# Hatching System affects Broiler Chick Behavior

**L.J.F. van de Ven,[1,2] Malou Gosselink[2], A.V. van Wagenberg, [1] B. Kemp, [2] and H. van den Brand[2]**

**[1]Vencomatic BV, PO Box 160, 5520 AD, Eersel, the Netherlands. [2]Adaptation Physiology Group, Wageningen University, PO Box 338, 6700 AH, Wageningen, the Netherlands**

**Summary**

The behavior of chickens is influenced by late prenatal and early postnatal conditions, such as light, sound, and communication with other chicks or the mother hen. Currently, in commercial hatcheries chickens hatch in baskets in darkness, in the presence of the background noise of fans and engines of the hatcher. An alternative system is the Patio, a multi-level housing system in which the hatching and brooding phase are combined, and chicks hatch in silence and light. Different conditions during hatching between hatchers and the Patio-system may influence hatching process and post-hatch behavior, which we studied in 2 experiments with broiler chicks. In the first experiment, all chickens received day light during hatching, but were exposed to one of 3 different sound treatments during hatching: 1) without background sound (Patio conditions); 2) background sound of a mother hen, and 3) background sound of a hatcher. Mean hatch time was higher ($P \leq 0.02$), and hatching window was increased ($P<0.01$) in chicks that hatched with the background sound of hatchers compared to other treatment groups. In the second experiment, post-hatch behavior of chickens that hatched from experiment 1 (light conditions), was compared to chicks that hatched in a hatchery (with background sound, in darkness). A social reinstatement test performed at d0, 7 and 32 showed shorter response times in chicks hatched in light conditions at all ages tested ($P<0.01$), but no clear effects were observed when the experiment was repeated.

Present results indicate that hatching window and post-hatch behavior of chicks are affected by hatching system.

## Introduction

In nature, early learning of social and foraging behavior is important for the chick as a precocial species. It must quickly imprint on its mother and conspecifics and discriminate between edible and inedible food shortly after hatching (Rose, 2000). The social behavior of chickens is influenced by late prenatal and early postnatal conditions, such as exposure to light (Bateson and Seaburne-May, 1973; Wichman et al., 2009), sound (Fält, 1981), substrate or presence of conspecifics (Hess, 1964). Effects of prenatal light exposure on chicks' behavior have been attributed to lateralization of the brain. When a chick turns to its' hatching position, the right eye faces the translucent eggshell and any available light, while the left eye is turned towards the body mass and receives little or no light leading to enhanced development of the left hemisphere. (Riedstra and Groothuis, 2003). The effects of prenatal exposure to sounds was recently associated to improved neuronal survival of brainstem auditory nuclei (Alladi et al., 2005).

Nowadays, chickens kept for commercial poultry husbandry worldwide are incubated in large scale hatcheries. The first 17-18 d of incubation of chicken eggs take place in incubators, after which eggs are transferred to hatcher machines for the last 3-4 days of incubation. The entire incubation process takes place in darkness, and in presence of background sound of fans and engines. Chicks hatch over a time window of about 36-48 h, and are only removed from the hatcher machines when the majority of the chicks has hatched (Careghi et al., 2005).

This means that the first 1-2 d of a chicks' posthatch life, which is considered the most sensitive period to learn several social behaviors (Hess, 1964), already passed during the stay of the chicks in the hatcher machine.
An alternative hatching system is the Patio, a multi-level housing system in which the hatching and brooding phase are combined, and chicks hatch in silence and light (Van de Ven et al., 2009). In addition, litter, water, and feed are present from the moment of emergence from the egg. Different conditions during hatching between hatcher machines and the Patio-system may influence behavior during and after hatching. We conducted 2 experiments to study effects of hatching environment on the hatching process and post-hatch behavior of broiler chicks. In the first experiment we focused on the effects of the background sound of the hatching system on hatching pattern, and in the second experiment, we compared the behavior of chicks hatched in the Patio or in a hatcher machine in a runway test.

## Materials and methods

*Hatching pattern.* After 18 days of incubation in a commercial hatchery, fertile hatching eggs were transported to the Patio house in a climate controlled truck and placed in the Patio system upon arrival. Eggs were vertically positioned with the air chamber up, on incubation trays with a capacity of 150 eggs. During hatching, eggs on 3 incubation trays (450 eggs in total) were subjected to one of 3 sound treatments: 1) without background sound (Patio conditions); 2) with background sound of a mother hen, and 3) with background sound of a hatcher machine. The mother hen sound was chosen with help of an expert, and the hatcher sound was recorded using a microphone placed between the eggs inside a commercial hatcher machine. Both sound treatments were played by speakers which were positioned at about 20 cm's above the hatching eggs. During hatching, lights were on (about 21 lux). Video recordings were made of the entire hatching process and analyzed afterwards. Time of emergence of the chick from each egg was registered. This experiment was repeated, so data of 2 cycles, mounting to a total of 900 eggs, were analyzed. Data on the mean time of hatching in minutes, were analyzed using the GLM procedure of SAS 9.1 (SAS institute, 2004), with treatment as main effect, and Levene's test was used to analyze the spread of hatching times (hatch window).
*Runway test.* Social post-hatch behavior was studied of chicks that hatched from the 3 sound treatment groups and of chicks that hatched in a hatcher machine (with background sound, in darkness). After hatch, 50 chicks from each treatment group were individually labeled, mounting to a total of 200 chicks. At 0, 7, and 32 days of age, social reinstatement was tested. Individual chicks of the 4 treatment groups were placed in a random order in a runway (1.3 x 2.0 m), and time until each of the chicks crossed the finish line (latency time) was registered. At the position of the finish line, a goal box with 3-4 (non-familiar) chicks was placed and in addition, peep calls of chicks were continuously played. The maximum latency time was set at 2 minutes. Data on latency times were log-transformed and subjected to survival analyses using the LIFEREG procedure, with day, treatment, and the interaction as main effects. This experiment was repeated, so data of in total 2 cycles, mounting to a total of 400 chicks, were analyzed. $P$–values $\leq 0.05$ were considered statistically significant.

## Results

*Hatching pattern*. Eggs were placed in the Patio system after 440 h and 437 h of incubation in the 1$^{st}$ and 2$^{nd}$ cycle, respectively. In the 1$^{st}$ cycle, mean hatching time in the silent treatment (467.6h) was shorter compared to the mother hen (469.1h; $P<0.01$) and the hatcher sound (474.8 h; $P<0.01$) treatments; and shorter in the mother hen than in the hatcher sound treatments ($P<0.01$). In the 2$^{nd}$ cycle, mean hatching time was shorter in the silent (461.1h) treatment compared to the mother hen (463.1h; $P=0.02$) and the hatcher sound (463.9 h;

*P*<0.01) treatments, but the mother hen and hatcher sound treatment groups did not differ. The hatch windows were affected by sound treatment (*P*<0.01 for both cycles), and mounted to 27, 23 and 38h in the 1st cycle, and 27, 33 and 36 h in the 2nd cycle, for the silent, mother hen and the hatcher machine sound, respectively.

*Runway test*. Mean latency times in the runway test are summarized in Figure 1. In both cycles, mean latency times were not affected by a day x treatment interaction, but significant effects were observed for day (*P*<0.01 in both cycles) and treatment (*P*<0.01 in the 1st cycle; *P*=0.02 in the 2nd cycle). In both cycles, mean latency time was lowest at day 7 (86.2±2.7 s in the 1st and 80.6±2.6 s in the 2nd cycle) and highest at day 32 (97.7±2.6 s in the 1st and 115.0±1.3 s in the 2nd cycle), with intermediate values at day 0 (89.6±2.6 s in the 1st and 110.4±1.9 s in the 2nd cycle). Effects of treatment were clear in the 1st cycle, when longest latency times were observed in chicks hatched in the hatchery at all ages tested. In the 2nd cycle, the differences were less pronounced.

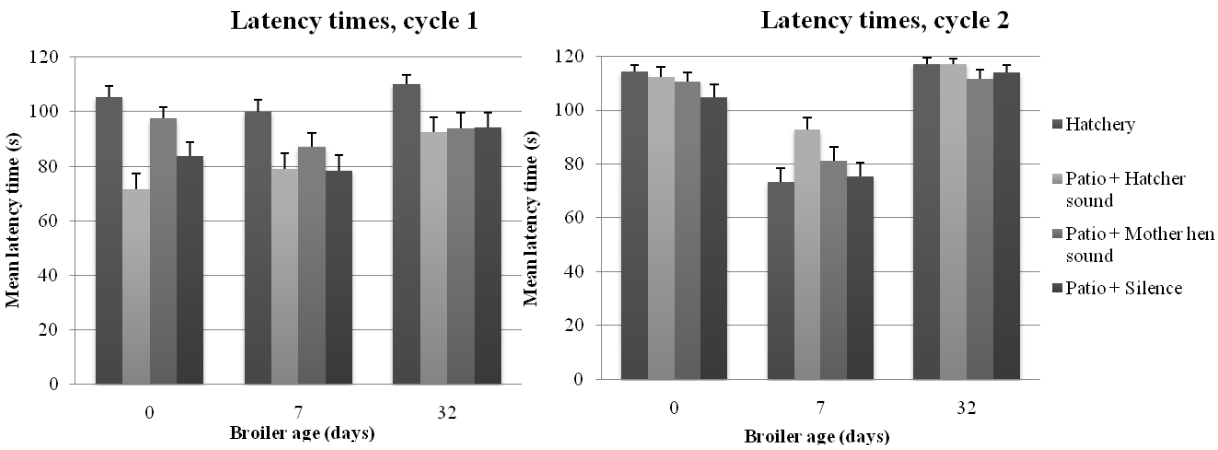


Figure 1. Mean latency times with SE in a Runway test performed at 0, 7 and 32 days of age in broilers hatched in the Hatchery; in the Patio system in presence of Hatcher sounds; in the Patio system in presence of Mother hen sounds; in the Patio system in silence.

## Discussion

In 2 hatching cycles, mean hatching time was shortest in eggs which hatched in silence, compared to eggs that were exposed to the sound treatments during hatching. In addition, hatching windows were largest in hatching eggs exposed to hatcher machine sounds. In several avian species, the hatching process in a clutch of eggs can be synchronized to a certain extent, either by accelerating the hatching process of retarded embryos, or by retarding the hatching process of more advanced embryos, or by both, depending on the species (Vince et al., 1984; Persson and Andersson, 1999). Thus, the time window between the first and the last hatchers can be decreased. A number of external factors are known to influence the rate of the hatching process, such as contact with other eggs, temperature, light, and clicking sounds, which are produced in the final incubation phase, when the embryo starts breathing rapidly (Vince et al., 1984). In chicken, the hatching process is known to be accelerated by clicking (Vince et al., 1970). In the present experiment, embryos in the silent conditions were possibly better able to hear clicking sounds produced by other embryos, which may have decreased mean hatching time and the hatch window.

Runway tests have been widely used to study social reinstatement responses and are considered indicative of underlying sociality in birds (Guzman and Marin, 2008). In the current experiment, shorter latency times were found in the runway test for chickens hatched in the Patio compared to hatchery chicks. It can be speculated that brains of chicks hatched in

Patio conditions, which were exposed to light during the last 3d of incubation, showed a higher degree of lateralization resulting in higher social cognition. Furthermore, if chicks in Patio were better able to hear pre-hatching vocalizations and clicking sounds, this may have stimulated auditory imprinting, and increased responsiveness to the goal box in the runway test. However, the effects of several background sounds within the Patio system were not clear, and in addition, in the second cycle, the effects of sound treatment on latency times were not obvious. These ambiguous results may be related to different parental background of the hatching eggs between the 2 cycles. Present results indicate that hatching window and post-hatch behavior of chicks are affected by hatching system.

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