

## SENSITIVITY TO SOCIAL VISUAL CUES IN THE DOMESTIC CHICK

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### Abstract

*We report recently obtained evidence concerning newborn chicks' predispositions to attend to social stimuli, considering in particular two types of visual cues characterising such stimuli: facial features and self propelled motion. Visually naïve chicks presented for the very first time with face-like vs. non-face-like controlled stimuli show a spontaneous preference to approach faces, and, when briefly presented with objects that exhibit either self-produced motion or motion caused by physical contact, prefer then to associate with self-propelled objects. The role of several perceptual properties was also considered. Symmetry/asymmetry, spatial frequencies, contrast polarity and orientation of features representing the comb were analyzed with regards to face preferences. Spatiotemporal cues were considered with regards to sensitivity to self propelled motion. Overall, our findings support the existence of evolutionarily ancient, predisposed neural mechanisms in the vertebrate brain for the analysis of socially relevant cues.*

Recent evidence consistently suggests the presence, in newborns of different species (including humans, non-human primates and domestic chicks), of early social competences which require the fundamental ability to detect and attend to conspecifics. Visual perceptual cues are crucial for the discrimination of conspecifics from inanimate objects, in particular cues regarding the configuration of features present in the head region of conspecifics as well as cues originated from their motion pattern. For example, human newborns and visually deprived monkeys show a spontaneous preference for looking at face-like stimuli (Morton and Johnson, 1991; Sugita, 2008). Similarly, visually naïve chicks prefer to approach hens (or even other animals) with respect to artificial stimuli, and this preference seems to be triggered by the configuration of features present in the head of the hen (Johnson and Horn, 1988). Moreover, both naïve chicks and human newborns present a striking sensitivity to the motion pattern of animate creatures, showing a preference for point light displays (Johansson, 1973) representing the biological motion pattern of a walking animal with respect to similar displays representing the non-biological motion of an inanimate object (Simion et al., 2008; Vallortigara et al., 2005).

We investigated chicks' sensitivity to visual cues originated by the configuration of face features of animate creatures and by their motion pattern. Results obtained from different research paradigms in our laboratory, and partly yet unpublished, are here for the first time presented together.

### Face preferences in visually naïve chicks

It has been theorized that chicks' and babies' preference for stuffed animals and faces could be due to a face-detecting mechanism active at birth, called CONSPEC: a template-matching device evolved to ensure early attention to animate creatures present in the environment. CONSPEC would contain a simple representation of faces' structure, characterized by the

presence of three high-contrast blobs in an upside down triangular configuration, corresponding to the position of the eyes and the mouth/bill (Morton and Johnson, 1991). The presence of a quite broad template for face detection explains also why chicks' social preferences are not species specific (chicks do not prefer a stuffed hen to another stuffed animal): CONSPEC reacts to the general triangular structure of faces, that is shared between many vertebrate species, especially when their faces are illuminated from above (i.e. according to natural illumination). However, this theory has been criticized suggesting that newborns' face preferences would be due to low-level perceptual properties of faces that render them more visible to newborns' visual system, rather than to their *facedness* (i.e. to the fact that they are faces *per se*). The first two studies that are presented here (Rosa Salva et al., 2010; under review) were aimed at investigating, in chicks, the role of two potentially relevant perceptual properties, namely the vertical asymmetry in the distribution of inner elements (*up-down asymmetry*, considered a crucial factor in babies' face preferences, Turati et al., 2002) and the spatial frequencies composing the stimuli (Kleiner, 1987). In the third and fourth studies, having ascertained that schematic faces are an attractive stimulus for chicks as they are for babies, we decided to investigate the role of a peculiar head feature that is relevant for individual recognition in chickens, but absent in human beings: the comb.

## Method

Subjects were chicks (N=34, 40, 32 and 40, respectively, in the four experiments reported) hatched in complete darkness and then kept in individual cages whose walls were lined with opaque white paper, so that they never had visual experience of other chicks' or humans' faces (a closed cardboard box was used to transport the chicks and manipulation for sexing and daily care was performed only after covering the chick's head). During the 2<sup>nd</sup> day of life chicks underwent a spontaneous preference test between two stimuli simultaneously presented at the two ends of a runway (stimuli's left-right position was balanced across animals). This choice runway was divided into three sectors (each 15 cm long): a central area equidistant from the two stimuli, and two side-areas, each of them adjacent to one of the two stimuli. At the beginning of the test, each chick was placed in the central area of the runway. If the chick remained in the mid compartment this indicated no choice, whereas entrance and permanence of the chick in one of the side compartments was regarded as a preference for the object placed at that end of the runway. Chicks' behaviour was recorded for a total of 6 consecutive minutes using a video camera placed above the apparatus. A computer-driven event recorder allowed the experimenter to score the time spent by the chick in each of the three areas during the test.

In the first experiment, stimuli were a schematic face and a control non-face-like stimulus (having the same outline as the face and the same inner elements, but in scrambled positions), both symmetrical with respect to the sagittal plane and both presenting a higher number of elements in their upper part (i.e. controlled in terms of the *up-down asymmetry*) (see Fig. 1, first pair of stimuli from left, and also Rosa Salva et al., 2010 for details). In the second experiment we exploited the non species-specific nature of chicks' social preferences, using as stimuli a full colour image of a female human face (face stimulus) and a scrambled version of the same image (noise stimulus) artificially constructed with the same spatial frequencies and colour as the face (see Fig. 1, second pair of stimuli, and Rosa Salva et al., under revision, for details). The stimuli used in these two experiments have the advantage of being controlled for potentially relevant perceptual properties and of resembling stimuli used in studies with human newborns, allowing direct comparisons of data obtained in the two species.

In the third experiment reported here, we compared chicks' preference for two schematic faces that differed in the orientation (either horizontal or vertical) of an elongated rectangular feature representing the comb of a hen's face (as it appears on a frontal view, see Fig. 1, third pair of stimuli). In this case the positive stimulus (i.e. the stimulus for which we expected to observe a preference) was the one with the vertically oriented comb, according to the structure of chicks' and hens' faces. Finally, in a fourth experiment we used stimuli having identical outline to those just described, but in which the comb was the only face feature present (see Fig. 1, fourth pair of stimuli). This was done in order to see whether any preference for stimuli with a vertically oriented comb would be evident also in the absence of any other face feature.

### Results and Discussion

In Exp. 1-3 chicks spent significantly more time by the positive stimulus (the face-like stimulus or that with the vertical comb) than expected by chance (chance level: 50%). On the contrary this preference was not significant in Exp. 4, in which the comb feature was presented in isolation within the stimulus outline. Results reveal that visually naïve chicks have a spontaneous, non-species-specific, preference for both schematic and photographic images of faces, which seems due to *facedness*, regardless of the *up-down asymmetry* (Exp. 1) or of spatial frequencies (Exp. 2). Moreover, chicks are also sensitive to the orientation of a schematic comb (Exp. 3), but only when that feature is embedded in a face-like configuration (Exp. 4).

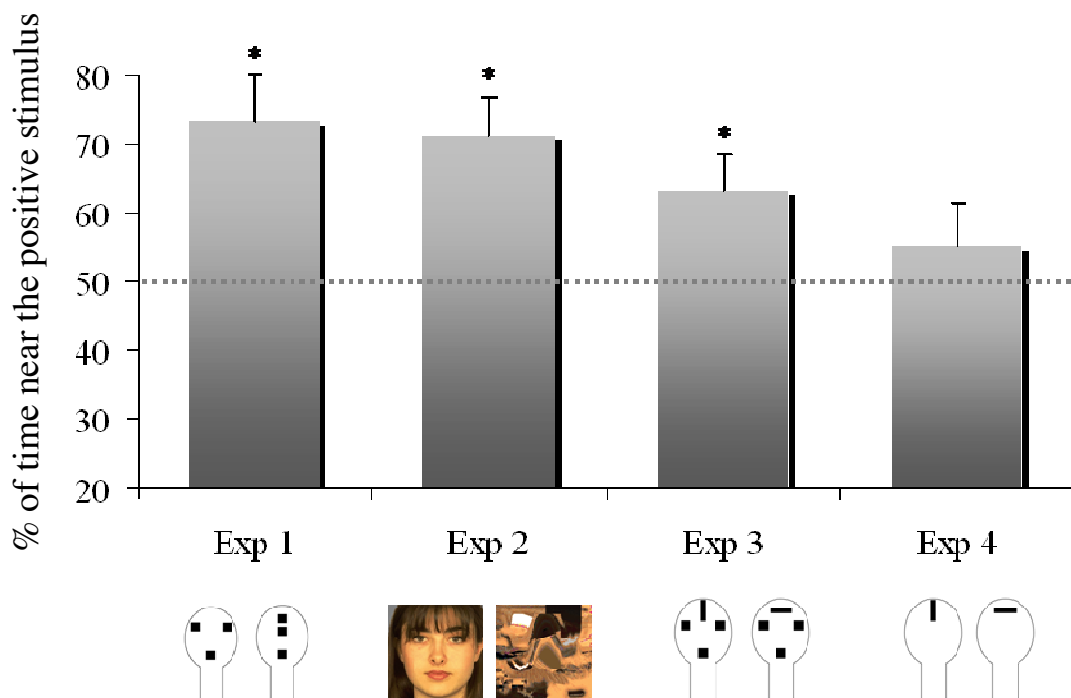


Fig. 1. Mean percentage of time spent at test near the positive stimulus in the four experiments (group means with SEM are shown, the dotted line represents chance level). Test stimuli used for each experiment are depicted below each bar (the positive stimulus is always on the left).

## Animacy detection by newborn chicks

Self-propelled motion seems to provide one of the most powerful cues about what makes an object “animate”, i.e. a type of object distinct from one that can be put into motion only as a result of physical contact. Its role in animacy attribution has been widely demonstrated, giving evidence that infants are sensitive to this particular cue of animacy since 5 months of life, being able to distinguish between motion that has no obvious external cause, and motion caused by an external event such as a collision (Luo et al., 2009). Therefore, it seems possible that human infants may be born with some innate understanding of animacy and that their perceptual system may be designed so that animate entities are inherently appealing (i.e., with perceptual features drawing infants’ attention to them). Nevertheless, the current state of the research cannot exclude the possibility that experience during the first five months of life may have shaped infants’ responses towards animate objects. A further open issue, moreover, regards the phylogenetic origin of animacy attribution: from previous research in non-human primates it remains unclear as to what role self-propelled motion plays in forming an expectation about an object’s potential capacity to move (Hauser, 1998). The research presented here (see Mascialzoni et al., 2010 for details) addresses such two issues: First, does the basic distinction between inert and self-propelled objects also hold true in non-human animal species? Second, does such a distinction emerge as a result of experience/maturation or is it rather predisposed experience-independent?

### Method

Four experiments were conducted to test whether newly-hatched visually *naïve* domestic chicks are sensitive to self-propulsion as a cue to animacy. On their first day of life chicks (N=102, 137, 123, 75 respectively, in the four experiments reported) were exposed to a computer-presented animation sequence picturing two objects which motion could be attributed to either a causal agentive role (i.e., self-propulsion) or a receptive role (i.e., the object appeared as moved by an external force). Immediately after exposure, chicks were tested for their spontaneous preference between those two objects presented at the opposite ends of a runway (the apparatus and procedure were identical to those described in the previous section). If chicks would be able to detect self-propulsion as a cue to animacy attribution, at test they would have chosen the object which had been perceived as self-propelled during exposure.

In Exp. 1 chicks were exposed to two objects performing a typical Launching Effect (Michotte, 1963; see Fig. 2 for a schematic representation of the animations): In this sort of display adult humans perceive a first object as a “self-propelled causal agent” pushing the second one and causing its movement. In Exp. 2 the order of the displacements of the two objects was swapped temporally: any perceived physical causality was disrupted and both objects would thus appear as self-propelled, allowing to control for a possible preference for the first object to move. In Exp. 3 we wondered whether chicks would show a preference for the object applying physical contact over the other, such contact perhaps may act as a cue of “animacy”. A stimulus totally identical to the Launching except for a 3 seconds delay between the time of contact and the motion of the second object was used: object B appeared in this case as being self-propelled, as was object A (Michotte, 1963). Finally, in the fourth and last Exp, we decided to ruled out any preference for the object which simply acted as the “cause” of the motion sequence, in absence of any cue about the nature of its motion (self-propelled vs. inert).

## Results and Discussion

Results showed that only when one of the two objects appeared as being self-propelled, did a preference emerge, as a choice for the self-propelled stimulus (Exp. 1). This preference was not due to a choice for the stimulus that moved first in the animation, since no preference did emerge for either stimulus when both objects appeared as self-propelled (Exp. 2). Physical contact which was not accompanied by physical causation (when both objects appeared as being self-propelled; Exp. 3), or physical causation without any cue about the nature (self/not-self propelled) of the motion of “the causal object” (Exp. 4), moreover, sufficed to abolish any preference.

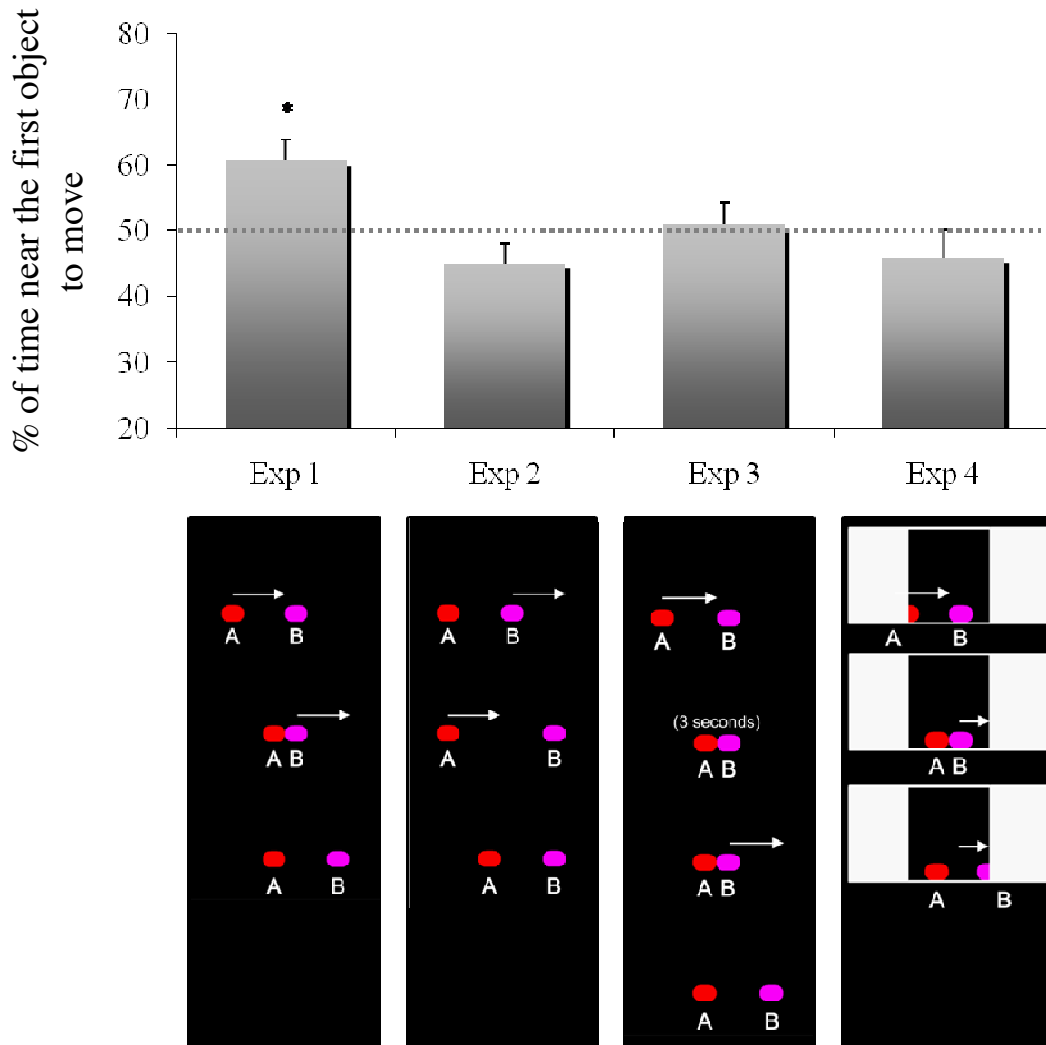


Fig. 2. Mean percentage of time spent at test near the stimulus which moved first in the exposure animation for each experiment (group means with SEM are shown, the dotted line represents chance level). The corresponding animation to which chicks were exposed in each experiment is depicted below each bar.

## Discussion

Overall, findings reported provide strong evidence for chicks' sensitivity to two crucial cues allowing the detection of animate creatures: faces and self-propelled motion. Chicks approached preferentially face-like stimuli (being also sensitive to the orientation of a schematic comb) and self-propelled objects. Such early social competences, independent from previous visual experience and low-level stimuli's perceptual properties, support the presence of predisposed mechanisms to preferentially process information about other living entities. The implications of these findings extend well beyond comparative cognition: the generality of the underlying basic mechanisms (highlighted by the parallelisms with findings in human newborns), together with the availability of a simple animal model, could disclose the door to direct investigation of their neural and genetic bases.

## References

- Aristotle. *The Physics*. Trans. by P. H. Wickstead and F. M. Cornford (1980). Cambridge (MA): Harvard Univ. Press.
- Hauser, M.D. (1998). A nonhuman primate's expectations about object motion and destination: The importance of self-propelled movement and animacy. *Developmental Science*, *1*(1), 31-37.
- Johansson, G. (1973). Visual perception of biological motion and a model for its analysis. *Perception & Psychophysics*, *14*, 201-211.
- Johnson., M. H. & Horn, G. (1986). Dissociation of recognition memory and associative learning by a restricted forebrain lesion of the chicks forebrain. *Neuropsychologia*, *24*, 329-340.
- Kleiner, K.A. (1987). Amplitude and phase spectra as indices of infant's pattern preferences. *Infant Behaviour and Development*, *10*, 49-59.
- Luo, Y., Kaufman, L., & Baillargeon, R. (2009). Young infants' reasoning about physical events involving inert and self-propelled objects. *Cognitive Psychology*, *58*, 441-486.
- Mascalzoni, E., Regolin, L., & Vallortigara, G. (2010). Innate sensitivity for self-propelled causal agency in newly hatched chicks. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(9), 4483-4485.
- Michotte, A. (1963). *The perception of causality*. New York (US): Basic Books.
- Morton, J., & Johnson, M. H. (1991). CONSPEC and CONLERN: a two-process theory of infant face recognition. *Psychological Review*, *98*, 164-181.
- Rosa Salva, O., Regolin, L. & Vallortigara, G. (2010). Faces are special for newborn chicks: Evidence for inborn domain-specific mechanisms underlying spontaneous preferences for face-like stimuli. *Developmental Science*, *13*, 565-577.
- Rosa Salva, O., Farroni, T., Regolin, L., Vallortigara, G. & Johnson, M. H. (under revision). Evolutionary continuity of social brain biases: face preferences in chicks and human newborns. *Developmental Science*.
- Simion, F., Regolin, L. & Bulf, H. (2008). A predisposition for biological motion in the newborn baby. *Proceedings of the National Academy of Sciences of the United States of America*, *105*, 809-813.
- Sugita, Y. (2008). Face perception in monkeys reared with no exposure to faces. *Proceedings of the National Academy of Sciences of the United States of America*, *105*, 394-398.
- Turati, C., Simion, F., Milani, I. & Umiltà, C. (2002). Newborns' preference for faces: what is crucial? *Developmental Psychology*, *6*, 875-882.
- Vallortigara, G., Regolin, L. & Marconato, F. (2005). Visually inexperienced chicks exhibit spontaneous preference for biological motion patterns. *PloS-Biology*, *3*, 1312-1316.