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Abstract

Polar bears (*Ursus maritimus*) are susceptible to stereotypical behaviour in captivity. Studies have found that different enrichment strategies can help activate the bears, thereby changing their behaviour and decrease stereotypies. When observing polar bears, it is apparent that individuals exhibit behaviours with different frequencies, which makes it relevant to examine if the animals have different behavioural reaction norms. This study aims to investigate the behaviour of two polar bears in Aalborg Zoo and how enrichments changes their behaviour. Furthermore, it investigates if the polar bears differ in behavioural patterns, reflecting differences in behavioural reaction norms. Although no significant differences were found, the results suggest an association between enrichments and decreased stereotypical behaviour for one bear while there was no detectable change in stereotypical behaviour for the other bear. The different reaction patterns for the two bears, may be due to different behavioural reaction norms e.g. individual differences in neophobia and exploratory behavior. In future studies presentation of the enrichment objects before the test days, may yield more heterogeneous results easier to interpret.

Keywords: polar bears, behavioural reaction norms, enrichment, novelty toys, activity, stereotypies, behaviour

Introduction

The polar bear (*Ursus maritimus*) is vulnerable in the wild and is at risk of becoming endangered due to climate change, human disturbance, and hunting (Pertoldi et al., 2009; IUCN, 2019; Sonne et al., 2019). Aalborg Zoo participates in the "European Endangered Species Programme" (EEP) with the polar bear. Studies have shown that animal behaviour is affected by the surrounding possibilities and limitations (Shepherdson et al., 2013; Cless et al., 2015). In this context, the limiting effect of enclosures in zoos can be a stress factor for captive animals (Ross, 2006; Cless et al., 2015).

Carnivores, such as felid and ursid species, often have larger and more naturalistic enclosures than other species in modern zoos, but they still seem to be susceptible to stereotypic behaviour (Lyons et al., 1997; Clubb & Mason, 2003; Vickery & Mason, 2003). Stereotypical behaviour is defined as invariant repetitive behaviour that have no functional purpose (Ross, 2006). This type of behaviour is a concern, as it can be a sign of decreased wellbeing (Mason, 1991a; Mason & Mendl, 1993; Mason & Latham, 2004). However, some studies suggest that stereotypies can be a leftover from previous environments, and as such, it is not necessarily a true sign of the current wellbeing of the animal (Mason, 1991b; Swaisgood & Shepherdson, 2005). Furthermore, it has been suggested that stereotypical behavior could be a coping mechanism leading to stress release and therefore not necessarily be a sign of decreased well-being (Shepherdson et al. 2004).

As an example, stereotypical behaviour can be expressed as pacing and specific swimming patterns which are especially expressed with polar bears (Wechsler, 1992; Ross, 2006). In the wild, polar bears have large home ranges and therefore rich foraging opportunities over long distances (Ferguson et al., 1999; Shepherdson et al. 2013). Ferguson et al. (1999) estimated the mean home range for female polar bears to be 125,100 km^2 ± 11,800 km^2. During foraging, senses such as sight and smell are greatly stimulated. However, these instincts are somewhat inhibited when the polar bears are kept in captivity and therefore the risk of developing abnormal behaviour increases (Shepherdson et al., 2013).

Studies have indicated that different types of enrichment strategies can reduce stereotypic behaviour (Kelly et al., 2015). The purpose of enrichment is to stimulate the animals' senses and activate them. If the animals are not sufficiently stimulated, it can affect both the types of behaviour and the frequency of which these behaviours are performed (Swaisgood & Shepherdson, 2005). Examples of this could be how long animals show inactive behaviour, how they interact in social associations, play with each other or that they show repetitive movement patterns (Swaisgood & Shepherdson, 2005; Mason, 1991a). Enrichment strategies include different kinds of scent in the enclosure, giving the animals access to different parts of the enclosure, or providing them with novelty tools and toys. Novelty tools and toys could be puzzle feeders that provide mental stimulation (Swaisgood & Shepherdson, 2005). Studies have indicated that different enrichments provide different effects and therefore it is important to consider this when choosing an enrichment strategy (Swaisgood & Shepherdson, 2005; Quirke & O'Riordan, 2011; Szokalski et al., 2012). Thus, enrichment can reduce stereotypical behaviour for polar bears in captivity, but it cannot exclude them (Ross, 2006; Kelly et al., 2015).

There are different triggers for specific stereotypical behaviour among individuals, such as seasonal changes or the presence of other conspecifics (Kelly et al., 2015). Stereotypical behaviour can differentiate among individuals due to animal's behavioural reaction norms. Behavioural reaction norms among animals is a consistent behaviour specific for that individual, and therefore a specific character trait (Dingemanse et al., 2009; Wolf & Weissing, 2012; Santicchia et al., 2019). Individuals could be more likely to do certain behaviours than others such as being more avoidant in high-risk situations (Briffa & Weiss, 2010; Wolf & Weissing, 2012; Santicchia et al., 2019). Also, the behavioural instability is a factor, as it indicates the predictability of animal behaviour and thereby behavioural reaction norms (Pertoldi et al., 2016).

This study seeks to investigate how six different enrichments changes the behaviour of two polar bears in Aalborg Zoo. We expected that both polar bears would show a significant reduction in stereotypical behaviour and instead exhibit an increased frequency of active non-stereotypical behaviour when given enrichment. Furthermore, we hypothesized that the two polar bears observed in this study, Nuka and Qilak would have different behavioural patterns, reflecting that they have contrasting behavioural reaction norms

Methods

Subjects

Observations were conducted at Aalborg Zoo on two female twin polar bears, named Nuka and Qilak, born in 2016 (November 26th) in Aalborg Zoo. Aalborg Zoo also houses Malik, the mother of the twins. Malik was pregnant at the time of the observations, and not included in this study.

Enclosure

The polar bear enclosure in Aalborg Zoo consists of two areas separated by a pit which means the polar bears in each area are separated, but still have visual contact. The size of the observed area was 768 m^2 and constructed with rocky terrain, a small stream, and a pool. Half of the enclosure's perimeter holds eight windows, which was accessible for guests and provides a complete view of the enclosure. The indoor area

was located behind a wall and was not visible for guests. This area was usually accessible for the polar bears and gave them and the zookeepers an opportunity to interact.

Enrichments

To stimulate activity of the polar bears, we designed six enrichment days with six different enrichment strategies. The enrichments were designed to stimulate olfactory senses and provide mental stimulation as well as stimulate natural behaviour such as "ice-breaking-behaviour". The first enrichment was two ice-rings that contained vegetables, fruit, and fish. The second was a puzzle feeder ("*Tug-a-Treat*") that contained blended fruit and vegetables. For the third enrichment, fish were hidden in the ground and to increase their stimulation some places only contained the scent of fish. The fourth enrichment was three wooden logs with drilled holes containing jam, honey, and pesto. The fifth was two feed barrels containing vegetables, fruit, and kibbles. The last enrichment was two traffic cones and two rings made of rope and plastic tubes (app. A).

Procedures

Four cameras (Escape HD5 Action Camera, Kitvision, 640x480) were placed so the entire enclosure was recorded. Overall, four days as control and six days with enrichment were taped. The four control days were recorded on October 4th, 7th, 11th, and 30th 2019 from 10 am to 3 pm. During the control days, the polar bears had access to a tire, two balls of different sizes, and a plastic tube. These toys were a part of the enclosure and because of this, we assumed that the polar bears were accustomed to them. The enrichment days were taped during the period of October 22nd-27th 2019 from 10 am to 3 pm. The polar bears received a new type of enrichment each day.

The analysis was made as a qualitative study meaning examining the behaviour of few animals. From prior observations, the observed behaviours determined and formed the ethogram seen in table 1. The ethogram consists of seven behavioural categories: "*Stereotypical*", "*Active (land)*", "*Active (water)*", "*Break in Behaviour*", "*Inactive*", "*Eating*", and "*Indoors*". This study defines stereotypical behaviour as a behaviour performed by an individual for two consecutive times or more. Additionally, there were some periods where the polar bears were out of sight, due to camera malfunctions.

Table 1. Behavioural ethogram used in this study.

Behavioural categories	Definition
Stereotypical	Repetitive behaviour for at least two consecutive times such as pacing.
Active (land)	Behaviour requiring physical activity, effort or intent such as regular walking, playing, rolling, scratching, object manipulation, etc.
Active (water)	Swimming and/or playing in water.
Break in Behaviour	Stopping ongoing behaviour, such as standing still or looking around while standing.
Inactive	Lying down, sitting still or sleeping.
Eating	When food is being consumed.
Indoors	Resides indoors.

Using Spearman's rank test (rs) a concordance was computed for the behavioural categories from the prior observations. For the categories "*Stereotypical*", "*Active (land)*", and "*Inactive*" the concordance, r = 1, was computed and *"Break in Behaviour"* with a concordance, r = 0.99.

Data analysis

For the statistical analysis, we compared the data for Nuka and Qilak on each control and enrichment days to see if there was a difference between the behaviour of the two individuals. Furthermore, the data from each enrichment day were compared with each control day, for both individuals and every behaviour, to see if the

behaviour of the polar bears during the enrichment days differed from the behaviour during the control days. The reason that all data for the enrichment days were compared with each control day, is because the polar bears had different behaviour on each control day. As data were not normally distributed, a non-parametric approach was used. For each comparison, a cumulative curve, boxplot, and Pearson correlation was performed. The cumulative curves show how the cumulative frequency of each behaviour is distributed. Kurtosis and skewness were found in order to see how skewed and narrow the distribution of the data was. Levene's test was performed to see if there was a significant difference between the interquartile of the distribution of the time intervals in which the behaviour occurs. Mann-Whitney test was used to examine if there was a significant difference between the medians of the time intervals of different behaviours, and Kolmogorov-Smirnov test to see if there was a significant difference between the distributions of the time intervals in which the behaviours occur.

Results

Enrichment effects

Overall the data was very diverse for the two polar bears, and therefore no general tendency was observed between the control and the enrichment periods. Each individual bear showed different changes in behaviour. This was the case in both the control and enrichment period. However, neither Mann-Whitney, Levene's or Kolmogorov-Smirnov tests showed significant differences. Although no tendencies were apparent, a few differences can be highlighted. In general Nuka performed less stereotypical behaviour during the enrichment days than the control days, as the boxplots are more compressed (fig. 1). This also showed in the correlations, especially between enrichment 3 and control 3 (r=-0.58)***.

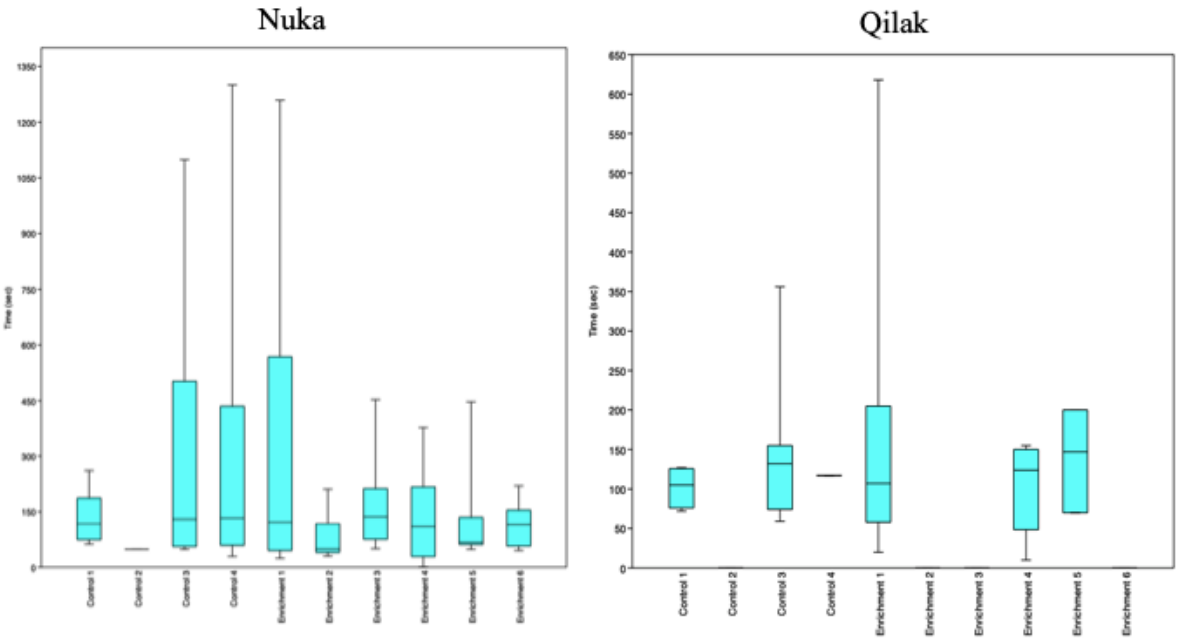

Figure 1: Boxplots of stereotypical behaviour. On the x-axis is the observed days and on the y-axis, is the time en seconds. The boxplots on the left is for Nuka and the boxplots on the right is for Qilak

For "*Break in Behaviour*", outliers were more apparent for Nuka and Qilak during enrichment days than control days (fig. 2). This was supported by skewness and kurtosis, which were both higher for enrichment days than control days. Enrichment 1 and control 3 were an example of this for both polar bears (app. A).

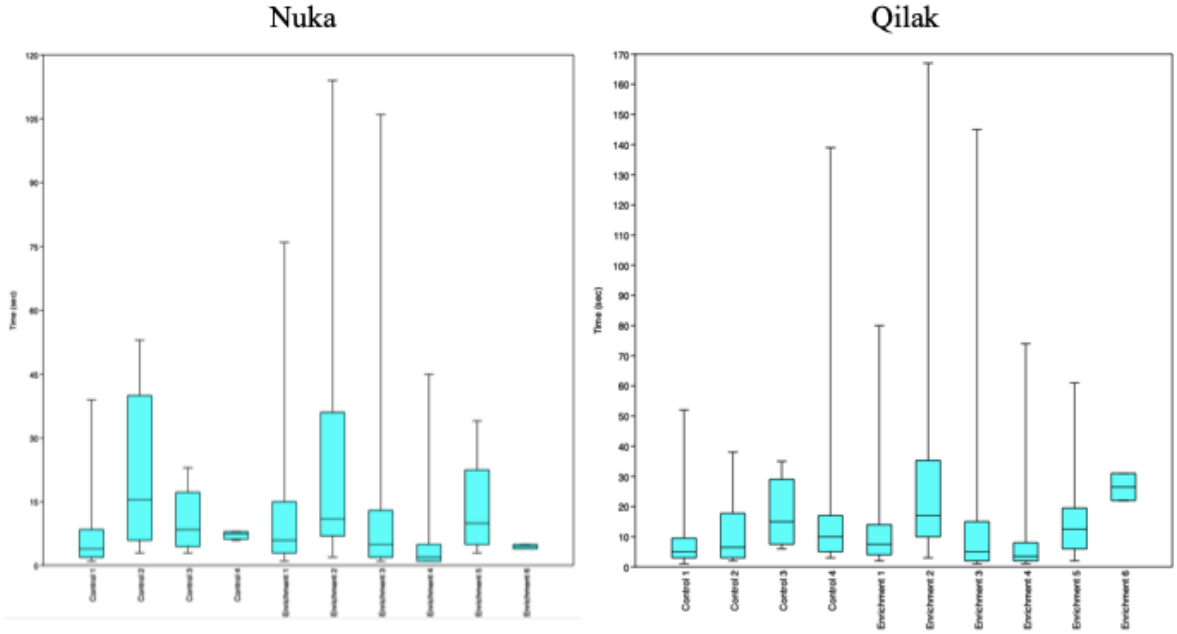

Figure 2: Boxplots of break in behaviour. On the x-axis is the observed days and on the y-axis, is the time in seconds. The boxplots on the left is for Nuka and the boxplots on the right is for Qilak.

Both Nuka and Qilak spent more time indoors on control days than on enrichment days. As an example, Nuka at the most spent 25.61 % (tab. 1, app. B) of the observation time indoors during control days, and Qilak 20.74 % (tab. 2, app. B). Whereas Nuka at the most spent 13.51 % (tab. 1, app. B) of the time indoors during enrichment days, and Qilak 10.43 % (tab. 2, app. B). Except for this, there were no significant differences between the data of the control period and the enrichment period.

Differences in behavioural reaction norms

Several differences were apparent between the two polar bears. Overall Nuka performed more stereotypical behaviour than Qilak during both the control and enrichment days (fig. 1). None of the tests performed revealed any significant differences between the two polar bears for the behaviour "*Stereotypical*" (app. C). However, Qilak did not show any stereotypical behaviour on several days. Furthermore, Qilak spent more time exhibiting the behaviour "*Active (water)*" than Nuka during both the control and enrichment days (app. B). The medians for the behaviour "*Active (water)*" had a tendency to be higher for Qilak than Nuka. However, the Mann-Whitney test did not show that the differences were significant (app. D).

On specific days, significant differences could be seen between the two polar bears. Both polar bears exhibited the behaviour "*Active (land)*" for approximately the same amount of time in the course of a day (app. B). However, Qilak exhibited the behaviour "*Active (land)*" for longer periods of time than Nuka during control day 3 (fig. 3). This was supported by the Levene's test, which was borderline significant ($p=0.053$) and the Mann-Whitney test ($p<0.001$), and furthermore, the Levene's test showed increased significance without outliers ($p<0.01$).

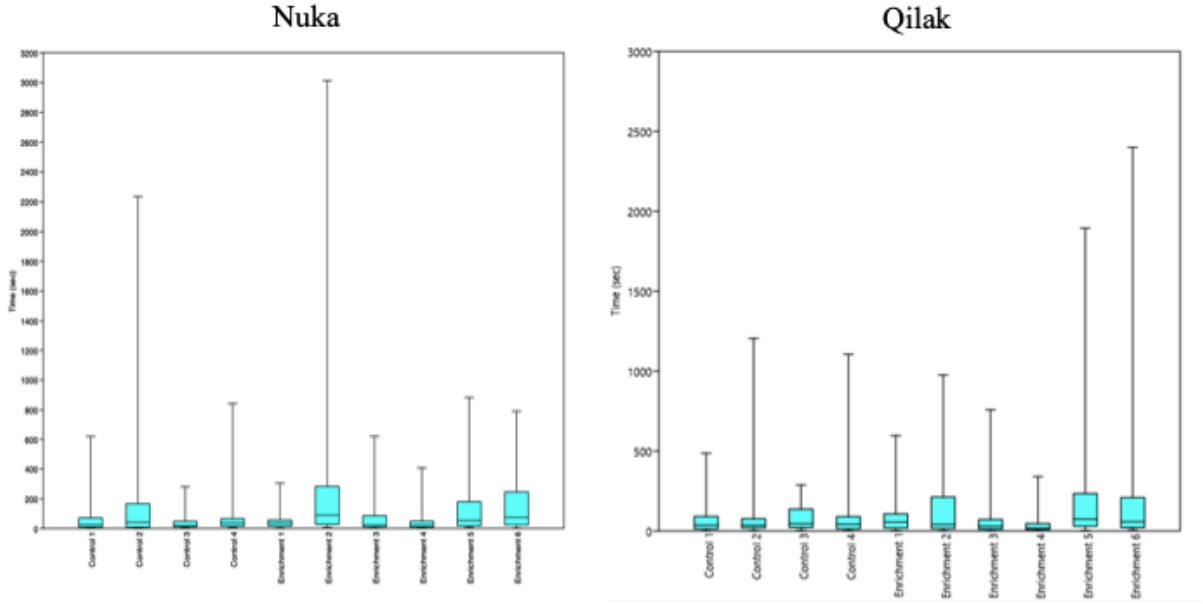

Figure 3: Boxplots of the behaviour Active (land). On the x-axis is the observed days and on the y-axis is the time in seconds. The boxplots on the left is for Nuka and the boxplots on the right is for Qilak.

The same could be seen with "*Break in behaviour*", where both polar bears exhibited the behaviour for approximately the same amount of time in the course of a day. However, Nuka performed the behaviour for shorter periods of time than Qilak during enrichment day 4 (fig. 2). This was supported by analyses of data without outliers, where the tests Levene's ($p<0.05$), Mann-Whitney ($p<0.001$), and Kolmogorov-Smirnov ($p<0.001$) were all significant. The data showed that several boxplots had large variance, indicating that the polar bears were more unpredictable which could be a sign of behavioural reaction norms (fig. 2).

Discussion

Enrichment effects

The results did not show any general tendencies or significance for the estimated parameters median, interquartiles, skewness, or kurtosis and also not for the tests Levene's, Mann-Whitney, or Kolmogorov-Smirnov. Therefore, it is unclear whether enrichments had any effects on the behaviour of the two polar bears. Both polar bears showed stereotypical behaviour during both the control and enrichment period. Nuka exhibited stereotypical behaviour every day and the results point towards that the enrichments decreased the stereotypical behaviour (fig. 1). This is consistent with a study by Kelly et al. (2014), who observed that providing polar bears with novel toys reduced the frequency of stereotypical behaviour. Qilak had several days where no stereotypical behaviour was apparent in both observed time periods. Montaudouin & Pape (2004) found that young brown bears (*Ursus arctos*) under the age of 11 years (?) showed less stereotypical behavior than older individuals. Furthermore, their study found that access to a large pool influenced the bears to express less stereotypical behaviour. Both Nuka and Qilak are three years old and with access to a pool allowing them both to swim, dive and play. Moreover, Nuka and Qilak are related and these factors could have influenced the fact that neither of them showed extreme stereotypic behaviour in either of the periods (Montaudouin & Pape, 2004).

In the wild, female polar bear reject their cubs when they reach the age of three (Regehr et al., 2010). In Aalborg Zoo, they were instead separated in different enclosures. However, they still have visible access to each other. This could make Nuka and Qilak nervous, stressed or simply curious, and thereby be a trigger to

the observed stereotypical behaviour. Shih et al. (2016) found that stereotypies were performed more often at locations with unavoidable external stimuli. This is consistent with our study, as the stereotypical behaviour primarily was performed as pacing along the pit, where the visible contact with their mother could be this external stimulus.

During our study, it was observed that the polar bears stopped and either looked up or sniffed while performing stereotypical behaviour, which was characterized as "*Break in Behaviour*". According to Wechsler (1992), this can be observed as appetitive behaviour, which is performed when animals are motivated to do specific behavioural patterns. When animals perform appetitive behaviour in the wild they are motivated to explore their home range, and since this is not possible in a smaller zoo enclosure, this can possibly lead to stereotypical behaviour (Wechsler, 1992; Clubb & Mason, 2003).

During this study, it was observed for some of the behavioural categories, that both polar bears showed more unpredictable frequencies during the enrichment days than the control days, which might be an effect of the enrichments. When observing each polar bear, it was apparent that the enrichments stimulated activity, however, the results did not show any significant difference. This might be caused by the fact that all behaviours exhibited by the polar bears were dependent on each other. For example, Nuka on average spent 29 % of the day expressing the behaviour "*Active (land)*" during the control period which leaves 71 % for other behaviours. During the enrichment period, the behaviour increased to an average of 42 %, leaving 58 % of the day for other behaviours. Furthermore, this study tested one period of control against another period of enrichment but a lot of factors were not taken into account. These could include seasonal changes, number of visitors, feeding times etc. The different reaction patterns Nuka and Oilak, may also be due to different behavioural reaction norms e.g. individual differences in neophobia and exploratory behavior. Although no significant differences were found, they do suggest an association between enrichments and decreased stereotypical behaviour for Nuka while there was no detectable change in stereotypical behaviour for Oliak.

Differences in behavioural reaction norms

The data showed heterogeneity which indicates that the polar bears have individual behavioural reaction norms. According to the results, Nuka exhibited both "*Break in behaviour*" and "*Active (land)*" for shorter periods of time than Qilak. This means that especially Qilak was more unpredictable in her behaviour, which may be caused by contradictory motivation either neophobic and curiosity and desire for exploratory behaviour. Biro & Adriaenssens (2013) describe unpredictability in expressing of behaviour as a behavioural reaction norm in animals. Some behavioural reaction norms were not possible to observe with the methods used in our study, as they were not detectable in the behavioural categories of the ethogram. This includes dominance relations and neophobia. Such character traits are a sign of different behavioural reaction norms and should be noted in future studies. Santicchia et al. (2019) measured animal behaviour in mammals along a proactive-reactive continuum. They found proactive animals to be bold, active-explorative and social, whereas reactive animals were found to be shy as well as less active-explorative and social (Santicchia et al., 2019). In our study Nuka seemed most reactive, while Qilak was more proactive. However, other measurements have to be applied in order to confirm this.

When outliers were removed from the data, the results showed an even bigger larger heterogeneity and furthermore increased significance. Removing outliers also means removing observation time, hence, it reflects the method of observing animal behaviour for randomised periods during a day. From this study, it is relevant to consider the type of method, as it would seem that consecutive observations for an entire day could give a different picture of the overall behaviour of the polar bears, observations recognizing dominance relations and neophobia.

Conclusion

There were no tendencies in overall behaviour changes when the bears were given enrichments. However, it is apparent that the data is heterogeneous between individuals, indicating that the polar bears have different behavioural reaction norms. The different reaction patterns for the two bears, may be due to different behavioural reaction norms e.g. individual differences in neophobia and exploratory behavior. In future studies presentation of the enrichment objects before the test days, may yield more heterogeneous results easier to interpret.

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Author's Contributions

C.P. and T.H.J. provided the ressources, while F.M.D., H.H.H., L.D.V., L.Ø.J. and P.S.S did the investigation and data collection as well as the analysis and visualization. All authors contributed equally in providing feedback and shaping the manuscript.

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Appendix A: Summary for break in behavior when comparing enrichment day 1 with control days.

NUKA Break in behavior - with outliers					
DAY:	**Enrichment 1**	**Control 1**	**Control 2**	**Control 3**	**Control 4**
N	43	61	8	8	4
Min	1	1	3	3	6
Max	76	39	53	23	8
Median	6	4	15.50	8.50	7.50
Q1	3	2	6	4.50	6.25
Q3	15	8.50	40	17.25	8
Skewness	3.56	2.29	0.84	0.92	-0.85
Kurtosis	16.93	5.95	-0.74	-0.31	-1.29
Mann-Whitney		0.014*	0.095	0.56	0.89
Levene's test		0.16	0.095	0.66	0.28
Kolm-Smirnov		0.061	0.32	0.96	0.36

QILAK Break in behavior - with outliers					
DAY:	**Enrichment 1**	**Control 1**	**Control 2**	**Control 3**	**Control 4**
N	54	81	14	5	19
Min	2	1	2	6	3
Max	80	52	38	35	139
Median	7.50	5	7.50	15	10
Q1	4	3	3	7.50	5
Q3	14	9.50	17.75	29	17
Skewness	3.25	3.21	1.54	0.84	3.85
Kurtosis	14.41	14.79	2.22	-0.24	15.78
Mann-Whitney		0.0038**	0.55	0.10	0.19
Levene's test		0.084	1	0.81	0.21
Kolm-Smirnov		0.062	0.36	0.41	0.24

Appendix B: Behavioural frequencies.

Table 1:

Nuka	**Stereotypical (%)**	**Active (land) (%)**	**Active (water) (%)**	**Break in Behaviour (%)**	**Inactive (%)**	**Eating (%)**	**Out of sight (%)**	**Indoors (%)**
Control 1	8.52	40.84	11.81	2.38	20.33	0.30	0	15.82
Control 2	0.27	42.0	16.91	0.95	0.74	1.93	11.58	25.61
Control 3	17.26	14.94	41.13	0.46	0.017	1.0	0.32	24.87
Control 4	42.11	19.92	25.09	0.16	3.96	3.41	0	5.35
Enrichment 1	47.86	22.16	16.53	2.64	0.51	1.74	0.13	8.44
Enrichment 2	4.041	66.13	16.73	2.31	7.38	0	0.19	3.21
Enrichment 3	11.04	50.36	12.89	5.19	9.63	0.94	0	9.94
Enrichment 4	19.85	27.79	35.95	1.55	0.28	0	1.07	13.51
Enrichment 5	5.11	38.62	40.54	0.61	0.62	12.19	0	2.32
Enrichment 6	10.25	41.20	25.17	0.050	2.40	8.25	0	12.67

Table 2:

Qilak	**Stereotypical (%)**	**Active (land) (%)**	**Active (water) (%)**	**Break in Behaviour (%)**	**Inactive (%)**	**Eating (%)**	**Out of sight (%)**	**Indoors (%)**
Control 1	2.29	47.92	24.85	3.28	5.30	0.88	0	15.48
Control 2	0	36.37	29.97	0.84	0.21	1.52	11.59	19.50
Control 3	7	21.39	43.94	0.49	0.32	4.14	1.98	20.74

Control 4	0.65	23.26	48.31	1.99	18.75	4.46	0	2.57
Enrichment 1	17.39	38.07	26.17	3.56	2.23	2.15	0	10.43
Enrichment 2	0	45.54	8.88	3.38	35.86	0	2.73	3.60
Enrichment 3	0	48.42	40.09	5.91	1.15	0.81	0	3.63
Enrichment 4	2.95	36.74	46.52	5.0	2.55	0	2.0	4.23
Enrichment 5	2.33	48.31	39.99	1.38	1.41	5.77	0	0.81
Enrichment 6	0	34.87	38.27	0.30	3.77	13.11	0	9.69

Appendix C: Summary for stereotypical behaviour.

Stereotypical behaviour - with outliers												
DAY:	**Enrichment 1**		**Enrichment 2**		**Enrichment 3**		**Enrichment 4**		**Enrichment 5**		**Enrichment 6**	
INDIVIDUAL	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**
N	27	23	9	0	12	0	28	5	7	3	16	0
Min	24	20	30	-	50	-	1	10	48	70	45	-
Max	1259	618	211	-	453	-	377	155	447	200	220	-
Median	121	107	49	-	136.50	-	109.50	124	67	147	115	-
Q1	45	58	40	-	75.25	-	28.75	48.50	61	70	57	-
Q3	568	205	117	-	212.50	-	217	150	135	200	154.50	-
Skewness	1.36	2.72	1.55	-	1.66	-	0.79	-1.30	2.40	-0.54	0.39	-
Kurtosis	0.46	9.70	1.94	-	3.47	-	-0.68	1.28	5.97	-2.33	-0.94	-
Mann-Whitney	0.40		-		-		0.76		0.27		-	
Levene's test	0.018*		-		-		0.086		0.73		-	
Kolm-Smirnov	0.11		-		-		0.54		0.38		-	

Stereotypical behavior - with outliers								
DAY:	**Control 1**		**Control 2**		**Control 3**		**Control 4**	
INDIVIDUAL:	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**
N	11	4	1	0	10	9	27	1
Min	66	72	-	-	48	59	29	-
Max	241	127	-	-	1099	356	1300	-
Median	122	105	-	-	130	132	133	-
Q1	88	76	-	-	55.75	74	59	-
Q3	184	125.75	-	-	502.25	155	435	-
Skewness	0.93	-0.27	-	-	1.50	2.050	1.82	-
Kurtosis	0.27	-4.12	-	-	1.35	5.090	3.43	-
Mann-Whitney	0.55		-		0.91		-	
Levene's test	0.40		-		0.096		-	
Kolm-Smirnov	0.85		-		0.59		-	

Appendix D: Summary for the behaviour Active (water).

Active (water) - With outliers												
DAY:	**Enrichment 1**		**Enrichment 2**		**Enrichment 3**		**Enrichment 4**		**Enrichment 5**		**Enichment 6**	
INDIVIDUAL:	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**
N	8	7	9	4	5	17	18	20	11	17	10	12
Min	59	211	150	150	25	20	17	27	142	21	14	11
Max	1070	1704	880	835	1088	1984	2001	2051	1981	1365	1034	1406
Median	172.50	533	186	323.50	111	61	137.50	215.50	552	361	439	535
Q1	99.25	341	177	168.75	28.50	34.50	47.50	88	194	110.50	126.75	203.25
Q3	722.75	752	498	731.75	1057	604	448.25	376	855	595	702	755.75
Skewness	1.27	1.83	1.61	1.26	0.60	1.70	2.09	2.18	1.30	1.24	0.22	0.72
Kurtosis	0.19	3.83	2.12	1.080	-3.27	1.63	4.02	3.99	1.095	1.15	-0.64	0.14
Mann-Whitney	0.15		0.85		0.81		0.53		0.25		0.63	
Levene's test	0.74		0.67		0.85		0.90		0.21		0.65	
Kolm-Smirnov	0.054		0.87		0.72		0.060		0.45		0.67	

Active (water) - With outliers								
DAY:	**Control 1**		**Control 2**		**Control 3**		**Control 4**	
INDIVIDUAL:	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**	**Nuka**	**Qilak**
N	3	6	9	16	16	8	8	10
Min	483	9	18	56	33	87	137	249
Max	1080	2176	948	688	1459	2682	1267	1424
Median	540	617.50	339	298	378	1049.50	385.50	874
Q1	483	20.25	84.50	202	140	236.75	166.75	499.75
Q3	1080	1295.50	496.50	509.50	619.75	1236.50	1003.25	1259.25
Skewness	1.67	1.29	1	0.22	1.37	1.14	0.59	-0.079
Kurtosis	-2.33	1.91	1.035	-0.83	1.55	1.89	-1.67	-1.81
Mann-Whitney	1		0.76		0.19		0.084	
Levene's test	0.39		0.25		0.11		0.89	
Kolm-Smirnov	0.99		0.75		0.13		0.17	