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Hierarchical Structure and Feeding Behaviors of Free-Range Hens (*Gallus gallus domesticus*)

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Chickens (*Gallus gallus domesticus*) are a social species and will form a hierarchy through agonistic dyadic encounters. This hierarchy will affect how different members of the flock access food, which may affect the specific feeding behaviors of the hens. The hierarchy of a 20-hen flock was determined by analyzing videoed dyadic encounters between the hens and creating a dominance matrix. The feeding behaviors were assessed by simultaneously offering free food via a feeder and food distributed in the grass requiring foraging. Overall, all hens preferred to forage, however, significantly more dominant birds ate at the feeder than neutral or subordinate birds. Foraging is a natural behavior that chickens will innately perform and is related to a positive welfare state. The methodology for determining the flock hierarchy and measuring feeding choices could be tested within the intensive farming environment to elucidate potential effects of dominance on feeding methods in commercial hens.

Keywords: chicken, contra-freeloading, pecking order, welfare

Chickens (*Gallus gallus domesticus*) are the most common animal in the agricultural industry (Peters et al., 2016), and are the producers of an egg industry worth approximately $110 billion USD (Statista, 2021). The welfare of these hens is becoming more important to consumers, indicated by the increased demand for free-range products (Rodgers, 2015). Due to this increased demand, some farmers are transitioning to the free-range system and prioritizing the welfare of their hens. One way of ensuring positive welfare is for all hens to have opportunities to obtain food (Savenije et al., 2010). In most farming systems chickens are typically fed "free" food in a feeder, where no effort is required to obtain nutrition (Inglis et al., 1997; RSPCA, 2016). This method aims to provide food to all individuals; however, the social structure within the flock may affect the amount of food each hen consumes (Li et al., 2021).

Positive welfare is promoted by the ability to express a range of innate behaviors, thus developing a rich behavioral repertoire (Campbell et al., 2020; Freire et al., 2003). When outdoors, chickens scratch at the ground, performing a natural foraging behavior (Costa et al., 2012). Goats (Rosenberger et al., 2020), pigeons (Lentz & Cohen, 2013), and chickens (Ferreira et al., 2021) are examples of species where individuals prefer to forage rather than receive "free" food. This preference for food obtained by 'effort,' rather than no effort, is a phenomenon called contra-freeloading. Contra-freeloading is commonly seen in environments where food provisioning is stable and available from multiple sites (e.g., a feeder, and from scatter feeding) where a hen chooses to perform effortful behavior to obtain food. The behavior is halted when she is housed in a farming system that does not provide forageable food (Lindqvist et al., 2006). Substantive research has been conducted in chickens investigating the preference and demand for foods (e.g., Foster et al., 2009), substrate (e.g., de Jong et al., 2007), environmental conditions (Kristensen et al., 2000), and sound (Jones et al., 2012) to extrapolate behavioral needs and ideal housing conditions (e.g., Cooper & Albertosa, 2003; Dawkins, 1983) to enhance the welfare of the animal.

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In social species, dominance hierarchies are a social structure that allows for amicable coexistence within the community (Barroso et al., 2000). Hierarchies are stable when all individuals in the community recognize their conspecifics and their relative position to those conspecifics (Pagel & Dawkins, 1997). The hierarchical rank of an individual will affect a hen's access to fundamental resources such as perching spots, nesting boxes, and food (Croney et al., 2007), which may, in turn, affect her behavior. A commonly reported hierarchical structure is linear, where there is a clear ranking of individuals from most dominant to most subordinate. For example, crayfish (Issa et al., 1999), mice (Williamson et al., 2016), and chickens (Litten & Cockrem, 2001) establish a linear hierarchy. However, more complex hierarchical structures have been observed in tree lizards (Deslippe et al., 1990) and bonobos (Paoli et al., 2006).

Hierarchies typically develop through agonistic encounters between pairs (dyads) of individuals that result in a dominant and subordinate individual (Herberholz et al., 2001; Williamson et al., 2016). Encounters between dyads do not need to involve physical aggression, they may consist of the threat of violence and a retreat by the aggressed (Sapolsky, 2005). Chickens will convey a threat by walking after a flockmate with a high-held head, sometimes accompanied by a flap of the wings (Eklund & Jensen, 2011). These encounters occur when unacquainted individuals meet (Pagel & Dawkins, 1997), or when an individual initiates a move up in the hierarchy (Gust, 1995). This action is seen in chickens when individuals in a flock first encounter one another (Pagel & Dawkins, 1997).

Once established, the hierarchy within a flock of chickens (pecking order) is highly stable, with relatively few aggressive encounters between flockmates (Cordiner & Savory, 2001; Estevez et al., 1997). The dominant behaviors typically seen in the establishment of hierarchy in hens include pecking, chasing, and leaping (Eklund & Jensen, 2011). These dominant behaviors are paired with subordinate behaviors by the aggressed hen, which include retreating, squatting, and remaining stationary (Riber et al., 2021). The agonistic encounters between hens can range from relatively harmless to potentially life-threatening. This is best exemplified by the range of pecks one hen can give another. Nicol et al. (1999) details the pecks as: (a) mild feather peck, a peck is directed at plumage without pulling a feather; (b) severe feather peck, a peck is directed at plumage and a feather is pulled out; or (c) aggressive peck, a peck that is directed at the head and is accompanied by a threat posture. Cloutier et al. (2002) explains that violent pecks can open wounds in a hen, which attracts future pecks from other curious flockmates. This process leads to a gang of flockmates partaking in cannibalism, which oftentimes results in a fatality (Tablante et al., 2000).

Other factors affecting hierarchal rank include the size and weight of an individual (Martin et al., 1997). Strength is correlated with an animal's size, and the outcome of an agonistic encounter may be based on the strength of the individuals in the encounter. A positive correlation between body size and dominance has been found in many species such as in male red jungle fowl (Ligon et al., 1990), common waxbill (Funghi et al., 2015), and copperhead snakes (Schuett, 1997). This correlation has been found in roosters (Graves et al., 1985), but the link between size and dominance rank in hens is less clear (Martin et al., 1997).

A hierarchy allows for resources to be divided between individuals without requiring conflict (Issa et al., 1999). Although a stable hierarchy will benefit all individuals by reducing socially induced stress (Sapolsky, 2005), the resource allocation that occurs due to a hierarchy favors the dominant individuals (Ang & Manica, 2010). Dominant individuals will have preferential access to mates (Cornwallis & Birkhead, 2006), living locations (Issa et al., 1999), and food (Barroso et al., 2000). This preferential access provides dominant individuals with better living conditions than subordinate individuals; likely granting a more positive welfare state.

The dominance hierarchy can influence the feeding behaviors of individuals (Nicol, 2004). Lanna et al. (2017) found that dominant hummingbirds would visit higher quality food patches more frequently than subordinate birds. Similarly, Boisvert and Sherry (2000) found that dominant black-capped chickadees stored their food regularly throughout the day whereas subordinate chickadees stored their food in the evening. Whether hierarchy affects feeding behaviors in free-range chickens is unknown; however, it is reported that the food available affects hen behavior in that aggression from a dominant hen towards a subordinate flockmate increases as food is depleted (Olsson & Keeling, 2002). Following this, it is likely that feeding behaviors may also change based on hierarchy and be related to how food is presented, such as whether it is forageable or available in a feeder.

To determine a flock's hierarchy, the encounters between hens can be logged into a dominance matrix table (Chase, 1980). The table collates the interactions and displays which individuals are dominating others and those that are being dominated. The absolute number of hens dominated by each individual can be calculated where the highest ranked hens dominate the most flockmates, while the lowest ranked hens dominate the fewest flockmates. It should be noted that in Chase (1980) the same flock was observed in a caged environment, thus the number of hens was always the same. A method similar to this is outlined by Leonard and Weatherhead (1996). They observed agonistic encounters between chickens and considered an individual dominant if it displayed a higher number of aggressive behaviors than the chicken they encountered. The chickens were ranked according to how many individuals they dominated, with no accounting for the number of hens that dominated them.

This study has two aims: firstly, to determine the hierarchy of free-range hens in a flock, and secondly, to measure the effect of flock hierarchy on the feeding behaviors. It was hypothesized that the hens would display different feeding behaviors relative to their position in the hierarchy. Chicken owners can use this study to determine the hierarchical structure of their flocks, as well as elucidate the most suitable method of feeding their hens.

Method

Subjects and Apparatus

An established flock of twenty domestic hens (*Gallus gallus domesticus*) between the ages of 5–8 years (estimated based on time in the flock) was observed in this study on private land (2.4 hectares) in Auckland, New Zealand. The hens ranged in breed (Australorp-cross, Buff Sussex-cross, Light-Sussex cross, Mixed breed, and Orpington-cross) and visual assessment of size (small, medium, and large). The hens were not well handled and could not be weighed. The hens had access to a coop and all land 24 hr a day. The hens were scatter-fed an equal parts of Chook Chow® chicken feed (a blend of maize, wheat, soya, barley, shell grit, limestone, and molasses) and Peck 'n' Lay® layer pellets (a mix of Grain and grain by-products, plant proteins, vegetable oils, and animal fats) twice per day on the grass; around 8 a.m. and 4 p.m. in an area 5 m from their coop with a size of 3 m^2. The hens also had a commercial 5 kg tank-stand feeder that was topped up in the morning with the same food mix.

The observations were conducted 10 m from the hen house where the chickens were typically fed. A Sony® HDR-CX190E Digital Video Recorder was used to record the behaviors of the hens during the two experiments.

Hierarchy Determination Procedure

Video recordings were taken 30 min before and 60 min after the morning and afternoon feedings to capture behavior leading up to, and occurring after, feeding which took place at approximately the same time every day. This resulted in twenty videos which were analyzed using an ethogram of dominant and subordinate hen behaviors developed using ethograms from the literature (Table 1). Scan sampling and ad libitum recording (all hens and all behaviors were noted) from the videos were used to count occurrences of agonistic dyadic encounters where every occurrence of dominant behavior for each hen was recorded.

The number of times a hen was dominant was logged in a dominance matrix, as per Chase (1980), however, as the flock was free-range not all hens were present for each observation, thus the proportion of instances when each hen was dominated and the dominator was used to determine the hierarchy. The analysis ranked the hens by the proportion of interactions where they were the dominator out of the total number of interactions in which that hen was the dominator and dominated.

Table 1

Ethogram of Dominant and Subordinate Behaviors Expressed by Chickens

Behavior	Description	Rank
Peck	Fast single jab of the beak touching any part of another chicken [2]	Dominant
Leap	Single jump towards another chicken [3]	
Chase	Following another chicken, either running, jumping, or flying [2]	
Attack	Running, jumping, or flying at another chicken and then inflicting three or more pecks [2]	
Mount	Standing on another chicken while they are squatting	
Retreat	Walking away from aggressor chicken [1]	Subordinate
Squat	Standing stationary with head low and wings partially open [1]	
Stationary	Standing stationary, making no effort to move	

Note. Adapted from [1] (Riber et al., 2021), [2] (Eklund & Jensen, 2011), [3] (Ventura et al., 2012).

Feeding Preferences Procedure

To test for the hens' preference for the method of food delivery, the hens were simultaneously offered the choice of free food from a feeder and food thrown on the grass that required effort to obtain through foraging, both typical feeding processes for this flock. The location of the feeder and where the food was thrown onto the grass was 0.7 m apart. The volume of food offered in the feeder and distributed onto the grass were both 1 L of typical food mix (equal parts Chook Chow® and Peck 'n' Lay®). Ten trials were conducted: five where food was placed in the feeder first and five where food was distributed on the grass first. The hens that were at each location were identified and counted at the initial provision of food and 1 min after the provision of food to measure any behavioral changes based on initial choice.

Statistical Analysis

We used the Statistical Package for Social Sciences (SPSS; version 24.0, Chicago, IL). The location of each hen at the feeder or grass was recorded for each hen at each time point. This was then cross referenced with the ranking of each hen within the hierarchical matrices. The number of hens at each feeding station at both time points, and hierarchical status using the hierarchy based on the proportion of dominator interactions was analyzed using a non-parametric repeated measures Friedman test. Mann-Whitney U tests were used to measure the effect of rank on preference for the feeder or on the grass, and time after provision of food.

Results

Hierarchy Determination

Twenty hens were observed in the videos that were used to determine the hierarchy of the flock. The dominance matrix for the flock indicates the number of times a hen dominated another hen (Table 2, Chase, 1980). Each hen dominated at least one other hen. The highest ranked hen dominated 17 hens and the lowest ranked hen dominated two hens. This method for determining rank did not consider the number of hens that were dominated by another hen; for example, although Mary dominated the most hens with Violet coming in second, the 10 hens that dominated Mary and only four hens that dominated Violet did not result in Violet being higher up the pecking order than Mary. To account for this the proportion of interactions where the hen was the dominator out of all interactions was used to determine rank.

Using the proportion of observations when the hen is dominant relative to the number of total interactions produced clear differences in the groups' hierarchy (Table 3). Those classed as dominant hens were dominators in more than 70% of interactions, those classed as neutral in 33%–44% of interactions, and the subordinate hens were the dominator in less than 21% of interactions. To use the prior example, Mary is now ranked fourth (equal in rank with Twitch) and Violet is the most highly ranked hen.

Furthermore, size of the hen had a small effect on rank position. The majority of subordinate hens were small while there were both large and medium hens in the dominant and neutral groups (Tables 2 and 3). Due to low numbers, no statistics could be computed.

Table 2

Dominance Matrix for This Flock of 20 Hens (Sizes in Parentheses S=small, M=medium, L=large), Showing the Total Number of Dominance Interactions, the Absolute Number of Hens Dominated by Each Individual, and Their Rank Within the Pecking Order Based on Chase (1980)

Dominant Hen	**Dominated Hen**																				**Total hens dominated**	**Rank (Chase, 1980)**
	Mary	Violet	Onyx	Sparrow	Bigun	Junior	Slippers	Twitch	Mellow	Beatrice	Jon	Syrup	Sweetie	Raven	Cocoa	Butter	Little One	Mid-night	Mana	Sugar		
Mary (M)	-	1	0	1	2	1	31	4	1	1	13	1	14	46	42	21	29	16	0	3	17	1
Violet (M)	10	-	3	2	8	6	0	4	1	5	0	5	0	4	10	4	0	2	7	2	15	2
Onyx (M)	3	0	-	5	1	0	2	1	1	3	1	0	1	2	3	6	0	1	3	2	15	2
Sparrow (M)	7	0	1	-	6	0	7	5	4	7	0	0	3	8	11	10	2	2	0	1	14	3
Bigun (L)	8	0	0	1	-	0	0	4	14	7	1	15	1	20	17	7	8	6	0	2	14	3
Junior (L)	5	0	1	3	0	-	1	1	2	3	2	7	0	0	5	3	2	0	0	2	13	4
Slippers (M)	0	2	0	0	1	0	-	1	0	6	0	3	1	6	3	3	5	1	1	1	13	4
Twitch (S)	0	0	1	1	1	0	0	-	0	1	0	1	20	17	1	52	4	22	0	25	12	5
Mellow (M)	4	0	0	1	0	0	1	2	-	0	0	1	1	12	10	9	22	1	0	0	11	6
Beatrice (M)	10	0	0	2	0	1	2	4	0	-	2	0	1	0	3	4	0	4	0	2	11	6
Jon (S)	0	0	0	1	2	0	0	1	1	0	-	0	2	1	2	2	1	1	0	0	10	7
Syrup (M)	3	0	0	6	0	0	0	0	2	4	7	-	0	4	3	0	0	4	7	0	9	8
Sweetie (L)	0	0	0	3	0	0	0	0	0	1	0	7	-	2	0	2	1	4	4	6	9	8
Raven (S)	0	0	0	0	0	0	0	4	0	7	1	0	4	-	22	5	10	12	0	2	9	8
Cocoa (M)	1	1	0	0	0	0	0	0	0	0	0	1	3	0	-	1	11	6	0	1	8	9
Butter (S)	0	0	1	0	0	1	0	0	0	0	0	22	4	2	0	-	0	3	0	4	7	10
Little One (S)	0	2	0	0	0	1	0	1	0	1	0	5	0	0	0	4	-	0	0	2	7	10
Midnight (S)	0	0	0	0	0	0	0	2	1	1	1	0	1	1	2	0	0	-	0	0	7	10
Mana (L)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	3	0	-	0	3	11
Sugar (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	-	2	12
Total hens dominated by	10	4	4	11	7	5	6	13	9	13	8	13	13	14	14	16	12	17	5	14		

Table 3

Hierarchical Level and Pecking Orders of the Flock

Hierarchical level	Rank	Proportion of interactions when hen was the dominator
Dominant	1	Violet (.92)
	2	Bigun (.84)
	3	Onyx (.83)
	4	Mary (.81)
	4	Twitch (.81)
	6	Junior (.79)
	7	Sparrow (.74)
	8	Mellow (.70)
Neutral	9	Slippers (.44)
	10	Beatrice (.43)
	11	Mana (.37)
	11	Syrup (.37)
	13	Sweetie (.35)
	13	Raven (.35)
	15	Jon (.33)
Subordinate	16	Butter (.21)
	17	Cocoa (.16)
	18	Little One (.14)
	19	Midnight (.09)
	20	Sugar (.07)

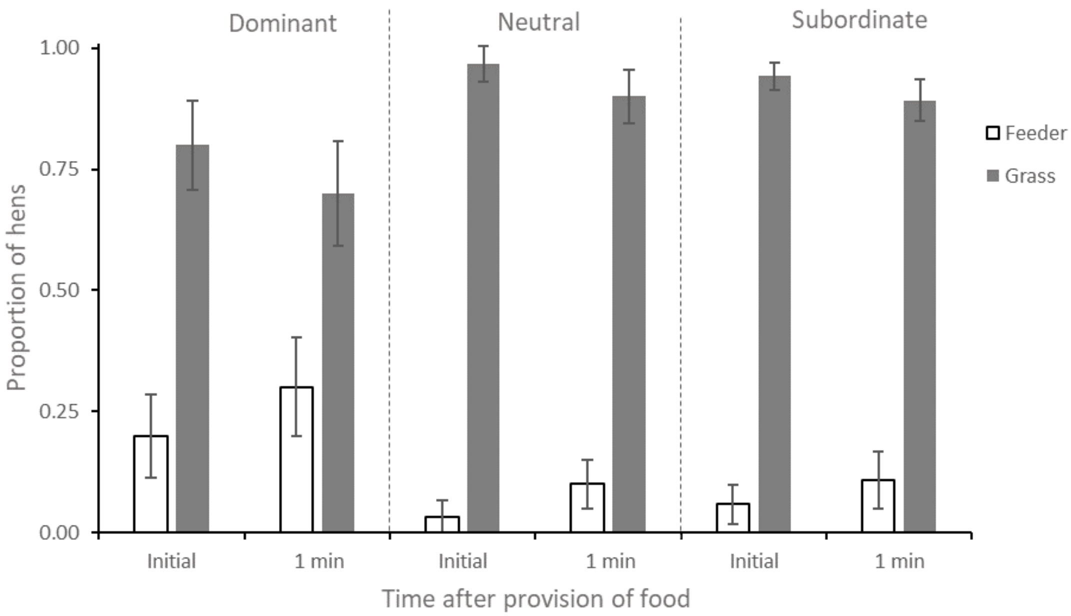
Note. The rank is provided. The proportion is provided in parentheses for each column. Dark grey indicates a large hen, light grey indicates a medium sized hen, and white indicates a small hen.

Feeding Preferences

We tested whether rank impacted feeding location. During each of the feeding trials there were between seven and 12 of the free-range hens present. Figure 1 shows a larger proportion of hens preferred to feed on the grass compared to the feeder after initial feeding (grass: $M = 0.90$, $SE = 0.03$ and feeder: $M = 0.10$, $SE = 0.03$ $U = 4.5$, $p < .001$) and one min later (grass: $M = 0.83$, $SE = 0.04$ and feeder: $M = 0.17$, $SE = 0.04$; $U = 55.5$, $p < .001$). There was a significant effect of hierarchy on feeding location. A higher proportion of dominant hens fed at the feeder ($M_{initial} = 0.20$, $SE = 0.09$, $M_{1min} = 0.30$, $SE = 0.10$) compared to neutral ($M_{initial} = 0.03$, $SE = 0.03$, $M_{1min} = 0.10$, $SE = 0.05$) or subordinate hens ($M_{initial} = 0.05$, $SE = 0.04$, $M_{1min} = 0.89$, $SE = 0.06$; $\chi^2\ (11) = 87.40$, $p < .001$). Wilcoxon Signed Ranks tests revealed significant differences in the proportion of dominant and neutral hens after 1 min at the feeder [$Z = -2.04$, $p = .41$] and on the grass [$Z = -2.04$, $p = .41$].

Figure 1

Mean Proportion of Dominant, Neutral, and Subordinate Hens at the Feeder or Grass at the Initial Point of Food Delivery and After 1 Minute



Note. The hierarchy was determined using the Proportion Method. Error bars show the standard error of the mean

Discussion

The hierarchical matrix provided a mechanism for determining the dominance hierarchy of the flock based on the proportion of instances when each hen was the dominator. Based on the rank of each hen, there was a significantly greater proportion of dominant hens feeding at the feeder during trials than of the neutral or subordinate hens. However, overall, most hens in this flock ate food thrown on the grass rather than from a feeder.

Our methodology determined a stable hierarchy with three distinct groups: dominant hens were the dominator in more than 70% of interactions, the neutral hens were the dominator in 33%–44% of interactions, and the subordinate hens were the dominator in less than 21% of interactions. Stability of a hierarchy relies on individuals being able to recognize one another (Pagel & Dawkins, 1997). Chickens can recognize up to 27 individual conspecifics (Douglis, 1948), but hens in flocks of 120 individuals do not show individual recognition (D'Eath & Keeling, 2003) which can affect poultry in intensive farming systems as a stable pecking order is unattainable (Hughes et al., 1997; Scrinis et al., 2017). Thus, feeding behavior and other behaviors usually controlled by hierarchy can result in aggressive interactions, injury, and cannibalism (Tablante et al., 2000).

A lack of recognition affects the establishment of a hierarchy and factors such as the size and age of individuals impact where a hen might place in that hierarchy. Cloutier and Newberry (2000) found body weight positively correlated with rank. The results of our study generally align with this conclusion since no large hens were found to be subordinate and the majority of dominant hens were large or medium-sized. However, one small hen was identified as dominant. This indicates that size is a primary factor, but not the only factor at play when a dominance hierarchy is established. Tindell and Craig (1959) found that older hens were ranked higher than younger hens. The present study could not analyze the ages of the hens; therefore, it is possible there was an effect of age on the hierarchy.

The current experiment measured the effects of hierarchy on feeding behaviors utilizing the incidence of foraging with most hens across ranks showing a preference for foraging over free food. Foraging is an innate behavior performed by hens, with associated behaviors (such as scratching and ground pecking) observed in cages with no substrate from which to forage, such as wire-floored cages (Weeks & Nicol, 2006). Thus, hens will expend effort (energy) to use forageable substrates (Cooper & Albentosa, 2003; de Jong et al., 2007; Weeks & Nicol, 2006), indicating that the opportunity to perform behaviors associated with foraging is of value to hens. Typical poultry farming systems that provide only free food subject their hens to behavioral restriction, which is being recognized as a welfare issue (Shimmura et al., 2008). If an animal shows motivation to perform a behavior, the animal should be provided with opportunities to display that behavior (Olsson & Keeling, 2002).

The preference for foraging versus free food indicates that hens will contra-freeload, that is, put forth effort to perform a natural behavior. This behavior is consistent with that shown in the red jungle fowl (see Ferreira et al., 2021; Jensen et al., 2002) and is commonly seen in stable conditions where predictability of resources is secure (Lindqvist et al., 2006). The current flock has been together in the same living conditions for over five years and has consistent food available, thus it is not surprising that the hens showed contra-freeloading behavior.

The display of contra-freeloading may be linked to an animal's biological evolution and physical environment. Schutz and Jensen (2001) concluded that red jungle fowl performed more contra-freeloading behaviors than a hen breed that was selectively bred for high egg production. This difference in behavioral strategies can be explained by resource allocation theory and is likely a result of the layer hens conserving energy from foraging to put towards egg production. Resource allocation theory illustrates that, when an animal is bred for a specific production quality, it must invest more resources into this trait than other tasks (Lindqvist et al., 2006). The environment in which the animal is living will affect which other tasks are reduced to increase the investment into production. For example, layer hens housed in barns with ad libitum food are likely to reduce scratching and foraging behaviors as they can get free food, thus conserving energy for egg production. The hens observed in our study were all mixed breed hens and were not bred for specific production qualities. Therefore, their strategies for food consumption are unlikely to be linked to increasing egg output. The physiology and complete free-range environment of this flock more closely resembles that of the red jungle fowl than modern-day agricultural hens housed in conventional farming systems. Therefore, it is unsurprising that their behavior is more similar to the red jungle fowl than to production hens.

Competition for resources results in despotic behaviors that negatively affect those who are ranked low in a hierarchy (Estevez et al., 2007). Competition specifically at feeding locations results in varying feeding rates between individuals, which leads to unequal feed distribution among the flock (Nielsen et al., 2016). In the current experiment, hens of all hierarchical levels chose to utilize both feeding methods at the same time, however, it is not likely that the hens were driven to contra-freeload solely due to a preference for foraging but as a result of hierarchy and competition for resources. Accordingly, dominant hens ate in close contact with subordinate hens. Olsson and Keeling (2002) noted hens of lower social status perched next to dominant hens if that was the only place available for them. This shows that the motivation to access some resources is stronger than the potential consequences of being in close contact and competition with a more dominant individual. In the current experiment, the food distributed onto the grass-covered a larger area than what the feeder provided. This likely accounted for the increased number of hens feeding on the grass rather than at the feeder, however, it would have resulted in up to 20 hens at a time foraging on the grass where there would also be competition based on the quantity of food. The subordinate hens in this flock were willing to risk an agonistic encounter to forage for food, indicating their drive to feed at that time. If only one area or feeding method is provided, some hens will consume less food than others or be aggressed by conspecifics. Since foraging is an innate behavior for chickens, opportunities should be provided to perform this behavior without competition from dominant hens which could be mitigated by the provision of both free and forageable food over a wider area. For example, farmers could provide all hens timed opportunities to feed in areas with scattered food alongside feeders to accommodate all hens of differing ranks.

This study used the data from a stable flock of 20 individuals to measure the effect of feeding at a feeder and foraging on the grass. However, feeding behaviors were only recorded at the time food was provided and 1 min later, whereas hens will forage for long stretches of time each day (Weeks & Nicol, 2006). In replications of this methodology, longer recording periods would be utilized to assess if the hierarchy had prolonged impacts on feeding from either the feeder or foraged areas.

In conclusion, this study identified that hierarchy of a flock will affect feeding and foraging behavior. Intensive farming operators may not be aware that the exclusive use of feeders may be negatively affecting the ability of middle- and low-ranked hens to obtain food. The flock in the present study had twenty individuals, far fewer than an intensive farming system, allowing each hen to recognize one another and maintain a stable pecking order. To ensure that animal behavior science genuinely advances the welfare of agricultural animals, it is imperative that methods applicable to a commercial scale are developed. Future research could co-opt this study to explore the potential effects of dominance on feeding methods in commercial hens.

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