Behavioural Differences in Captive Sumatran Tigers (Panthera tigrissumatrae)

Hangstrup, Camilla Weje; Hentzen, Sarah Vernersen; Lauridsen, Ditte Grønnegaard; Nielsen, Michelle; Linder, Anne Cathrine; Alstrup, Aage Kristian Olsen; Pagh, Sussie; Jensen, Trine Hammer; Pertoldi, Cino

Published in:
Genetics and Biodiversity Journal

DOI (link to publication from Publisher):
10.46325/gabj.v5i3.144

Publication date:
2021

Document Version
Publisher's PDF, also known as Version of record

Genetics and Biodiversity Journal

Journal homepage: http://ojs.univ-tlemcen.dz/index.php/GABJ

e-ISSN: 2588-185X p-ISSN: 2602-5582

OPEN ACCESS

Original Research Paper

Behavioural Differences in Captive Sumatran Tigers (*Panthera tigris sumatrae*)

Hangstrup C.W.[1, ‡, §], Hentzen S.V.[1, ‡], Lauridsen D.G.[1, ‡], Nielsen M.[1, ‡], Linder A.C.[1], Alstrup A.K.O.[3, 4], Pagh S.[1], Jensen T.H.[1, 2] and Pertoldi C.[1, 2]

[1] *Department of Chemistry and Bioscience, Aalborg University, Fredrik Bajers Vej 7H, DK-9220 Aalborg Øst, Denmark*

[2] *Department of Zoology, Aalborg Zoo, Mølleparkvej 63, DK-9000 Aalborg, Denmark*

[3] *Department of Nuclear Medicine and PET, Aarhus University Hospital, Incuba Skejby, building 2, Palle Juul-Jensens Boulevard 82, DK-8200 Aarhus N, Denmark*

[4] *Department of Clinical Medicine, Aarhus University Hospital, Incuba Skejby, building 2, Palle Juul-Jensens Boulevard 82, DK-8200 Aarhus N, Denmark*

[‡] *These authors contributed equally to this work.*

[§] **Corresponding Author**: Camilla Weje Hangstrup **Email**: camilla.hangstrup@gmail.com

Article history; Received: Janauray 20th 2021 ; Revised: May 15th 2021; Accepted: May 25th 2021

Abstract

Measuring behavioural differences for captive Sumatran tigers (*Panthera tigris sumatrae*) is a useful tool for the optimisation of captive environments and animal welfare. Behavioural differences can be measured by comparing several individuals and by comparing days with enrichment to days without enrichment. The behaviour of two individuals can vary for reasons such as age and sex, where age can play a part in the activity level of an individual as well as age-related diseases can impact behavior. Using statistical analyses on data collected by observing tigers (n=4) in Aalborg Zoo, Denmark, throughout 15 days, it was possible to visualize and calculate significant changes in behaviour when comparing enrichment and control days. The main focus of this study was the individual behavioural differences on enrichment and control days. All individuals showed increased activity on enrichment days. This study also aimed to investigate whether meloxicam had an effect on the behaviour of an aged male Sumatran tiger as a tool to assess if he had pain. No significant behavioural changes were observed in the behaviour of the tiger with or without meloxicam treatment. In conclusion, there were differences in the behaviour of individuals of different age and sex and how the individuals reacted to enrichment.

Keywords: Behavioural reaction norms; enrichment, ethogram, stereotypy

Introduction

The Sumatran tiger (*Panthera tigris sumatrae*) lives in isolated populations on the islands of Sumatra, Indonesia (Wibisono and Pusparini, 2010). The Sumatran tiger is listed as critically endangered by the International Union for Conversation of Nature (IUCN) due to loss of habitats, illegal trade and prey-based depletion (Linkie *et al.*, 2008). It is difficult to obtain precise numbers on the global population of the Sumatran tiger (Luskin *et al.*, 2017), however according to IUCN, the population of Sumatran tigers is lower than 400 individuals in 2021 (IUCN, 2021).

Because of the listing as critically endangered by the IUCN, a recovery target for the Sumatran tiger is set internationally in 2010 to double the individuals in the wild before 2022 (Wibisono and Pusparini, 2010). The longevity of captive felids is increasing due to improved husbandry and veterinary care. It is therefore expected to see the incidence of age-related disease rising in captive animals. Degenerative conditions such as chronic renal failure and osteoarthritis are some of the major age-related diseases that are commonly reported in captive large felids (Longley, 2011).

These diseases are likely painful and can have a negative impact on animal welfare (Longley, 2011).

The average behaviour of an animal and its changes in behaviour over time can be classified by the behavioural reaction norms (Dingemanse *et al.*, 2009). The behavioural reaction norms specify the relationship between environmental conditions and response value (Dingemanse *et al.*, 2009). A reaction norm is commonly known as the relationship between a behavioural response of an individual when applied to the same genotype (Dingemanse *et al.*, 2009). Under various conditions, different consistent reaction norms can vary, e.g. enrichment, stress and population density (Santicchia *et al.*, 2020; Montiglio *et al.*, 2012; Luo *et al.*, 2019).

Wild animals are kept in captivity for the purposes of conservation, education, research and recreation (Pitsko, 2003). If the enclosures do not provide opportunities for natural behaviours such as climbing, predation, stalking, and swimming, the animals can develop abnormal and stereotypic behaviours (Pitsko, 2003). It is difficult to mimic a natural environment for tigers in captivity due to their extensive territories ranging from 7 to 1000 km^2 and their natural predatory hunting behaviour in the wild (Pitsko, 2003; Biolatti *et al.*, 2016). The enclosures can be a stressful environment for the tigers if they feel threatened or exposed. This can be minimized by providing hiding spaces for the tigers in the enclosures (Clubb and Vickery, 2006). Captive tigers and other big felids have a tendency to respond negatively in the shape of stereotypic behaviour, such as pacing, and are therefore much more vulnerable to welfare issues than their wild counterparts (Biolatti *et al.*, 2016).

Stereotypic behaviour such as pacing can be a sign of stress and tigers showing more stereotypic behaviour have showed signs of higher levels of the stress hormone cortisol in their feces (Clubb and Vickery, 2006). Wilson *et al.* (2019) studied how the personality of an individual animal differs when coping with stress and how this could be beneficial to animal welfare. Wilson *et al.* (2019) defines personality as "*Individual differences in behaviour and emotion*" and is expressed in variation through one individual's reaction and behaviour in a specific situation. A way of visualising the variation is through a reaction norm plot. The personality differs from each individual, and these differences in behaviour for each individual are even more evident when comparing males and females, as well as the individuals differences in age (Wilson *et al.*, 2019; Rouck *et al.*, 2005). Female tigers in captivity have shown to be more easily negatively affected by the presence of another tiger, often males, whereas male tigers are not as easily affected by the presence of a female tiger (Rouck *et al.*, 2005).

Enrichment is used for many different species in captivity and research shows that different kinds of enrichment, some more species-specific than others, can decrease stereotypic behaviour (Metter *et al.*, 2008). Enrichment is used as a stimulation for the animal, both psychologically when smelling and thinking, and physiologically in strength and moving around the enclosure (Pitsko, 2003). Although not every type of enrichment has the same effect on every captive animal, nor for every individual of the same species, its primary purpose is improving the general welfare of the captive animals (Metter *et al.*, 2008).

This study aims to understand how behavioural reaction norms/behavioural responses differ among 4 Sumatran tigers, as well as determine the influence of age and sex on the personalities of the individuals. Age-related diseases, often with symptoms of pain, are common in captive felids such as Sumatran tigers. Therefore, this study aims to investigate if the behaviour of an old male tiger changes when he is given the non-steroid anti-inflammatory drug meloxicam.

Methods and materials

Subjects

The four subjects included in the study were a 5-year-old breeding female Sumatran tiger, a 17-year-old breeding male Sumatran tiger and their two male cubs of 1.5-years-old.

Enclosure

The enclosure consisted of two outdoor areas and two indoor areas, all visible to guests at Aalborg Zoo (see Figure 1). The two outdoor areas were connected resulting in one large continuous enclosure. The outdoor areas were constructed by earthy ground with bushes and trees, some rocky terrain, a pool with

water, and with two overlooking towers for guests. The area of the complete outdoor exhibit was approximately 627 m^2.

The largest of the indoor areas could be divided into three separate areas, and thus used as a way of separating the tigers during feeding, enrichment and other. Each of the three small enclosures had a door to the largest of the outdoor areas, as well as a raised platform in each. One of the three enclosures also had a door to the smallest outdoor enclosure. The second indoor enclosure was approximately the size of one of the three smaller enclosures but had no raised platform.

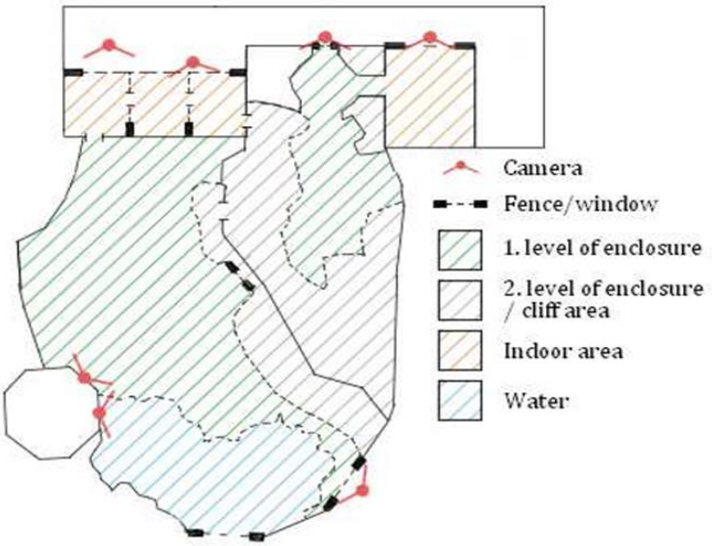


Figure 1: Map of the Sumatran Tiger enclosure at Aalborg zoo. The exhibit housed an adult male and an adult female tiger as well as their two male cubs. The placement of the seven cameras used for surveillance is marked. Only the coloured-in areas are accessible to the tigers.

Enrichment

All enrichment was designed by the animal caretakers in Aalborg Zoo. Information regarding the days and type of enrichment are provided in Table 1. In total there were eight days with enrichment and seven control days.

Table 1: Schedules for enrichment during week 42, 43, and 44 as well as a description of the components of each enrichment. The time of enrichment differs throughout the days and does not occur in a consistent pattern throughout the weeks. Enrichment could occur at any day of the week and could also be combined with the feeding of the tigers.

Week 42		
	Activity and time, am	**Activity and time, pm**
Monday	Inside, 10 am: Cocoa powder, cardboard boxes and blood	Outside, 2 pm: Plastic lid and ball
Tuesday		
Wednesday	Inside, 8 am: Cardboard boxes when feeding	Inside, 3 pm: Cardboard boxes and cold coffee
Thursday		Inside, 2:30 pm: Water, hose with meat, hammock
Friday		
Week 43		
	Activity and time, am	**Activity and time, pm**
Monday		
Tuesday	Outside, 11:30 am: Cinnamon and perfume	Inside, 2:45 pm: Cardboard boxes
Wednesday		
Thursday		
Friday	Inside, 11:20 am: Cardboard boxes and boiled eggs	Inside, 4:20 pm: Cardboard boxes and rabbit scent

Week 44		
	Activity and time, am	**Activity and time, pm**
Monday		Inside, 1:35 pm: Cardboard boxes, ball, paprika and cold coffee
Tuesday		
Wednesday	Outside, 9:30 am: For the adult female; hung meat	
Thursday		Inside, 3:30 pm: Cardboard box
Friday		

Procedure

Observations began on October 12th, 2020 and lasted until October 30th, 2020, with observations all weekdays from 8 am (UTC+2 and UTC+1) to 3:30 pm (UTC+2 and UTC+1), in total 15 days each with 7.5 hours of video observations. The surveillance was conducted by seven Kitvision Venture 4K action cameras, placed around the enclosure, which made both the outdoor and indoor areas observable, and ensured minimal blind spots (see Figure 1).

The adult male was given meloxicam for 14 coherent days, with an initial dose of 0.2 mg/kg and then maintained on 0.1 mg/kg daily.

Data Analysis

Based on a previous study by Linder *et al.* (2020) an ethogram with minor tailoring was created (see Table 2). The ethogram consists of seven different behaviours: 'Social activity', 'Play', 'Locomotion', 'Inactive social', 'Inactive nonsocial', 'Other', which also contained blind spots and 'Stereotypic pacing' as described in the introduction (see Table 2).

Table 2: The behavioural ethogram used in this study.

Behaviour	Description
Social activity	Interaction between two or more individuals, can be shown as fighting, playing, grooming, hissing etc. with another subject
Play	Playing alone, for example with enrichment
Locomotion	Walking from A to B, both indoors and outdoors
Inactive social	Sitting, laying and sleeping with or close by another subject
Inactive nonsocial	Sitting, laying and sleeping alone
Other	Drinking, eating, self-grooming, urinating and when subject is located in a blind spot
Stereotypic pacing	Walking in the same path for more than 1.5 repetitions

Analysis of the data was conducted in RStudio® version 3.6.2 (RStudio® Team, 2019). When analysing the data, it was decided to keep outliers as described by Linder *et al.* (2020).

Mean, median, variance, Q1, Q3, IQR, skewness, kurtosis, and percentage of behaviour for the specific day and week were calculated for all data sets. From the calculated data, a stacked bar plot for every subject for pooled enrichment and control days and for the adult male for each day was created to see the proportion of time spent on each behaviour, as well as the difference for each individual. Reaction norm plots were also created in order to visually compare the medians, variances, skewness and kurtoses of each individual.

χ^2 tests were conducted for percentage of time, median, variance, skewness, and kurtoses, and had the purpose of testing whether or not each week was significantly different from the others. P-values <0.05 were considered significant.

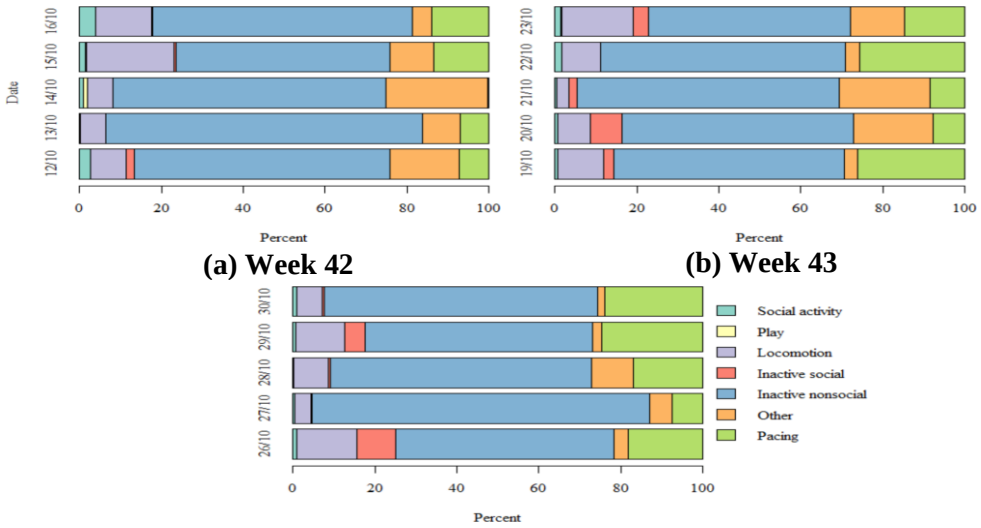
Furthermore, Mann-Whitney U tests were carried out, testing the differences in medians for control days and days with enrichment. P-values <0.05 were considered significant.

Results

Time budget

The proportion of time the adult male spent on each type of behaviour differed between each day and week. Figure 2 shows that the adult male spends the majority of his day as 'Inactive nonsocial'. Furthermore, behaviours such as 'Locomotion', 'Other' and 'Stereotypic pacing' occupied the majority of his time during a day.

The exact percentage of time per day spent on 'Inactive nonsocial' was between 52.09% and 77.31% for week 42, 49.19% and 63.84% for week 43, and 53.16% and 82.36% for week 44 (see Figure 2). The proportion oftime spent on 'Inactive nonsocial' was approximately between the same intervals for all three weeks,and the χ^2 test showed no significant difference between the three weeks of observations (see Table A1in Appendix A).



(a) Week 42 **(b) Week 43**

(c) Week 44

Figure 2: a-c: Proportion of time in percent the adult male has spent on every behaviour for each observed week. Each colour represents a specific behaviour, which is defined on the right.

The stacked bar plots in Figure 3 and 4 were from pooled data containing all days with enrichment as E, and all control days, i.e. days without enrichment, as C. Figure 3 showed a comparison of proportion of time between two subjects: the adult male and female.

Despite a visible difference in Figure 3, results from the χ^2 test showed no significant difference in neither 'Inactive nonsocial' nor 'Stereotypic pacing' for both the adult male and female (see Table A1 in Appendix A). Results from the Mann-Whitney U test showed a significant difference for the adult male in 'Play' for the first enrichment day (E1) with the median for the behaviour being greater than all the control days (p <0.01). For the behaviour 'Social activity' for the adult male the Mann-Whitney U test showed a significant difference between enrichment day eight (E8) and all control days. Here the median for 'Social activity' was greater for all control days than for E8 (p <0.05) (see Table B1 in Appendix B). A significant difference in 'Stereotypic pacing' for the adult female between enrichment day five (E5) and all control days in addition to other enrichment days was observed. For E5 the behaviour 'Stereotypic pacing' occurred less compared to all other days (p <0.05) (see Table B2 in Appendix B).

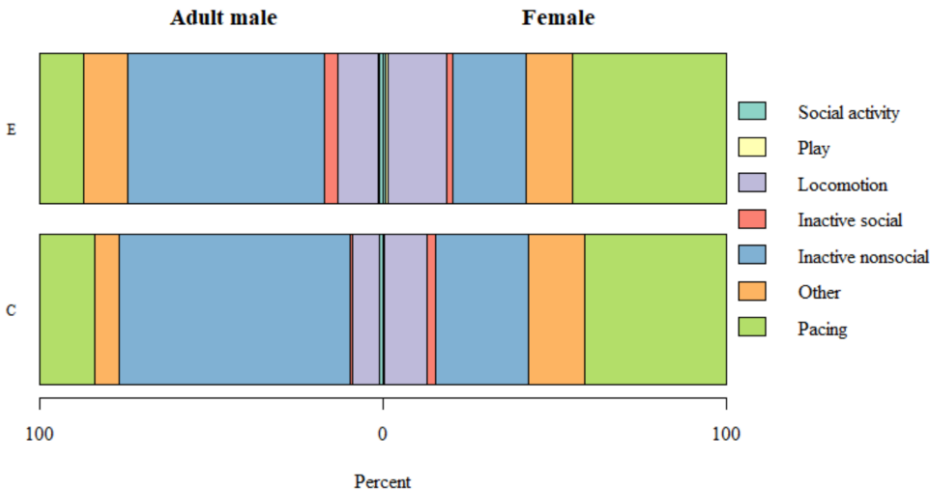


Figure 3: Stacked bar plot for the adult male and the adult female, showing the proportion of time spent in pooled data for enrichment days (E) and control days (C). Each colour represents a specific behaviour defined on the right. The x-axis shows the percentage of time the tigers spent on each behaviour.

In Figure 4 a comparison of proportion of time between Cub 1 and Cub 2 is shown. Visibly there was no remarkable difference between the two subjects for days with enrichment and control days, although a difference between enrichment and control days could be seen. The Mann-Whitney U test confirmed the results for both Cub 1 and Cub 2, showing that they had similar behaviour.

For both Cub 1 and Cub 2 a significant difference was found in 'Social activity' for E8 compared to the control days. It showed that the median for 'Social activity' was greater on control days than on E8 (p <0.001). For the behaviour 'Locomotion' a significant difference was found between enrichment day four (E4) and all control days, where the median for 'Locomotion' was greater for E4 than for all control days, except control day seven (C7) which was greater than E4 (p <0.05) (see Tables B3 and B4 in Appendix B).

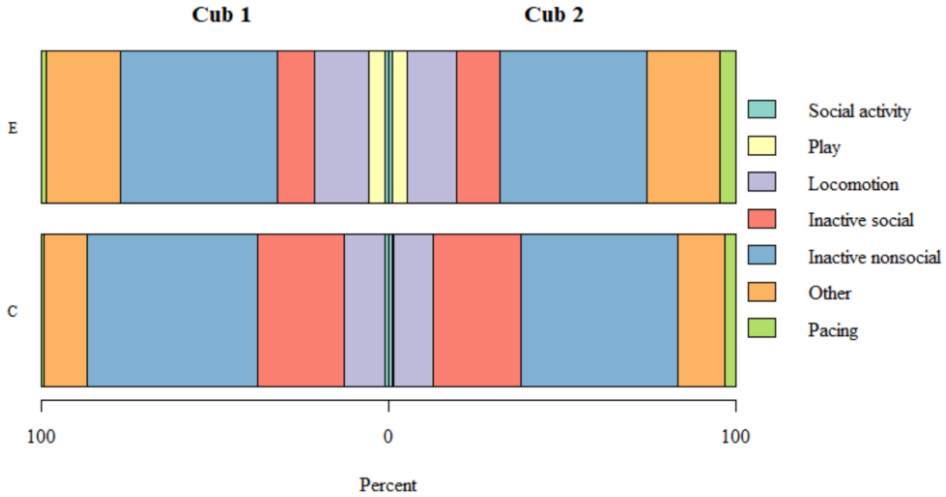


Figure 4: Stacked bar plot for Cub 1 and Cub 2, showing the proportion of time spent in pooled data for enrichment days (E) and control days (C). Each colour represents a specific behaviour, which is defined on the right. The x-axis shows the percentage of time the tigers spent on each behaviour.

Behavioural reaction norms for testing difference between enrichment and control days

Slope plots were created in order to visualise the reaction norms of each individual. The slope plots in Figure 5 and 6 shows that Cub 1 and Cub 2 had very similar reaction norms. They only differ in variance for the behaviours 'Social activity', 'Play', and 'Stereotypic pacing'. The variance for Cub 2 for the behaviour 'Social activity' for enrichment days was high (variance for E = 6390835) in comparison to

the other individuals (p <0.001) (see Table A3 in Appendix A), therefore that point is not visible in the plot. In 'Play' a significant difference in medians was found for the adult male and Cub 1 (p <0.001) (see Table A2 in Appendix A), whereas despite a visual difference in Figure 5, no significant difference was found for the adult female and Cub 2 between control days and enrichment days.

In Figure 6 for 'Stereotypic pacing' all but Cub 1 shows a decrease in median. The median for the adult female was higher than the other subjects, even though there was no significant difference for the adult female in 'Stereotypic pacing'. A significant difference was found for the adult male, Cub 1 and Cub 2 for the same behaviour (p <0.01) (see Table A2 in Appendix A). The decrease in 'Stereotypic pacing' in median for the adult female in Figure 6 shows that she paces for shorter periods of time on enrichment days, but Figure 3 showed that the total proportion of time spent on 'Stereotypic pacing' was higher on enrichment days.

The slope plot for medians of the behaviour 'Inactive nonsocial' shows that the adult male was inactive for shorter periods of time on enrichment days than on control days. The same was shown in the plot for variance, as the enrichment days seem to have a much lower variance than the control days.

The slope plots for skewness shows that most of the data is skewed to the right, which indicated that the tigers mostly had done each behaviour for shorter periods of time. The skewness for 'Play' and 'Stereotypic pacing' for Cub 1 on control days were negative (see Figures 5 and 6), which indicated that Cub 1 had played and paced for longer periods of time on control days compared to enrichment days. Although, the only nonsignificant behaviour in the χ^2 test in Table A4 in Appendix A for Cub 1 was 'Inactive nonsocial'.

The kurtoses were increased on enrichment days for most of the tigers for most behaviours, which indicated that most of the data was closer to the median on enrichment days, than control days. For Cub 1 the kurtosis was decreased for 'Locomotion' and 'Inactive nonsocial', therefore the data was spread out more widely around the median for those two behaviours on enrichment days. Furthermore, the kurtosis for the adult female was also decreased on enrichment days for the behaviour 'Inactive social' (see Figures 5 and 6). Although, the χ^2 test showed that all behaviours for the adult female and Cub 1 were significant (p <0.001) (see Table A5 in Appendix A).

Discussion

Behavioural reaction norms and personality

In Figure 3 and 4 the adult female shows more 'Stereotypic pacing' than the other three tigers both during enrichment days and control days. A study by Bertocchi *et al.* (2015) shows similar results, where the male in the study did not show stereotypical behaviour, while the female did.

Furthermore, Rouck *et al.* (2005) shows pacing from all individuals in their study, which were all female, and discusses whether this can be due to the visibility of other big felids and prey animals in neighboring and visible enclosures from the tiger's perspective. This behaviour is observed in this study as well, as the adult female often shows 'Stereotypic pacing' behaviour near the neighboring lion enclosure, as well as fencing from where visitors and caretakers walking reindeer are visible. Rouck *et al*. (2005) also discuss how the housing of the captive animals, such as tigers, affect the percentage of time spent on stereotypic behaviours such as pacing. For pair-housed animals with neighbours, which is similar to the circumstances in Aalborg zoo, the average percentage of stereotypic pacing is 21.3%, whereas the adult female in this study's average percentage is 43.26%. The average percentage of time spent on 'Stereotypic pacing' for the adult female is approximately double the percentage from observations made by Rouck *et al.* (2005). This could be explained by the numbers of tigers in the same enclosure, where only pair-housed animals were observed by Rouck *et al.* (2005) whereas the adult female in this study is housed with three other male tigers. The lowest observed percentage of time spent on 'Stereotypic pacing' by Rouck *et al.* (2005) is 4.67%, for pair-housed animals without neighbours, which indicates a higher level of stereotypy in tigers when housed next to other big felids.

Cub 1 and Cub 2 are brothers and are born in Aalborg Zoo. Due to the same age, environment, and parents their differences in behaviour, apart from what may be caused due to dizygosity, are not expected to be affected by these parameters. In Figure 4 a slight difference in 'Stereotypic pacing' between the

cubs can be seen, where Cub 2 spends more time on pacing than Cub 1. However, these results are not shown in the χ^2 test, due to the proportion of time spent on 'Stereotypic pacing' being too low to calculate in the χ^2 test, and therefore have no calculable significant difference (see Table A1 in Appendix A).

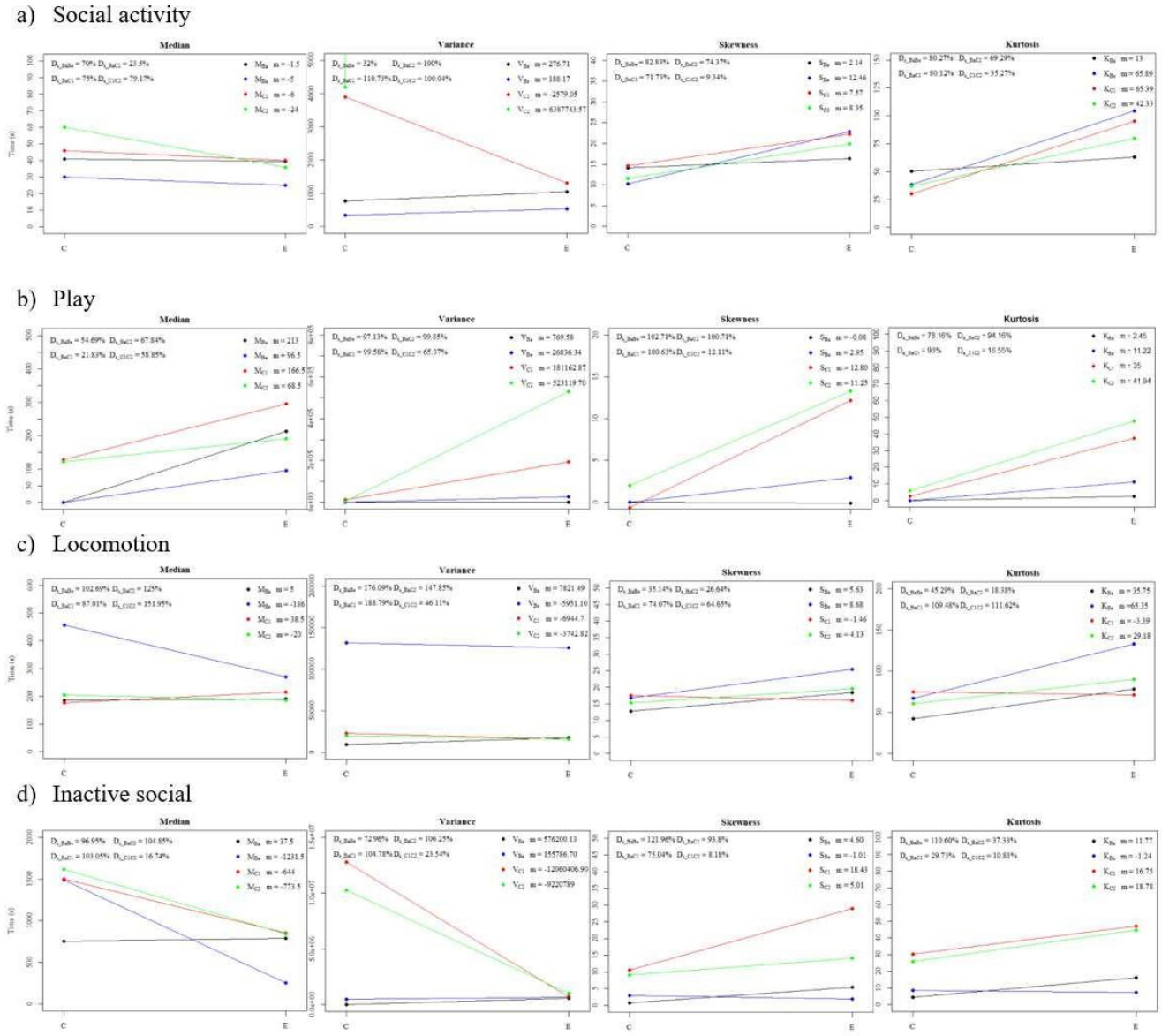


Figure 5: Behavioural reaction norms for all four individuals: the adult male = black, the adult female = blue, Cub 1 = red and Cub 2 = green, showing the median, variance, skewness, and kurtosis for pooled control days (C) and pooled enrichment days (E). The slope (m) for each individual is given as well as a difference in slope in percent (D_s) for the adult male and the adult female (D_{s_BaBe}), the adult male and Cub 1 (D_{s_BaC1}), the adult male and Cub 2 (D_{s_BaC2}), and Cub 1 and Cub 2 (D_{s_C1C2}).

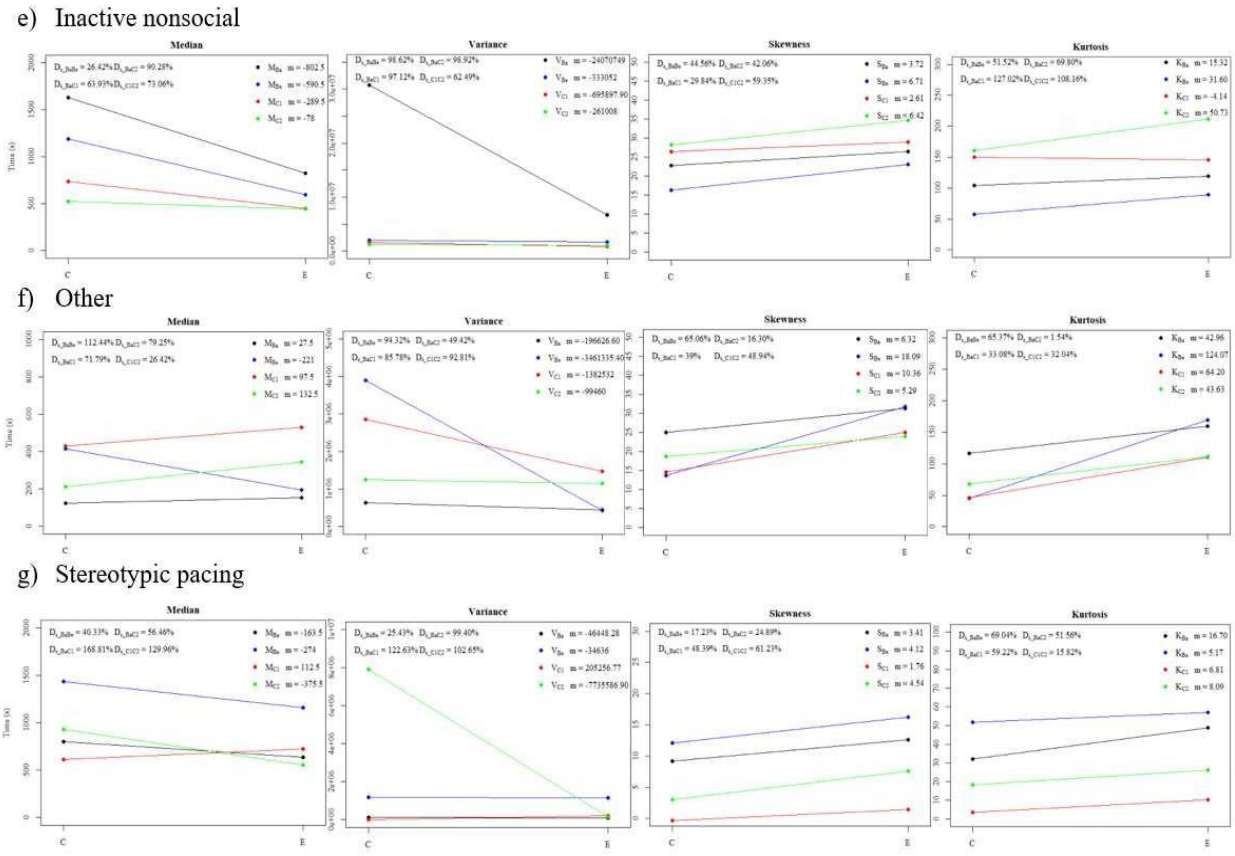


Figure 6: Behavioural reaction norms for all four individuals: the adult male = black, the adult female = blue, Cub 1 = red and Cub 2 = green, showing the median, variance, skewness, and kurtosis for pooled control days (C) and pooled enrichment days (E). The slope (m) for each individual is given as well as a difference in slope in percent (D_s) for the adult male and the adult female (D_{s_BaBe}), the adult male and Cub 1 (D_{s_BaC1}), the adult male and Cub 2 (D_{s_BaC2}), and Cub 1 and Cub 2 (D_{s_C1C2}).

The reaction norms for skewness in Figures 5 and 6 show that Cub 1 has played and paced for longer continuous periods of time during control days compared to enrichment days, which can indicate that there have been less distractions on control days. Furthermore, the reaction norms for Cub 1 shows that the kurtosis is decreased on enrichment days for the behaviours 'Locomotion' and 'Inactive nonsocial' compared to control days. This indicates that the periods of time Cub 1 has spent on those two behaviours varies more on enrichment days than on control days. The same can be seen on the reaction norms for the adult female, where the kurtosis for the behaviour 'Inactive nonsocial' is also decreased on enrichment days compared to control days. Therefore, the periods of time she spends on that behaviour varies more on enrichment days than on control days. This difference in kurtosis can indicate that enrichment lessens the predictability of 'Locomotion' and 'Inactive nonsocial' for Cub 1 and 'Inactive social' for the adult female.

In Figures 3 and 4 a difference in several behaviours between the adult male and the cubs can be seen. The results show that the cubs are more social by behaviours such as 'Inactive social' (Cub 1: 24.87% and Cub 2: 25.04% on control days, Cub 1: 10.93% and Cub 2: 12.29% on enrichment days) than the adult male (0.75% on control days, and 3.62% on enrichment days). Furthermore, the adult male spends a greater amount of time being 'Inactive nonsocial' (67.12% on control days, and 57.4% on enrichment days) than the cubs (Cub 1: 48.81% and Cub 2: 45.17% on control days, Cub 1: 45.14% and Cub 2: 42.31% on enrichment days). This can indicate that age and age-related diseases may affect these behaviour patterns (Bellows *et al.*, 2016).

A study from Swaisgood *et al.* (2001) shows that subadults responded more to enrichment than adults. However, adults preferred feeding enrichment over nonfeeding enrichment (Swaisgood *et al.*, 2001). This is observed for the adult male on enrichment day three (E3), where they are given a hose with meat

(Table 1). The Mann-Whitney U test for the adult male shows a significant difference in the behaviour 'Play' between E3 and most of the control days and some of the other enrichment days (p <0.05) (see Table B1 in Appendix B). The median for E3 for 'Play' is also greater than the median for all other days, except for E5. Furthermore, the adult male also reacts significantly to E1 (p <0.01) where part of the enrichment was blood, which may have been a similar stimulation to prey (see Table 1 and Table B1 in Appendix B) (Swaisgood *et al.*, 2001). 'Stereotypic pacing' changes significantly for the adult female on E5 which included boiled eggs and rabbit scent as enrichment (see Table 1 and Table B2 in Appendix B). This enrichment can be more interesting to the adult female as it is edible and smells like prey (Swaisgood *et al*., 2001).

Cub 1 and Cub 2 showed a significant difference for enrichment day two (E2) (p <0.05 for 'Inactive nonsocial'), E3 (p <0.01 for both 'Inactive nonsocial' and 'Social activity') and E8 (p <0.001 for 'Social activity') between four or more control days (see Tables B3 and B4 in Appendix B). This indicates that the cubs have more interest in enrichment with edibles and scents (see Table 1), similar to the adult male and the adult female. Although observations show a high interest in the hammock and cardboard boxes for the cubs as well.

Medication of the adult male

Pain relief as a diagnostic tool was investigated in one animal. The adult male tiger had decreased activity and stiff hind part and back, he was given meloxicam with the intention of relieving potential osteoarthrosis related pain. However, no significant difference in behaviours between weeks with and without meloxicam treatment indicated that meloxicam changed the male's behaviour. Therefore, he was X-rayed after this observation study and no signs of osteoarthrosis was found.

Conclusion

Throughout this study the behavioural reaction norms are investigated for four tigers of different sex and age. The results show a difference between the individuals and their behavioural reaction norms. Cub 1 and Cub 2 are the same age and sex, and their behavioural reaction norms are similar, furthermore the adult male is the oldest individual and the results show more inactive behaviour compared to the cubs, which indicates that age and/or age-related diseases may have an effect on the behavioural reaction norms. The only female in this study, displays more stereotypic behaviour compared to the other three individuals which support the results from other studies indicating that sex has an effect on the behavioural reaction norms. The adult male shows symptoms of age-related problems, therefore the aim of the paper is to determine if a pain-relieving medication has an effect on his behaviour. This was not the case, therefore other age-related diseases have been taken into account in the discussion.

In conclusion, it is possible to observe and quantify differences in behaviour with the observation methods used in this study. Using statistical analyses it is possible to determine significant changes in behaviour between the three observed weeks using a χ^2 test, as well as compare behavioural differences between days to determine the effects of enrichment using a Mann-Whitney U test.

In future studies it would be advantageous to include several females in the study in order to compare female individuals, as well as more individuals in general to determine behavioral differences between sexes and age groups, along with differences between individuals of the same sex and age group.

Acknowledgments

Aalborg Zoo Conservation Fund is acknowledged for economic support for cameras and the carnivore keepers of Aalborg Zoo are acknowledged for their help conducting this study.

References

Bellows J. Center S. Daristotle L. Estrada AH. Flickinger EA. Horwitz DF. Lascelles BDX. Lepine A. Perea S. Scherk M. Shoveller AK. 2016. Aging in cats: Common physical and functional changes. Journal of Feline Medicine and Surgery, 18, pp. 534.

Bertocchi M. Spiezio C. Ianni FD. Parmigiani EM. Sandri C. Ponzio P. Quintavalla F. 2015. Welfare of a pair of Captive Tigers: a Hand-Reared Female and a Parent-Reared Male. Journal Advances In Agriculture, 5, pp. 553.

Biolatti, C. Modesto P. Dezzutto D. Pera F. Tarantola M. Gennero MS. Maurella C. Acutis PL. 2016. Behavioural analysis of captive tigers (Panthera tigris): A water pool makes the difference. Applied Animal Behaviour Science, 174, pp. 173–174.

Clubb R. and Vickery S. 2006. Stereotypic Animal Behaviour, Fundamentals and Applications to Welfare, CABI. ISBN: 1-84593-042-8, eBook. pp. 58-79 (Chapter 3).

Dingemanse NJ. Kazem A. J. Réale D. Wright J. 2009. Behavioural reaction norms: animalpersonality meets individual plasticity. Trends in Ecology and Evolution, 25, pp. 82.

IRIS 2019. Diagnosing, Staging, and Treating Chronic Kidney Disease in Dogs and Cats. Pocket Guide.

IUCN 2021. Saving the Sumatran tiger. https://www.iucn.org/theme/species/our work/actionground/integrated-tiger-habitat-conservation-programme/saving-sumatran-tiger. Visited: 08-02- 2021.

Linder AC. Gottschalk A. Lyhne H. Langbak MG. Jensen TH. Pertoldi C. 2020. Using Behavioral Instability to Investigate Behavioral Reaction Norms in Captive Animals: Theoretical Implications and Future Perspectives. Symmetry, 12, pp. 1–20.

Linkie M. Wibisono H. Martyr D. Sunarto S. 2008. Panthera tigris ssp. sumatrae. The IUCN Red List of Threatened Species: e.T15966A5334836. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T15966A5334836.en. Visited: 10-12-2020.

Longley L. 2011. A review of ageing studies in captive felids. Int. Zoo Yb., 45, pp. 91–93.

Luo L. Reimert I. de Haas EN. Kemp B. Bolhuis JE. 2019. Effects of early and later life environmental enrichment and personality on attention bias in pigs (Sus scrofa domesticus). Animal Cognition, 22, pp. 959.

Hangstrup et al, 2021. *Genet. Biodiv. J* , 5(2); 33-43 **43**

Luskin, MS. Albert WR. Tobler MW. 2017. Sumatran tiger survival threatened by deforestation despite increasing densities in parks. Nature Communications, 8, pp. 2.

Metter JEV. Harriger MD. Bolen RH. 2008. Environmental enrichment utilizing stimulus objects for African lions (Panthera leoleo) and Sumatran tigers (Panthera tigrissumatrae). Bios, 79, pp. 7–8, 14–15.

Montiglio PO. Garant D. Pelletier F. Réalea D. 2012. Personality differences are related to long-term stress reactivity in a population of wild eastern chipmunks, Tamias striatus. Animal Behaviour, 84, pp. 1071.

Pitsko LE. 2003. Wild Tigers in Captivity: A Study of the Effects of the Captive Environment on Tiger Behavior. Virginia Polytechnic Institute and State University. pp. 2.

Ramsay EC. 2008. Use of Analgesics in Exotic Felids, Saunders. ISBN: 978-1-4160-4047-7, eBook. pp. 289-293 (Chapter 35).

Rouck, MD. Kitchener A. Law G. Nelissen M. 2005.A comparative study of the influence of social housing conditions on the behaviour of captive tigers (Panthera tigris). Animal Welfare, 4, pp. 229–230, 234–236.

RStudio® Team 2019. RStudio®: Integrated Development for R. RStudio®, Inc.: Boston, MA, USA

Santicchia F. Wauters L. A. Dantzer, B. Westrick S. E. Ferrari N. Romeo C. Palme R. Preatoni D. G. and Martinolia A. 2020. Relationships between personality traits and the physiological stress response in a wild mammal. Current Zoology, 66, pp. 198.

Swaisgood RR. White AM. Zhou X. Zhang H. Zhang G. Wei R. Hare VJ. Lindburg EMTDG. 2001. A quantitative assessment of the efficacy of an environmental enrichment programme for giant pandas. Animal Behaviour, 61, pp. 451.

Wibisono HT. and Pusparini W. 2010. Sumatran tiger (Panthera tigrissumatrae): A review of conservation status. Integrative Zoology, 5, pp. 313–315.

Wilson, V. Guenther A. Øyvind Øverli Seltmann M. W. Altschul D. 2019. Future Directions for Personality Research: Contributing New Insights to the Understanding of Animal Behavior. Animals, 9, pp. 1–17.

Appendix A

The comparison of percent, medians, variances, skewness, and kurtoses of the pooled data for each behavior for different data sets results in χ^2 test. Before the calculation of the χ^2 test, the pooled data for skewness and kurtosis were multiplied by 100 to get more useful data. The table shows the results for the four subjects. A blank space indicates the behavior made up less than 5% of the week. Significant differences are marked with one or more '*', each indicating a different p-value: * = p-value <0.05, ** = p-value <0.01 and *** = p-value <0.001.

Table A1. χ^2 test of pooled percentage of each behavior for each week.

Behavior		Adult male	Adult female	Cub 1	Cub 2
Social activity	**χ^2-value**				
	p-value				
Play	**χ^2-value**				
	p-value				
Locomotion	**χ^2-value**	0.25341	4.0226	1.372	0.37127
	p-value	0.881	0.1338	0.5036	0.8306
Inactive social	**χ^2-value**			2.113	1.417
	p-value			0.3477	0.4924
Inactive nonsocial	**χ^2-value**	0.55735	1.9748	4.6176	3.3276
	p-value	0.7568	0.3725	0.09938	0.1894
Other	**χ^2-value**	4.4625	28.081	21.404	21.272
	p-value	0.1074	***	***	***
Stereotypic pacing	**χ^2-value**	3.8471	1.5756		
	p-value	0.1461	0.4549		

Table A2. χ^2 test of pooled medians of each behavior for each week.

Behavior		Adult male	Adult female	Cub 1	Cub 2
Social activity	**χ^2-value**	0.5	0	0.125	0.4
	p-value	0.7788	1	0.9394	0.8187
Play	**χ^2-value**	58.19	1.9	9.2152	0.83784
	p-value	***	0.3867	**	0.6578
Locomotion	**χ^2-value**	2.4932	17.081	3.3671	3.4545
	p-value	0.2875	***	0.1857	0.1778
Inactive social	**χ^2-value**	34.2	66.353	64.347	95.529
	p-value	***	***	***	***
Inactive nonsocial	**χ^2-value**	26.089	13.862	6.9394	7.7979
	p-value	***	***	0.03113	0.02026
Other	**χ^2-value**	1.303	0.14894	10.19	4.6986
	p-value	0.5213	0.9282	**	0.09543
Stereotypic pacing	**χ^2-value**	11.064	0.72195	87.197	11.676
	p-value	**	0.697	***	**

Table A3: χ^2 test of pooled variances of each behaviour for each week.

Behavior		Adult male	Adult female	Cub 1	Cub 2
Social activity	**χ^2-value**	0.5	0.63051	83.595	299.15
	p-value	***	0.7296	***	***
Play	**χ^2-value**	96.004	8470	22060	266.4
	p-value	***	***	***	***
Locomotion	**χ^2-value**	30.079	997.73	20497013	182
	p-value	***	***	***	***
Inactive social	**χ^2-value**	2555.9	43728	52675	120675
	p-value	***	***	***	***
Inactive nonsocial	**χ^2-value**	35232	7558.5	34797	1250.3
	p-value	***	***	***	***
Other	**χ^2-value**	639.9	192611	89253	7101.2
	p-value	***	***	***	***
Stereotypic pacing	**χ^2-value**	12803	41955	44276	36133
	p-value	***	***	***	***

Table A4: χ^2 test of pooled skewness of each behaviour for each week.

Behavior		Adult male	Adult female	Cub 1	Cub 2
Social activity	χ^2**-value**	17.538	180.21	28.334	45.32
	p-value	***	***	***	***
Play	χ^2**-value**	18.542	209.34	190.4	177.06
	p-value	***	***	***	***
Locomotion	χ^2**-value**	13.188	8.1129	218.91	3.6562
	p-value	**	0.01731	***	0.1607
Inactive social	χ^2**-value**	6.2118	102.78	123.05	141.81
	p-value	0.04478	***	***	*
Inactive nonsocial	χ^2**-value**	42.125	10.251	76.729	11.03
	p-value	***	***	0.6814	0.004025
Other	χ^2**-value**	60.639	94.469	85.678	22.341
	p-value	***	***	***	***
Stereotypic pacing	χ^2**-value**	7.1012	45.618	75.713	69.699
	p-value	0.02871	***	***	***

Table A5. χ^2 test of pooled kurtoses of each behavior for each week.

Behavior		Adult male	Adult female	Cub 1	Cub 2
Social activity	χ^2**-value**	319.52	3656.1	547.76	941.78
	p-value	***	***	***	***
Play	χ^2**-value**	134.28	376.6	431.86	1881.1
	p-value	***	***	***	***
Locomotion	χ^2**-value**	309.43	127.37	146.23	53.507
	p-value	***	***	***	0.06888
Inactive social	χ^2**-value**	78.232	433.47	1825.3	1997.2
	p-value	***	***	***	***
Inactive nonsocial	χ^2**-value**	964.29	273	1740.3	375.74
	p-value	***	***	***	***
Other	χ^2**-value**	2438.3	1920.1	1472.4	467.03
	p-value	***	***	***	***
Stereotypic pacing	χ^2**-value**	63.168	669.67	193.76	353.55
	p-value	***	***	***	***

Appendix B

Results from the Mann-Whitney U test is shown for each individual and each behaviour in Tables B1, B2, B3 and B4. Significant differences are marked with one or more '*', each indicating a different p-value: * = p-value <0.05, ** = p-value <0.01 and *** = p-value <0.001. The difference in the median for each test is also indicated with a <, > or =.

Table B1: The adult male

Social activity															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1=C2	C1>C3	C1<C4	C1>C5	C1>C6	C1>C7	C1>E1	C1<E2	C1>E3	C1>E4	C1>E5	C1>E6	C1>E7	C1>E8*
C2			C2>C3	C2<C4	C2>C5	C2>C6*	C2>C7	C2>E1	C2<E2	C2>E3***	C2>E4	C2>E5*	C2>E6*	C2>E7**	C2>E8***
C3				C3<C4	C3=C5	C3>C6	C3=C7	C3<E1	C3<E2	C3>E3	C3>E4	C3>E5	C3>E6	C3>E7	C3>E8
C4					C4>C5	C4>C6*	C4>C7	C4>E1	C4<E2	C4>E3*	C4>E4	C4>E5	C4>E6*	C4>E7*	C4>E8**
C5						C5>C6	C5=C7	C5<E1	C5<E2	C5>E3*	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8**
C6							C6<C7	C6<E1*	C6<E2*	C6>E3	C6>E4	C6=E5	C6=E6	C6>E7	C6>E8
C7								C7<E1	C7<E2	C7>E3	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8**
E1									E1<E2	E1>E3*	E1>E4	E1>E5*	E1>E6*	E1>E7*	E1>E8**
E2										E2>E3*	E2>E4	E2>E5*	E2>E6*	E2>E7*	E2>E8**
E3											E3>E4	E3<E5	E3<E6	E3<E7	E3=E8
E4												E4<E5	E4<E6	E4<E7	E4=E8
E5													E5=E6	E5>E7	E5>E8
E6														E6>E7	E6>E8
E7															E7>E8
E8															

Play															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1=C2	C1=C3	C1=C4	C1=C5	C1=C6	C1=C7	C1<E1***	C1<E2	C1<E3**	C1<E4	C1<E5	C1<E6	C1=E7	C1=E8
C2			C2=C3	C2=C4	C2=C5	C2=C6	C2=C7	C2<E1***	C2<E2	C2<E3**	C2<E4	C2<E5	C2<E6	C2=E7	C2=E8
C3				C3=C4	C3=C5	C3=C6	C3=C7	C3<E1***	C3<E2	C3<E3**	C3<E4	C3<E5	C3<E6	C3=E7	C3=E8
C4					C4=C5	C4=C6	C4=C7	C4<E1**	C4<E2	C4<E3	C4<E4	C4<E5	C4<E6	C4=E7	C4=E8
C5						C5=C6	C5=C7	C5<E1***	C5<E2	C5<E3**	C5<E4	C5<E5	C5<E6	C5=E7	C5=E8
C6							C6=C7	C6<E1**	C6<E2	C6<E3	C6<E4	C6<E5	C6<E6	C6=E7	C6=E8
C7								C7<E1**	C7<E2	C7<E3*	C7<E4	C7<E5	C7<E6	C7=E7	C7=E8
E1									E1>E2**	E1<E3***	E1>E4***	E1<E5***	E1<E6***	E1>E7**	E1>E8
E2										E2>E3**	E2>E4*	E2>E5*	E2>E6	E2>E7	E2>E8
E3											E3>E4	E3<E5	E3>E6	E3>E7	E3>E8*
E4												E4<E5	E4<E6	E4>E7	E4>E8
E5													E5>E6	E5>E7	E5>E8
E6														E6>E7	E6>E8
E7															E7=E8
E8															

Locomotion															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1>E1	C1=E2	C1<E3	C1<E4	C1<E5	C1>E6	C1<E7	C1<E8
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2>E1	C2>E2	C2<E3	C2<E4	C2<E5	C2>E6	C2<E7	C2>E8
C3				C3>C4	C3>C5	C3>C6	C3<C7	C3>E1	C3>E2	C3>E3	C3>E4	C3>E5	C3>E6	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4<C7	C4>E1	C4>E2	C4<E3	C4<E4	C4<E5	C4>E6	C4>E7	C4>E8
C5						C5>C6	C5<C7	C5>E1	C5>E2	C5<E3	C5<E4	C5<E5	C5>E6	C5>E7	C5>E8
C6							C6<C7	C6>E1	C6>E2	C6<E3	C6<E4	C6<E5	C6>E6	C6=E7	C6>E8
C7								C7>E1	C7>E2	C7>E3	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8
E1									E1<E2	E1<E3	E1<E4	E1<E5	E1<E6	E1<E7	E1<E8
E2										E2<E3	E2<E4	E2<E5	E2>E6	E2<E7	E2<E8
E3											E3<E4*	E3>E5	E3>E6	E3>E7	E3>E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5>E6	E5>E7	E5>E8
E6														E6<E7	E6<E8
E7															E7>E8
E8															

Inactive Social															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1<E1	C1<E2	C1<E3	C1<E4	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2<E1	C2=E2	C2<E3	C2<E4	C2<E5	C2<E6	C2<E7	C2<E8
C3				C3<C4	C3>C5	C3>C6	C3>C7	C3<E1	C3>E2	C3>E3	C3<E4	C3<E5	C3>E6	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4>E7	C4>E8
C5						C5<C6	C5<C7	C5<E1	C5>E2	C5<E3	C5<E4	C5<E5	C5<E6	C5<E7	C5>E8
C6							C6<C7	C6<E1	C6>E2	C6<E3	C6<E4	C6<E5	C6<E6	C6<E7	C6>E8
C7								C7<E1	C7>E2	C7>E3	C7<E4	C7<E5	C7<E6	C7<E7	C7>E8
E1									E1>E2	E1>E3	E1>E4	E1<E5	E1>E6	E1>E7	E1>E8
E2										E2<E3	E2<E4	E2<E5	E2<E6	E2<E7	E2<E8
E3											E3<E4*	E3<E5	E3<E6	E3<E7	E3>E8
E4												E4<E5	E4>E6	E4>E7	E4>E8
E5													E5>E6	E5>E7	E5>E8
E6														E6<E7	E6>E8
E7															E7>E8
E8															

Inactive nonsocial															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1>C3	C1>C4	C1>C5	C1<C6	C1>C7	C1>E1	C1>E2	C1>E3**	C1>E4	C1>E5	C1>E6	C1<E7	C1>E8
C2			C2<C3***	C2<C4**	C2<C5*	C2<C6***	C2<C7*	C2<E1*	C2>E2	C2>E3	C2<E4	C2<E5**	C2<E6	C2<E7*	C2<E8
C3				C3>C4	C3>C5	C3<C6	C3>C7	C3>E1	C3>E2	C3>E3**	C3>E4	C3>E5	C3>E6	C3<E7	C3>E8
C4					C4>C5	C4<C6	C4>C7	C4>E1	C4>E2	C4>E3**	C4>E4	C4<E5	C4>E6	C4<E7	C4>E8
C5						C5<C6	C5<C7	C5<E1	C5>E2	C5>E3**	C5>E4	C5<E5	C5>E6	C5<E7	C5>E8
C6							C6>C7	C6>E1	C6>E2	C6>E3**	C6>E4	C6>E5	C6>E6*	C6>E7	C6>E8*
C7								C7<E1	C7>E2	C7>E3	C7>E4	C7<E5**	C7>E6	C7<E7	C7>E8
E1									E1>E2	E1>E3*	E1>E4	E1<E5	E1>E6	E1<E7	E1>E8
E2										E2>E3	E2<E4	E2<E5	E2<E6	E2<E7	E2<E8
E3											E3<E4*	E3<E5**	E3<E6	E3<E7*	E3<E8*
E4												E4<E5	E4<E6	E4<E7	E4>E8
E5													E5>E6	E5<E7	E5>E8
E6														E6<E7	E6>E8
E7															E7>E8
E8															

Other															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2*	C1<C3	C1<C4*	C1<C5	C1<C6	C1>C7*	C1<E1	C1<E2	C1>E3	C1<E4	C1<E5	C1>E6*	C1>E7	C1>E8
C2			C2<C3*	C2<C4**	C2<C5	C2<C6*	C2>C7	C2<E1*	C2<E2***	C2<E3	C2<E4**	C2<E5***	C2<E6	C2<E7	C2<E8
C3				C3=C4	C3<C5	C3<C6	C3>C7*	C3<E1	C3<E2	C3>E3	C3<E4	C3<E5	C3>E6	C3>E7	C3>E8
C4					C4<C5**	C4<C6	C4>C7**	C4>E1	C4>E2	C4>E3**	C4>E4	C4>E5	C4>E6**	C4>E7*	C4>E8**
C5						C5>C6*	C5>C7	C5>E1	C5>E2**	C5>E3	C5>E4*	C5>E5**	C5>E6	C5>E7	C5>E8
C6							C6>C7*	C6>E1	C6>E2	C6>E3	C6>E4	C6>E5	C6>E6*	C6>E7	C6>E8
C7								C7<E1*	C7<E2***	C7<E3	C7<E4**	C7<E5**	C7<E6	C7<E7	C7<E8
E1									E1<E2*	E1>E3	E1<E4	E1<E5	E1>E6*	E1>E7	E1>E8
E2										E2>E3**	E2<E4	E2>E5	E2>E6***	E2>E7*	E2>E8*
E3											E3<E4*	E3<E5*	E3>E6	E3<E7	E3>E8
E4												E4>E5	E4>E6**	E4>E7	E4>E8
E5													E5>E6**	E5>E7	E5>E8*
E6														E6<E7	E6<E8
E7															E7>E8
E8															
Stereotypic pacing															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1<C3	C1<C4*	C1<C5	C1<C6*	C1<C7	C1<E1	C1<E2	C1>E3	C1<E4	C1<E5	C1>E6	C1<E7*	C1>E8
C2			C2<C3*	C2<C4**	C2<C5**	C2<C6**	C2<C7***	C2<E1*	C2<E2	C2>E3	C2<E4	C2<E5	C2>E6	C2<E7***	C2>E8
C3				C3<C4*	C3<C5	C3<C6*	C3<C7	C3<E1	C3>E2	C3>E3**	C3>E4	C3>E5	C3>E6**	C3<E7*	C3>E8**
C4					C4>C5	C4>C6	C4>C7	C4>E1*	C4>E2	C4>E3***	C4>E4*	C4>E5*	C4>E6***	C4>E7	C4>E8***
C5						C5<C6	C5<C7	C5>E1	C5>E2	C5>E3***	C5>E4	C5>E5	C5>E6***	C5<E7	C5>E8***
C6							C6>C7	C6>E1*	C6>E2	C6>E3**	C6>E4*	C6>E5*	C6>E6**	C6<E7	C6>E8***
C7								C7>E1	C7>E2	C7>E3***	C7>E4	C7>E5	C7>E6***	C7<E7	C7>E8***
E1									E1>E2	E1>E3*	E1>E4	E1>E5	E1>E6*	E1<E7*	E1>E8**
E2										E2>E3	E2<E4	E2<E5	E2>E6	E2<E7	E2>E8
E3											E3<E4	E3<E5*	E3<E6	E3<E7***	E3>E8
E4												E4<E5	E4>E6	E4<E7*	E4>E8*
E5													E5>E6*	E5<E7**	E5>E8**
E6														E6<E7***	E6>E8
E7															E7>E8***
E8															

Table B2: The adult female

Social activity															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1>C3	C1>C4	C1>C5	C1>C6	C1>C7	C1>E1*	C1>E2	C1>E3	C1>E4	C1>E5	C1>E6	C1>E7*	C1>E8
C2			C2>C3	C2<C4	C2<C5	C2<C6	C2<C7	C2=E1	C2<E2	C2=E3	C2=E4	C2>E5	C2=E6	C2<E7	C2>E8
C3				C3<C4*	C3<C5	C3<C6	C3<C7*	C3<E1	C3<E2	C3<E3	C3<E4	C3>E5	C3<E6	C3<E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1*	C4=E2	C4>E3*	C4>E4*	C4>E5*	C4>E6*	C4>E7*	C4>E8*
C5						C5=C6	C5=C7	C5>E1	C5<E2	C5>E3	C5>E4	C5>E5	C5>E6	C5=E7	C5>E8
C6							C6=C7	C6>E1	C6<E2	C6>E3	C6>E4	C6>E5	C6>E6	C6=E7	C6>E8
C7								C7>E1	C7<E2	C7>E3*	C7>E4	C7>E5*	C7>E6*	C7=E7*	C7>E8
E1									E1<E2	E1=E3	E1=E4	E1>E5	E1=E6	E1<E7	E1>E8
E2										E2>E3	E2>E4	E2>E5	E2>E6	E2>E7	E2>E8
E3											E3=E4	E3>E5	E3=E6	E3<E7	E3>E8
E4												E4>E5	E4=E6	E4<E7	E4>E8
E5													E5<E6	E5<E7	E5=E8
E6														E6<E7	E6>E8
E7															E7>E8
E8															

Play															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1=C2	C1=C3	C1=C4	C1=C5	C1=C6	C1=C7	C1<E1	C1<E2	C1<E3	C1<E4	C1<E5	C1<E6	C1=E7	C1=E8
C2			C2=C3	C2=C4	C2=C5	C2=C6	C2=C7	C2<E1	C2<E2	C2<E3	C2<E4	C2<E5	C2<E6	C2=E7	C2=E8
C3				C3=C4	C3=C5	C3=C6	C3=C7	C3<E1	C3<E2	C3<E3	C3<E4	C3<E5	C3<E6	C3=E7	C3=E8
C4					C4=C5	C4=C6	C4=C7	C4<E1	C4<E2	C4<E3	C4<E4	C4<E5	C4<E6	C4=E7	C4=E8
C5						C5=C6	C5=C7	C5<E1	C5<E2	C5<E3	C5<E4	C5<E5	C5<E6	C5=E7	C5=E8
C6							C6=C7	C6<E1	C6<E2	C6<E3	C6<E4	C6<E5	C6<E6	C6=E7	C6=E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7<E6	C7=E7	C7=E8
E1									E1<E2	E1<E3	E1<E4	E1>E5	E1<E6	E1>E7	E1>E8
E2										E2>E3	E2>E4	E2>E5	E2>E6	E2>E7	E2>E8
E3											E3<E4	E3>E5	E3>E6	E3>E7	E3>E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5<E6	E5>E7	E5>E8
E6														E6>E7	E6>E8
E7															E7=E8
E8															

Locomotion															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1=C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1>E1**	C1<E2	C1<E3	C1<E4*	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2>E1**	C2<E2	C2<E3	C2<E4	C2<E5	C2<E6	C2<E7	C2<E8
C3				C3=C4	C3<C5	C3=C6	C3<C7	C3>E1**	C3>E2	C3>E3	C3<E4*	C3>E5	C3>E6	C3>E7	C3>E8
C4					C4<C5	C4=C6	C4<C7	C4>E1**	C4>E2	C4>E3	C4<E4	C4>E5	C4>E6	C4>E7	C4>E8
C5						C5>C6	C5>C7	C5>E1*	C5>E2	C5>E3	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8
C6							C6<C7	C6>E1**	C6>E2	C6>E3	C6<E4	C6>E5	C6>E6	C6>E7	C6>E8
C7								C7>E1**	C7>E2	C7>E3	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8
E1									E1<E2***	E1<E3***	E1<E4***	E1<E5***	E1<E6***	E1<E7***	E1<E8***
E2										E2<E3	E2<E4**	E2<E5*	E2<E6	E2<E7	E2<E8*
E3											E3<E4**	E3<E5*	E3<E6	E3<E7	E3<E8*
E4												E4>E5	E4>E6	E4>E7*	E4>E8
E5													E5>E6	E5>E7	E5>E8
E6														E6>E7	E6>E8
E7															E7<E8
E8															

Inactive social															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1>C3	C1<C4	C1>C5	C1<C6	C1<C7	C1>E1	C1>E2	C1<E3	C1<E4	C1>E5	C1>E6	C1<E7	C1>E8
C2			C2>C3	C2<C4	C2>C5	C2<C6	C2<C7	C2>E1	C2>E2	C2<E3	C2<E4	C2>E5	C2>E6	C2<E7	C2>E8
C3				C3<C4	C3=C5	C3<C6	C3<C7*	C3=E1	C3=E2	C3<E3	C3<E4	C3=E5	C3=E6	C3<E7	C3=E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4>E7	C4>E8
C5						C5<C6	C5<C7	C5=E1	C5=E2	C5<E3	C5<E4	C5=E5	C5=E6	C5<E7	C5=E8
C6							C6>C7	C6>E1	C6>E2	C6>E3	C6>E4	C6>E5	C6>E6	C6>E7	C6>E8
C7								C7>E1	C7>E2	C7>E3	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8
E1									E1=E2	E1<E3	E1<E4	E1=E5	E1=E6	E1<E7	E1=E8
E2										E2<E3	E2<E4	E2=E5	E2=E6	E2<E7	E2=E8
E3											E3<E4	E3>E5	E3>E6	E3>E7	E3>E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5=E6	E5<E7	E5=E8
E6														E6<E7	E6=E8
E7															E7>E8
E8															

Inactive nonsocial															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2*	C1>C3	C1<C4	C1>C5	C1>C6	C1>C7	C1>E1	C1>E2*	C1>E3*	C1>E4	C1>E5**	C1>E6	C1>E7*	C1>E8*
C2			C2<C3	C2<C4	C2<C5	C2<C6***	C2<C7*	C2<E1	C2>E2	C2>E3	C2<E4	C2>E5	C2<E6	C2<E7	C2>E8
C3				C3<C4	C3<C5	C3<C6	C3>C7	C3>E1	C3>E2	C3>E3*	C3>E4	C3>E5*	C3>E6	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3**	C4>E4	C4>E5*	C4>E6	C4>E7	C4>E8
C5						C5>C6	C5>C7	C5>E1	C5>E2	C5>E3*	C5>E4	C5>E5*	C5>E6	C5>E7	C5>E8
C6							C6>C7	C6>E1	C6>E2**	C6>E3***	C6>E4	C6>E5***	C6>E6	C6>E7**	C6>E8**
C7								C7>E1	C7>E2*	C7>E3**	C7>E4	C7>E5*	C7>E6	C7>E7	C7>E8
E1									E1>E2	E1>E3	E1>E4	E1>E5	E1>E6	E1>E7	E1>E8
E2										E2>E3	E2<E4	E2>E5	E2<E6	E2<E7	E2<E8
E3											E3<E4**	E3>E5	E3<E6	E3<E7	E3<E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5<E6	E5<E7	E5<E8
E6														E6>E7	E6>E8
E7															E7>E8
E8															

Other															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2**	C1>C3**	C1<C4	C1>C5**	C1>C6	C1>C7	C1>E1***	C1>E2	C1>E3**	C1>E4**	C1>E5***	C1>E6***	C1>E7*	C1>E8**
C2			C2<C3	C2<C4**	C2>C5	C2<C6***	C2<C7	C2>E1	C2<E2*	C2<E3	C2<E4	C2>E5	C2>E6	C2<E7*	C2>E8
C3				C3<C4*	C3>C5	C3<C6**	C3<C7	C3>E1	C3<E2	C3<E3	C3<E4	C3>E5	C3>E6	C3<E7	C3>E8
C4					C4>C5*	C4>C6	C4>C7	C4>E1**	C4>E2	C4>E3*	C4>E4*	C4>E5**	C4>E6***	C4>E7	C4>E8**
C5						C5<C6***	C5<C7	C5<E1	C5<E2**	C5<E3	C5<E4	C5>E5	C5<E6	C5<E7*	C5<E8
C6							C6>C7*	C6>E1***	C6>E2	C6>E3***	C6>E4**	C6>E5***	C6>E6***	C6>E7	C6>E8***
C7								C7>E1	C7<E2	C7<E3	C7>E4	C7>E5	C7>E6*	C7<E7	C7>E8
E1									E1<E2**	E1<E3	E1<E4	E1>E5	E1>E6*	E1<E7**	E1<E8
E2										E2>E3	E2>E4	E2>E5*	E2>E6***	E2<E7	E2>E8**
E3											E3>E4	E3>E5	E3>E6***	E3<E7	E3>E8
E4												E4>E5	E4>E6*	E4<E7	E4>E8
E5													E5<E6**	E5<E7*	E5<E8
E6														E6<E7***	E6<E8
E7															E7>E8*
E8															

Stereotypic pacing															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1<C3	C1<C4	C1<C5	C1>C6	C1>C7	C1>E1	C1<E2	C1>E3	C1>E4	C1>E5	C1>E6	C1<E7	C1>E8
C2			C2<C3**	C2<C4	C2<C5**	C2<C6	C2<C7	C2<E1	C2<E2**	C2<E3	C2<E4	C2>E5	C2<E6	C2<E7	C2<E8
C3				C3<C4	C3>C5	C3>C6**	C3>C7*	C3>E1*	C3<E2	C3<E3**	C3>E4**	C3>E5***	C3>E6***	C3>E7	C3>E8***
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4<E2	C4>E3	C4>E4	C4>E5***	C4>E6*	C4>E7	C4>E8*
C5						C5>C6	C5>C7	C5>E1	C5<E2	C5>E3*	C5>E4*	C5>E5***	C5>E6*	C5>E7	C5>E8*
C6							C6<C7	C6>E1	C6<E2*	C6>E3	C6>E4	C6>E5*	C6>E6	C6<E7	C6>E8
C7								C7>E1	C7<E2	C7>E3	C7>E4	C7>E5**	C7>E6	C7<E7	C7>E8
E1									E1<E2	E1>E3	E1>E4	E1>E5**	E1>E6	E1<E7	E1>E8
E2										E2>E3*	E2>E4**	E2>E5***	E2>E6**	E2>E7	E2>E8**
E3											E3<E4	E3>E5	E3>E6	E3<E7	E3>E8
E4												E4>E5	E4>E6	E4<E7	E4>E8
E5													E5<E6	E5<E7*	E5<E8
E6														E6<E7	E6<E8
E7															E7>E8
E8															

Table B3: Cub 1

Social activity															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1=C4	C1<C5	C1>C6	C1<C7	C1<E1	C1>E2	C1>E3	C1>E4	C1<E5	C1<E6	C1<E7	C1>E8
C2			C2<C3	C2>C4	C2<C5	C2>C6	C2<C7	C2=E1	C2>E2	C2>E3***	C2>E4*	C2>E5*	C2=E6	C2<E7	C2>E8***
C3				C3>C4	C3<C5	C3>C6	C3<C7	C3>E1	C3>E2	C3>E3**	C3>E4	C3>E5	C3>E6	C3=E7	C3>E8***
C4					C4<C5*	C4>C6	C4<C7*	C4<E1	C4>E2	C4>E3	C4>E4	C4<E5	C4<E6	C4<E7	C4>E8
C5						C5>C6	C5=C7	C5>E1	C5>E2	C5>E3***	C5>E4*	C5>E5*	C5>E6	C5>E7	C5>E8***
C6							C6<C7	C6<E1	C6=E2	C6=E3	C6>E4	C6<E5	C6<E6	C6<E7	C6>E8
C7								C7>E1	C7>E2*	C7>E3**	C7>E4**	C7>E5*	C7>E6	C7>E7	C7>E8***
E1									E1>E2	E1>E3*	E1>E4	E1>E5	E1=E6	E1<E7	E1>E8**
E2										E2=E3	E2>E4	E2<E5	E2<E6	E2<E7	E2>E8*
E3											E3>E4	E3<E5	E3<E6**	E3<E7	E3>E8*
E4												E4<E5	E4<E6*	E4<E7	E4>E8
E5													E5<E6	E5<E7	E5>E8*
E6														E6<E7	E6>E8***
E7															E7>E8*
E8															
Play															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1<C4	C1=C5	C1=C6	C1=C7	C1<E1	C1<E2	C1<E3	C1<E4	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2>C3	C2>C4	C2>C5	C2>C6	C2>C7	C2>E1	C2>E2	C2>E3	C2>E4	C2>E5	C2>E6	C2>E7	C2>E8
C3				C3<C4	C3>C5	C3>C6	C3>C7	C3>E1	C3<E2	C3<E3	C3<E4	C3<E5	C3<E6	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4<E2	C4<E3	C4<E4	C4<E5	C4<E6	C4>E7	C4>E8
C5						C5=C6	C5=C7	C5<E1	C5<E2	C5<E3	C5<E4	C5<E5	C5<E6	C5<E7	C5<E8
C6							C6=C7	C6<E1	C6<E2	C6<E3	C6<E4	C6<E5	C6<E6	C6<E7	C6<E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7<E6	C7<E7	C7<E8
E1									E1<E2	E1<E3	E1<E4**	E1<E5	E1<E6	E1=E7	E1>E8
E2										E2>E3	E2<E4	E2>E5	E2<E6	E2>E7	E2>E8
E3											E3<E4	E3<E5	E3<E6	E3>E7	E3>E8*
E4												E4>E5	E4>E6	E4>E7	E4>E8**
E5													E5<E6	E5>E7	E5>E8
E6														E6>E7	E6>E8*
E7															E7>E8
E8															
Locomotion															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1<E1	C1<E2	C1<E3	C1<E4**	C1<E5*	C1<E6	C1<E7*	C1<E8*
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2>E1	C2>E2	C2>E3	C2<E4*	C2<E5	C2>E6	C2<E7	C2<E8
C3				C3=C4	C3>C5	C3<C6	C3<C7	C3>E1	C3>E2	C3>E3	C3<E4*	C3<E5	C3>E6	C3<E7	C3<E8
C4					C4>C5	C4<C6	C4<C7	C4>E1	C4>E2	C4>E3	C4<E4*	C4<E5	C4>E6	C4<E7	C4<E8
C5						C5<C6	C5<C7	C5>E1	C5>E2	C5>E3	C5<E4*	C5<E5	C5>E6	C5<E7	C5<E8
C6							C6<C7	C6>E1	C6>E2	C6>E3	C6<E4*	C6<E5	C6>E6	C6<E7	C6<E8
C7								C7>E1	C7>E2	C7>E3	C7>E4*	C7>E5	C7>E6	C7=E7	C7>E8
E1									E1<E2	E1<E3	E1<E4***	E1<E5**	E1<E6	E1<E7***	E1<E8***
E2										E2>E3	E2<E4**	E2<E5*	E2<E6	E2<E7*	E2<E8*
E3											E3<E4***	E3<E5***	E3<E6	E3<E7***	E3<E8***
E4												E4>E5	E4>E6**	E4<E7	E4=E8
E5													E5>E6*	E5<E7	E5<E8
E6														E6<E7*	E6<E8*
E7															E7>E8
E8															

Inactive social															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1<E1	C1>E2	C1>E3	C1<E4	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2<E1	C2>E2	C2>E3	C2<E4	C2<E5	C2>E6	C2<E7	C2>E8
C3				C3<C4	C3<C5	C3>C6	C3<C7	C3>E1	C3>E2**	C3>E3**	C3>E4	C3>E5	C3>E6*	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4>E7	C4>E8
C5						C5>C6	C5>C7	C5>E1	C5>E2	C5>E3	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8
C6							C6<C7	C6>E1	C6>E2*	C6>E3*	C6>E4	C6>E5	C6>E6	C6>E7	C6>E8
C7								C7>E1	C7>E2**	C7>E3*	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8
E1									E1>E2*	E1>E3	E1>E4	E1>E5	E1>E6	E1<E7	E1>E8
E2										E2<E3	E2<E4*	E2<E5	E2<E6	E2<E7**	E2<E8
E3											E3<E4	E3<E5	E3<E6	E3<E7*	E3<E8
E4												E4<E5	E4>E6	E4<E7	E4>E8
E5													E5>E6	E5<E7	E5>E8
E6														E6<E7	E6>E8
E7															E7>E8
E8															

Inactive nonsocial															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2*	C1>C3*	C1>C4	C1>C5	C1>C6	C1>C7	C1>E1	C1>E2*	C1>E3**	C1>E4	C1>E5*	C1>E6*	C1>E7	C1>E8
C2			C2>C3	C2<C4***	C2<C5*	C2<C6**	C2<C7	C2>E1	C2>E2	C2>E3	C2<E4	C2>E5	C2>E6	C2<E7	C2<E8
C3				C3<C4**	C3<C5	C3<C6*	C3<C7	C3>E1	C3>E2	C3>E3	C3<E4	C3>E5	C3<E6	C3<E7	C3<E8
C4					C4>C5	C4>C6	C4>C7*	C4>E1**	C4>E2***	C4>E3***	C4>E4*	C4>E5**	C4>E6**	C4>E7*	C4>E8*
C5						C5<C6	C5>C7	C5>E1**	C5>E2***	C5>E3***	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8
C6							C6>C7	C6>E1**	C6>E2**	C6>E3**	C6>E4	C6>E5*	C6>E6*	C6>E7	C6>E8
C7								C7>E1	C7>E2	C7>E3	C7<E4	C7>E5	C7>E6	C7>E7	C7<E8
E1									E1=E2	E1<E3	E1<E4	E1<E5	E1<E6	E1<E7	E1<E8
E2										E2<E3	E2<E4*	E2<E5	E2<E6*	E2<E7	E2<E8*
E3											E3<E4	E3<E5	E3<E6	E3<E7	E3<E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5<E6	E5<E7	E5<E8
E6														E6<E7	E6<E8
E7															E7<E8
E8															
Other															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2*	C1>C3	C1>C4	C1>C5	C1>C6	C1>C7	C1>E1*	C1>E2	C1>E3	C1>E4	C1<E5	C1>E6*	C1>E7	C1>E8**
C2			C2<C3	C2<C4*	C2<C5	C2<C6	C2>C7	C2>E1	C2<E2	C2<E3	C2<E4	C2<E5**	C2<E6	C2<E7	C2>E8
C3				C3<C4	C3>C5	C3>C6	C3>C7	C3>E1	C3>E2	C3>E3	C3>E4	C3<E5	C3>E6*	C3>E7	C3>E8*
C4					C4>C5*	C4>C6	C4>C7	C4>E1**	C4>E2	C4>E3	C4>E4*	C4<E5	C4>E6**	C4>E7*	C4>E8**
C5						C5>C6	C5>C7	C5>E1	C5<E2	C5<E3	C5<E4	C5<E5**	C5>E6	C5<E7	C5>E8
C6							C6>C7	C6>E1	C6<E2	C6<E3	C6<E4	C6<E5*	C6<E6	C6<E7	C6>E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7<E6	C7<E7	C7>E8
E1									E1<E2	E1<E3	E1<E4	E1<E5**	E1<E6	E1<E7	E1>E8
E2										E2<E3	E2>E4	E2<E5*	E2>E6	E2>E7	E2>E8
E3											E3>E4	E3<E5*	E3>E6*	E3>E7	E3>E8*
E4												E4<E5**	E4>E6	E4>E7	E4>E8*
E5													E5>E6***	E5>E7**	E5>E8**
E6														E6<E7	E6>E8
E7															E7>E8*
E8															

Stereotypic pacing															
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**
C1		C1>C2	C1>C3	C1<C4	C1>C5	C1<C6	C1>C7	C1>E1	C1>E2	C1>E3	C1>E4	C1>E5	C1>E6	C1<E7	C1>E8
C2			C2>C3	C2<C4	C2>C5	C2<C6	C2>C7	C2<E1	C2<E2	C2>E3	C2<E4	C2<E5	C2>E6	C2<E7	C2>E8
C3				C3<C4	C3=C5	C3<C6	C3=C7	C3<E1	C3<E2	C3<E3	C3<E4	C3<E5	C3=E6	C3<E7	C3<E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4<E7	C4>E8
C5						C5<C6	C5=C7	C5<E1	C5<E2	C5<E3	C5<E4	C5<E5	C5=E6	C5<E7	C5<E8
C6							C6>C7	C6>E1	C6>E2	C6>E3	C6>E4	C6>E5	C6>E6	C6<E7	C6>E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7=E6	C7<E7	C7<E8
E1									E1<E2	E1>E3	E1>E4	E1<E5	E1>E6	E1<E7	E1>E8
E2										E2>E3	E2>E4	E2<E5	E2>E6	E2<E7	E2>E8
E3											E3<E4	E3<E5	E3>E6	E3<E7	E3>E8
E4												E4<E5	E4>E6	E4<E7*	E4>E8
E5													E5>E6	E5<E7	E5>E8
E6														E6<E7	E6<E8
E7															E7>E8
E8															

Table B4: Cub 2

Social activity

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1<C2	C1<C3	C1=C4	C1<C5	C1>C6	C1<C7	C1<E1	C1>E2	C1>E3	C1>E4	C1<E5	C1<E6	C1<E7	C1>E8
C2			C2<C3	C2>C4	C2<C5	C2>C6	C2<C7	C2=E1	C2>E2	C2>E3***	C2>E4*	C2>E5*	C2=E6	C2<E7	C2>E8***
C3				C3>C4	C3<C5	C3>C6	C3<C7	C3>E1	C3>E2	C3>E3**	C3>E4	C3>E5	C3>E6	C3=E7	C3>E8***
C4					C4<C5*	C4>C6	C4<C7*	C4<E1	C4>E2	C4>E3	C4>E4	C4<E5	C4<E6	C4<E7	C4>E8
C5						C5>C6	C5=C7	C5>E1	C5>E2	C5>E3***	C5>E4*	C5>E5*	C5>E6	C5>E7	C5>E8***
C6							C6<C7	C6<E1	C6=E2	C6=E3	C6>E4	C6<E5	C6<E6	C6<E7	C6>E8
C7								C7>E1	C7>E2*	C7>E3**	C7>E4**	C7>E5*	C7>E6	C7>E7	C7>E8***
E1									E1>E2	E1>E3*	E1>E4	E1>E5	E1=E6	E1<E7	E1>E8**
E2										E2=E3	E2>E4	E2<E5	E2<E6	E2<E7	E2>E8*
E3											E3>E4	E3<E5	E3<E6**	E3<E7	E3>E8*
E4												E4<E5	E4<E6*	E4<E7	E4>E8
E5													E5<E6	E5<E7	E5>E8*
E6														E6<E7	E6>E8***
E7															E7>E8*
E8															

Play

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1<C2	C1<C3	C1<C4	C1=C5	C1=C6	C1=C7	C1<E1	C1<E2	C1<E3	C1<E4	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2>C3	C2>C4	C2>C5	C2>C6	C2>C7	C2>E1	C2>E2	C2>E3	C2>E4	C2>E5	C2>E6	C2>E7	C2>E8
C3				C3<C4	C3>C5	C3>C6	C3>C7	C3>E1	C3<E2	C3<E3	C3<E4	C3<E5	C3<E6	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4<E2	C4<E3	C4<E4	C4<E5	C4<E6	C4>E7	C4>E8
C5						C5=C6	C5=C7	C5<E1	C5<E2	C5<E3	C5<E4	C5<E5	C5<E6	C5<E7	C5<E8
C6							C6=C7	C6<E1	C6<E2	C6<E3	C6<E4	C6<E5	C6<E6	C6<E7	C6<E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7<E6	C7<E7	C7<E8
E1									E1<E2	E1<E3	E1<E4**	E1<E5	E1<E6	E1=E7	E1>E8
E2										E2>E3	E2<E4	E2>E5	E2<E6	E2>E7	E2>E8
E3											E3<E4	E3<E5	E3<E6	E3>E7	E3>E8*
E4												E4>E5	E4>E6	E4>E7	E4>E8**
E5													E5<E6	E5>E7	E5>E8
E6														E6>E7	E6>E8*
E7															E7>E8
E8															

Locomotion

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1<E1	C1<E2	C1<E3	C1<E4**	C1<E5*	C1<E6	C1<E7*	C1<E8*
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2>E1	C2>E2	C2>E3	C2<E4*	C2<E5	C2>E6	C2<E7	C2<E8
C3				C3=C4	C3>C5	C3<C6	C3<C7	C3>E1	C3>E2	C3>E3	C3<E4*	C3<E5	C3>E6	C3<E7	C3<E8
C4					C4>C5	C4<C6	C4<C7	C4>E1	C4>E2	C4>E3	C4<E4*	C4<E5	C4>E6	C4<E7	C4<E8
C5						C5<C6	C5<C7	C5>E1	C5>E2	C5>E3	C5<E4*	C5<E5	C5>E6	C5<E7	C5<E8
C6							C6<C7	C6>E1	C6>E2	C6>E3	C6<E4*	C6<E5	C6>E6	C6<E7	C6<E8
C7								C7>E1	C7>E2	C7>E3	C7>E4*	C7>E5	C7>E6	C7=E7	C7>E8
E1									E1<E2	E1<E3	E1<E4***	E1<E5**	E1<E6	E1<E7***	E1<E8***
E2										E2>E3	E2<E4**	E2<E5*	E2<E6	E2<E7*	E2<E8*
E3											E3<E4***	E3<E5***	E3<E6	E3<E7***	E3<E8***
E4												E4>E5	E4>E6**	E4<E7	E4=E8
E5													E5>E6*	E5<E7	E5<E8
E6														E6<E7*	E6<E8*
E7															E7>E8
E8															

Inactive social

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1<C2	C1<C3	C1<C4	C1<C5	C1<C6	C1<C7	C1<E1	C1>E2	C1>E3	C1<E4	C1<E5	C1<E6	C1<E7	C1<E8
C2			C2<C3	C2<C4	C2<C5	C2<C6	C2<C7	C2<E1	C2>E2	C2>E3	C2<E4	C2<E5	C2>E6	C2<E7	C2>E8
C3				C3<C4	C3<C5	C3>C6	C3<C7	C3>E1	C3>E2**	C3>E3**	C3>E4	C3>E5	C3>E6*	C3>E7	C3>E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4>E7	C4>E8
C5						C5>C6	C5>C7	C5>E1	C5>E2	C5>E3	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8
C6							C6<C7	C6>E1	C6>E2*	C6>E3*	C6>E4	C6>E5	C6>E6	C6>E7	C6>E8
C7								C7>E1	C7>E2**	C7>E3*	C7>E4	C7>E5	C7>E6	C7>E7	C7>E8
E1									E1>E2*	E1>E3	E1>E4	E1>E5	E1>E6	E1<E7	E1>E8
E2										E2<E3	E2<E4*	E2<E5	E2<E6	E2<E7**	E2<E8
E3											E3<E4	E3<E5	E3<E6	E3<E7*	E3<E8
E4												E4<E5	E4>E6	E4<E7	E4>E8
E5													E5>E6	E5<E7	E5>E8
E6														E6<E7	E6>E8
E7															E7>E8
E8															

Inactive nonsocial

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1>C2*	C1>C3*	C1>C4	C1>C5	C1>C6	C1>C7	C1>E1	C1>E2*	C1>E3**	C1>E4	C1>E5*	C1>E6*	C1>E7	C1>E8
C2			C2>C3	C2<C4***	C2<C5*	C2<C6**	C2<C7	C2>E1	C2>E2	C2>E3	C2<E4	C2>E5	C2>E6	C2<E7	C2<E8
C3				C3<C4**	C3<C5	C3<C6*	C3<C7	C3>E1	C3>E2	C3>E3	C3<E4	C3>E5	C3<E6	C3<E7	C3<E8
C4					C4>C5	C4>C6	C4>C7*	C4>E1**	C4>E2***	C4>E3***	C4>E4*	C4>E5**	C4>E6**	C4>E7*	C4>E8*
C5						C5<C6	C5>C7	C5>E1**	C5>E2***	C5>E3***	C5>E4	C5>E5	C5>E6	C5>E7	C5>E8
C6							C6>C7	C6>E1**	C6>E2**	C6>E3**	C6>E4	C6>E5*	C6>E6*	C6>E7	C6>E8
C7								C7>E1	C7>E2	C7>E3	C7<E4	C7>E5	C7>E6	C7>E7	C7<E8
E1									E1=E2	E1<E3	E1<E4	E1<E5	E1<E6	E1<E7	E1<E8
E2										E2<E3	E2<E4*	E2<E5	E2<E6*	E2<E7	E2<E8*
E3											E3<E4	E3<E5	E3<E6	E3<E7	E3<E8
E4												E4>E5	E4>E6	E4>E7	E4>E8
E5													E5<E6	E5<E7	E5<E8
E6														E6<E7	E6<E8
E7															E7<E8
E8															

Other

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1>C2*	C1>C3	C1>C4	C1>C5	C1>C6	C1>C7	C1>E1*	C1>E2	C1>E3	C1>E4	C1<E5	C1>E6*	C1>E7	C1>E8**
C2			C2<C3	C2<C4*	C2<C5	C2<C6	C2>C7	C2>E1	C2<E2	C2<E3	C2<E4	C2<E5**	C2<E6	C2<E7	C2>E8
C3				C3<C4	C3>C5	C3>C6	C3>C7	C3>E1	C3>E2	C3>E3	C3>E4	C3<E5	C3>E6*	C3>E7	C3>E8*
C4					C4>C5*	C4>C6	C4>C7	C4>E1**	C4>E2	C4>E3	C4>E4*	C4<E5	C4>E6**	C4>E7*	C4>E8**
C5						C5>C6	C5>C7	C5>E1	C5<E2	C5<E3	C5<E4	C5<E5**	C5>E6	C5<E7	C5>E8
C6							C6>C7	C6>E1	C6<E2	C6<E3	C6<E4	C6<E5*	C6<E6	C6<E7	C6>E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7<E6	C7<E7	C7>E8
E1									E1<E2	E1<E3	E1<E4	E1<E5**	E1<E6	E1<E7	E1>E8
E2										E2<E3	E2>E4	E2<E5*	E2>E6	E2>E7	E2>E8
E3											E3>E4	E3<E5*	E3>E6*	E3>E7	E3>E8*
E4												E4<E5**	E4>E6	E4>E7	E4>E8*
E5													E5>E6***	E5>E7**	E5>E8**
E6														E6<E7	E6>E8
E7															E7>E8*
E8															

tereotypic pacing

	C1	C2	C3	C4	C5	C6	C7	E1	E2	E3	E4	E5	E6	E7	E8
C1		C1>C2	C1>C3	C1<C4	C1>C5	C1<C6	C1>C7	C1>E1	C1>E2	C1>E3	C1>E4	C1>E5	C1>E6	C1<E7	C1>E8
C2			C2>C3	C2<C4	C2>C5	C2<C6	C2>C7	C2<E1	C2<E2	C2>E3	C2<E4	C2<E5	C2>E6	C2<E7	C2>E8
C3				C3<C4	C3=C5	C3<C6	C3=C7	C3<E1	C3<E2	C3<E3	C3<E4	C3<E5	C3=E6	C3<E7	C3<E8
C4					C4>C5	C4>C6	C4>C7	C4>E1	C4>E2	C4>E3	C4>E4	C4>E5	C4>E6	C4<E7	C4>E8
C5						C5<C6	C5=C7	C5<E1	C5<E2	C5<E3	C5<E4	C5<E5	C5=E6	C5<E7	C5<E8
C6							C6>C7	C6>E1	C6>E2	C6>E3	C6>E4	C6>E5	C6>E6	C6<E7	C6>E8
C7								C7<E1	C7<E2	C7<E3	C7<E4	C7<E5	C7=E6	C7<E7	C7<E8
E1									E1<E2	E1>E3	E1>E4	E1<E5	E1>E6	E1<E7	E1>E8
E2										E2>E3	E2>E4	E2<E5	E2>E6	E2<E7	E2>E8
E3											E3<E4	E3<E5	E3>E6	E3<E7	E3>E8
E4												E4<E5	E4>E6	E4<E7*	E4>E8
E5													E5>E6	E5<E7	E5>E8
E6														E6<E7	E6<E8
E7															E7>E8
E8															