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The domestication effects on social support in
chickens (*Gallus gallus*)

Caroline Bergvall

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Handledare: Per Jensen, Linköpings universitet

Examinator: Anders Hargeby, Linköpings universitet



Linköpings universitet

Institutionen för fysik, kemi och biologi

Linköpings universitet

581 83 Linköping

Denna rapport är ett examensarbete på kandidatnivå (16 hp) som har genomförts av författaren i samarbete med två studentkollegor, Rebecca Katajamaa och Sofia Nilsson. Samarbetet har omfattat projektplanering samt insamling och bearbetning av data, medan studenterna individuellt var för sig har författat och strukturerat rapporten i alla dess delar.

This report is a degree thesis at the Bachelors level (16 ECTS credits) performed by the author in collaboration with two study colleagues, Rebecca Katajamaa and Sofia Nilsson. This cooperation included the planning of the study, the collection of data and analyses. Thereafter each student has written and structured the report in all its parts individually.



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When animals are stressed they use a trait called social support to alleviate their stress responses. With domestication many traits from the ancestor red junglefowl have changed in the domesticated breed white leghorn. White leghorns are bred to be able to live in large groups where it becomes hard to recognize every chicken. They are therefore not as dependent of familiar stimuli birds for social support as red junglefowl. Our hypotheses were that red jungle males would be more interested in unfamiliar stimuli birds than white leghorn male before stress due to their territoriality. We tested total 56 chickens in an open field test. The test arena was divided in three zones and the time the focal birds spent in each zone was recorded. The focal bird was recorded in 300 seconds before being stressed by being suspended in a net and then recorded again in 300 seconds. The results showed that social support and social behaviour differs between females and males for both breeds. No significant differences were found between the breeds. There was a tendency for significant of breed ($P=0.08$) effects in the central zone unstressed. The two interactions before stressed between breed and sex, central zone ($P<0.01$) and unfamiliar zone ($P<0.01$) had significant effects. We observed fights between white leghorn males and familiar stimuli. Waltzing did also occur in red jungle males in front of unfamiliar. In conclusion, numeric differences can be seen but not large enough to be significant and our hypotheses are not confirmed.

Nyckelord/Keyword:

White leghorn, red junglefowl, social support, acute stressor, unstressed, stressed

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1 Abstract

When animals are stressed they use a trait called social support to alleviate their stress responses. With domestication many traits from the ancestor red junglefowl have changed in the domesticated breed white leghorn. White leghorns are bred to be able to live in large groups where it becomes hard to recognize every chicken. They are therefore not as dependent of familiar stimuli birds for social support as red junglefowl. Our hypotheses were that red jungle males would be more interested in unfamiliar stimuli birds than white leghorn male before stress due to their territoriality. We tested total 56 chickens in an open field test. The test arena was divided in three zones and the time the focal birds spent in each zone was recorded. The focal bird was recorded in 300 seconds before being stressed by being suspended in a net and then recorded again in 300 seconds. The results showed that social support and social behaviour differs between females and males for both breeds. No significant differences were found between the breeds. There was a tendency for significant of breed ($P=0.08$) effects in the central zone unstressed. The two interactions before stressed between breed and sex, central zone ($P<0.01$) and unfamiliar zone ($P<0.01$) had significant effects. We observed fights between white leghorn males and familiar stimuli. Waltzing did also occur in red jungle males in front of unfamiliar. In conclusion, numeric differences can be seen but not large enough to be significant and our hypotheses are not confirmed.

2 Introduction

Chickens are social animals that under normal circumstances lives in groups with a stable social structure either in a small group with close relatives or in a larger mixed group. However with today's domestication of chicken their natural instincts are changed. It has been showed that animals which been domesticated are different in their fearfulness and behaviour (Price, 1984). Many studies with different methods have come to the conclusion that all domesticated chicken are descended from red junglefowl (Romanov and Weigend, 2001; Fumihito et al., 1994). One well known domesticated chicken is white leghorn which is a productive layer of eggs. White leghorn use a more energy-conserving strategy when it comes to foraging and are less active in fearful situations than red junglefowl (Shütz et al., 2001). They are bred to be able to live in large groups and it becomes difficult to recognize every chicken in such a group.

When an animal is exposed to a stressful situation the response will alleviate if the animal is together with conspecific animals, this trait is called social support (Rault, 2012). Social support have not been studied much in chicken but a study carried out by Marin et al. (2001) showed that domestic chicks used social support after exposure to an acute stressor. The study also showed that the chicks associated more with familiar cagemates than with strange chicks. Väisänen and Jensen (2004) did a comparison study between red junglefowl and white leghorn and their responses to familiar and unfamiliar social stimuli. The study revealed differences between the two breeds and also between genders. Red junglefowl males showed more interest in unfamiliar social stimuli than the females. White leghorn associated more with familiar than unfamiliar conspecifics than the red junglefowl did.

With this background the goals of this study were to do a comparison between red junglefowl and white leghorn in their affiliation with familiar and unfamiliar stimuli, to see if domestication had changed their preference. We also observed if chickens social behaviour with the stimuli differed before and after an acute stressor and if there was any gender difference.

One hypothesis for this study was that before the acute stressor male red junglefowls will show more interest in the unfamiliar stimuli than the familiar because of the territoriality (Hughes, 1977 in Dawkins, 1995). Due to the domestication the hypothesis after the acute stressor was that red junglefowl will prefer to affiliate with familiar stimuli rather than with unfamiliar stimuli more than the white leghorn will do.

3 Materials & methods

3.1 Animals

In this study two breeds of chickens were used. Red junglefowl descending from a Swedish zoo population and has lived on the research facility at Vreta from 1998. White leghorn with ancestry from the breeding lane SLU 13 and bred at the Swedish University of Agricultural Sciences since 1970. The breeds lived together in gender-specific pens and were between 62 to 65 weeks old during the observations. Fourteen chicken of each gender and breed were observed, total of 56 chickens. After a bird been observed it was marked with a leg band keeping it from being observed again. The chickens used as unfamiliar stimuli birds were a cross breed and were between 22 to 29 weeks old.

3.2 Test arena

The test arena was a runway with the measurements 290x 90x180 cm, built of plywood and wire mesh on wooden frames. The floor in the test arena was covered with wood chips. Two compartments were built with the measurement 55x90x180 cm at the opposite ends of the test arena. In each compartment two stimuli birds were placed, they were visible for the focal bird but separated by wire mesh. This allows the focal bird to see, smell and hear the stimuli birds but not come in contact with them. The stimuli birds were provided with food and water and were exchanged with new stimuli birds after two tests. Four birds were observed per day and they were placed in a temporary compartment (90x90x180 cm) in the beginning of the day. The observations started two hours after the birds have been placed in the temporary compartment. The focal bird was placed in the central of the runway, which were divided into three equal zones (60x90x180 cm): a familiar, a central and an unfamiliar zone.

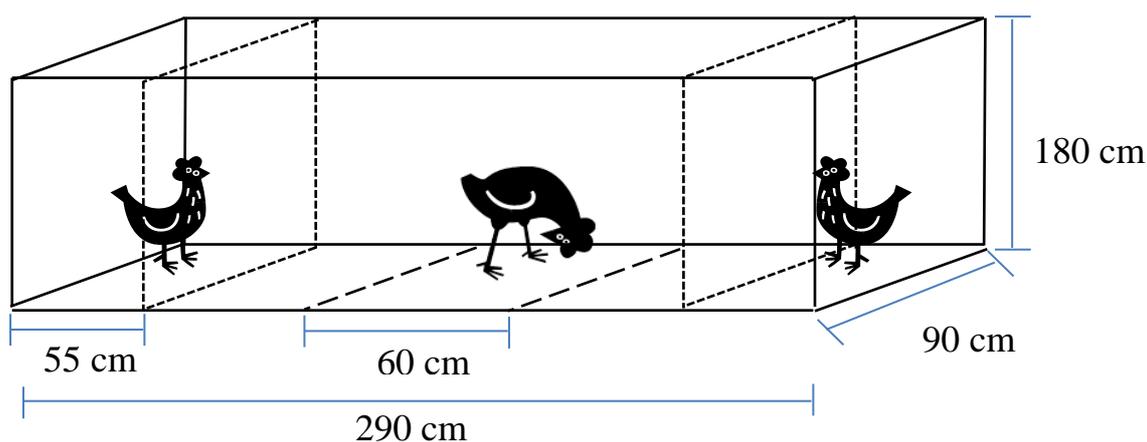


Figure 1. The test arena and the measurements.

3.3 Experimental layout

The stimuli birds were given an acclimatization time of 15 minutes before the focal bird was released in the test arena. In one compartment two stimuli birds were familiar to the focal bird and in the other compartment there were two stimuli birds unfamiliar, and all birds during an observation were of the same gender. The location of the stimuli of familiar birds and unfamiliar were balanced between the observation and birds. The focal bird was caught in a net and suspended from the test arenas roof, hanging there for 180 seconds. This type of an acute stressor

will have a significant increase in the chickens corticosterone levels (Karlsson et al., 2011).

3.4 Sampling

Observation occurred 300 seconds before the focal bird was caught in the net and 300 seconds after it was released from the net. The duration the focal bird spent in each zones was recorded in seconds.

3.5 Statistics

The data was statistical analysed by general linear model ANOVA using the program SPSS Statistics 20. For all statistic tests the significance levels were set to $P < 0.05$. The mean time difference was calculated by taking the mean time in the zone when the chickens were stressed minus the mean time from the same zone when the chickens were unstressed.

4 Results

4.1 Unstressed

The results from the general linear model ANOVA for the zones when the chickens were unstressed showed no significant effects of sex ($F_{1, 52} = 2.483$, $P > 0.05$), breed ($F_{1, 52} = 0.537$, $P > 0.05$) and interaction between sex and breed ($F_{1, 52} = 1.468$, $P > 0.05$) in familiar zone. In the central zone there were significantly effects of sex (Figure 2b, $F_{1, 52} = 11.865$, $P < 0.01$) and the interaction between breed and sex (Figure 2b, $F_{1, 52} = 10.285$, $P < 0.01$). A tendency to significant effect was seen of breed in the central zone (Figure 2b, $F_{1, 52} = 3.192$, $P = 0.08$). The mean for the time spent in the central zone for the two breeds were 49.54 s for white leghorn and 74.79 s for red junglefowl. The general linear model ANOVA showed significant effects of sex (Figure 2c, $F_{1, 52} = 8.859$, $P < 0.01$) and the interaction (Figure 2c, $F_{1, 52} = 11.274$, $P < 0.01$) in the unfamiliar zone. No significant effect was found of breed in the unfamiliar zone ($F_{1, 52} = 0.388$, $P > 0.05$).

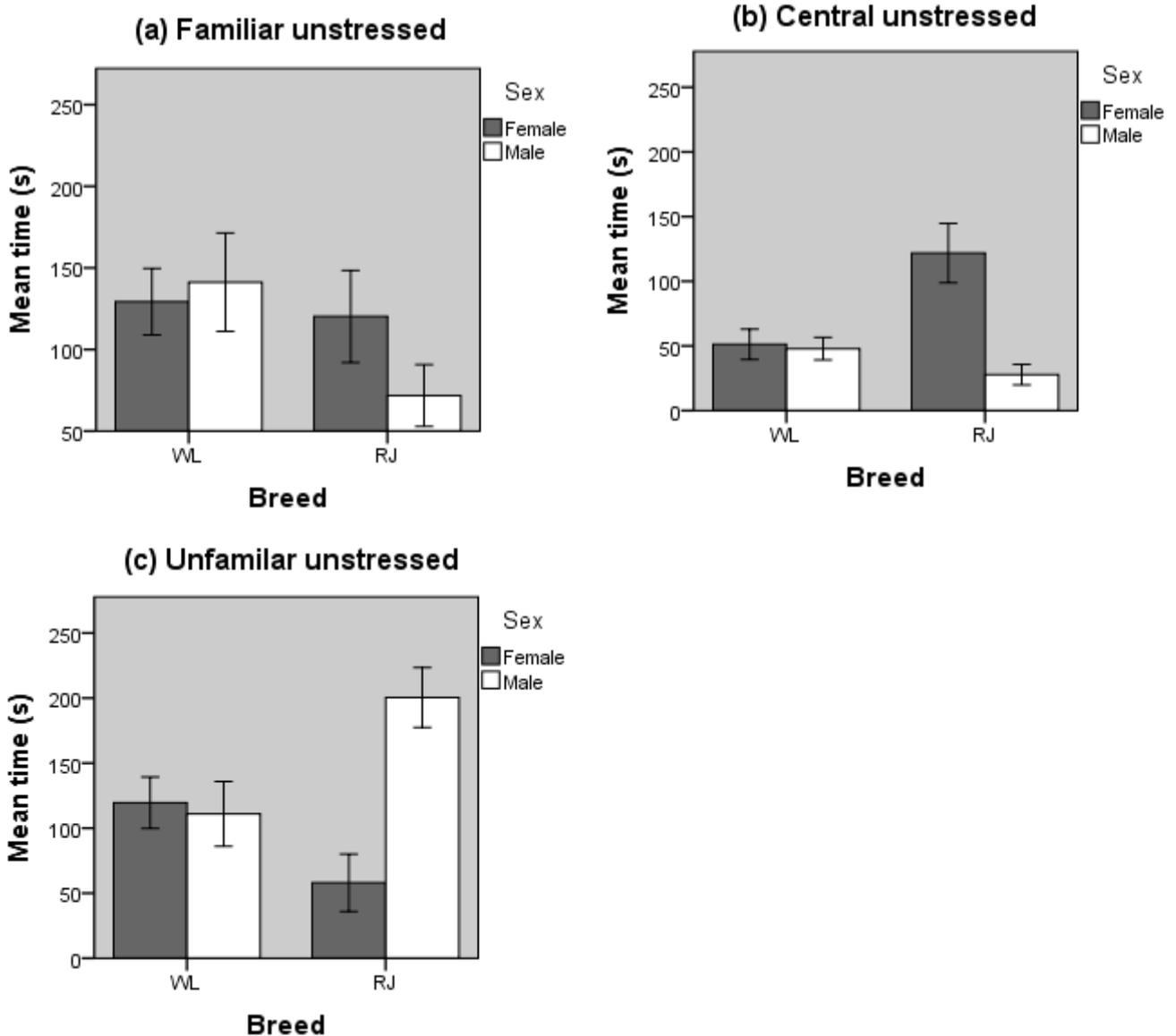


Figure 2. Time spent in the zones for white leghorn and red junglefowl before being stressed (mean time in $s \pm SD$); a, mean time spent in the familiar zone, b mean time spent in central zone and c mean time in unfamiliar zone.

The plots in Figure 3 shows the significant interaction between breed and sex in the central zone and the unfamiliar zone before the chickens were exposed to stress. The plot (Figure 3a) shows a large interaction with no effect of breed and a large effect of sex in the central zone. The plot for the unfamiliar zone (Figure 3b) shows a large interaction with no effect of breed and a large effect of sex.

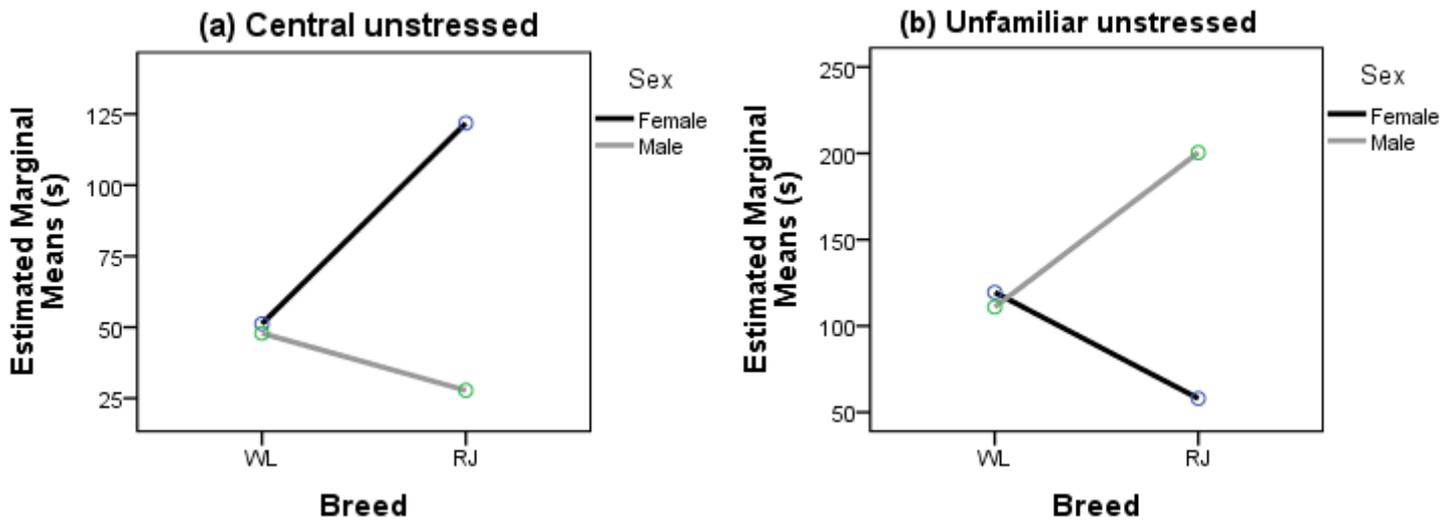


Figure 3. Interactions between breed and sex in the mean time (s) spent in central and unfamiliar zones before stressed.

4.2 Stressed

The results from the general linear model ANOVA for the zones after that the chickens been stressed showed no significant effects in familiar zone of breed ($F_{1,52}=0.012$, $P>0.05$) and interaction ($F_{1,52}=0.138$, $P>0.05$) but a significant effect was seen of sex (Figure 4a, $F_{1,52}=8.053$, $P<0.01$). In the central zone no significant differences were found between sex ($F_{1,52}=1.105$, $P>0.05$), breed ($F_{1,52}=1.379$, $P>0.05$) and the interaction ($F_{1,52}=2.177$, $P>0.05$). A significant effect was found in the unfamiliar zone after stress of sex (Figure 4c, $F_{1,52}=16.921$, $P<0.001$) while no significant effects were found of breed ($F_{1,52}=0.413$, $P>0.05$) and the interaction ($F_{1,52}=2.029$, $P>0.05$).

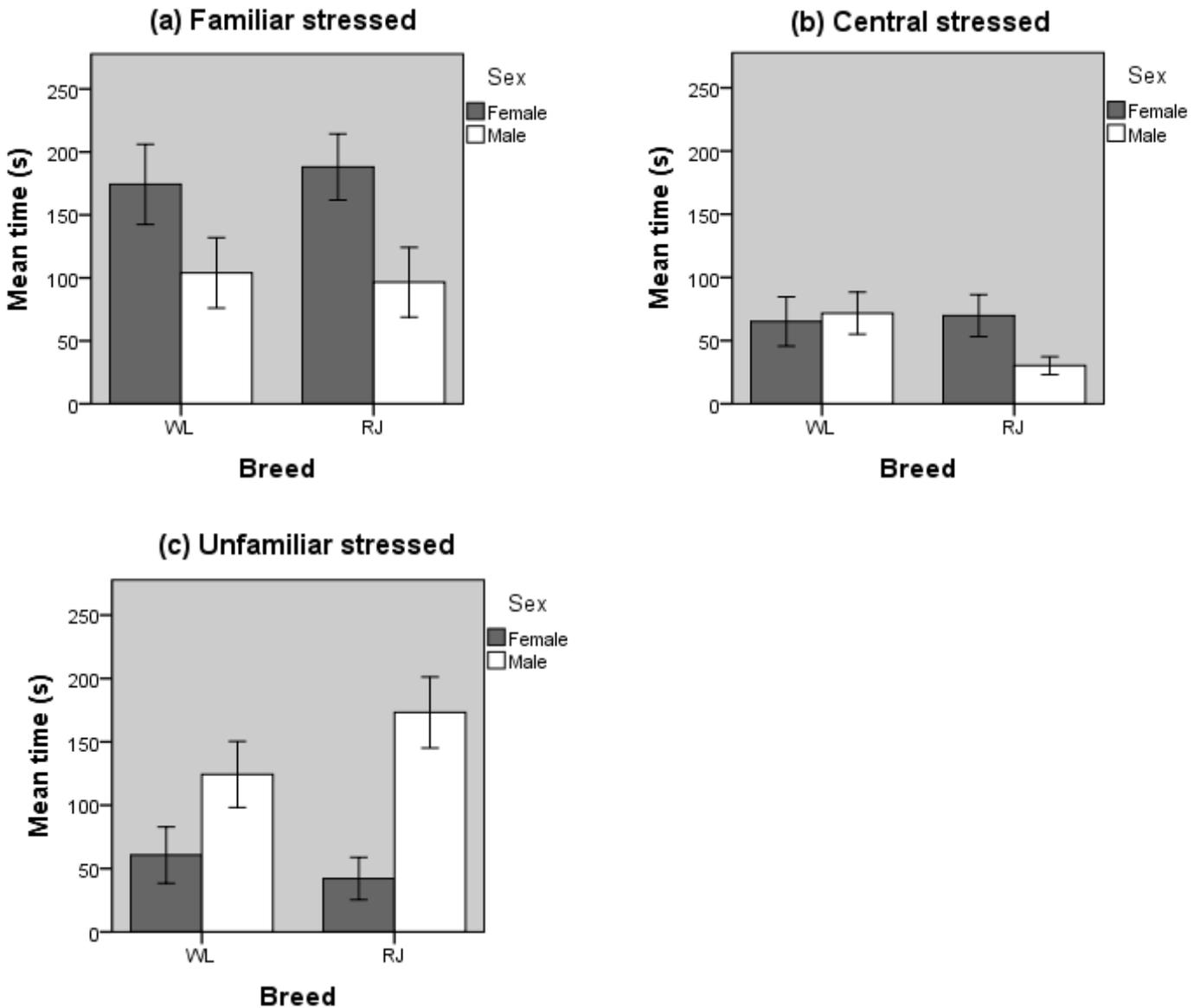


Figure 4. Time spent in the zones for white leghorn and red junglefowl after being stressed (mean time in s \pm SD); a, mean time spent in the familiar zone, b mean time spent in central zone and c mean time in unfamiliar zone.

4.3 Difference

The general linear model ANOVA showed a significant effect of sex in the familiar zone (Figure 5a, $F_{1, 52}=4.568$, $P<0.05$) while no significant effects were found of breed ($F_{1, 52}=2.096$, $P>0.05$) and the interaction between breed and sex ($F_{1, 52}=0.446$, $P>0.05$). For the central zone significant effects were found of breed (Figure 5b, $F_{1, 52}=9.255$, $P<0.01$) and of sex (Figure 5b, $F_{1, 52}=5.043$, $P<0.05$) but no significant difference

was found in the interaction between breed and sex ($F_{1, 52}=2.398$, $P>0.05$). The general linear model ANOVA showed no significant effects in the unfamiliar zone of breed ($F_{1, 52}=0.002$, $P>0.05$), sex ($F_{1, 52}=1.376$, $P>0.05$) or the interaction ($F_{1, 52}=2.594$, $P>0.05$).

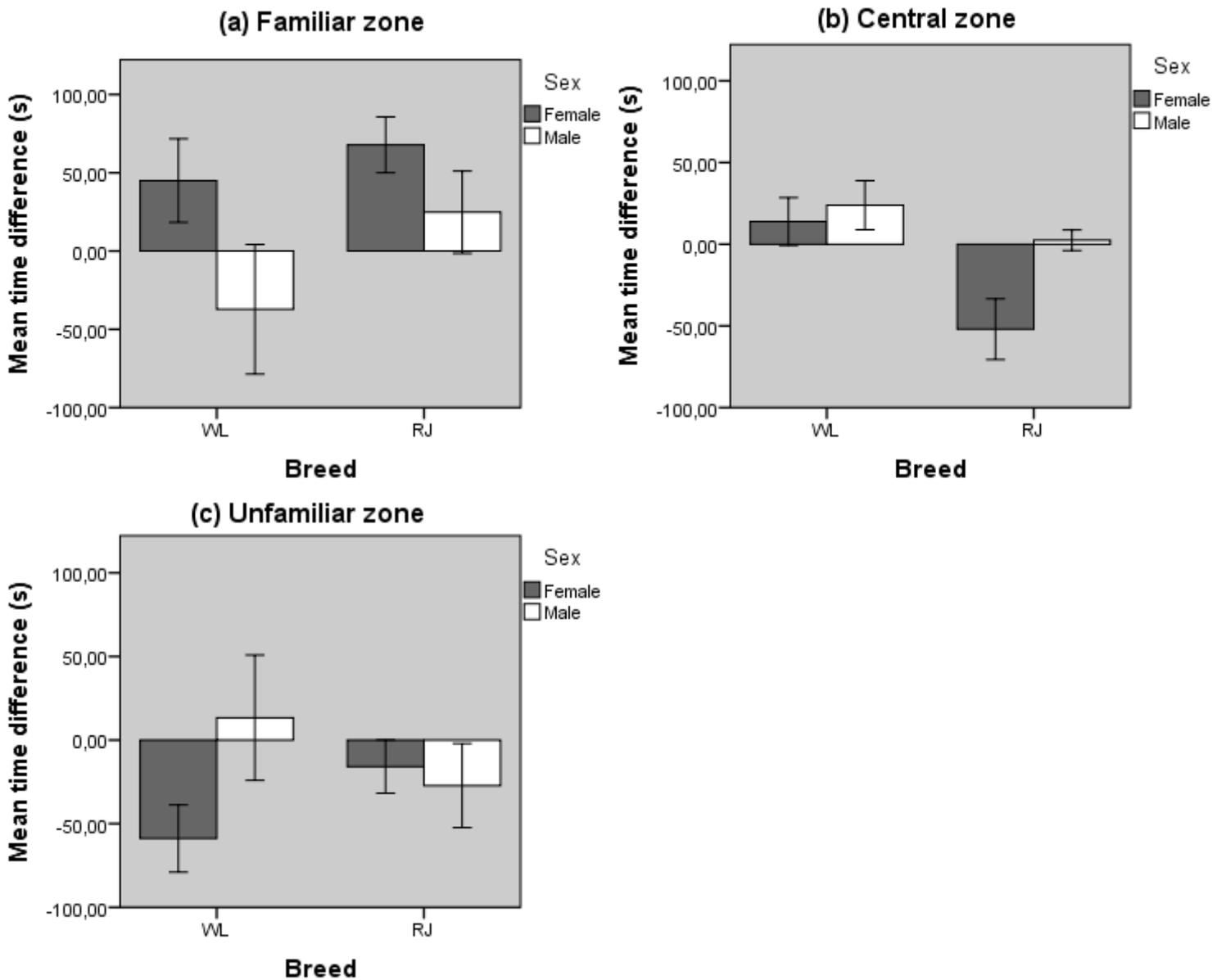


Figure 5. Time difference (stressed – unstressed) spent in the zones for white leghorn and red junglefowl (mean time in s \pm SD); a, mean time difference spent in the familiar zone, b mean time difference spent in central zone and c mean time difference in unfamiliar zone.

4.4 Other observations

Some white leghorn males tried to fight with familiar stimuli birds. They blew up their feather around the neck and attacked the wire mesh that separated the focal bird from the stimuli birds. Red jungle males performed the behaviour waltzing towards unfamiliar stimuli birds. Waltzing is when the bird circles around another bird and lowers the outer wing. It looks like the bird is dragging the wings along the ground (Wood-Gush, 1956; Ericsson, 2010).

5 Discussion

The results showed that the males spent more time in the unfamiliar zone than females, which indicates a greater territoriality in males than females. Red jungle fowl spent less time in central zone after stress than white leghorn which indicates a need to be close to other chickens and that social support is more important in red junglefowl than white leghorn. Our results also showed that females spent more time in familiar zone after stress than males which implies they react more in a stressful situation than males.

Females and males in white leghorn spent almost the same amount of time in each zones before stress. This leads to a theory that the sexual dimorphism in white leghorn has been affected by the domestication leading to a lower dimorphism between females and males in white leghorn. However, after stress white leghorn does not show any tendency to this reduced sexual dimorphism, as there was a general sex difference in the choice between unfamiliar and familiar stimuli birds.

One of our hypotheses was that red jungle males would show more interest in the unfamiliar stimuli birds than white leghorn males (Hughes, 1977 in Dawkins, 1995). Indeed, this was also the case, resulting in a significant interaction between breed and sex before the stress event. If more chickens were used in the study it is possible that a significant difference would be found, which would confirm our hypothesis. However, the present result indicates that red jungle males do not show more interest in unfamiliar stimuli birds than white leghorn males.

From the results all significant differences that were found in this study were between the sexes. Female spent significant more time than males in the central zone and males spent significant more time in the unfamiliar zone before stressed. These results support the theory that their behaviour differs due to social structure. Males are defending the groups and are

observant if strangers occur, because strangers can threaten their position in the group. The territoriality in red junglefowl increase males' responsiveness to unfamiliar stimuli (Väisänen and Jensen, 2004).

Females from both breeds increased their time in the familiar zone significant more than the males after stressed. The males spent more time in the unfamiliar zone after stress than females. Previous results from a study by Schütz et al (2001) indicated that females were more active in response to stress, our results confirms this indication. This can also be seen in our results, where red jungle females decreased their time spent in the central zone and white leghorn decreased their time spent in the unfamiliar zone after being stressed. With this result we can draw a conclusion that females react to stress more strongly than males and they are more dependent of familiar stimuli birds after stress.

There have not been many studies about social support in different breeds. The effects of social support can various considerable due to different types of relationships (Hennessy et al., 2009). What has been studied is that chickens seek other familiar conspecifics for social support after a stressful situation (Marin et al., 2001; Rault, 2012). As a result of the domestication white leghorn weight more than double then their ancestor, produces more eggs per year and the eggs are twice as heavy as those from red junglefowl (Johnsgard, 1986 in Shütz & Jensen, 2001). They live in large group; it becomes hard to remember every chicken in the group and the relationships breaks down (Hughes et al., 1997; D'Eath, R.B. & Keeling L.J. 2003). Therefore one hypothesis was that after the acute stress the red junglefowl would prefer to be with the familiar stimuli birds more than white leghorn would do. Our results do not support this hypothesis because no significant difference for breed was found in the familiar zone after the acute stress. These results can be due to different stress levels in the two breeds. One study have shown that white leghorn avoided unfamiliar stimuli and preferred familiar which may indicate on a weaker ability to cope with a stressful situation (Väisänen and Jensen, 2004). While another study got results which indicated that white leghorn have a lower level of fearfulness than red junglefowl (Campler et al., 2009). These differences about the stress levels can have affected our results. Even though the acute stressor we used have been proved that it increase chickens corticosterone levels significantly (Karlsson et al., 2011), maybe it had different effect on the two breeds. If one of the breed had a lower stress level the full search for social support would not be seen in that breed.

Our study is limited by the fact that we have used small groups of birds (56 birds) and as a result of that the standard error means are high. If a higher numbers of birds have been used our standard error means would probably decrease. In a study by D'Eath and Keeling (2003) where they tested the discrimination between familiar and unfamiliar birds in two different sized groups. They used 280 white leghorns in the experiment and got small standard error means. The tendency to significant difference between white leghorn and red junglefowl in the central zone before stress may become significant if more chickens are used in the study.

It may not only be the number of birds that affected our result. A study by Eklund and Jensen (2011) comparing behaviour and inter-individual distances between red junglefowl and white leghorn, used 60 birds and got significant differences between breed. The observed fights between white leghorn and familiar stimuli birds can have affected our results. We were expecting fight in red junglefowl and unfamiliar stimuli birds, therefore we was not surprise when some of our red jungle males performed waltzing towards unfamiliar stimuli birds, which is an aggressive behaviour (Wood-Gush, 1956). A theory why white leghorn males were trying to fight with familiar stimuli birds is that they have bad memory and does not remember the familiar birds. Another theory is that the groups they were kept in are too large for the birds to remember each other. The maximum number of birds in a social group is unknown; Doughles (1948) reported in her study that a bird can recognize 27 other birds, while Guhl (1953) found a social group with 96 birds. It is therefore hard to tell if our groups were too large, the male group of 59 birds and the female group consisted of 42 birds.

In conclusion, the present study showed that social support and social behaviour differs between females and males in both breeds. Females spent more time in the central zone before stressed while males spent more time in the unfamiliar zone. Females from both breeds increased their time in familiar zone after stress. In the males distributed results, red jungle males increased their time in the familiar zone while white leghorn males decreased their time. The breed effect in the interactions differs depending on the sex, white leghorn shown a lower sexual dimorphism than red junglefowl which can be a result from domestication. More studies have to examine social support using an improved experimental setup before a certain conclusion can be drawn about the domestication effect on the social support in red junglefowl and white leghorn.

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