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Trade-offs between feeding and social companionship in cattle: Intra-animal consistency over short and extended periods

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ABSTRACT

The conflict between sociability and foraging motivation in animals is considered to be of potential value for use in the management of grassland systems to improve grazing pattern of livestock over grasslands. However, individual differences in behaviors relating to this conflict have not been fully explored. Three experiments with two test repeats 1–3 days apart were conducted using 8–16 Japanese Black cows at intervals of approximately 3 weeks between Experiments 1 and 2 and 1 year between Experiments 2 and 3. Individual cows were tested in a grassed arena (85 m × 30 m in Experiments 1 and 2, 130 m × 18 m in Experiment 3) with an adjoining group pen holding the peers. Plastic washtubs (16 in Experiments 1 and 2, 25 in Experiment 3) containing 150 g grain-based concentrate were placed at 5 m increments on the centerline of the arena to entice test cows away from the group. Behavior of test cows were recorded for 30 min as: maximum (D_{max}) and mean (D_{mean}) distance from the group, number of total (N_{total}) and different (N_{diff}) tub visits, and proportion of time eating concentrate ($P_{eatconc}$) and grazing sward (P_{graze}). Cows showed consistency in D_{max}, D_{mean}, N_{total} and N_{diff} over the short periods of 1–3 days (repeatability within experiments = 0.41–0.80) and approximately 3 weeks (Pearson r between Experiments 1 and 2 = 0.81–0.91, $P < 0.05$). Cows were further consistent in D_{max}, N_{total} and N_{diff} over the extended period of 1 year (Pearson r between Experiments 2 and 3 and between Experiments 1 and 3 = 0.68–0.93, $P < 0.05$). By contrast, $P_{eatconc}$ and P_{graze} showed poorer consistency within cows, giving low repeatability estimates (0.29–0.34) in Experiment 2 and low Pearson r between Experiments 2 and 3 (0.30–0.31, $P > 0.05$). It was concluded that D_{max}, N_{total} and N_{diff} provide a reliable measure of the propensity for individual cows to trade sociability for feeding when the test is repeated over both short and extended periods. A test arena longer than 130 m would be necessary for fully discriminating individual behavioral traits of cattle.

1. Introduction

Individual animals show different behavioral tendencies which remain relatively stable across various kinds of situations and over time (Searle et al., 2010). Individual differences can be seen in various behaviors, such as aggressiveness, activity, exploration, risk taking, fearfulness and emotional reactivity. A number of studies have examined individual behavioral differences in domesticated animals in relation to the handler's safety and the animal's welfare and productivity (Breuer et al., 2000; Gibbons et al., 2009, 2010, 2011; Grignard et al., 2001; Kilgour et al., 2006; Müller and von Keyserlingk, 2006).

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In recent years, there has been increasing research interest in utilizing individual behavioral differences of grazing animals for management of grassland systems (Searle et al., 2010). Spatially uneven distribution of livestock (i.e. patterns of use and non-use) in extensive pastures has long been a major issue for land and livestock managers because of the deleterious effects on vegetation, riparian function and/or wildlife (Ganskopp and Bohnert, 2009; Vallentine, 1990). Bailey et al. (2004, 2006) suggested the potential for individual difference in terrain use of cattle (hill climber and bottom dweller) to improve uniformity of grazing on foothill rangelands. Expansion of grazing patterns in portions of the landscape that are under-utilized or avoided might be facilitated by forming a herd with individuals that are leaders in group movement (Dumont et al., 2005; Greenwood and Rittenhouse, 1997; Ramseyer et al., 2009) or willingly move away from groups to forage (Michelena et al., 2009; Sibbald et al., 2006), because these individuals are more likely to explore new environments (Searle et al., 2010).

The willingness of individual animals to move away from their conspecifics for feeding has been quantified using a trade-off test developed by Sibbald et al. (2006). In this test, an animal is faced with a food reward in bowls placed at incremental distances away from a group of familiar peers, and its propensity to move away from the group (or to stay in close proximity to the group) is quantified by behavioral measures such as maximum and average distance from the group and number of bowl visits. However, the nature of these behavioral measures has not been fully explored. Although Sibbald et al. (2006) found that the average distance from group and the number of bowl visits were consistent within individuals over a 2 or 4-week period, intra-animal consistency over an extended period (e.g. 1 year) is unknown. Furthermore, little is known about how the behavioral measurements obtained in the trade-off test are associated with each other. With respect to animal species, limited information is available on cattle (Patison et al., 2010) as most previous studies have been with sheep (Dumont and Boissy, 2000; Michelena et al., 2009; Sibbald and Hooper, 2004; Sibbald et al., 2006).

In the study reported here, we investigated the willingness of individual cows to move away from a social group for feeding using a trade-off test similar to that described by Sibbald et al. (2006). Three experiments with two test repeats each were conducted at intervals of approximately 3 weeks between Experiments 1 and 2, and 1 year between Experiments 2 and 3. The primary aim of the study was to assess intra-animal consistency in behavioral measures of a sociability–food trade-off in cows over short and extended periods. We also evaluated effects of repeated tests and experiments on the measurements and correlations between the measurements.

2. Materials and methods

The study comprised three experiments and was conducted on 3 and 6 November 2010 (Experiment 1), 27–30 November 2010 (Experiment 2) and 22–23 November 2011 (Experiment 3) at the Sumiyoshi Livestock Science Station (31°59′ N, 131°28′ E), Faculty of Agriculture, University of Miyazaki, southern Kyushu, Japan. The procedures used in the experiments were approved by the Animal Care and Use Committee of the university (#2009–006–2 and 3; Feeding strategy of grazing animals in a spatially heterogeneous environment).

2.1. Animals

Eight, 16 and 12 Japanese Black (*Bos taurus*) cows from the same herd (approximately 30 animals) were used for Experiments 1, 2 and 3, respectively. The 16 cows used in Experiment 2 included the eight individuals tested in Experiment 1. The 12 cows tested in Experiment 3 were the individuals that were available (depending on calving dates, illness and culling) out of the 16 used in Experiment 2, and included seven cows out of the eight tested in Experiment 1. The mean body weight (±SE) of the cows in Experiments 1, 2 and 3 was 462 ± 22 kg, 444 ± 11 kg and 464 ± 18 kg, respectively. When not being tested or trained, the cows were maintained with their herd companions. During the grazing season (early May to early November), they were stocked on pastures dominated by bahiagrass (*Paspalum notatum*) or centipedegrass (*Eremochloa ophiuroides*) during the daytime (09:00–16:00 h Japan standard time (JST)) and kept in a free barn at night (16:00–09:00 h JST). During the remainder of the year, the cows were housed in the barn with provision of hay of Italian ryegrass (*Lolium multiflorum*), rhodesgrass (*Chloris gayana*) or guineagrass (*Panicum maximum*) depending on the seasonal availability.

2.2. Experimental plots

Two experimental plots were established: one on a centipedegrass pasture for Experiments 1 and 2, and the other on a sudangrass (*Sorghum sudanense*) pasture for Experiment 3. The pastures were uniformly cut prior to Experiments 1 and 3. The mean sward height (±SE) of the pastures at the beginning of Experiments 1, 2 and 3 were 71 ± 2 mm, 67 ± 2 mm and 80 ± 3 mm, respectively. Each plot consisted of a test arena and an adjoining group pen. In Experiments 1 and 2, the test arena and the group pen measured 85 m × 30 m and 8 m × 26 m, respectively, and 16 plastic washtubs (0.4 m diameter and 0.13 m height) were fixed to the ground with four iron stakes at 5 m intervals down the middle of the test arena (Fig. 1). In Experiment 3, the test arena had an extended length and a narrower width of 130 m × 18 m (25 tubs at 5 m intervals on the centerline), adjoined by the group pen of 10 m × 18 m. The tubs were brightly colored and highly visible.

2.3. Training

For 3 days prior to Experiment 1, three training sessions (one session per day) were conducted to familiarize the eight test cows with the experimental plot and allow them to establish an association between the tubs and a preferred food. For each training session, the cows were first held in the group pen to view the process in which 40 tubs were laid out across the test arena (16 on the centerline and an extra scattered randomly) and filled with