

# Smelling out predators is innate in birds

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The role of olfaction for predation risk assessment remains barely explored in birds, although predator chemical cues could be useful in predator detection under low visibility conditions for many bird species. We examine whether Great Tits *Parus major* are able to use the odour of mustelids to assess predation risk when selecting cavities for roosting. We analysed whether the response to predator chemical cues is innate and assessed whether the anti-predatory response is associated with exploratory behaviour, a proxy for the personality of birds. In a choice experiment in aviaries, we offered naïve adult Great Tits of known personality two nest-boxes, one control and one experimental. The experimental nest-box had the odour of a mustelid predator or a strong new odour without biological significance, the control nest-box contained no odour. When one of the cavities contained the odour of a predator, birds avoided the use of either of the two offered nest-boxes, whereas there was no avoidance of boxes when one of the nest-boxes contained a control odour. There was no relationship with exploratory behaviour. We show that the ability to use the chemical cues of predators is innate in birds, but individual differences in the response to predator chemical cues cannot be explained by the personality of the bird.

Key words: avian olfaction, chemical ecology, innate, *Parus major*, personality, predation risk assessment

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The importance of chemical communication in different contexts of an organism's life has been extensively studied for a great number of taxa, including invertebrates (Dicke & Grostal 2001) and vertebrates such as reptiles or mammals (Kats & Dill 1998). However, in the case of birds it has been historically neglected (Kats & Dill 1998). Nowadays, it has been shown that olfaction may be a more important sense in birds than was traditionally believed (Steiger *et al.* 2008). Recent evidence suggests that birds can use odours in several ecological contexts and with different functions (Roper 1999, Hagelin 2007, Hagelin & Jones 2007, Rajchard 2007, 2008, Balthazart & Taziaux 2009, Caro & Balthazart 2010). At the intra-specific level, they are known to emit chemical compounds, which are important in several aspects of avian life histories (Caro & Balthazart 2010). For example, birds can recognize

their nest using chemical cues (Mínguez 1997, O'Dwyer *et al.* 2008, Bonadonna & Bretagnolle 2002, Bonadonna *et al.* 2003a,b, 2004, de León *et al.* 2003, Caspers & Krause 2011) and they are able to discriminate the scent of their partners from the scent of other conspecifics (Bonadonna & Nevitt 2004, Jouventin *et al.* 2007). Therefore, chemical cues may play a role in social behaviour (Hagelin 2007). Chemical cues appear to also be useful in the relationship between birds and their environment. For example, birds can use the sense of smell to discriminate aromatic plants (Petit *et al.* 2002, Mennerat *et al.* 2005, Gwinner & Berger 2008), to orientate and navigate (Bonadonna *et al.* 2004, Wallraff 2004, Nevitt & Bonadonna 2005) and to forage (Hutchison & Wenzel 1980, Nevitt *et al.* 1995, Marples & Roper 1996, Kelly & Marples 2004, Cunningham *et al.* 2008).

1 The ability to use chemical cues to ascertain pred- 53  
2 ator presence has been documented in a great number of 54  
3 taxa (Apfelbach *et al.* 2005), but scarcely in birds (Kats 55  
4 & Dill 1998, Hagelin 2007, but see Amo *et al.* 2008, 56  
5 Roth *et al.* 2008). However, using chemical cues to 57  
6 assess predation risk could be important in birds, espe- 58  
7 cially in species that use habitats where visual detection 59  
8 of predators is impaired (Amo *et al.* 2008). This is the 60  
9 case in hole-nesting birds such as the Great Tit *Parus* 61  
10 *major*, that use cavities for breeding and roosting, 62  
11 where they may encounter predators such as mustelids. 63  
12 The chemical cues of predators provide a first assess- 64  
13 ment of predation risk. This may be especially impor- 65  
14 tant when survival depends on ascertaining predator 66  
15 presence and avoiding an encounter with a predator. In 67  
16 this case, natural selection may favour the innate detec- 68  
17 tion of predator chemical cues. Animals may also have 69  
18 the ability to learn to detect and recognize chemical 70  
19 cues of predators, since this ability may be important 71  
20 when confronted with new predators. Naïve animals of 72  
21 several species are known to discriminate the chemical 73  
22 cues of their predators (van Damme *et al.* 1995, 74  
23 Dalesman *et al.* 2007, Sundermann *et al.* 2008). How- 75  
24 ever, whether the recognition of predator chemical cues 76  
25 in birds is innate or learned remains unknown. To our 77  
26 knowledge, the only contexts where the ability to 78  
27 recognize and respond to chemical cues has been 79  
28 proved to be innate in birds is in a foraging context 80  
29 (Bonadonna *et al.* 2006) and in the discrimination of 81  
30 the aromatic plants that some species introduce in the 82  
31 nests (Gwinner & Berger 2008).

32 Although recognition of the chemical cues of pred- 84  
33 ators may confer an advantage to prey as it allows an 85  
34 early assessment of predation risk, it can also lead to an 86  
35 overestimation of risk if the animal continues to avoid 87  
36 an area when the predator is no longer present (Kats & 88  
37 Dill 1998). Therefore, once an animal has detected 89  
38 predator chemical cues, it should evaluate the 'real' risk 90  
39 of predation that these cues are signalling, to perform 91  
40 an adequate anti-predatory response. Furthermore, the 92  
41 response to predator chemical cues may be the result of 93  
42 the trade-off between the anti-predator responses 94  
43 appropriate to the risk perceived and other require- 95  
44 ments such as foraging, reproduction (Lima & Dill 96  
45 1990, Sih 1992) or the avoidance of costs of the anti- 97  
46 predatory response itself (Ydenberg & Dill 1986, Sih 98  
47 1997). Changes in cost-benefits may explain variation 99  
48 in the anti-predatory response of the same individual, 100  
49 as well as differences between individuals differing in 101  
50 sexes or ages that may have a different solution to the 102  
51 trade off between avoiding predation and other 103  
52 requirements (Lima & Dill 1990). However, individual

animals often behave in a way that distinguishes them 53  
from other members of their species of the same sex, 54  
state and age class, and understanding the source of 55  
this variation is fundamental to evolutionary studies 56  
(Bennett 1987, Wilson 1998). 57

Individuals of many animal species are known to 58  
differ consistently in several aspects of their behaviour, 59  
such as aggressiveness, activity, exploration, risk- 60  
taking, fearfulness and reactivity (Wilson *et al.* 1994, 61  
Gosling & John 1999, Réale *et al.* 2007). Suites of these 62  
consistent traits are also referred to as animal personal- 63  
ity, behavioural syndromes, coping styles or tempera- 64  
ment (Koolhaas *et al.* 1999, Sih *et al.* 2004, Groothuis 65  
& Carere 2005, Réale *et al.* 2007) and are comparable 66  
to how humans differ in personality. 67

Here, we explore the use of chemical cues of pred- 68  
ators for predation risk assessment when selecting cavi- 69  
ties for roosting by a hole-nesting songbird, the Great 70  
Tit. Firstly, we aimed to determine whether the ability 71  
to detect predator chemical cues for roosting selection 72  
is innate in birds. Roosting may be an important behav- 73  
iour for overwinter survival, as one of the benefits of 74  
sleeping in a cavity is a decrease in energetic costs 75  
during cold nights (Walsberg 1986, Webb & Rogers 76  
1988). Birds actively select warmer and thermally more 77  
stable roosting places (Veľký *et al.* 2010). Furthermore, 78  
birds also avoid roosting in cavities containing the 79  
signals of predators (mammal fur and mangled feath- 80  
ers) (Ekner & Tryjanowski 2008). Roosts also help to 81  
decrease the risk of predation by owls, but increase the 82  
risk of predation by mammals such as mustelids 83  
(Dhondt *et al.* 2010). Differences in the costs and bene- 84  
fits of roosting in different populations may have exert- 85  
ed different selection pressures that have led to 86  
population differences in the use of cavities during the 87  
night (Dhondt *et al.* 2010). Dhondt *et al.* (2010) 88  
showed that Blue Tits *Cyanistes caeruleus* from popula- 89  
tions where owls are scarce and mammals abundant 90  
did not use cavities for roosting, while birds from popu- 91  
lations where the relative abundances of predators is 92  
the opposite did. Therefore, if natural selection favours 93  
the use of cavities while the costs of this behaviour are 94  
lower than its benefits, it may also favour the ability to 95  
assess the costs of roosting, such as the innate detection 96  
of chemical cues of predators. Thus, we hypothesized 97  
that the response to predator chemical cues may be 98  
innate in birds, as it may be subjected to strong selec- 99  
tion. We expect this because mustelid predators can be 100  
hidden in cavities where visual detection is difficult, 101  
and once the bird has entered a cavity containing a 102  
predator survival is unlikely. Secondly, we aimed to 103  
examine whether the personality of individuals influ- 104

ences the response to predator chemical cues in order to understand individual variability in anti-predatory behaviour. In the Great Tit, birds from wild populations can be placed along an axis ranging from slow to fast explorers in a novel environment (Verbeek *et al.* 1994, Drent *et al.* 2003). This is correlated with differences in their reaction to novel objects (Verbeek *et al.* 1994), aggressiveness (Verbeek *et al.* 1996), recovery time and behaviour after lost contests (Verbeek *et al.* 1999), foraging behaviour (Drent & Marchetti 1999, Marchetti & Drent 2000) and reactions to stress (Carere & van Oers 2004, Fucikova *et al.* 2009). Artificial selection combined with cross fostering resulted in clear evidence for a genetic basis of these traits (heritabilities between 20 and 50%; Drent *et al.* 2003, van Oers *et al.* 2004b) and in natural populations variation in personality was found to be under natural (Dingemanse & Réal 2005) and sexual selection (van Oers *et al.* 2008). The personality of birds is also related to the response of birds to a risky situation, with fast Great Tits being more prone to return to a risky feeding place than slow individuals (van Oers *et al.* 2004a). Therefore, we hypothesize that birds of different personality types may also differ in their anti-predatory behaviour when exposed to predator chemical cues, with slow birds exhibiting a greater anti-predatory response than fast birds.

## METHODS

### Study species

We used 20 hand reared captive Great Tits (8 females and 12 males) belonging to the 4th generation of a bidirectional artificial selection program for fast and slow (7 fast and 13 slow) exploratory behaviour (for details see Drent *et al.* 2003). All birds were 1 year old. Birds used in the experiments were naïve to predator odour, as they were maintained in captivity since 10 days after hatching. Furthermore, nest-boxes where nestlings were reared during the first 10 days of their life were frequently inspected and neither predation events nor signals of predator visits were detected.

Birds were housed individually in cages of 0.9 m (L) × 0.4 m (W) × 0.5 m (H), with wooden bottom, top, side, and rear walls, a wire-mesh front, and three perches. The bottom was covered with sawdust. They were kept under natural winter daylight augmented with fluorescent light tubes and provided with ad libitum water, sunflower seeds, a commercial dry mixture (proteins, trace elements, minerals, and vitamins), a fresh mixture of raw heart and live mealworms. A week

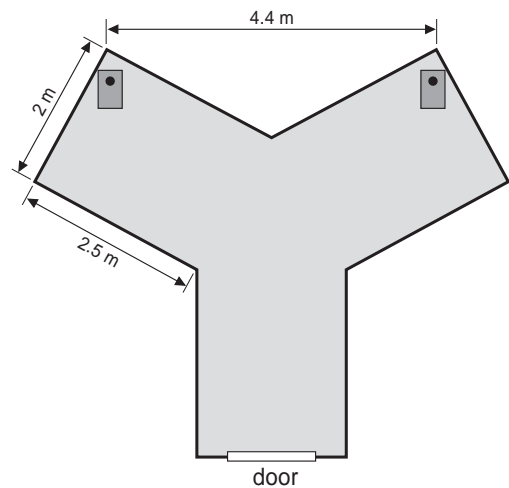


Figure 1. The aviary where the experiment was carried out.

before the experiment, the Great Tits were released into the experimental aviary individually for one hour to decrease stress due to novelty of the environment during the experiment. Birds did not exhibit any sign of stress and were healthy during the experiment.

### Experimental set up

The experiment was carried out during February and March 2007. We performed the experiment in two outdoor Y-shaped aviaries (Fig. 1). Aviaries were built with mesh screens (mesh size 1.3 cm), with each branch of the aviary measuring 2.5 m × 2 m × 2 m. The central branch was closed 72 cm from the intersection with the other two branches. Each aviary contained food and water and two perches, one near each nest-box. The perches were branches of trees, of similar shape and number of small branches. One nest-box was placed at the end of each of the branches of the aviary, separated 4.4 m from each other (Fig. 1). One of the nest-boxes was a control and the other the experimental nest-box. The control nest-box contained an 'odourless control' (water). The experimental nest-box had one of the following treatments impregnated in absorbent papers: a) 'predator' (ferret scent) (see Amo *et al.* 2008) or b) 'cologne' (Eau de Cologne from Hema).

We prepared the odourless control treatment by adding several drops of water to a clean absorbent paper. We did this to resemble the level of humidity of the papers containing the two other treatments, and water has been widely employed as an odourless control stimulus in studies on chemical detection (e.g. Cooper & Burghardt 1990, Cooper 1998, Amo *et al.*

2004, 2008). We obtained predator odour by placing clean absorbent papers inside the cage of a male Ferret *Mustela furo*. Even though Ferrets are not natural predators of Great Tits, the scent (especially that produced by an anal sac secretion used to mark the territory) is very similar to those of other mustelids as Stoat *Mustela erminea* (Brinck *et al.* 1983) that include birds in their diets. This similarity in odour may explain why ferret scent is recognized and avoided by other species that are not a natural prey of this mustelid, including birds (e.g. Zhang *et al.* 2007, Amo *et al.* 2008). In our study area, European Pine Marten *Martes martes* is present, and predated Great Tits (pers. obs.).

The Ferret was housed in a 100 × 60 × 50 cm cage. It had water and food (dry pellets for Ferrets) ad libitum. We placed papers in the Ferret cage three days before the experiment, to ensure odour collection. When collecting papers daily for the experiment, we selected wet papers containing fresh urine. This method of odour collection has proven successful in previous studies with hole-breeding passerines (Amo *et al.* 2008). The cologne treatment was obtained by placing some drops of 50% diluted Eau de Cologne on clean absorbent papers. We used cologne as an odorous control that allows us to compare the behaviour of birds when they find the odour of a predator inside the nest-box or a new pungent odour without biological significance.

We added the corresponding treatment to the nest-boxes by introducing an absorbent paper (12 × 7 cm) soiled with the corresponding odour in a plastic-mesh cage completely covering the bottom of the nest-box. In this way, the birds could not touch the paper. Furthermore, to avoid birds visually detecting the paper with the treatment, we placed a clean absorbent paper on this mesh cage. On each test day, we used new papers and clean nest-boxes. We cleaned the nest-boxes with water and soap. The location of treatments (control vs. experimental) in the nest boxes of an aviary was balanced, as well as the treatments in the aviaries (cologne vs. predator). To control for a possible effect of ambient conditions in the behaviour of birds, every test day one of the aviaries contained the cologne treatment and the other aviary contained the predator treatment.

Birds were released in the aviary one and a half hours before sunset to allow them to inspect the aviary and the nest-boxes before choosing one to spending the night in. We filmed the behaviour of birds during one hour with a video camera located 5 m in front of each aviary. We recorded the nest-box visited for the first time and the proportion of visits to the experimental

nest-box in each treatment. We defined a visit as when a bird perched on the entry hole of the nest-box. We could not record the behaviour of three birds due to problems with the video camera. We determined which nest-box the bird spent the night in by examining the presence of faeces inside the nest-boxes. This is a reliable method to assess the use of a nest-box, since results of another study, in which we forced birds to sleep in cavities containing different scents, including predator scent, show that birds always defecate during the night (L. Amo, S.P. Caro and M.E. Visser, unpubl. data). We thereby noted whether the birds used the control nest-box, the experimental nest-box or whether they spent the night outside any nest-box. We performed a repeated measures design: all birds were tested in the two treatments (predator and cologne) in a balanced order. The following morning, birds were captured and returned to their cages. Only one trial was conducted per bird per day, and there was at least one week between trials with the same bird.

### Statistical analyses

We analysed whether there were differences between treatments and personality types in the nest-box of the aviary visited first, as well as in the proportion of visits to the experimental nest-box by using generalized linear mixed models (GLMM; lmer in R package lme4) with binomial errors and a logit link function. In order to analyse the location where the bird spent the night, we distinguished two dependent variables: (1) whether the bird slept inside any nest-box or outside; (2) when the bird used a nest-box, whether the bird slept inside the control or the experimental nest-box. We analysed whether both variables were affected by treatment and personality with GLMM with binomial errors and a logit link function. We included the interaction in the models to test whether the response to the treatments differed between fast and slow birds. We also included the individual as a random factor. We used the software package R 2.7.2 and STATISTICA for statistical analysis. We calculated the power of a McNemar's test analysing the proportion of birds that slept outside or inside the nest-box without including the personality (Power = 0.87), and separately for each personality type (Power: for slow birds = 0.74, for fast = 0.02).

## RESULTS

There were no differences in the behaviour of males and females in any of the variables considered ( $P > 0.05$  in all cases), or in the number of males and females

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1 that slept outside the nest-box or inside any nest-box in  
 2 the cologne (Chi-squared test:  $\chi^2_1 = 1.20$ ,  $P = 0.27$ )  
 3 and predator treatments ( $\chi^2_1 = 0.59$ ,  $P = 0.44$ ). The  
 4 sexes did not differ in their choice of nest-box in the  
 5 cologne ( $\chi^2_1 = 0.03$ ,  $P = 0.86$ ) and predator treat-  
 6 ments ( $\chi^2_1 = 1.89$ ,  $P = 0.17$ ). Therefore, we did not  
 7 include the sex of birds in subsequent analyses.

8 During the first hour of observed behaviour, all  
 9 birds visited at least one of the nest-boxes. More birds  
 10 approached the experimental nest-box before the  
 11 control nest-box when the experimental box contained  
 12 predator scent (12 vs. 5) compared to when the experi-  
 13 mental box contained cologne scent (7 vs. 13) (lmer:  
 14  $\chi^2_1 = 4.65$ ,  $P = 0.03$ ). There were no significant differ-  
 15 ences between personality types (lmer:  $\chi^2_1 = 0.54$ ,  $P =$   
 16  $0.46$ ), and also the interaction was not significant  
 17 (lmer:  $\chi^2_1 = 1.98$ ,  $P = 0.16$ ). The proportion of visits  
 18 to the experimental nest-box did not differ between  
 19 treatments (lmer:  $\chi^2_1 = 1.52$ ,  $P = 0.22$ ) or personality  
 20 type (lmer:  $\chi^2_1 = 0.14$ ,  $P = 0.71$ ). The interaction was  
 21 also not significant (lmer:  $\chi^2_1 = 1.69$ ,  $P = 0.19$ ).

22 When one of the nest-boxes contained predator  
 23 scent, more birds did not use any nest-box and slept  
 24 outside than when one of the nest-boxes contained  
 25 cologne (lmer:  $\chi^2_1 = 17.86$ ,  $P < 0.0001$ ; Table 1). There  
 26 were no differences in this behaviour associated with  
 27 the personality of the birds (lmer:  $\chi^2_1 = 0.02$ ,  $P = 0.90$ )  
 28 and also the interaction between treatment and person-  
 29 ality was not significant (lmer:  $\chi^2_1 = 0.10$ ,  $P = 0.75$ ),  
 30 indicating that birds with different personality types did  
 31 not react differently to the presence of predator scent.

32 Within birds that used a nest-box, there was no  
 33 difference in the number of birds that slept inside the  
 34 control or the experimental nest-box between treat-  
 35 ments (lmer:  $\chi^2_1 = 1.18$ ,  $P = 0.28$ ; Table 1), neither  
 36 did personality affect this choice (lmer:  $\chi^2_1 = 2.81$ ,  
 37  $P = 0.09$ ). The interaction between treatment and  
 38 personality was not significant (lmer:  $\chi^2_1 = 1.35$ ,  
 39  $P = 0.25$ ), indicating that birds of different personality  
 40 did not differ in their reaction to the treatment.

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 42 **Table 1.** Number of birds (by type, 'fast' or 'slow' birds) that spent the night in the control nest-box, experimental nest-box or outside  
 43 any nest-box in the 'Cologne' or 'Predator' treatments.

Type	Cologne treatment			Predator treatment		
	Control nest-box	Experimental nest-box	Outside	Control nest-box	Experimental nest-box	Outside
Fast	4	2	1	1	4	2
Slow	10	3	0	6	2	5
Total	14	5	1	7	6	7

## DISCUSSION

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 55 Our results provide evidence that birds can detect the  
 56 chemical cues of predators and use them to assess the  
 57 level of predation risk while selecting cavities to roost in.  
 58 When there was predator scent in one of the nest-boxes,  
 59 more birds slept outside a nest-box. These results agree  
 60 with the experiment of Ekner & Tryjanowski (2008) in  
 61 natural conditions that shows that small hole nesting  
 62 passerines, mainly Great Tits, prefer to roost in control  
 63 nest-boxes compared to nest-boxes containing signals of  
 64 predators and predation (mammal fur and mangled  
 65 feathers). Our results are also in accordance with previ-  
 66 ous studies on Blue Tits (Amo *et al.* 2008) and House  
 67 Finches (Roth *et al.* 2008), which show that birds can  
 68 detect and use chemical cues of predators in a reproduc-  
 69 tive and a foraging context, respectively. We did not find  
 70 any significant effect of the cologne treatment on choos-  
 71 ing a nest-box for roosting, despite the fact that birds are  
 72 known to exhibit aversive responses to unknown odours  
 73 (Jones *et al.* 2002; reviewed in Roper 1999). Therefore,  
 74 this suggests that birds are responding to specific preda-  
 75 tor chemical cues but not to a new scent or a non-biolog-  
 76 ical scent, comparable to previous results using different  
 77 controls such as bird scent (Amo *et al.* 2008) or non-  
 78 predatory mammal scent (Roth *et al.* 2008). However,  
 79 we did not find differences in the use of nest-boxes  
 80 between control and experimental nest-boxes, which  
 81 suggests that birds perceived the whole aviary as a risky  
 82 area. This result may be explained because the mini-  
 83 mum home range of the European Polecat *Mustela puto-*  
 84 *rius* is 60 hectares (Blanco 1998), and therefore, the  
 85 presence of predator chemical cues in one of the nest-  
 86 boxes may indicate an elevated risk of predation at both  
 87 boxes inside the aviary. Our results provide the first  
 88 evidence that the chemical detection of predators is  
 89 innate in birds, as it has been previously found in other  
 90 taxa (Turner *et al.* 2006, Sundermann *et al.* 2008).

91 Our results show that individual differences in the  
 92 response to predator chemical cues could not be  
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1 explained by the personality of the individual. This is  
 2 despite the results of a previous study that showed that,  
 3 in a foraging context, the personality of birds helped to  
 4 explain individual differences in anti-predatory behav-  
 5 iour, with slow Great Tits returning later to a feeding  
 6 place after being startled than fast individuals (van  
 7 Oers *et al.* 2004a). Birds were released in the aviary at  
 8 least one and a half hours before sunset, when they  
 9 usually explore potential sites for roosting (Velký *et al.*  
 10 2010) and therefore, they had time to assess the risk of  
 11 predation by using chemical cues and to respond to it.  
 12 Furthermore, more birds approached the experimental  
 13 nest-box first when it contained predator chemical cues  
 14 than when it contained a control scent; i.e. they  
 15 inspected the predator-scented nest-boxes before nest-  
 16 boxes containing a control scent. They thereby perched  
 17 on the hole of the nest-box, looking around and inside.  
 18 This inspecting behaviour may allow birds to identify  
 19 the odour source and assess predator presence. This  
 20 predator inspection behaviour has been described in  
 21 many prey fish (Brown & Dreier 2002), but birds are  
 22 also known to approach predators during nest defence  
 23 (Regelmann & Curio 1983). This result indicates that  
 24 Great Tits were able to detect the chemical cues of  
 25 predators from outside the nest-box, in agreement with  
 26 previous findings (Amo *et al.* 2008). Also, after the first  
 27 visit, both cologne and predator scented nest-boxes  
 28 were visited similarly. The personality of birds did not  
 29 influence which nest-box was visited for the first time  
 30 and the proportion of visits to the experimental nest-  
 31 boxes or the choice between either sleeping inside or  
 32 outside one of the nest-boxes. However, we may have  
 33 incurred Type II error due to the low sample size of  
 34 each personality type used in the experiment, therefore,  
 35 the low power of our test in relation to personality does  
 36 not allow us to draw strong conclusions. Thus, the  
 37 factors affecting the anti-predatory behaviour of birds  
 38 that perceived the chemical cues of predators remain  
 39 unclear. Further research is needed to try to disentangle  
 40 the causes of individual variation in the anti-predatory  
 41 responses of birds to predator chemical cues.

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 50 col no CTE 07.01).  
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## SAMENVATTING

Er is weinig onderzoek verricht naar de rol die het ruikvermogen bij vogels speelt om de aanwezigheid van roofdieren vast te stellen. Vooral in het donker zouden vogels er veel baat bij kunnen hebben als ze roofdieren kunnen ruiken. De auteurs onderzochten of koolmezen *Parus major* de keuze voor een slaappleaats laten beïnvloeden door de geur van marterachtigen. Tevens werd onderzocht of de reactie op de geur van roofdieren aangeboren is. Ook werd nagegaan of exploratief gedrag (een maat voor de persoonlijkheid van de vogels) hierbij een rol speelt. In de experimenten met koolmezen die in gevangenschap waren opgegroeid, bestond de keuze uit twee typen slaappleaatsen. Het ene type was een sterk ruikende nestkast die of behandeld was met de geur van marterachtigen of met parfum, het andere een niet-behandelde nestkast. Wanneer een van de twee kasten naar een marter rook, vermeden de mezen beide nestkasten. Parfum daarentegen schrikte de mezen niet af. De conclusie wordt getrokken dat het vermogen om gebruik te maken van de geur van roofdieren aangeboren is. De persoonlijkheid van de mezen speelt hierbij volgens de experimenten geen aantoonbare rol. (DH)

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