of ventilation frequency and setting the thermostatic control at  $32 \pm 2\text{ }^{\circ}\text{C}$ . The noise event was composed of random emission of 40 short sounds (alarms, animals, metallic and human voices) of 30 seconds, every 10 minutes for four consecutive hours twice a day (during the afternoon resting period, and during the night feeding period). The enrichment consisted of an extra straw supply in the pen in the first repetition and in the second by the provision of jute bags, a brush, and ropes inside the pen. During the impoverishment event, there was no straw or games in the pen. Each “event week” followed a “control week” (without any unusual perturbation event induced).

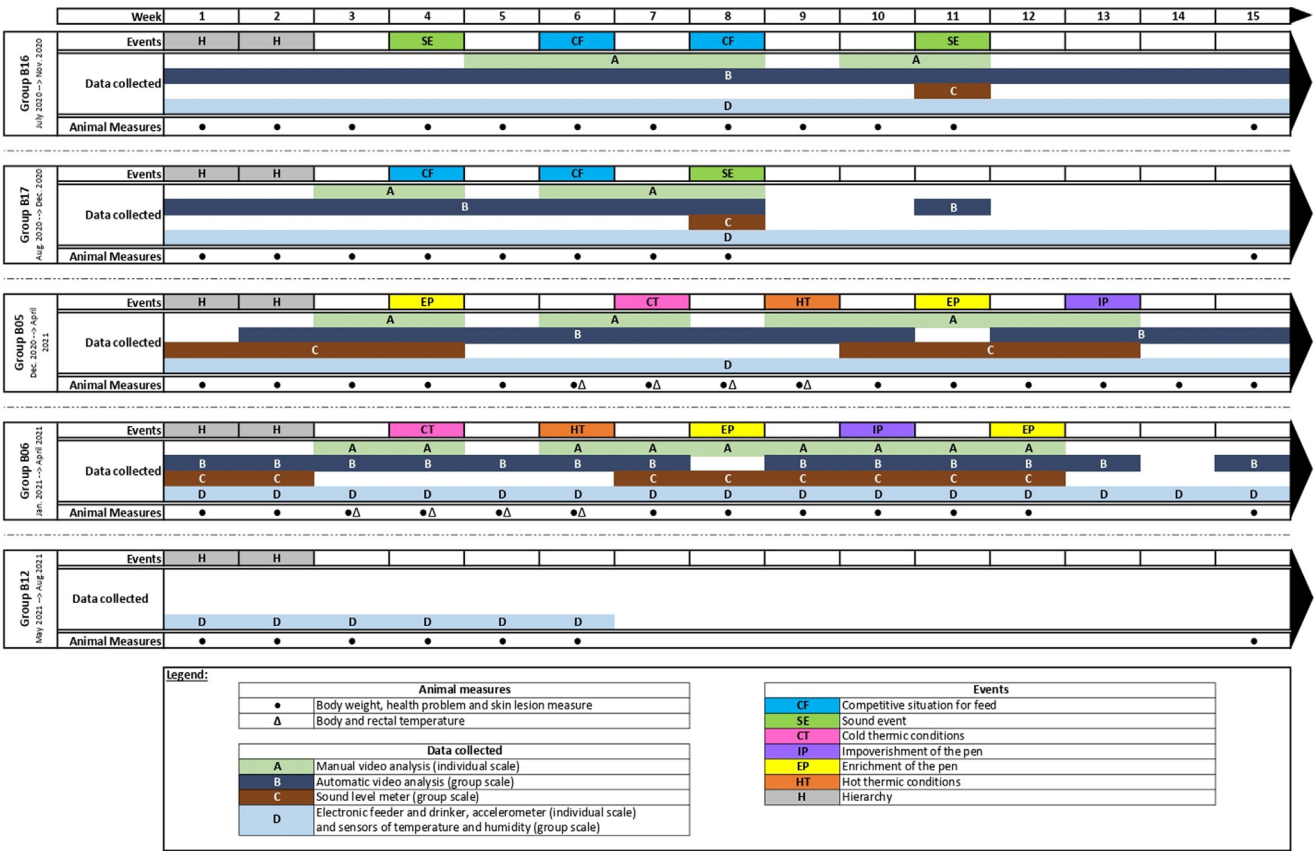


Fig. 2. Summary of the experimental design and data collection on gestating sows. Weeks correspond to group-housed.

## Ethics approval

Ethical approval concerning the French legislation on experimental animal care was approved by the Ethics Committee in Animal Experimentation in Rennes, France (authorisation on living animals No. 25883-2020070711528084).

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## Author contributions

**MD, CG, JYD** and **CL** were involved in the conception of the project. **MD, CG** and **JYD** managed data collection in the farm and equipment follow-up. **MD, CL** and **LB** developed the database structure and the data pretreatment process. All the authors drafted, read and approved the final manuscript.

## Declaration of interest

None.

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