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# Situation and context impacts the expression of personality: The influence of breeding season and test context

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## ABSTRACT

Non-human animal personality is defined as consistent behavioural differences across time and situations/contexts. Behaviours are, however, often plastic and to explain how plasticity and personality may coexist an adaptive framework has been developed. Still, there is little information on how personality is impacted by situations and contexts on an individual level. We investigated this in the European mink (*Mustela lutreola*) by performing a set of five experiments in two situations consisting of non-breeding and breeding season, and by using different test contexts. Three personality trait domains were identified; boldness, exploration and sociability. The levels of boldness and exploration changed between seasons but remained repeatable, which implies behavioural reaction norms and supports that the concept of personality remained applicable despite plasticity. Whilst males became bolder and more explorative in the breeding season females became shyer, which reflects European mink breeding behaviour. Furthermore, behaviours performed in mirror stimulus tests fell into different domains depending on whether, the test was conducted in the own territory or not, suggesting plasticity in the response towards conspecifics. To conclude, our results highlight the importance of situation and context for the expression of personality, and the significance of measuring multiple personality trait domains with several methods.

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## 1. Introduction

Animal personality is defined as consistent behavioural differences between and within individuals across time and situations/contexts<sup>1</sup> (Gosling, 2001; Sih et al., 2004a). In the broadest sense, animal personality is considered to be the internal organisation of behaviour that is stable but not necessarily non-plastic over considerable time, and yet varies among individuals (Uher, 2011).

That the concept of personality (including similar terms such as behavioural syndromes) could coexist with behavioural phenotypic plasticity has been questioned with the argument that

animals can adapt their behaviour to different situations and contexts rather, than being constrained to exhibiting the same, possibly maladaptive, level of a behaviour across situations and contexts (Neff and Sherman, 2004). However, although behaviour might change, individuals still differ consistently in behaviour within situations and contexts, and they may also differ in how their behaviour possibly changes (Sih et al., 2004b). The level of phenotypic plasticity has indeed been shown to differ consistently between individuals of many species (reviewed in Dingemans et al., 2009) and plasticity thus appears to be a trait which construct closely resembles that of personality traits. It has even been suggested that plasticity might in fact be a personality trait (Carter et al., 2012a).

In order to examine the combination of behavioural plasticity and personality an adaptive framework have been developed with behavioural reaction norms in the centre (Nussey et al., 2007; Dingemans et al., 2009). Such behavioural reaction norms have, for example, been shown in Namibian rock agamas (*Agama planiceps*) as a response to changing seasons (Carter et al., 2012a). However, albeit this theoretical advance regarding analysing plasticity and personality there are still few studies that have investigated how the expression of personality in individuals is affected by different contexts and situations (e.g. fish: Coleman and Wilson, 1998; birds:

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<sup>1</sup> We use the definitions of context and situation that can be found in Sih et al. (2004), where context stands for a functional behavioural category, such as antipredator behaviour, territorial behaviour or parental care, and situation for the conditions either, at one point in time or across time, for example, environmental variation along a continuum (such as predation risk) respectively non-breeding versus breeding season.

van Oers et al., 2005; Schuett and Dall, 2009; laboratory rodents: Kanda et al., 2012). For example, the latency to return to feeding after a mild startle has been measured in great tits (*Parus major*) in both a social and non-social context. Context had a relationship to the expression of personality trait domains (groups of correlated behaviours, for example, boldness or exploration) but the impact of context varied with sex and whether, males were fast or slow in their explorative behaviour (van Oers et al., 2005). In squids, however, where the influence of context have been studied on several personality traits simultaneously, behaviours measured in different test contexts fell into the same personality trait domains (e.g. boldness and reactivity) with only one exception (Sinn and Moltschaniwskyj, 2005). Whether, there is a plastic response in the expression of personality to situations or context can thus seemingly vary between species, but if between-species differences are due to different adaptations, physical constraints or other, reasons is yet to be tested. However, in order to do so more empirical data are needed on the responses to both contexts and situations in ecologically significant contexts.

The most well-studied personality trait domain is boldness (Conrad et al., 2011; Réale et al., 2007). However, for a more complete understanding of the impact of personality on, for example, dispersal, reproduction and survival, we need to include more personality trait domains than boldness in our analyses (Réale et al., 2007). The first step towards such an understanding could be to simultaneously explore a number of personality trait domains and examine how behavioural traits are distributed within and between these domains. Moreover, in order to understand how personality relates to fitness it is probably more informative to include multiple personality trait domains based on several traits.

We used non-domesticated captive bred specimens of the critically endangered European mink (*Mustela lutreola*) to investigate multiple personality trait domains and to test if personality trait domains were affected by (1) situation; by following individuals from non-breeding season to breeding season and (2) context; in this case behaviour in the home territory and outside of it, in a novel arena. The breeding season of the European mink is connected to heightened levels of sex hormones in the spring (Amstislavsky et al., 2009; A. Nagl, pers. commun.). It has been suggested that the best approach to examine personality in non-human species should be based on the ethological tradition with a careful documentation of behaviours and how an animal handles different situations (Nettel, 2008). Therefore, in order to identify personality trait domains and examine how situation and context affects them, each individual was exposed to five personality experiments, measuring 21 behavioural traits in total. The experiments were performed in the fall (non-breeding season) and repeated in the following spring (breeding season).

## 2. Methods

### 2.1. Animals

The European mink is a solitary living semi-aquatic small carnivore that inhabits riverbanks, brooks and wetlands. The species has been declining heavily since the 19th century and is now extinct in large parts of its former area of distribution (Maran and Henttonen, 1995; Maran et al., 1998). Furthermore, it is classified as critically endangered in the red list (IUCN Redlist, 2012) and listed on Appendix II of the Bern Convention.

The experiments were conducted at the conservation breeding facility of Tallinn Zoological Gardens (off-public) in Estonia. The animals were captive-bred and lived in individual partially roofed outdoor enclosures (200 cm × 400 cm × 180 cm) with tunnels, roots, vegetation and water for swimming (64 cm × 35 cm × 30 cm).

They also had access to a nest box (with straw) divided into two compartments (each compartment being 34 cm × 25 cm × 27 cm) connected to the enclosure with a ladder. The animals were fed once a day with rodents, fish, birds or minced meat mixed with carrots. Human contact was minimised in the everyday handling, however, animal keepers entered the enclosures every day to clean and give food and thus the animals were somewhat habituated to human presence.

Animal welfare was taken deeply into regard in the experimental design; however, according to Estonian law and EU-legislation there was no need of specific permission for the animal testing in this study. The animals were kept as usual after the behavioural study.

### 2.2. Experiments

The experiments were conducted in November–December 2009 ( $N_{\text{total}} = 80$ ,  $N_{\text{female}} = 40$ ,  $N_{\text{male}} = 40$ ) and in the breeding season March–April 2010 ( $N_{\text{total}} = 68$ ,  $N_{\text{female}} = 32$ ,  $N_{\text{male}} = 36$ ). During the breeding season none of the tested individuals were mated before or during the time of the experiments. Written protocols and a Sony handycam DCR-DVD 106E were used to record the trials.

In both seasons five different trials were performed with each individual, whereof three in the home enclosures and two in an indoor novel arena (with 125 cm high plywood walls measuring 190 cm × 240 cm, placed on tile floor). Pilot trials were conducted with animals that would not participate in the experiments in order to develop the experimental setups. For example, the pilot trials were used to test that the animals did not respond to the mirror as a novel object but actually focused on the mirror image.

Behaviours were scored only the first time they were made since repeated scoring was not regarded as a good measure. For example, repeated scores could result in that an individual that approaches a novel object numerous times but that does not dare to examine it gets a higher, score than an individual that approaches and attacks at once and then holds the novel object until the end of the trial (this occurred frequently). Furthermore, measuring how many times a novel object was bitten, for example, was rarely possible since the animals often carried the object away and hid with it under some obstacle in the enclosure. We gave higher, scores the earlier a behaviour was made. This helped in distinguishing between individuals on different positions along behavioural continuums since individuals that, for example, attacked a novel object immediately clearly differed in their behaviour from individuals that hesitated, sometimes for several minutes, before attacking. The test period of 4 min was thus divided into three 80 s periods. A behaviour gave 3 points if it was performed in the first 80 s period, 2 points in the second period and 1 point in the last period.

In all the different experiments the latency to leave the nest or transport box was measured in s (with a maximum of 240 s). The animal was regarded to be outside the box when the whole body including the tail was out for at least 1 s. The boxes were open during the trials and the animals could return at any point. Prior to the experiments the novel arena, the mirror and the novel objects were presented to five animals that were not included in the experiments so that no experimental animal would encounter the objects or the arena without the smell of other, animals. This was done due to the difficulty of completely removing smells between each trial. The experiments were conducted before feeding at ca. 4 PM and at least two days passed between experiments for each individual.

The order of the experiments was not randomised since the novel arena test had to be made before the mirror test in the arena, otherwise the arena would not have been a novel environment and it was not possible to house several arenas.

The first two experiments consisted of novel object tests in the home enclosure. Before the start of each trial a novel object was

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