Anim Cogn. Author manuscript; available in PMC 2015 May 04.

Published in final edited form as:
Anim Cogn. 2012 September ; 15(5): 1015–1019. doi:10.1007/s10071-012-0508-8.

You sound familiar: carrion crows can differentiate between the calls of known and unknown heterospecifics

Claudia A. F. Wascher,
Konrad Lorenz Forschungsstelle (KLF), Department of Behavioural Biology, University of Vienna, Fischerau 11, 4645 Grünau, Austria; Department of Cognitive Biology, University of Vienna, Vienna, Austria

Georgine Szipl,
Konrad Lorenz Forschungsstelle (KLF), Department of Behavioural Biology, University of Vienna, Fischerau 11, 4645 Grünau, Austria; Department of Cognitive Biology, University of Vienna, Vienna, Austria

Markus Boeckle, and
Department of Cognitive Biology, University of Vienna, Vienna, Austria

Anna Wilkinson
Department of Cognitive Biology, University of Vienna, Vienna, Austria; School of Life Sciences, University of Lincoln, Lincoln, UK

Abstract

In group-living animals, it is adaptive to recognize conspecifics on the basis of familiarity or group membership as it allows association with preferred social partners and avoidance of competitors. However, animals do not only associate with conspecifics but also with heterospecifics, for example in mixed-species flocks. Consequently, between-species recognition, based either on familiarity or even individual recognition, is likely to be beneficial. The extent to which animals can distinguish between familiar and unfamiliar heterospecifics is currently unclear. In the present study, we investigated the ability of eight carrion crows to differentiate between the voices and calls of familiar and unfamiliar humans and jackdaws. The crows responded significantly more often to unfamiliar than familiar human playbacks and, conversely, responded more to familiar than unfamiliar jackdaw calls. Our results provide the first evidence that birds can discriminate between familiar and unfamiliar heterospecific individuals using auditory stimuli.

Keywords

Interspecies recognition; Familiarity; Vocal information; Playback; Carrion crows

---

C. A. F. Wascher claudia.wascher@gmail.com.

Electronic supplementary material The online version of this article (doi:10.1007/s10071-012-0508-8) contains supplementary material, which is available to authorized users.

Introduction

The ability to differentiate familiar from unfamiliar conspecifics is adaptive as association with familiar individuals decreases aggression (Barnard and Burk 1979; Temeles 1994; Johnsson 2010), increases foraging success (Hojesjo et al. 1998) and can result in enhanced predator detection (Hare 1998). Animals are able to recognize group members on the basis of visual (Parr et al. 2000; Dale et al. 2001; Marechal et al. 2010; Wilkinson et al. 2010), auditory (Rendall et al. 1996; Sayigh et al. 1998; Clark et al. 2006), or olfactory cues (Thom and Hurst 2004; Bonadonna et al.2007).

In nature, animals forage (Powell 1974; Lynnes et al. 2002) and mob predators in mixed-species flocks (Humphrey 1989) interact aggressively with members of other species (Frye 1983; Waite 1984a, b; Wallace and Temple 1987) and recognize and respond appropriately to heterospecific alarm calls (Rainey et al. 2004a; Magrath et al. 2009a; Kitchen et al. 2010). This suggests that animals frequently eavesdrop on information given by heterospecifics (Lea et al. 2008; Magrath et al. 2009b; Fallow and Margrath 2010). Thus, discriminating familiar from unfamiliar individuals of other species is likely to be beneficial for essentially the same reasons as are postulated for individual or class level recognition in conspecifics (Tibbetts and Dale 2007). Recent research has revealed that American crows (*Corvus brachyrhynchos*), magpies (*Pica pica*), and Northern mockingbirds (*Mimus polyglottos*) quickly learn to discriminate between threatening and non-threatening humans (Levey et al. 2009; Marzluff et al. 2010; Lee et al. 2011). However, except in the specific case of predatory situations, very little is known about whether animals are able to discriminate between and respond appropriately to individual heterospecifics. It is therefore particularly interesting to investigate whether they use information about heterospecifics in other contexts and, if so, whether they are able to encode it on an individual level. Contact calls are traditionally thought to encode more information about the caller in order to allow individual recognition than alarm calls in which the animals may respond to a call-specific feature (Snowdon and Cleveland 1980; Chapman and Weary 2005) but see (Blumstein and Munos 2005; Hare 1998; Yorzinski et al. 2006).

In the present study, we investigated whether carrion crows (*Corvus corone corone*) could discriminate between voices and calls of familiar and unfamiliar individuals of two heterospecific species, humans, and jackdaws (*Corvus monedula*). Crows are social-living animals that form long-term relationships with valuable partners and have been shown to recognize individual conspecifics (Yorzinski et al. 2006; Kondo et al. 2012). Free-living crows, jackdaws, and humans all live in a shared habitat (e.g., cities) and frequently use the same foraging and roosting areas (Röell 1978; Waite 1984a). It can therefore be expected that these species are relevant to each other (e.g., eavesdropping on each other’s alarm calls). The crows used in this study are aviary housed and visited by human experimenters and caretakers. A free-living flock of jackdaws forages daily around the Konrad Lorenz research station (KLF) in direct proximity to the crow aviaries. Individuals of both species are thus in regular auditory and visual proximity. Anecdotal observations suggest that the crows do attend to jackdaw calls and, for example, respond with vigilance to jackdaw alarm calls (unpublished observation). This provides an ideal setup to investigate this research question.

Methods

Study subjects and playback stimuli

From June to July 2010, we tested eight captive carrion crows (4 females and 4 males) kept in three large outdoor aviaries at the KLF in Austria.

Five women familiar to the crows and five women unfamiliar to the crows were recorded saying “Hey,” a frequently used greeting when approaching the crow aviaries. Familiar humans had regularly worked with the animals for at least 2 months; unfamiliar humans had never met the crows. From each person, ten different “Hey” stimuli were recorded in a standardized way and used in the playbacks. For the jackdaw stimuli “tchak” contact calls from five familiar and five unfamiliar birds were recorded. Five different calls from each jackdaw were used for the playback. Thus, we ensured that each stimulus of either the human or the jackdaw playback was repeated, at maximum, twice per focal individual. Recordings of familiar jackdaws were collected at the KLF from individuals who either bred directly at the KLF in close proximity to the crow aviaries or frequently joined for the daily feedings. This ensured that the individuals were highly familiar to the crows. Contact calls from jackdaws kept at the ornithological station in Radolfzell, Germany, were recorded for the unfamiliar stimuli. In order to test for inter- and intra-individual variation in human and jackdaw stimuli, we performed a sound analysis, which showed that individual discrimination was significant in humans and jackdaws, whereas calls could not be classified correctly by group membership (for details, see online supplementary material).

One female crow (“Resa”) was kept in Radolfzell before coming to Grünau at the end of April 2010. As we do not have any information on whether this bird was kept within auditory distance of the jackdaw aviary in Radolfzell, we ran the analysis of the behavioral responses to the jackdaw stimuli both without this individual and with the Radolfzell stimuli as familiar and the KLF stimuli as unfamiliar. In contrast, we made sure that she met and was highly familiar with all the human caretakers used in the present experiment. The period of 2 months also exactly corresponded with the minimum familiarization period to the humans for the other crows.

Testing procedure

All birds were tested individually and in auditory isolation from each other. When tested, they entered the test compartment on a voluntary basis. We conducted two sessions for each stimulus type (human and jackdaw) per crow. In each session, 10 stimuli consisting of five familiar and five non-familiar individuals were presented in pseudo-randomized order. We randomized playback stimuli (humans: 1–10 and jackdaws: 1–5), whereby each recording was used only once per session to avoid habituation to specific recordings. The mean duration of each stimulus was 0.302 ± 0.097 s (mean ± SD) for the jackdaw calls and 0.476 ± 0.104 s (mean ± SD) for human vocalizations. The inter-trial interval varied between 45 and 180 s to ensure that stimulus occurrence was not predictable. In addition, after five stimulus presentations, the birds received a 10-min break in each session. The presentation of five stimuli took 4.212 ± 0.599 min (mean ± SD). The birds were given at least a oneweek break between the two sessions of each stimulus type. A human experimenter filmed all responses.

Video and statistical analysis

All trials were coded from videotapes by CAFW using SOLOMON Coder v. 11.09 (András Péter, www.solomoncoder.com). Head and body movement toward the speaker, looking up and changes into vigilance position shortly after the playback stimulus (latency to respond mean ± SE: 0.583 ± 0.174 s) were coded as responses. An inter-observer reliability analysis using the Kappa statistic was performed on 25 % of the trials, which were coded by a second observer (GS; Cohen's *K* human stimuli = 0.826, jackdaw stimuli = 0.896). To analyze the data, we used generalized linear mixed models (GLMMs) with binomial error distribution and a log link function. Response variable was the individuals' behavioral response in each trial (reaction yes/no). Session, sex, identity of the vocal model, and category (familiar/unfamiliar) served as fixed factors. In order to account for repeated measures for each individual, the individual identity was included as random factor. We used second-order Akaike's information criterion (AICc) to choose the best model, starting with all main effects and interactions between all factors and individual identity. All factors and interactions remaining in the final model are presented here, irrespective of their significance. All GLMM analyses were performed in SPSS 19.0.

Results

In response to human stimuli, the familiarity of the caller significantly influenced behavioral responses ($n = 8$, $df = 2$, $F = 43.462$, $p < 0.001$). Crows responded more often to unfamiliar human stimuli (Fig. 1). The interaction between familiarity of the caller and session remained in the final model, but was not significant ($n = 8$, $df = 2$, $F = 1.515$, $p = 0.223$).

Carrion crows' behavioral response to jackdaw calls tended to be influenced by the familiarity of the caller when one female previously housed in Radolfzell was excluded from the analysis ($n = 7$, $df = 2$, $F = 3.033$, $p = 0.052$). Birds responded more to familiar individuals (Fig. 2). The interaction between focal individual and familiarity of the caller remained in the final model but was not significant ($n = 7$, $df = 12$, $F = 0.893$, $p = 0.556$). When the additional bird was included in the statistical analysis but with switched familiarity contingencies (KLF stimuli: unfamiliar, Radolfzell stimuli: familiar), the crows' behavioral response was marginally significant ($n = 8$, $df = 2$, $F = 3.053$, $p = 0.05$).

Discussion

The present study shows that carrion crows discriminate between familiar and unfamiliar humans and jackdaws on the basis of vocal cues. This is the first evidence that birds can differentiate between familiar and unfamiliar individuals of another species using contact calls. This shows that species living in complex social systems like carrion crows may use heterospecific information in addition to information transmitted by members of their own species. Individuals' responses to heterospecific alarm calls are relatively well investigated (Rainey et al. 2004a, b; Magrath et al. 2009a; Fallow and Margrath 2010; Kitchen et al. 2010); however, this study presents first evidence that crows use information in contact calls of heterospecifics. The use of auditory stimuli may be particularly relevant to carrion crows as they belong to the order of songbirds. Thus, acoustic stimuli and their encoded information might play a significant role in their everyday social life and as such a general sensitivity to acoustic information may have been selected for. Little is known about the function of acoustic communication in carrion crows' social life but they are likely to play a role in the context of everyday social interactions (e.g., affiliative and agonistic encounters), reproduction (e.g., mating and territory defense), and enhance cooperative behaviors (e.g., transmitting information about food and predators, helping behavior in the context of cooperative breeding; Parr 1997).

Our study provided the crows with a very limited amount of auditory information; this is in contrast to everyday situations where individuals can evaluate humans based on a combination of large amounts of visual and auditory information. The stimuli in this study were very short, and their presentation was entirely unpredictable for the crows. In addition, they were decoupled from visual information, that is, a human approaching. Still, the crows did respond more often to unfamiliar than to familiar stimuli.

The ability to categorize human individuals based on familiarity might be facilitated by the fact that the crows in this study are captive reared and thus had early and regular exposure to human caretakers. However, the ability to recognize individual humans has been anecdotally described in the free-living bird literature. It is likely that this is facilitated by the fact that crows frequently inhabit human-dominated areas and probably does not require close interactions and bonding with humans (Lorenz 1952; Marzluff and Angell 2005).

Interestingly, the behavior of the crows differed depending on the species of heterospecific. Hence, in crows, heterospecific recognition may be based on different mechanisms or serve different functions depending on the species (Hopp et al. 2001). From our results, it seems that familiar individuals of both jackdaws and humans have similar relevance and crows are responding to them at approximately the same rates; however, they are responding more to unfamiliar humans and less to unfamiliar jackdaws. This suggests that responding to familiar jackdaws might facilitate the association with preferred and the avoidance of non-preferred social partners and recognition of highly successful individuals in a foraging flock might be beneficial. There are currently no studies that we are aware of investigating heterospecific social interactions in mixed-species flocks, and research on this topic would be highly desirable. In contrast, responding to unfamiliar humans may be adaptive given the crow's long history of extensive hunting. In this study, we did not find an effect of type of behavioral response (look up, turn head to speaker, move to speaker, vigilance) depending on familiarity. Therefore, we can only speculate about possible functions of the observed behaviors and further work is required in order to investigate the mechanisms controlling this behavior.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We are grateful to Thomas Bugnyar, Ludwig Huber, and Kurt Kotrschal for their support and Karl-Heinz Siebenrock, Carlos David Santos, and Monika Krome for enabling us access to the jackdaw aviary in Radolfzell and András Péter for the Solomon Coder. We also would like to thank Stephen E. G. Lea and two anonymous referees for valuable comments on the manuscript, Thomas Walsdorff for help with filming and thanks to Ulli Aust, Katharina Kramer, Alexandra Christian, Nadja Kavcik, Vera Brust, Irene Campderrich, Gesche Fitch, Anna Ria Holtmann for providing the stimuli. The project was funded by the FWF project (P19574 AND START2008-1013) the ESF EUROCORES program TECT: COCOR (I105-G11). Permanent support was provided by the "Verein der Förderer" and the Herzog von Cumberland Stiftung.

References

Barnard CJ, Burk T. Dominance hierarchies and the evolution of individual recognition. J Theor Biol. 1979; 81:65–73. [PubMed: 575180]

Blumstein DT, Munos O. Individual, age and sex-specific information is contained in yellow-bellied marmot alarm calls. Anim Behav. 2005; 69:353–361.

Bonadonna F, Miguel E, Grosbois V, Jouventin P, Bessiere JM. Individual-specific odour recognition in birds: an endogenous olfactory signature on petrels' feathers? J Chem Ecol. 2007; 33:1819–1829. [PubMed: 17710497]

Chapman CA, Weary DM. Variability in spider monkeys' vocalizations may provide basis for individual recognition. Am J Primatol. 2005; 22:279–284.

Clark JA, Boersma PD, Olmsted DM. Name that tune: call discrimination and individual recognition in Magellanic penguins. Anim Behav. 2006; 72:1141–1148.

Dale J, Lank DB, Reeve HK. Signalling individual identity versus quality: a model and case studies with ruffs, queleas, and house finches. Am Nat. 2001; 158:75–86. [PubMed: 18707316]

Fallow PM, Margrath RD. Eavesdropping on other species: mutual interspecific understanding of urgency information in avian alarm calls. Anim Behav. 2010; 79:411–417.

Frye RJ. Experimental field evidence of interspecific aggression between two species of kangaroo rat (*Dipodomys*). Oecologia. 1983; 59:74–78. [PubMed: 25024151]

Hare JF. Juvenile Richardson's ground squirrel, *Spermophilus richardsonii*, discriminate among individual alarm callers. Anim Behav. 1998; 55:451–460. [PubMed: 9480711]

Hojesjo J, Johnsson JI, Petersson E, Jarvi T. The importance of being familiar: individual recognition and social behaviour in sea trout (*Salmo trutta*). Behav Ecol. 1998; 9:445–451.

Hopp SL, Jablonski PG, Brown JL. Recognition of group membership by voice in Mexican jays, *Aphelocoma ultramarina*. Anim Behav. 2001; 62:297–303.

Humphrey RC. Observations on cooperative mobbing of a bald eagle. J Raptor Res. 1989; 23:48.

Johnsson JI. Individual recognition affects aggression and dominance relations in rainbow trout, *Oncorhynchus mykiss*. Ethology. 2010; 103:267–282.

Kitchen DM, Bergman TJ, Cheney DL, Nicholson JR, Seyfarth RM. Comparing responses of four ungulate species to playbacks of baboon alarm calls. Anim Cogn. 2010; 13:861–870. [PubMed: 20607576]

Kondo N, Izawa E-I, Watanabe S. Crows cross-modally recognize group members but not non-group members. Proc R Soc B. 2012 doi:10.1098/rspb.2011.2419.

Lea AJ, Barrera JP, Tom LM, Blumstein DT. Heterospecific eavesdropping in a nonsocial species. Behav Ecol. 2008; 19:1041–1046.

Lee WY, Lee S-i, Choe JC, Jablonski PG. Wild birds recognize individual humans: experiments on magpies, *Pica pica*. Anim Cogn. 2011; 14:817–825. [PubMed: 21614521]

Levey DJ, Londono GA, Ungvari-Martin J, Hiersoux MR, Jankowski JE, Poulsen JR. Urban mockingbirds quickly learn to identify individual humans. PNAS. 2009; 106:8959–8962. [PubMed: 19451622]

Lorenz, K. King Solomon's Ring. T.Y. Crowell; New York: 1952.

Lynnes A, Reid K, Croxall J, Trathan P. Conflict or co-existence? Foraging distribution and competition for prey between Adélie and chintrap penguins. Mar Biol. 2002; 141:1165–1174.

Magrath RD, Pitcher BJ, Gardner JL. Recognition of other species' aerial alarm calls: speaking the same language or learning another? Proc R Soc B. 2009a; 276:760–774. [PubMed: 19004753]

Magrath RD, Pitcher BJ, Gardner JL. An avian eavesdropping network: alarm signal reliability and heterospecific response. Behav Ecol. 2009b; 20:745–752.

Marechal L, Genty E, Roeder JJ. Recognition of faces of known individuals in two lemur species (*Eulemur fulvus* and *E. macaco)*. Anim Behav. 2010; 79:1157–1163.

Marzluff, JM.; Angell, T. In the company of crows and ravens. Yale University Press; New Haven, CT: 2005.

Marzluff JM, Walls J, Cornell HN, Withney JC, Craig DP. Lasting recognition of threatening people by wild American crows. Anim Behav. 2010; 79:699–707.

Parr, CS. Social behavior and long-distance vocal communication in Eastern American crows. University of Michigan; Michigan: 1997.

Parr LA, Winslow JT, Hopkins WD, de Waal FBM. Recognizing facial cues: individual discrimination by chimpanzees (*Pan troglodytes)* and rhesus monkeys *(Macaca mulatta)*. J Comp Psych. 2000; 114:47–60.

Powell GVN. Experimental analysis of the social value of flocking by starlings (*Sturnus vulgaris*) in relation to predation and foraging. Anim Behav. 1974; 22:501–505.

Rainey HJ, Zuberbühler K, Slater PJB. Hornbills can distinguish between primate alarm calls. Proc R Soc B. 2004a; 271:755–759. [PubMed: 15209110]

Rainey HJ, Zuberbühler K, Slater PJB. The responses of black-casqued hornbills to predator vocalisations and primate alarm calls. Behaviour. 2004b; 141:1263–1277.

Rendall D, Rodman PS, Emond RE. Vocal recognition of individuals and kin in free-ranging rhesus monkeys. Anim Behav. 1996; 51:1007–1015.

Röell A. Social behaviour of the jackdaw, *Covus monedula*, in relation to its niche. Behaviour. 1978; 64:1–124.

Sayigh LS, Tyack PL, Wells RS, Solow AR, Scott MD, Irvine AB. Individual recognition in wild bottlenose dolphins: a field test using playback experiments. Anim Behav. 1998; 57:41–50. [PubMed: 10053070]

Snowdon CT, Cleveland J. Individual recognition of contact calls by pygmy marmosets. Anim Behav. 1980; 28:717–727.

Temeles EJ. The role of neighbors in territorial systems-when are they dear enemies. Anim Behav. 1994; 47:339–350.

Thom MD, Hurst JL. Individual recognition by scent. Ann Zool Fenn. 2004; 41:765–787.

Tibbetts EA, Dale J. Individual recognition: it is good to be different. Trends Ecol Evol. 2007; 22:529–537. [PubMed: 17904686]

Waite RK. Sympatric corvids. Behav Ecol Sociobiol. 1984a; 15:55–59.

Waite RK. Winter habitat selection and foraging behaviour in sympatric corvids. Ornis Scand. 1984b; 15:55–62.

Wallace MP, Temple SA. Competitive interactions within and between species in a guild of avian scavengers. Auk. 1987; 104:290–295.

Wilkinson A, Specht HL, Huber L. Pigeons can discriminate group mates from strangers using the concept of familiarity. Anim Behav. 2010; 80:109–115.

Yorzinski JL, Vehrencamp SL, McGowan KJ, Clark AB. The inflected alarm caw of the American crow: differences in acoustic structure among individuals and sexes. Condor. 2006; 108:518–529.

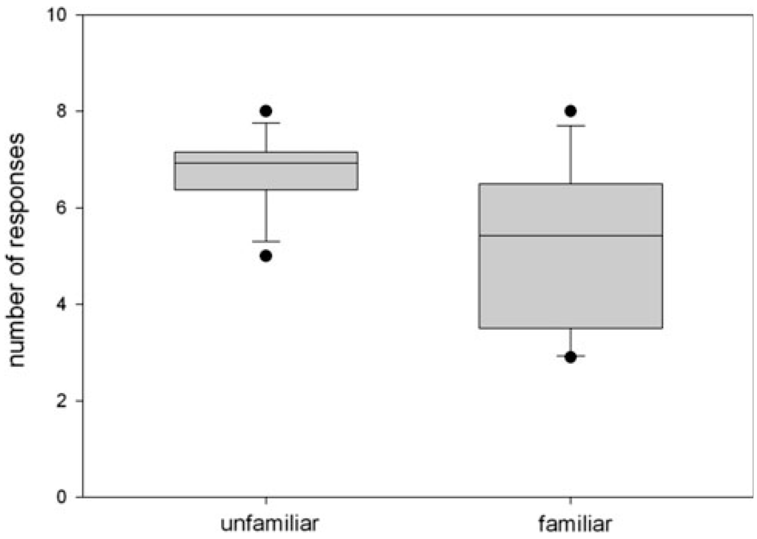

Fig. 1.

Carrion crows' behavioral responses to familiar and unfamiliar human voices. *Y*-axis shows number of behavioral responses to the playback stimuli ($n = 8$)

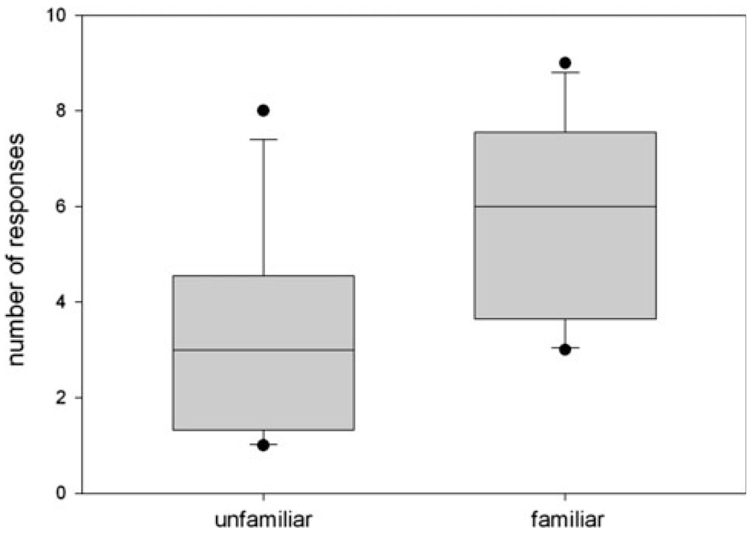

Fig. 2.

Carrion crows' behavioral responses to calls of familiar and unfamiliar jackdaws. *Y*-axis shows number of behavioral responses to the playback stimuli ($n = 7$). One individual ("Resa") previously housed in Radolfzell and with switched familiarity has been excluded from the graph