

## 4 RESULTS

### 4.1 Qualitative description: Group formation at Paignton Zoo

In 1996/97, the Gorilla-EEP (European Endangered Species Program) decided the formation of an all-male group at Paignton Zoo (UK), as a response to the existing surplus of male gorillas in the captive population (Schmidt, personal communication, 1996). Claus and Pertinax were chosen to initiate this new group. These two young silverbacks were 15 years old at the time and had been members of a multi-male group at the Cologne Zoo, before they moved to Paignton Zoo. At this time, the group at Cologne Zoo consisted of one leading silverback, three adult females, two juveniles and one infant. The decision that these two young silverbacks should be the “founders” of the new bachelor group was because these two males grew up together, much like brothers (see Meder 1985 b, 1987 and Holzer-Blersch, 1990 for further information on their adolescence and relationship).

Thus, it was believed that they would get along with each other and would ensure a successful start of the all-male group. Another reason for their move was that both could not stay longer in the current condition, due to increased tension between the silverbacks and the alpha male (Schmidt, personal communication, 1996).

While at the Cologne Zoo, Claus and Pertinax were not seen to engage in social affiliative behaviors with each other, however, they affiliated with the other group members. Claus, in particular, interacted frequently with the juveniles at the Cologne Zoo. As far as distance between them was concerned, both stayed as far as possible (>5 m, if enclosure permitted the distance) from each other, throughout the time of observation. Both silverbacks were frequently seen on the opposite sides of the larger showroom (see Fig. 13 [showroom Cologne] on page 25). For instance, when the social unit around Kim was in the small show den (Fig. 12 [blueprint of the enclosure at Cologne] on page 25), Claus and Pertinax would stay in the big room by themselves, avoiding close contact by staying at either end of the enclosure.

Social interactions between both Claus and Pertinax consisted of agonistic encounters. Figure 21 and 22 on page 41 show a display sequence between them at the Cologne Zoo, with Pertinax running a bluff charge towards Claus. During the observation sessions at Cologne Zoo, 14 agonistic interactions between Claus and Pertinax were observed, at a rate of 0,7 per hour. Nine out of these 14 encounters took place in the afternoon (about 3-7 pm). However, during some instances, both silverbacks supported each other during agonistic interactions with the alpha male. For instance, during one occurrence Pertinax supported Claus against Kim (the alpha male of the group). Claus approached Kim and both strut-walked towards each other. Eventually Pertinax displayed towards Kim, afterwards all of the group relaxed. A couple of minutes later, for no apparent reason, Claus displayed towards Pertinax who did not respond to this incident. During another occurrence, Claus approached Pertinax who retreated and left. When Pertinax returned, Claus and Kim stand faced towards Pertinax who retreated again. Then Kim displayed towards Claus who in turn retreated.



Fig. 21: Pertinax (rear) and Claus (front, facing back) head divert towards each other.



Fig. 22: Pertinax (rear) bluff charges towards Claus (front).

Claus and Pertinax arrived at Paignton Zoo on 22.04.1997, late at night. When the silverbacks arrived at the Zoo, they spent the night inside the dens and gained access to the show den in the morning. Pertinax was first to explore the new environment, whereas Claus appeared more hesitant. Right from the beginning, Claus occupied the rear den, whereas Pertinax preferred the front den. After Pertinax briefly explored the show den, he returned to the front den. Claus entered the front den as well upon which Pertinax left and went into the rear den. Pertinax explored the show den a second time more extensively, including the upper level for a longer time. Once Pertinax returned to his den, Claus finally entered the show den and started to explore it slowly while holding onto a piece of burlap, used as a “security blanket”.

The relationship between Claus and Pertinax prior to the arrival of the juveniles was characterized by avoidance and displays between the silverbacks. Only one of the silverbacks would be inside the show den at a time while the other was in one of the other dens. On one occasion, both were together inside the show den in the afternoon during which both displayed towards each other by strut walking and stand facing towards each other. Particularly, Pertinax kept displaying towards Claus and towards the staff. Claus still preferred to stay inside the rear den area whereas Pertinax spent more time in show den.

On 26.04.1997, the two males Richard and Avahli arrived together. Since these juveniles had not met before, the zoo management decided that they should be introduced to each other immediately upon their arrival, to give them ample time to get accustomed to each other. Eventually, they were expected to bond and support each other later on when necessary. The juveniles were kept separate from the adults; thus, they had access to two of the dens and a small outside holding facility.

As Claus damaged some of the sliding doors between two of the dens during the preceding night, the decision was made to keep Pertinax in the show den and Claus in the rear den. Both silverbacks displayed heavily during the transfer of the juveniles into the den area. Avahli moved without problems, whereas Richard was more interested in paying attention to Pertinax, which prolonged the whole process of moving the juveniles into their designated areas. In the meantime both silverbacks

displayed loudly by body slamming against the bars and doors. Eventually, Richard moved to his designated den, and Claus was given access to the show den again.

Once the silverbacks were back together again, almost immediately they displayed towards each other, which escalated into a serious fight, during which Pertinax received wounds on his hip and elbow. Subsequently, Claus was separated from Pertinax for the rest of the day. After this fight, Pertinax (at the upper level (L1)) examined his wounds, then followed Claus everywhere by head to head display, challenging Claus to retreat throughout the show den and den areas. Whenever Claus passed the sliding doors, he banged at these doors, which produced very loud noises. Both silverbacks were then separated during the night. Since Pertinax's wounds did not require surgery, he was given an antibiotic to prevent an infection. After this incident, Pertinax kept cleaning his wounds continuously. During the week after this fight, both silverbacks were seen to display towards each other thirteen times at a rate of 0.4 per hour, five displays occurred during the afternoon. On 02.05.1997, they had another fight with physical contact during which Pertinax was injured a second time. Both silverbacks were separated after this last incident.

Once Pertinax seemed to have recovered from his injuries it was decided that Claus and Pertinax should be introduced to each other again, under supervision. As it turned out, during the morning, both stayed calm and away from each other, but during the afternoon both started to display. For that purpose, Pertinax grabbed one of the ropes to produce loud noises by pulling at it and then let it go, throw straw or burlap and both strut-walked towards each other with heads diverted and tight lip facial expressions. As a result, the silverbacks were separated for some time.

Claus and Pertinax had not been together for a couple of weeks. Eventually on 13.06.1997, both were together for the first time since they had been separated (with access to the show den and the island) until the afternoon. At about 3-4 pm, both started to display towards each other, so both were separated during the afternoon. That worked fine until they were not separated early enough and Pertinax got a cut on his leg (25.06.1997). They have been kept apart since then while the cut was healing. On 06.07.1997, while they were supposed to be separated, Pertinax was on the island

and Claus was downstairs off show, Claus started body slamming when he saw Pertinax being on the island. Claus eventually bent the slide door to the island far enough to get out and chased Pertinax all around the island. No serious injuries occurred at that time and the supply of branches was increased to keep him occupied.

After it was evident that Claus and Pertinax would not get along with one another, it was decided to keep one to start the all-male group and to find a suitable place for the other. Finally, on 23.01.1998 Claus was sent to Bristol Zoo, to start a social group. Once Claus had left, Pertinax engaged extensively in regurgitation and reingestion of various food items (about 60-70% of the time, according to Graig Gilchrist, gorilla keeper at Paignton Zoo). He also started sitting in the corner facing the wall with one hand over his head. Thus, the management decided it was best to try an introduction of Pertinax with the juveniles as soon as possible. It was hoped that the juveniles will keep Pertinax occupied and subsequently his time spent with stereotypic behaviors would decrease. The introduction took place on 28.01.1998.

Before the introduction of the juveniles, Pertinax was very inactive, spending most of his time either feeding or resting but with high occurrences of regurgitation and reingestion, which will be described in more detail in the following chapter.

In the meantime, Richard and Avahli were introduced to each other “off-show” in the night dens, were they started to interact with each other fairly soon (acc. to keepers’ logs). Unfortunately, direct observation of the whereabouts of the juveniles was not possible at the time. Before the group formation, the interactions between Richard and Avahli were of an affiliative nature, with Richard often initiating play, when it was possible to determine.

The introduction took place in the off-show den area on 28.01.1998 and the following descriptions are based on the keepers’ logs, since the presence of the author would have caused additional stress to the animals. Pertinax was in the sleeping dens and the juveniles in the show den with all the slides being open just enough for the juveniles to pass through and get everywhere (show den, all sleeping dens and island). Pertinax was limited to two sleeping dens and the bridges. At first, Richard and Avahli

chased each other round and round the sleeping dens and show den, and Pertinax sat in one of the bridges ignoring the two while handling and eating a cardboard-box. Eventually, Richard was bored with that game and tried to take the box from Pertinax. Each time he tried, Pertinax seemed to pretend to hit him, and Richard ran off until Pertinax eventually went for him by running a bluff charge towards him. Richard managed to get away through the slides but then stopped, so the way for Avahli was blocked. Pertinax grasped Avahli's arm until he screamed so loudly that Pertinax let go and went back to his bridge and box. Avahli did not come back into the sleeping dens after this incident. Richard, however, kept teasing Pertinax more intensively. At one point, Pertinax was sitting on the floor, and Richard was swinging round and round the post clipping the top of Pertinax's head with his hand every time he swung round. Pertinax put up with it for a while but eventually he grabbed him, pinned him to the floor and stood on him. He went as though to bite him but just showed his teeth and let him go so it seems it was just a warning. This behavior was also observed by Aspinall (1980), he described it as "mouthing". The silverback goes through all the stages of a bite but does not put pressure on the young animal. Richard behaved himself for a while after that but came back later to annoy him again. Pertinax just looked at him and carried on eating his box. According to the keepers, Pertinax was behaving just how silverbacks are supposed to towards younger ones during the introduction. Pertinax appeared to be more active than he had been before. The staff was watching him for about five hours, and he engaged in regurgitation and reingestion one time, which was much better than over the previous weekend. It looked at one point as though Avahli might be left out, but later on, Richard eventually got bored with Pertinax and went back to playing with Avahli. Avahli was quite subdued anyway, as he had a cut on his hand (quite small), an injury that he might have had prior to this incident with Pertinax.

Richard and Avahli expressed new behaviors after the group formation. Avahli started to push straw in front of Richard by holding a pile of straw with both hands, bending his elbows and moving forward. Similar behaviors were seen during an introduction of two infant females into a group (Nitsch, 1995) and in Meder's study, (1987).

Richard started to display by grabbing the rope, lifting it and pulling rapidly on it, thus, creating loud noises. He might have seen this behavior by the adult gorillas during display. Richard applied this behavior in the context of “winding up” or “roughing up” Pertinax, when the silverback was in the vicinity. During the observations past of the introduction, however, Pertinax did not react to Richard’s attempts to wind him up. Whenever Pertinax approached the juveniles or even if he just went to another place within the enclosure, both Richard and Avahli retreated.

After the young juveniles had been together for several days, with Pertinax given access to only the show den and the juveniles given an overall area access, Richard was still trying to wind up Pertinax, who ignored these attempts. Pertinax appeared to be more interested in getting Avahli to make the right submissive gestures. Avahli was obviously terrified and tried to be submissive, but apparently, he did not know the appropriate behaviors. Up to this point, there were no bites or serious encounters. In the following weeks, all three were kept together during the afternoon, while Pertinax was kept by himself during the morning and night. During the morning when the juveniles were by themselves, they engaged in a wrestling game or a chase game with Richard chasing Avahli. For instance, when Avahli was sitting at the cargo net, Richard grabbed the rope while swinging over to Avahli. Both sat across each other, touched each other and expressed play faces. Later Richard let himself fall down to the floor upon which Avahli followed and their play continued.

One reason why the management decided that they were allowed together only half a day was due to the fact that the juveniles played with each other when they were alone, but Richard hardly interacted with Avahli once Pertinax was also in the show den. Whereas Richard was more interested in watching the silverback, either Avahli retreated far up high to one of the wooden inside climbing structures or he went outside, being alone on the island, sometimes covering himself with burlap. Eventually, the decision was made to let them be together all day and night, to provide Avahli with the opportunity to get accustomed to Pertinax.

After these three gorillas proved they could get along with each other, the management decided to add two additional juvenile gorilla males, Asato and Mambi,



to the group. The following information is based on the keepers' logs. Asato, from Jersey Zoo, was the first one who arrived on 08.05.1999 at Paignton Zoo. He was kept within sight, but separated from the other gorillas until 10.05.1999 when he was introduced to Richard. That day both stayed together for three hours, Richard initiated contact with Asato. On 11.05.1999, all three (Richard, Avahli and Asato) were put together. Interactions were seen almost exclusively between Richard and Asato, while Avahli appeared to be left out. On 14.05.1999, all three gorillas stayed together for the first time for 24 hours, which proved to be without problems.

Mambi, from Twycross Zoo arrived on 17.05.1999 and was introduced to Richard on 19.05.1999 for half a day. The following day, Mambi spent half a day with Richard and Avahli. As of 24.05.1999, all four youngsters stayed together all day and all night with no problems observed between them. Richard, Avahli and Asato got on very well and were seen playing with each other, whereas Mambi hardly interacted with them.

Pertinax was introduced off show to Mambi and Asato on 14.07.1999. The youngsters had access to the Island whereas Pertinax did not. From mid July until mid September 1999, all five were together for a few hours each day, where the youngsters had escape routes, which could not be accessed by Pertinax. All were fine with the exception of Mambi, who was not interacting at all or interacted with Pertinax in an inappropriate way. Mambi was pinned down by Pertinax often, but the rest of the group joined in against Pertinax who was chased off. Mambi had difficulties to fit into the group structure. By mid-September in 1999, Mambi was still causing problems by annoying Pertinax. Subsequently, Mambi were transferred to La Boissiere du Dore Zoo, France, in October 2003 (Hilsberg, 2003). Table 5 on page 48 summarizes the main events during the first two years of the initial stage of the formation of the all-male group at Paignton Zoo. The qualitative data on the influence of the introduction on the behavior of the gorillas will be presented in the next chapter.

Table 5: Summary of the main events of the group formation of the all-male group at Paignton Zoo.

<b>Date</b>	<b>Event</b>	<b>Remarks</b>
22.04.1997	Arrival of Claus and Pertinax at Paignton Zoo	Claus was unloaded first, he was calm Pertinax screamed a couple of times at first. Both were separated during the night
23.04.1997	First time access to the show den	Pertinax more adventurous Claus reluctant at first to enter show den Both were never in show den nor in the same den at the same time
26.04.1997	Arrival of Richard and Avahli	Claus broke one of the slide doors during the night During unloading of juveniles, Claus stayed in the rear den while Pertinax was in the show den Pertinax displayed in the show den
26.04.1997	Physical fight between Claus and Pertinax	After the move of the juveniles, Claus and Pertinax were allowed together; at one point Claus bit Pertinax
01.05.1997	Silverbacks keep displaying towards each other	Claus apparently did not let Pertinax settle at the upper level. Both displayed by rattling ropes, hitting windows and chest beating
02.05.1997	Claus attacked Pertinax	Claus went for the Pertinax's old wounds. Both were separated
7.05.1997	Claus first time on the Island	Very hesitant
13.05.1997	Pertinax first time access to the show den again after last injury	Both stayed separated
19.05.1997	Pertinax starts regurgitation and reingestion	
21.05.1997	Pertinax first time access to the Island	Far more adventurous than Claus had been
13.06.1997	Claus and Pertinax were allowed together	P unbothered by C. P went outside to "steal" browse from C. C inside the den then returns and take the browse from P, P not bothered. P went to upper level and C soon followed, both started to display. Afternoon, display increased, Claus initiated a fight, Pertinax received small bite on his right hand
25.06.1997	Claus and Pertinax fight again	Pertinax got bitten on his left ankle, both were separated and Pertinax received medication
06.07.1997	Claus and Pertinax together	Claus broke arm on the sliding door to the Island and "introduced" himself to Pertinax Both were separated since then and kept, (together with the juveniles) on a rotating schedule (one on the Island, one inside show den or off show)

23.01.1998	Claus sent to Bristol Zoo	Pertinax showed intense regurgitation and reingestion behaviors after Claus left (see the following chapter for detailed description)
28.01.1998	Richard and Avahli introduced to Pertinax	
26.02.1998	First time that all three had access to the Island.	Although the show den was half open for the kids, Pertinax was also able to pass through the opening
12.03.1998	Pertinax and the juveniles were let together for 24 hours.	At this day, the fishing board was also implemented to provide additional environmental enrichment.
08.05.1999	Asato arrives at Paignton Zoo	
10.05.1999	Introduction of Asato to Richard	
11.05.1999	All three juveniles together	Since 14.05.1999 together day and night without problems
17.05.1999	Mambi arrives at Paignton Zoo	
19.05.1999	Mambi introduced to Richard	
24.05.1999	All four juveniles together	
14.07.1999	Off-show introduction of Pertinax with the four juveniles	Mambi was having difficulties with Pertinax, see above text for details.
02.10.2002	Mambi sent to La Boissiere du Dore Zoo, France	

## 4.2 Quantitative Results: Group formation at Paignton Zoo

The applied ethogram is based on the author's previous studies on western lowland gorillas (Nitsch, 1995), and modified through additional reconnaissance observations and additional descriptions (i.e. Fossey 1983; Ogden and Schildkraut, 1991; Robbins 1996; Schaller 1963).

The following section denotes data obtained through focal animal point sampling (Lehner, 1996; Martin & Bateson, 1993) to describe the influences of the group formation at Paignton Environmental Park on the individual group members for non-social and social behaviors as well as the distribution within the enclosure.

The presentation shows the results prior and post group formation for each individual as well as between the juveniles, since Pertinax was alone prior to group formation. The graphical representations show a comparison of the individual behavioral categories prior and post group formation, based on the data obtained while the gorillas were inside. Since the gorillas spent little time on the Island subsequent to the group formation (Richard and Avahli were seen only once, although they had frequent access to the Island whereas Pertinax had no access at that time), the time spent with social and non-social behaviors prior to the group formation on the Island is presented in the text.

### 4.2.1 Social and non-social behaviors

#### 4.2.1.1 Idle

##### Behavioral description:

This behavioral category describes inactive behaviors such as sitting or lying. In any of the positions the subject looks around, appears to watch another gorilla, a keeper or the public. This category was recorded when the focal animal was not engaged in any other activity, for example, feeding or play activities. Idle was scored also when the focal animal was asleep.

Results:

Fig. 23 shows that all three group members were more inactive during the period post rather than prior to the group formation. Pertinax proved to be the most inactive male of the group; he spent almost half of the time resting (mainly sitting or lying down). Prior to the group formation, Pertinax had spent 46.5 % of the recorded time idle, this increased nearly 1.5 times to 61.2 % post group formation (Fig. 23). Notably, idle behaviors increased for both juveniles post group formation as well (Fig. 23). For Richard idle behaviors increased 1.6 times from 27.4 % prior to 45.0 % post group formation. Avahli spent 22.9 % of his time in idle behaviors before the group formation, which almost doubled to 41.4 % post group formation. Comparing Richard with Avahli, both spent about the same time in idle behaviors with Richard spending slightly more time resting than Avahli.

Prior to the group formation, all gorillas had access to the island, either Pertinax alone or Richard and Avahli together. Pertinax spent 44.5 % of his time idle that is very similar to the data from the show den. Richard spent 28.8 % and Avahli spent 23.8 % of their time budget idle, which is also similar to the data obtained from the inside enclosure. Avahli was the only gorilla spending time alone on the island post introduction whereas Richard stayed inside. Avahli's time budget in idle behaviors increased to 37.8 % compared to the data taken prior to group formation.

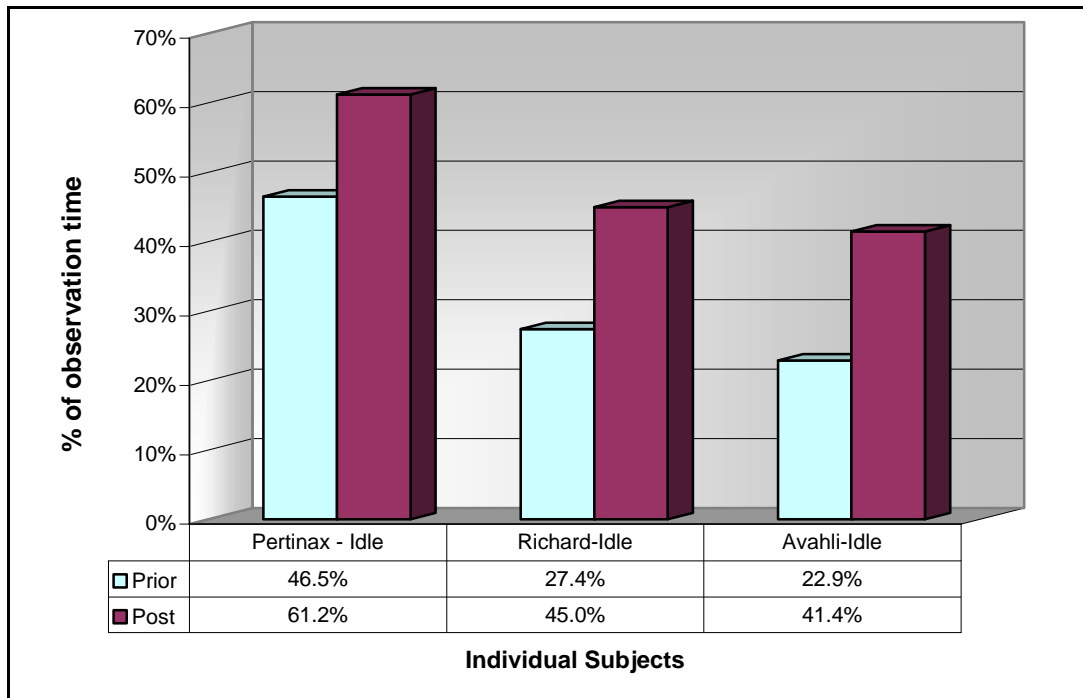


Fig. 23: Idle behavior, as percentage of observation time, for each individual gorilla at Paignton Zoo; prior to and post group formation.

#### 4.2.1.2 Locomotion

##### Behavioral description:

This category includes quadrupedal and bipedal movements along horizontal surfaces from point A to point B. Locomotion was scored as any movement such as walking, running or climbing. Due to the enclosure design, some places were accessible only by climbing. Locomotion as being part of foraging or any other social or non-social activity was excluded in this category. Thus, it includes climbing up and down ropes, vertical posts, and elevated surfaces such as rocks, benches etc. within the exhibit. Quadrupedal, bipedal locomotion and climbing were analyzed together to assess the overall activity level prior and post group formation.

Results:

Not all males spent a lot of time with locomotion. For both Pertinax and Richard, the time spent with locomotion remained nearly the same prior as well as post group formation, but decreased slightly for Avahli from 9.5 % to 7.4 % (Fig. 24). Pertinax engaged in the least locomotor activity of all group members, with 4.1 % prior and post group formation. When comparing the juveniles, Avahli (9.5 %) spent more time with locomotion during prior to the group formation than Richard (7.1 %), whereas Richard and Avahli spent equal time in locomotive behaviors post group formation (7.4 % both). Since locomotion was recorded as being active excluding other behaviors, the males spent on average over 90 % of their time with other behaviors.

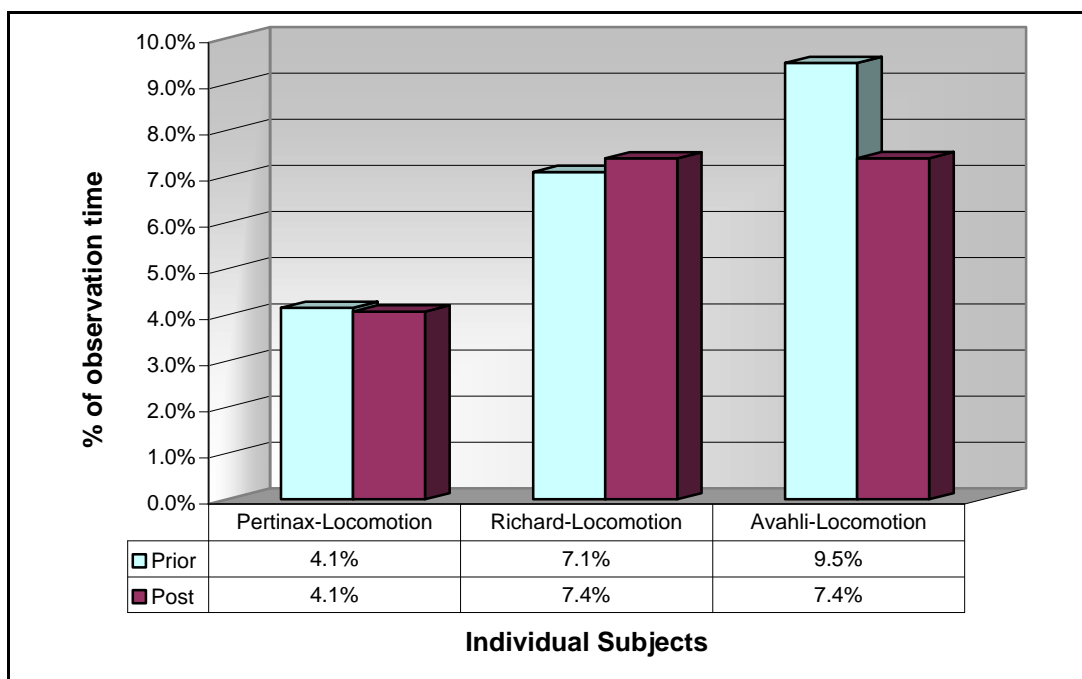


Fig. 24: Locomotion, as percentage of observation time, of all three gorillas at Paignton Zoo, prior to and post group formation.

On the Island, Pertinax spent more time with locomotion (18.1 %) than inside in the show den (4.1 %) prior to group formation. Richard also spent more time with locomotion (13.5 %) on the island than inside (7.1 %), and Avahli spent similar time with locomotive behaviors (13.4 %) on the island as Richard. Post group formation, Avahli spent nearly the same time with locomotion 13.9 %, when he was together with Richard, than prior to group formation. Especially the spacious ground encouraged the males to spend more time in locomotive activities.

#### **4.2.1.3 Ingestion**

##### Behavioral description:

The behavioral category in this section includes feeding and foraging for the various supplied food items, i.e. fruits, vegetables, nuts and seeds.

##### Results:

All three males reduced foraging and feeding post group formation, although there was no change in the food availability during the observation time. Pertinax's food intake decreased from 38.0 % of the observation time, prior to group formation to 22.2 % post group formation. For Avahli his food intake decreased from 42.5 % prior to group formation to 33.6 % post group formation. Richard spent 39.6 % prior to the group formation with ingestion, post group formation decreased slightly to 32.2 % (Fig. 25). Prior to group formation the food was frequently cut into small pieces, leading to an increase in time spent with foraging. Post group formation, however, the gorillas received more often whole vegetable items, such as cabbage and celeriac.

Prior to group formation, Pertinax spent less time with feeding and foraging on the island (28.9 %) than in the show den (37.0 %), although there was no difference in food availability. Richard spent also less time feeding when on the island (33.2 %) compared to the show den (39.6 %). Avahli spent prior to group formation 39.5 % with feeding and foraging when on the island, but 42.5 % when he was inside. Post to



group formation he spent 32.5 % of his time feeding when on island, which was similar to his time spent with this behavior when he was inside (33.6 %).

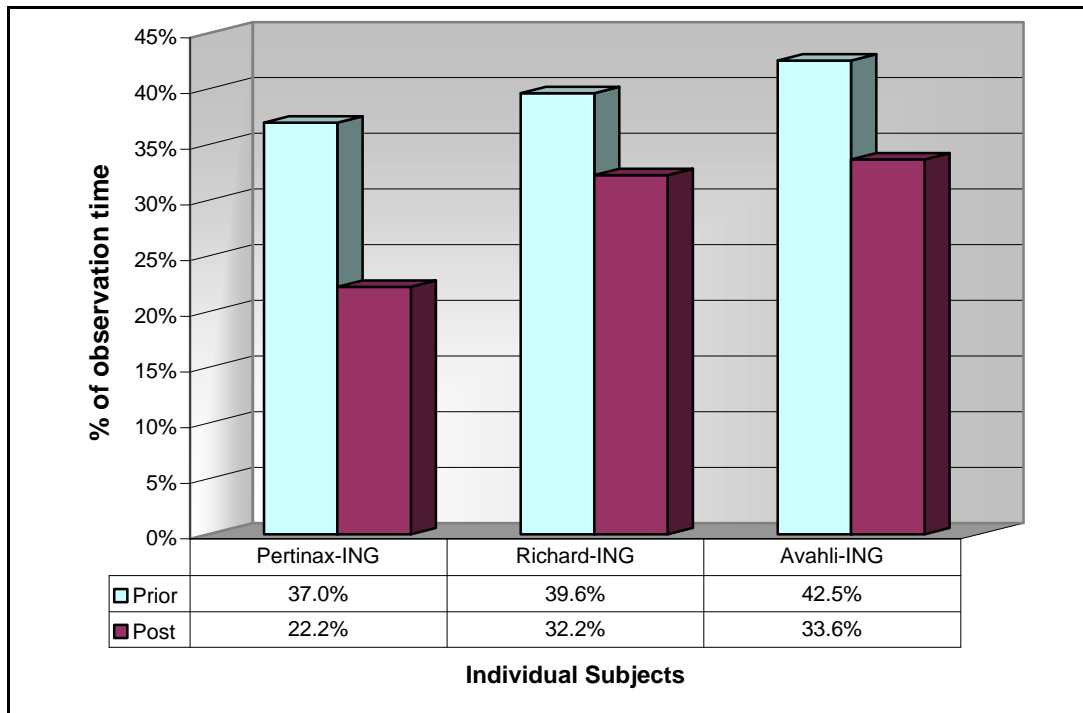


Fig. 25: Ingestion (ING), as percentage of the observation time, expressed by the group at Paignton Zoo prior to and post group formation.

#### 4.2.1.4 Self-directed behavior

##### Behavioral description:

This behavioral category includes self-directed behaviors such as autogrooming, using fingers and lips to remove any kind of particles from the fur, scratching oneself (if not repetitive), and picking one's nose.

Results:

Self-directed behavior increased slightly for Pertinax from 1.2 % prior to group formation to 2.0 % post group formation. Richard showed the highest increase from 3.3 % prior to the group formation to 4.7 % post group formation whereas for Avahli the behavior decreased from 3.7 % prior to the group formation to 3.1 % post group formation. When comparing both juveniles with each other, both of them were almost equal (prior: Richard: 3.3 % and Avahli: 3.7 %). Post group formation, Richard spent more time with self-directed behaviors (4.7 %) than Avahli (3.1 %).

Prior to group formation, when on the island, Pertinax spent 1.4 % of his time budget with self directed behaviors, compared to 1.2 % when inside. Richard spent 2.5 % when on the island and 3.3 % inside with self directed behaviors prior to the group formation. Avahli spent on the island 2.9 % and inside 3.7 % with self directed behaviors. Post group formation, Avahli spent 1.3 % of his time with this behavioral category when on the island.

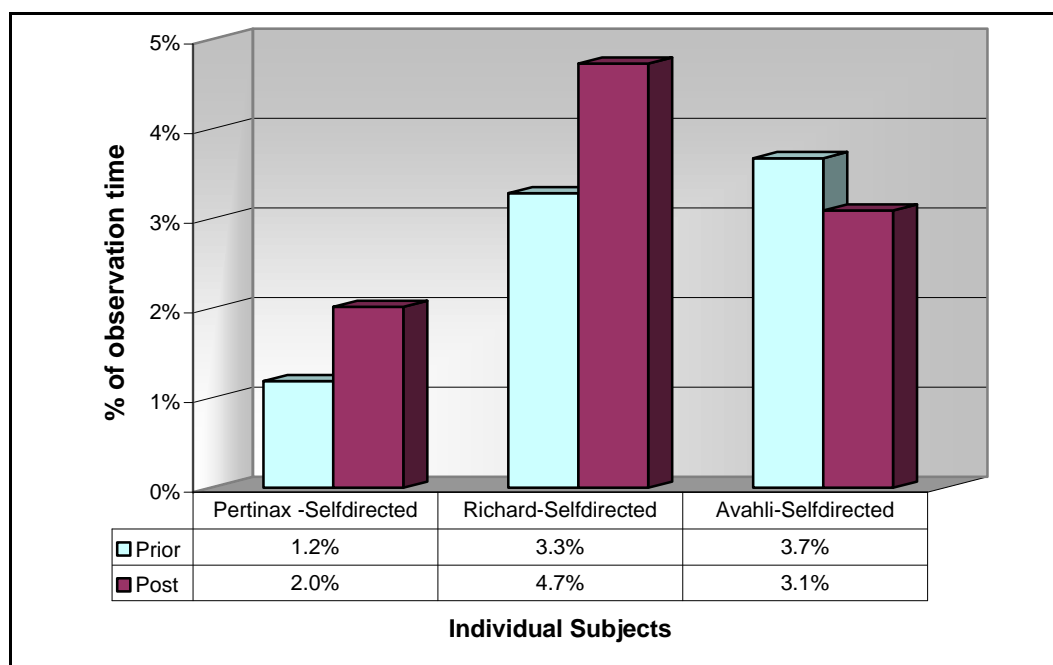


Fig. 26: Self-directed behaviors, as percentage of the observation time, expressed by the group members at Paignton Zoo; prior to and post group formation.

#### 4.2.1.5 Stereotypic and aberrant behaviors

##### Behavioral description:

Stereotypic behaviors include the following:

- 1.) Rocking: The animal sits and rocks from side to side, or front to back in a repetitive manner. Usually holds vegetation or any other objects between its hands and moves it back and forth on the floor.
- 2.) Hair- and skin plucking: The animal removes hair and skin from its extremities with thumb and index finger. When this behavior is performed on a continuous basis, bare areas on arms and/or legs are apparent
- 3.) Ear covering: Animal sits or squats and covers both ears with its hands (Woods, 1996).
- 4.) Hugging oneself: Animal sit or squats and giving oneself a hug by placing one hand to the opposite shoulder, can be accompanied by rocking.

Aberrant behaviors including the following:

Regurgitation and reingestion, an animal chews and swallows food (or other edible items) and almost immediately regurgitates it and swallows it again (see Akers and Schildkraut, 1985 for description).

##### Results:

Fig. 27 denotes the overall expression of the combination of stereotypic and aberrant behaviors. Pertinax expressed a high increase from 1.9 % prior group formation to 8.7 % post group formation. Prior to group formation, he engaged only in regurgitation and reingestion of various food items, sometimes even the tea that was provided in the afternoon. Post group formation, 8.7 % of his time budget was made up of the following, 3.5 % of his time with regurgitation and reingestion, 5.0 % with hair and skin plucking of his ankles and 0.1 % with ear covering. After the separation

from Claus, Pertinax spent more of his time with stereotypic and aberrant behaviors, which continued even after the introduction of Richard and Avahli.

Richard did not show any stereotypic or aberrant behaviors prior to the group formation (0.0 %), the slight increase post introduction (0.1 %), consisted exclusively of regurgitation and reingestion.

Avahli's expression increased also from 0.0 % prior to the group formation to 2.4 % post group formation. The behavior expressed by Avahli was "hugging himself" as if to comfort himself and rocking slightly front to back. Notably, when Richard and Avahli were alone, without Pertinax (post group formation) no stereotypic behaviors were seen by Avahli. Both Richard and Avahli, did not show stereotypic or aberrant behaviors prior to the group formation. Post group formation Avahli spent more time (2.4 %) with these behaviors than Richard (0.1 %).

While on the island, Pertinax spent 2.7 % of his time with regurgitation and reingestion prior to group formation. Richard did not express stereotypic behaviors prior to the group formation. Avahli was seen once (0.1 % of his time budget) hugging himself prior to the group formation. Subsequent to the group formation, Avahli retreated often to the island alone where he mainly engaged in hugging himself and rocking while at the same time covering himself with burlap, when available. The time he spent with stereotypic behaviors increased to 6.1 % of his time budget.

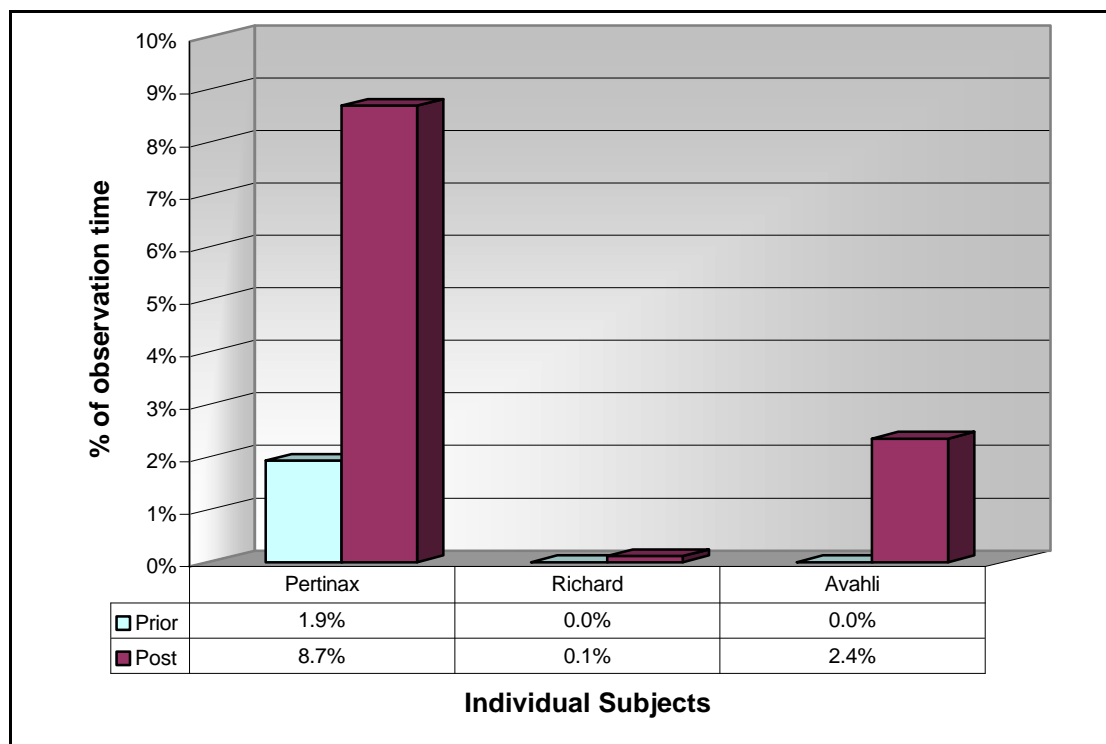


Fig. 27: Stereotypic and aberrant behaviors, as percentage of the observation time, expressed by the gorillas at Paignton Zoo prior and post group formation.

Since Pertinax seemed to express regurgitation and reingestion often, therefore, all occurrences of this behavior were recorded additionally throughout this study, by counting the onset of one sequence of regurgitation and reingestion as one event. The obtained data revealed a rate per hour of 3.0 (n = 54 events during 18.2 hours of observation) prior to the group formation, which increased slightly to 3.5 per hour (n = 93 events during 26.6 hours of observation) post group formation.

#### 4.2.1.6 Solitary play

##### Behavioral description:

This category included all solitary playful activities with the exception of object play. Behaviors such as swinging, jumping, dancing, somersaulting, sliding, slapping own hands or feet, etc., are included in this category.

Results:

The silverback never engaged in solitary play behaviors neither in the show den nor on the island. For the juveniles this behavior decreased after the group formation, for Richard for about 50 % from 1.3 % to 0.6 % of the time observed and for Avahli for about 66 % from 1.2 % to 0.4 %. Comparing both juveniles with each other, it becomes apparent, that they spent almost equal time with solitary play (prior to the group formation: Richard 1.3 %; Avahli 1.2 % and post group formation: Richard 0.6 %; Avahli 0.4 %). For instance, Avahli spent a great deal of time walking bipedally while his eyes were closed, until he run into a barrier, such the public window. This behavior was frequently accompanied with a play face.

On the island, prior to the group formation Richard spent 0.2 % of his time with solitary play. In the same period Avahli spent 1.2 % of his time with solitary play, post group formation it decreased to 0.8 % of his time budget.

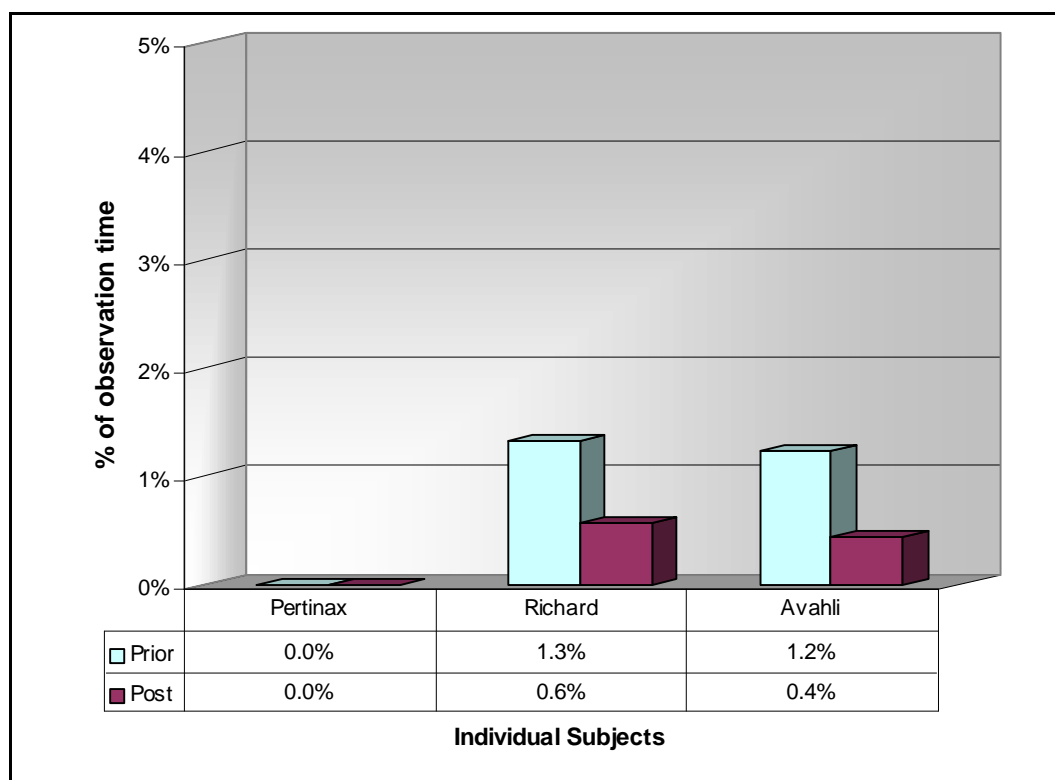


Fig. 28: Solitary play, as percentage of the observation time, expressed by the individual gorillas at Paignton Zoo prior and post group formation.

#### 4.2.1.7 Object play

##### Behavioral description:

This category includes using or manipulating objects, nest building, carrying objects, throwing objects, exploring the environment by biting, scratching and touching. The manipulation of objects included activities such as grasping and shaking objects, such as ropes, boxes, burlap (if not used during agonistic interactions), biting into objects while playing with them; manipulating objects with hands by taking them apart or pulling out pieces of them (such as dismantling rope material). The animal might also cover itself with an object (e.g., plant material over its shoulder/head).

##### Results:

Object manipulation and play occurred among all group members, but decreased post group formation. This can be mainly attributed to the reduced availability of objects, such as boxes and burlap sacks. Since Pertinax started to engage in R+R with the boxes, it was decided to remove these objects. Since he also used the burlap as “tool” to pull on the mesh doors, these objects were removed. Thus, the available objects consisted mainly of branches, which were supplied towards the end of time observation, post group formation. Pertinax as well as Richard used these as tools for the fishing board, which were implemented towards the end of the observation period. Pertinax showed the largest difference, of approximately 90 %, when comparing the time prior (7.8 %) to post group formation (0.6 %). Richard’s interactions with various objects decreased from 6.4 % (prior to the group formation) to 4.8 % (post group formation) and for Avahli it decreased from 7.1 % (prior to group formation) to 5.5 % (post group formation). When comparing both juveniles, Avahli spent more time (7.1 %) in object play than Richard (6.4 %) prior and post group formation (Avahli: 5.5 %; Richard: 4.8 %).

On the island, Pertinax spent 2.7 % of his time with object interaction. Richard spent prior to the group formation 8.1 % of his time with object play and Avahli 7.8 %. Post group formation, Avahli’s time spent with object play decreased to 1.3 %.

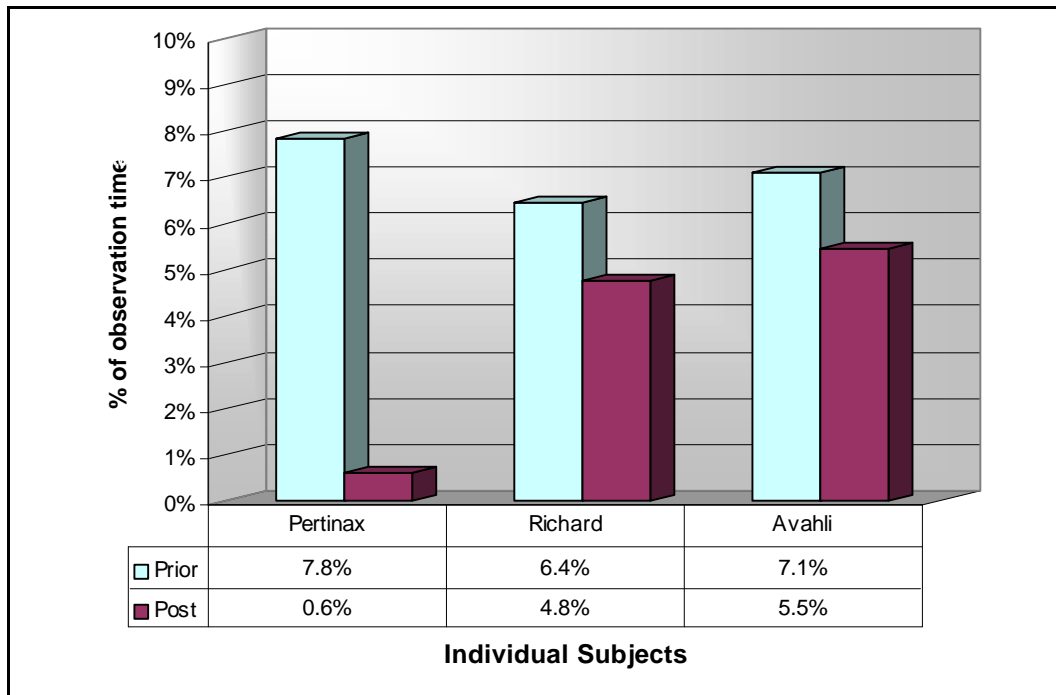


Fig. 29: Object play, as percentage of the observation time, expressed by the gorillas at Paignton Zoo prior and post group formation.

#### 4.2.1.8 Social affiliative behaviors

##### Behavioral description:

These behaviors include any playful activities in which the gorillas interact with one another, such as rough and tumble games, chasing each other, bumping into each other, and being in physical contact with each other. Wrestling games between Richard and Avahli involved pulling, pushing, mock biting, play face, holding other, rolling around on the floor with each other and bumping into each other while walking bipedally.



Results:

The method of recording did not allow to distinguish which animal initiated the play bouts as well as the duration of the play sessions. Therefore, the following results reflect the percentage of time the focal animal was involved in social play activities.

A typical play bout of Richard and Avahli was for instance; both were sitting across from each other and were looking towards one another. Then both would stand up, chest beat, turn around themselves and start a wrestling game. Chest beating appeared to be quite often the start of a game as well as the expression of a play face. Although it was hardly possible to determine who initiated the play, oftentimes it was terminated by Richard by walking away from Avahli who looked towards Richard.

Social affiliative play was seen only between the juveniles prior and post group formation, which decreased approximately 60 % from 11.7 % to 4.6 %.

When Richard and Avahli were by themselves, in the mornings after the group formation, they engaged more often in social affiliative behaviors, making up 11.5 % of the time spent. This is almost the same as prior to group formation. Thus, the presence of Pertinax in the afternoon influenced the social affiliative play between Richard and Avahli. Pertinax did not engage in social affiliative behaviors during the course of this study.

On the island, Richard and Avahli spent 10.7 % with social affiliative play prior to the group formation. Post group formation, when Richard and Avahli were alone on the island, while being observed, they spent 6.3 % of their time with social play.

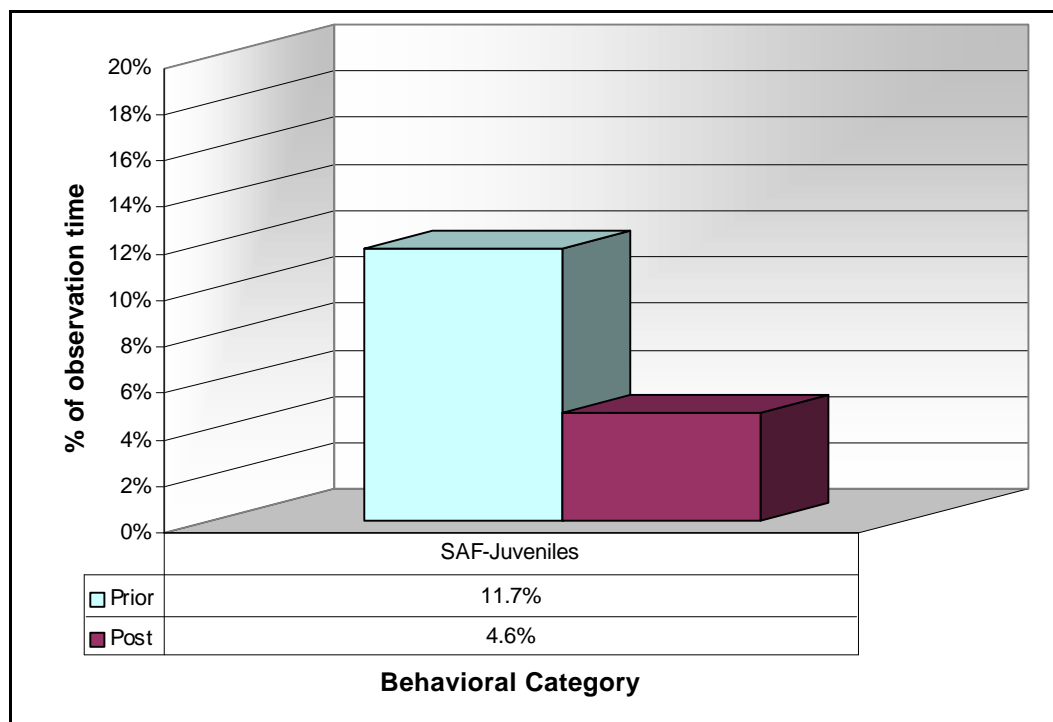


Fig. 30: Social affiliative behaviors (SAF), as percentage of the observation time, expressed by the gorillas at Paignton Zoo prior and post group formation.

#### 4.2.1.9 Agonistic behaviors

##### Behavioral description:

Display and apprehensive behaviors directed towards another gorilla were recorded as agonistic behaviors. Display behaviors included banging at surfaces, such as doors, walls, or windows, all producing loud noises. Other behaviors included standing in front of an other gorilla quadrupedally and looking at the other animal for several seconds (stand facing; Meder, 1987), quadrupedal running and jumping, often accompanied by piloerection of the hair on arms and/or legs.

Agonistic behaviors were defined as low, moderate and high aggressive behaviors, following the description of Robbins (1996). Low aggression consisting of vocalizations such as cough grunts, was not possible to determine, since it was nearly impossible to hear sounds at the zoos, due to noises by the visitors, the indoor enclosures shielded by windows, etc. Moderate aggression was based on body postures and facial expressions, such as stand facing towards each other (see Fig. 21),

the chest beating or strut-walking sequence as described by Schaller (1963) or any aspect the described series.

High aggression (as noted by Robbins, 1996) consisted of fights with body contact. This behavior was seen during the agonistic interactions between Claus and Pertinax, as described in the previous section. Since these behaviors were not seen after the silverbacks had been separated, the following results present the occurrence of moderate aggressive behaviors only.

### Results:

Agonistic behaviors were low and consisted of moderate aggression. Pertinax displayed prior to the group formation (1.2 %) mainly towards Claus, when he was in his vicinity, or occasionally towards the public. Post group formation (1.2 %), he directed displays towards the juveniles and towards the public. Richard spent more time with agonistic displays prior to the group formation (1.9 %) than post group formation (0.8 %) as did Avahli (prior: 0.9 % and post: 0.3 %). Prior to the group formation, both juveniles engaged mainly in “teasing” Claus, but not Pertinax. Since Claus was kept separate from the others (see previous section for details), he was not able to get in direct contact with them. However, Richard and Avahli appeared to “enjoy” winding up Claus.

For instance, when Claus was in the show den and the juveniles were outside on the Island, they kept banging at the outside door, and Claus started to display, running bluff charges and banging himself at the door. When Richard and Avahli are compared with each other, Richard spent more time with moderate agonistic behaviors than Avahli in either period.

On the Island, prior to the group formation, Pertinax spent 1.0 % of his time budget with moderate agonistic behaviors, directed towards Claus when he saw him inside the show den. Richard and Avahli showed 0.6 % (Richard) and 0.3 % (Avahli)

of moderate aggression, directed also towards Claus mainly by hitting towards the door. Claus hit as a response at the door from the inside.

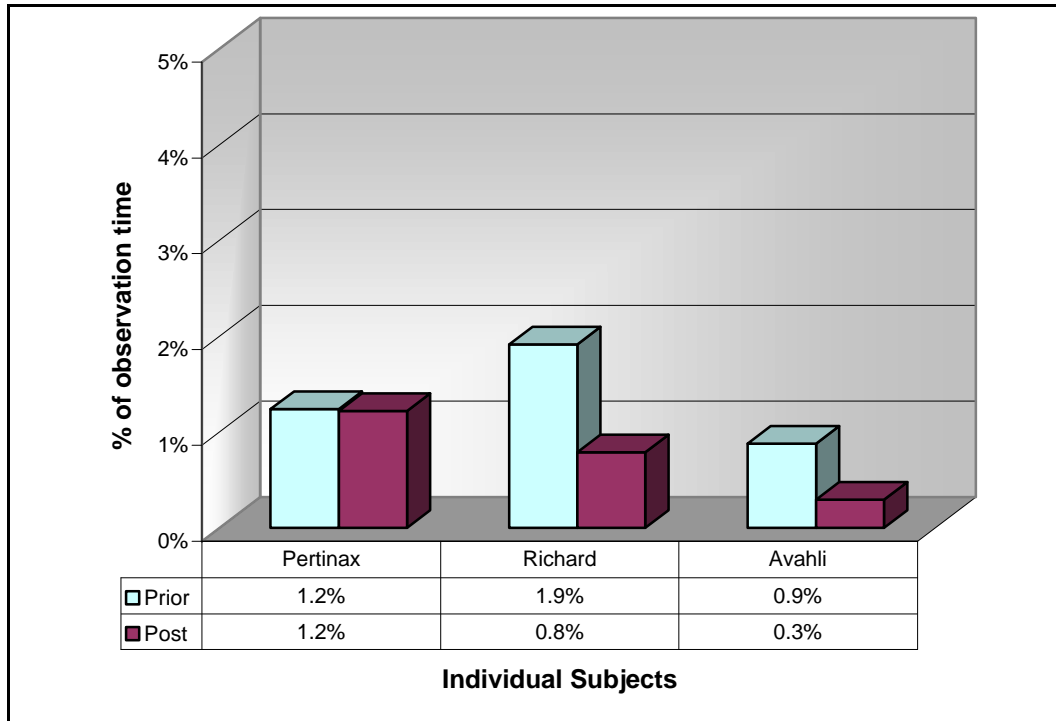


Fig. 31: Moderate aggression, as percentage of the observation time, expressed by the gorillas at Paignton Zoo prior and post group formation.

Other forms of aggression were not observed between these gorillas.

#### 4.2.2 Enclosure utilization at Paignton Zoo

The following section describes the usage and preferred areas of all three gorillas prior and post group formation. Pertinax as well as the juveniles were kept on a rotating schedule prior to the group formation, i.e., either in the show den, the island or being off show in the sleeping den areas. Thus, data presented prior to the group formation are limited to the show den area. After the group formation, the juveniles had access to the show den as well as to the other dens and the island whereas; Pertinax's access was limited to the show den only. This restriction provided the juveniles with the opportunity to get away from Pertinax when necessary. Thus, data presented post introduction includes all areas available to the gorillas at all times.

#### Results

The upper level (L1, see Fig. 14) turned out to be the preferred section within the show den at Paignton Zoo among all individuals. This area was by far the favorite area of Pertinax at all times (prior: 77.4 %; post: 81.4 %), especially the bench in the far corner of L1 (see Fig. 15). For Richard, L1 became his favorite area post group formation (50.2 %) while prior to group formation, he spent most of the time at L2 (59.8 %). Prior to group formation Avahli spent more time at L1 (44,7 %) than during post (22.5 %). Avahli's increased preference for the climbing structures after the group formation (post: 25.0 %; prior I: 13.4 %) seems to be related to the circumstances that these structures offered him a possibility to keep a great distance from the silverback. Besides retreating to the climbing structures, Avahli spent most of the time post introduction outside on the Island (34.6 %) alone. For Richard, on the other hand, the climbing structures became less interesting to him (prior: 12.5 %; post: 5.6 %), since he favored the upper level (L1) where he was able to observe Pertinax. The same could be observed as well as for the central level (L2) (post: 36.8 %), which was his favorite area prior to the group formation (59.8 %).

Table 6: Enclosure utilization, as percentage of the observation time, prior and post group formation.

Highlighted numbers denote the preferred locations of each gorilla during both phases.

	Pertinax- Prior	Pertinax – Post	Richard- Prior	Richard - Post	Avahli - Prior	Avahli - Post
Climbing Structures	2.8 %	1.1 %	12.5 %	5.6 %	13.4 %	25.0%
Upper Level (L1)	77.4 %	81.4 %	27.7 %	50.2 %	44.7 %	22.5 %
Central Level (L2)	19.9 %	11.5 %	59.8 %	36.8 %	41.9 %	15.4 %
Island	-	2.7 %	-	2.4 %	-	34.6 %
Den	-	3.3 %	-	5.0 %	-	2.5 %

### **4.3 The all-male group at Loro Park**

The study of the all-male group at Loro Park focused primarily on the social affiliative and agonistic behaviors between the group members and the enclosure utilization of the group. As described in the previous chapter, the all-male group at Loro Park consisted of six males, at the ages between 26 and 7 years.

#### **4.3.1 Social affiliative behaviors**

##### Behavioral description:

This category includes all activities when the animals were engaged in affiliative behaviors with each other. Social plays included rough and tumble play, chasing each other, play biting, or bumping into each other. When play ceased for more than 1 min., the next one was considered as a new play bout. Social contact with one another was recorded when the individuals had body contact with each other such as hugging or grooming one another. Proximity was recorded when two animals were resting within an arm's distance apart.

The following paragraphs describe firstly the distribution of all social affiliative behaviors for each individual. The second section presents the preferred partners for each individual gorilla for social affiliative behaviors. The third section splits the affiliative behaviors in play, social contact and resting in proximity to each individual interacting dyad.

Results:

Comparing the proportional distribution of all affiliative behaviors combined (n = 394), Maayabu expressed the highest rate of social affiliative behaviors (n = 246; 14.4 / hour, Fig. 32) when compared with the other group members. Thus, he was the most social gorilla of this group, whereas the silverback (Schorsch) was the least social group member, keeping his distance from the rest of the group.

The rate of social affiliative behaviors of Maayabu were significantly higher when compared with Schorsch (n = 28; 1.2 / hour; Mann-Whitney-U:  $p < 0.001$ ), Noel (n = 98; 6.1 / hour; Mann-Whitney-U:  $p < 0.05$ ) and Ivo (n = 102; 6.0 / hour; Mann-Whitney-U:  $p < 0.01$ ), but not significantly higher than Polepole's or Rafiki's social affiliative behaviors.

Polepole (n = 135; 8.2 / hour) spent significantly more time with social affiliative behaviors than Schorsch (n = 28; 1.2 / hour; Mann-Whitney-U:  $p < 0.001$ ) or Ivo (n = 102; 6.0 / hour; Mann-Whitney-U:  $p < 0.01$ ).

Rafiki (n = 175; 10.9 / hour) spent significantly more time with social affiliative behaviors than Schorsch (n = 28; 1.2 / hour; Mann-Whitney-U:  $p < 0.001$ ), Ivo (n = 102; 6.0 / hour; Mann-Whitney-U:  $p < 0.001$ ) or Noel (n = 98; 6.1 / hour; Mann-Whitney-U:  $p < 0.01$ ).



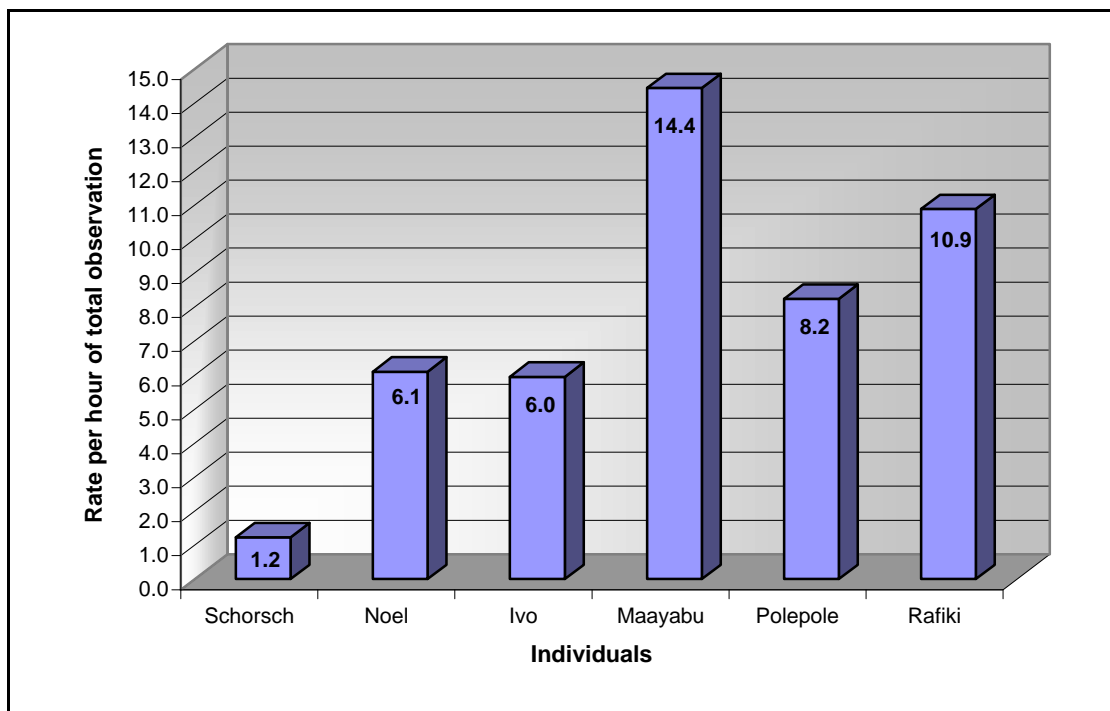


Fig. 32: Proportional rates of all social affiliative behaviors (n = 394), for each individual at Loro Park.

When looking at each individual and the time spent in social affiliative interactions with the other group members the following can be seen, as shown in Fig. 33.

Schorsch, being the leading silverback at the time of observation, was in proximity to Maayabu mainly, and with whom he had body contact, thus, making up 54.5 % (Fig. 33 A) of all his social interactions when compared with others. Although none of the interactions were statistically significant. His preferred partner was Maayabu ( $n = 15$ ; 54.5 %) followed by Noel ( $n = 5$ ; 19.5 %) and Rafiki ( $n = 4$ ; 15.5 %). Schorsch spend less time with Polepole ( $n = 2$ ; 7.3 %) and Ivo ( $n = 1$ ; 3.3 %).

Noel's time spent in affiliative behaviors was significantly higher with Maayabu ( $n = 55$ ; 55.9 %, Fig. 33 B) when compared to his interactions with Schorsch ( $n = 5$ ; 3.9 %; Mann-Whitney-U:  $p < 0.01$ ) or Ivo ( $n = 2$ ; 2.0 %, Mann-Whitney-U:  $p < 0.001$ ) or Rafiki ( $n = 3$ ; 3.3 %; Mann-Whitney-U:  $p < 0.01$ ). Social affiliative interactions between Noel and Polepole made up 34.9 % ( $n = 33$ ) and were significantly higher than his interactions with Rafiki (Mann-Whitney-U:  $p < 0.01$ ). For example, (4.6.98) Noel and Polepole were playing, Polepole initiated play with Noel, and at one time Maayabu got in the middle of it and chased Polepole away.

Ivo (Fig. 33 C) spent half of his social interactions with Rafiki ( $n = 50$ ; 50.4 %) and significantly less ( $n = 40$ ; 38.0 %; Mann-Whitney-U:  $p < 0.05$ ) with Maayabu and with Polepole ( $n = 9$ ; 8.9 %; Mann-Whitney-U:  $p < 0.05$ ). He spent less time with Polepole ( $n = 9$ ; 8.9 %), Noel ( $n = 2$ , 2.1 %) and with Schorsch 0.7 % ( $n = 1$ ), but this was not significantly different. An example of play interaction between Ivo and Rafiki (10.07.98): Ivo and Rafiki at social play at the east terrace gentle wrestling. At one instant, Ivo approached Rafiki, both resumed play, than Rafiki departed, returned, and both resumed playing. After 20 min., Rafiki left Ivo, thus, cutting off social contact.

Maayabu (Fig. 33 D) spent significantly more time with Rafiki ( $n = 84$ ; 35.0 %) than with Ivo ( $n = 40$ ; 15.7 %; Mann-Whitney-U:  $p < 0.01$ ) and with Polepole ( $n = 52$ ; 21.1 %; Mann-Whitney-U:  $p < 0.05$ ) or with Schorsch ( $n = 15$ ; 4.6 %; Mann-Whitney-U:  $p < 0.001$ ). He spent significantly more time with Noel ( $n = 55$ ; 23.2 %) than with

Ivo ( $n = 40$ ; 15.7 %; Mann-Whitney-U:  $p < 0.05$ ) or with Schorsch ( $n = 15$ ; 4.6 %; Mann-Whitney-U:  $p < 0.001$ ).

Polepole's (Fig. 33 E) preferred social interaction partners were Maayabu ( $n = 52$ ; 37.0 %), Rafiki ( $n = 39$ ; 29.6 %) and Noel ( $n = 33$ ; 25.9 %). Those interactions were not statistically significantly different. Polepole spent significantly less time in social affiliative behaviors with Ivo ( $n = 9$ ; 6.4 %; Mann-Whitney-U:  $p < 0.001$ ) and with Schorsch ( $n = 2$ ; 1.1 %; Mann-Whitney-U:  $p < 0.001$ ) when compared to his interactions with Noel, Maayabu or Rafiki.

Rafiki's (Fig. 33 F) preferred social partner was Maayabu ( $n = 84$ ; 46.4 %), followed by Ivo ( $n = 50$ ; 27.6 %) and Polepole ( $n = 39$ ; 22.4 %), but this was not statistically significant different. He spent significantly less time in social affiliative interactions with Noel ( $n = 3$ ; 1.8 %; Mann-Whitney-U:  $p < 0.001$ ) and with Schorsch ( $n = 4$ ; 1.8 %; Mann-Whitney-U:  $p < 0.001$ ) with whom he rarely interacted, especially since Schorsch avoided social interactions with almost all group members, except Maayabu.

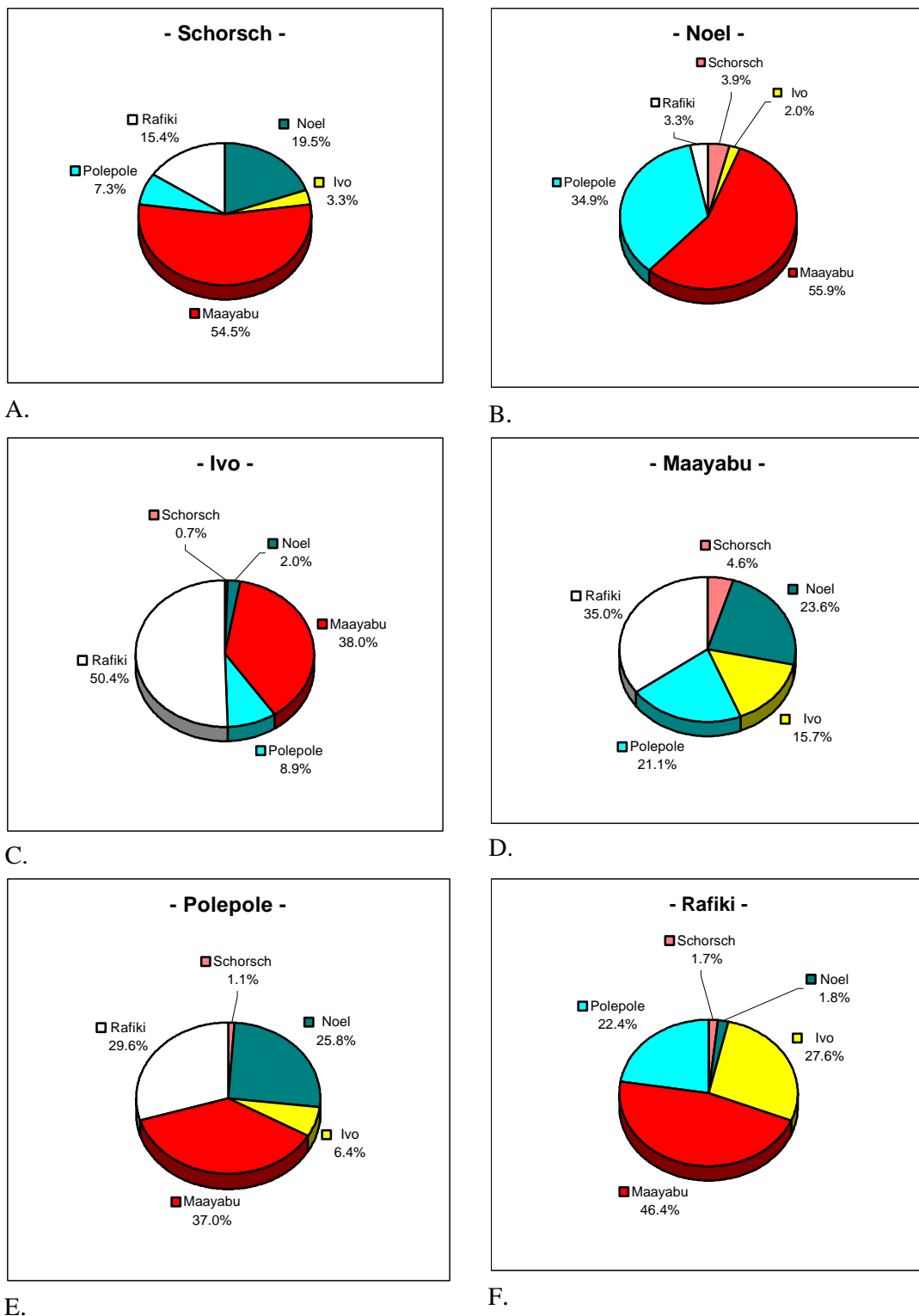


Fig. 33: Partner preferences for social affiliative interactions for each gorilla at Loro Park. Order of graphs correspond with the ages of the gorillas.

Note that Noel (B.) spent 56 % of his time with Maayabu who himself (D.) spent 24 % of his time with Noel but also almost equally often with the rest of the group, thus, Maayabu has twice as much affiliative interactions than Noel.

The results show that affiliative behaviors, in general, occurred between all 15 male-male dyads (Fig. 34 and Table 7), ranging in total for all subjects from 0.0 to 5.1 occurrences per hour of observation. Social interactions took place mainly between the younger group members, such as Maayabu, Polepole and Rafiki.

All blackbacks and subadults engaged in play activities, which is shown in Fig. 34 and Fig. 35. A total of 143 play bouts were observed with the majority being expressed by Maayabu and Rafiki ( $n = 41$ ; 2.5 / hour; highlighted section in Fig. 34) when compared to the other pairs. Figure 35 denotes a play bout between Maayabu and Rafiki inside the cave at the east (larger) terrace. Additionally, Polepole and Rafiki expressed the second highest rate of play interactions ( $n = 23$ ; 1.4 / hour), although not statistically significant. Frequent play interactions were also seen between Maayabu and Noel ( $n = 20$ ; 1.2 / hour), Maayabu and Polepole ( $n = 20$ ; 1.2 / hour) and Ivo with Rafiki ( $n = 18$ ; 1.1 / hour). Fewer play bouts were seen between Ivo and Maayabu ( $n = 10$ ; 0.6 / hour) and for Noel with Polepole ( $n = 8$ ; 0.5 / hour) and Rafiki ( $n = 2$ ; 0.1 / hour). Ivo and Polepole were seen playing only once (0.1 / hour). Noel's play interactions with Polepole or Rafiki were not statistically significant different. His social play interactions with Maayabu included mainly rough and tumble play, accompanied by play faces of both animals. They also used palm fronds quite frequently during their play sessions. Ivo interacted significantly more with Rafiki ( $n = 18$ ; 1.1 / hour, Mann-Whitney-U:  $p < 0.05$ ) than with Polepole ( $n = 1$ ; 0.1 / hour), but not significantly more with Maayabu ( $n = 10$ ; 0.6 / hour).

Resting in contact was accounted for in 81 instances; the dyads of Maayabu with Rafiki ( $n = 19$ ; 1.1 / hour) and Ivo with Rafiki ( $n = 16$ ; 1.0 / hour) accounted for the majority of interactions, but not statistically different. Maayabu and Polepole rested more in contact ( $n = 15$ ; 0.9 / hour) than Maayabu and Ivo ( $n = 13$ ; 0.7 / hour). Schorsch and Noel rested significantly less in proximity ( $n = 0$ ) than Ivo and Maayabu ( $n = 13$ ; 0.7 / hour; Mann-Whitney-U:  $p < 0.05$ ), Ivo with Rafiki ( $n = 8$ ; 0.5 / hour; Mann-Whitney-U:  $p < 0.001$ ), Maayabu with Polepole ( $n = 15$ ; 0.9 / hour; Mann-Whitney-U:  $p < 0.05$ ), Maayabu with Rafiki ( $n = 19$ ; 1.1 / hour; Mann-Whitney-U:  $p < 0.01$ ) and Polepole with Rafiki ( $n = 8$ ; 0.5 / hour; Mann-Whitney-U:  $p < 0.05$ ).

Schorsch and Ivo ( $n = 0$ ) spent significantly less time resting in contact than Ivo with Maayabu ( $n = 13$ ; 0.7 / hour; Mann-Whitney-U:  $p < 0.05$ ), Ivo with Rafiki ( $n = 16$ ; 1.0 / hour; Mann-Whitney-U:  $p < 0.01$ ), Maayabu with Polepole ( $n = 15$ ; 0.9 / hour, Mann-Whitney-U:  $p < 0.05$ ), Maayabu with Rafiki ( $n = 19$ ; 1.1 / hour; Mann-Whitney-U:  $p < 0.01$ ) and Polepole with Rafiki ( $n = 8$ ; 0.5 / hour; Mann-Whitney-U:  $p < 0.01$ ). Polepole spent more time resting in contact with Rafiki ( $n = 8$ ; 0.5 / hour) than with Ivo ( $n = 3$ ; 0.2 / hour). Noel spent less time resting in contact with Polepole ( $n = 2$ ; 0.1 / hour) than with Maayabu ( $n = 4$ ; 0.3 / hour). The lowest rate was seen between Schorsch and Maayabu ( $n = 1$ ; 0.0 / hour).

Resting in proximity was seen in 170 instances, for the most part between Noel with Maayabu ( $n = 31$ ; 1.9 / hour) and with Polepole ( $n = 23$ ; 1.5 / hour). Noel stayed in proximity mostly with Maayabu ( $n = 31$ ; 1.9 / hour) and with Polepole ( $n = 23$ ; 1.5 / hour), followed by Schorsch ( $n = 5$ ; 0.2 / hour), Ivo ( $n = 2$ ; 0.1 / hour) and Rafiki ( $n = 1$ ; 0.1 / hour).

Table 7: Distribution of social affiliative behaviors at Loro Park.

Rate per hour of observation for each interacting pair,  
total number of occurrences in parentheses.

Legend: S=Schorsch; N=Noel; I=Ivo; M=Maayabu; P=Polepole; R=Rafiki

<b>Interacting Pair</b>	<b>Play</b>	<b>Contact</b>	<b>Proximity</b>
S / N	-	-	0.2 (5)
S / I	-	-	0.0 (1)*
S / M	-	0.0 (1)*	0.6 (14)
S / P	-	-	0.1 (2)
S / R	-	-	0.2 (4)
N / I	-	-	0.1 (2)
N / M	1.2 (20)	0.3 (4)	1.9 (31)
N / P	0.5 (8)	0.1 (2)	1.5 (23)
N / R	0.1 (2)	-	0.1 (1)
I / M	0.6 (10)	0.7 (13)	1.0 (17)
I / P	0.1 (1)	0.2 (3)	0.3 (5)
I / R	1.1 (18)	1.0 (16)	1.0 (16)
M / P	1.2 (20)	0.9 (15)	1.0 (17)
M / R	2.5 (41)	1.1 (19)	1.4 (24)
P / R	1.4 (23)	0.5 (8)	0.5 (8)

\* Equals rate per hour of 0.04

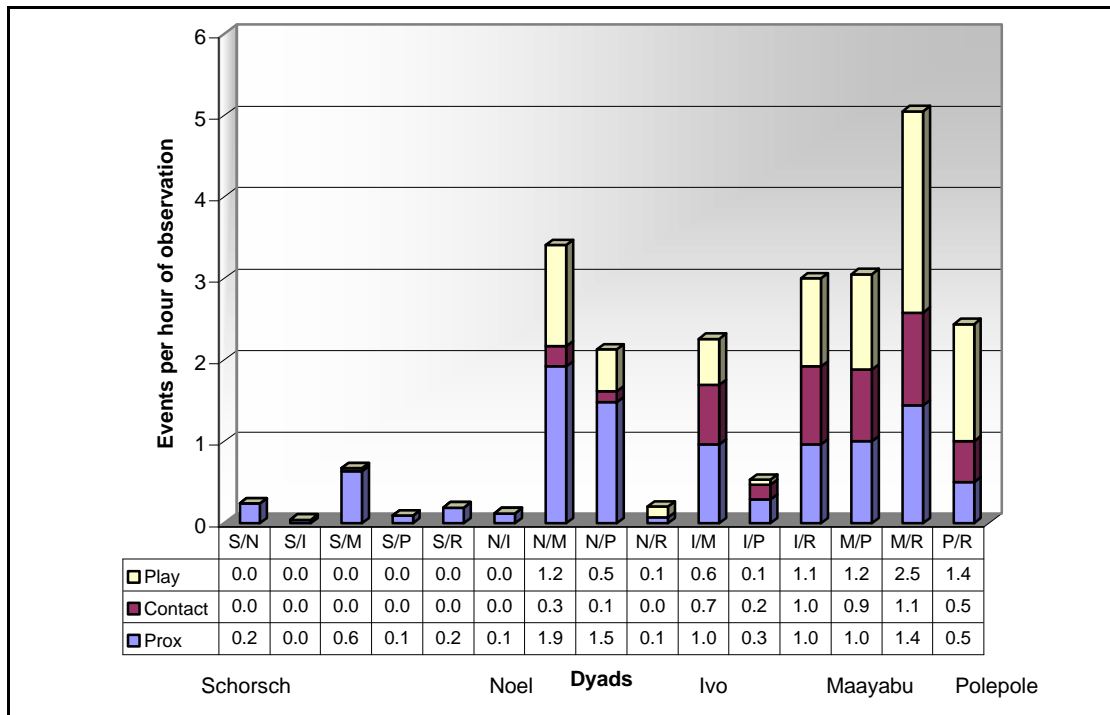


Fig. 34: Distribution of selected affiliative behaviors within the all-male group at Loro Park, for each interacting dyad.

Legend: S=Schorsch; N=Noel; I=Ivo; M=Maayabu; P=Polepole; R=Rafiki

Total number of events for each behavioral category, for play (n = 143), for contact (n = 81), for proximity (n = 170).





Fig. 35: Maayabu and Rafiki (top) playing inside the cave at the west terrace.

### 4.3.2 Aggressive behaviors

#### Behavioral description:

Aggressive behaviors were subdivided into moderate and high aggressive behaviors based on the following criteria, as also described in the previous chapter on agonistic behaviors during the group formation at Paignton Zoo. Moderate aggression was noted based on body postures, such as stand facing towards each other or any part of the chest beating display as described by Schaller (1963) or teasing another gorilla by pushing, pulling or hitting the other, described also as rough up by Porton and White (1996). High aggression was noted when two gorillas fought with each other by hitting or biting.

The following paragraphs denote firstly the distribution of all aggressive behaviors for each gorilla and secondly which individual had the most aggressive encounters. The third section splits the aggressive behaviors into moderate and high aggression for each interacting pair.

#### Results:

Looking at the proportional distribution of all aggressive behaviors combined ( $n = 159$ ), Noel showed the highest rate with 8.2 events / hour ( $n = 136$ , Fig. 36) when compared to the other gorillas at Loro Park. His rate of aggressive behaviors was significantly higher when compared to Schorsch ( $n = 22$ ; 1.1 / hour; Mann-Whitney-U:  $p < 0.001$ ), to Ivo ( $n = 72$ ; 4.4 / hour; Mann-Whitney-U:  $p < 0.01$ ); Maayabu ( $n = 69$ , 4.2 / hour; Mann-Whitney-U:  $p < 0.001$ ); Polepole ( $n = 10$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.001$ ) or Rafiki ( $n = 9$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.001$ ). Ivo's rate of aggressive behaviors ( $n = 72$ ; 4.4 / hour) was significantly higher when compared with Schorsch ( $n = 22$ ; 1.1 / hour; Mann-Whitney-U:  $p < 0.05$ ), Polepole ( $n = 10$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.01$ ) or Rafiki ( $n = 9$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.01$ ). Maayabu's rate of aggressive behaviors ( $n = 69$ ; 4.2 / hour) was significantly higher compared to Rafiki ( $n = 9$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.05$ ).

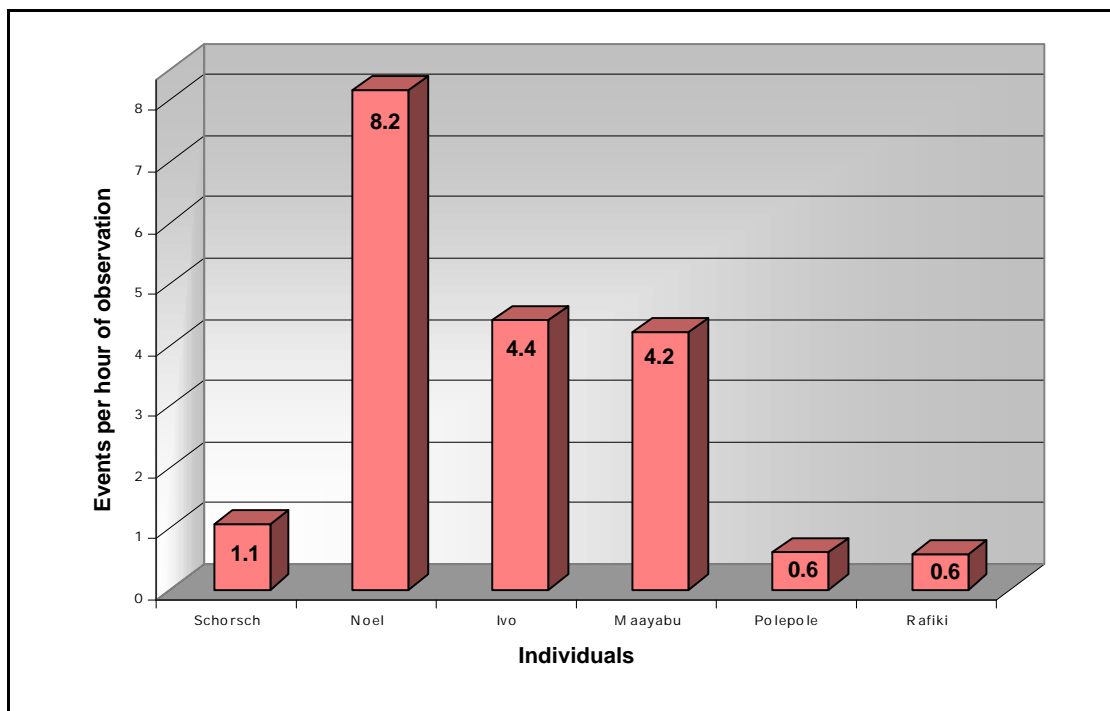


Fig. 36: Proportional rates of all agonistic behaviors (n = 159) for each individual at Loro Park.

When looking at the individuals and with whom they were involved in aggressive behaviors, the following could be seen (as denoted in Fig. 37):

Schorsch (Fig. 37 A) spent 91.4 % ( $n = 20$ ) of his time in aggressive behaviors with Noel and significantly less time with Polepole ( $n = 1$ ; 4.8 %; Mann-Whitney-U:  $p < 0.05$ ) and with Maayabu ( $n = 1$ ; 3.8 %; Mann-Whitney-U:  $p < 0.01$ ).

Noel's main aggressive encounters were primarily with Ivo ( $n = 59$ ; 44.8 %, see also Fig. 37 B) and Maayabu ( $n = 54$ ; 41.0 %), but this was not statistically different. His aggressive interactions with Schorsch made up 11.8 %, which was significantly less than with Ivo ( $n = 59$ ; 44.8 %; Mann-Whitney-U:  $p < 0.01$ ) and significantly more than with Rafiki ( $n = 1$ ; 0.9 %; Mann-Whitney-U:  $p < 0.05$ ). Noel had highly significantly more aggressive interactions with Ivo or Maayabu than with Polepole and Rafiki (Mann-Whitney-U:  $p < 0.001$ ).

Ivo (Fig. 37 C) was mainly involved in aggressive interactions with Noel ( $n = 59$ ; 83.2 %) and highly significantly less with Maayabu ( $n = 12$ ; 15.5 %) and Rafiki ( $n = 1$ ; 1.4 %), (Mann-Whitney-U:  $p < 0.001$ ).

Maayabu's (Fig. 37 D) time spent in aggressive behaviors was mainly with Noel ( $n = 54$ ; 80.0 %) and highly significantly less with Ivo ( $n = 12$ ; 16.2 %; Mann-Whitney-U:  $p < 0.001$ ), as well as with Polepole ( $n = 1$ ; 1.4 %), Rafiki ( $n = 1$ ; 1.4 %) and with Schorsch ( $n = 1$ ; 1.0 %).

Polepole's (Fig. 37 E.) aggressive interactions were mainly with Rafiki ( $n = 6$ ; 60.7 %) and with Noel ( $n = 2$ ; 21.3 %), which were not significantly different. His interactions with Maayabu ( $n = 1$ ; 9.8 %) and with Schorsch ( $n = 1$ ; 8.2 %) were also not significantly different from each other.

Rafiki's (Fig. 37 F.) main interactions took place with Polepole, making up 66.1 % ( $n = 6$ ) of his time spent in aggressive interactions. He got involved less, but not significantly different, with Noel ( $n = 1$ ; 12.5 %), Ivo ( $n = 1$ ; 10.7 %) and Maayabu ( $n = 1$ ; 10.7 %) in aggressive interactions.

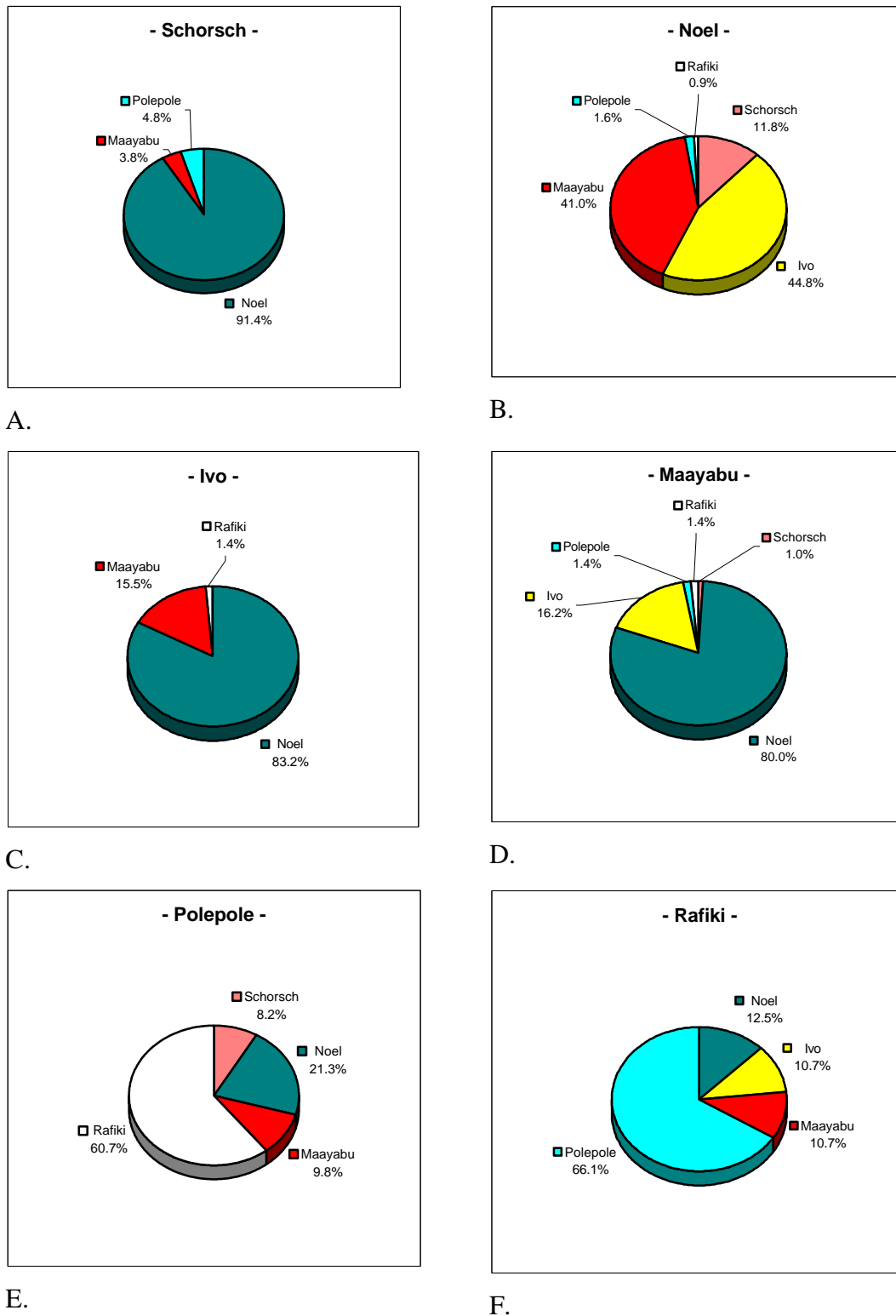


Fig. 37: Individual distribution of agonistic interactions for each gorilla at Loro Park.

Note Schorsch (A.) was 91 % of his time involved with Noel, whereas Noel (B.) was only 12 % of his time involved with Schorsch.

Aggressive interactions, in general, occurred mainly between Noel and Ivo or Maayabu and between Noel and Schorsch (Fig. 38 and Table 8), ranging in total for all interacting pairs from 0.0 to 3.7 occurrences per hour of observation.

Moderate aggression was noted in 150 instances, with the majority expressed between the dyad of Noel and Ivo ( $n = 59$ ; 3.7 / hour of observation), mainly displaying towards each other as can be seen in Fig. 39. Noel and Maayabu expressed the second highest rate of aggressive interactions ( $n = 53$ ; 3.3 / hour) although not significantly different. Noel and Ivo had significantly more aggressive interactions than Noel and Schorsch ( $n = 14$ ; 0.7 / hour; Mann-Whitney-U:  $p < 0.05$ ) and highly significantly more than Ivo and Maayabu ( $n = 11$ ; 0.6 / hour; Mann-Whitney-U:  $p < 0.001$ ). Noel and Ivo's rate of moderate aggressive behaviors was also highly significantly higher (Mann-Whitney-U:  $p < 0.001$ ) when compared to the observed interactions between Schorsch and Maayabu ( $n = 1$ ; 0.0 / hour), Schorsch and Polepole ( $n = 1$ ; 0.1 / hour), Noel and Polepole ( $n = 2$ ; 0.1 / hour), Noel and Rafiki ( $n = 1$ ; 0.1 / hour), Ivo and Polepole or with Rafiki and Maayabu with Polepole and Rafiki ( $n = 1$ ; 0.1 / hour each) or with the moderate aggressive interactions between Polepole and Rafiki ( $n = 5$ ; 0.3 / hour). Noel and Maayabu's rate of moderate aggressive behaviors were significantly higher than Noel's aggressive interactions with Schorsch ( $n = 14$ ; 0.7 / hour; Mann-Whitney-U:  $p < 0.05$ ) and highly significant higher (Mann-Whitney-U:  $p < 0.001$ ) than all other observed moderate aggressive encounters with the exception of the previously mentioned encounters between Noel and Ivo.

High aggression was noted in nine instances, mainly between Schorsch and Noel ( $n = 6$ ; 0.3 / hour), which was significantly higher than Noel's fight with Maayabu ( $n = 1$ ; 0.1 / hour; Mann-Whitney-U:  $p < 0.05$ ), the rest of the few high aggressive interactions were not statistically different.

Table 8: Distribution of aggressive behaviors at Loro Park.

Events per hour of observation for each interacting pair,  
total number of occurrences in parentheses (n=159).

Legend: S=Schorsch; N=Noel; I=Ivo; M=Maayabu; P=Polepole; R=Rafiki

<b>Interacting Pair</b>	<b>Moderate Aggression</b>	<b>High Aggression</b>
S / N	0.7 (14)	0.3 (6)
S / I	-	-
S / M	0.0 (1)*	-
S / P	0.1 (1)	-
S / R	-	-
N / I	3.7 (59)	-
N / M	3.3 (53)	0.1 (1)
N / P	0.1 (2)	-
N / R	0.1 (1)	-
I / M	0.6 (11)	0.1 (1)
I / P	-	-
I / R	0.1 (1)	-
M / P	0.1 (1)	-
M / R	0.1 (1)	-
P / R	0.3 (5)	0.1 (1)

\* equals events per hour of 0.04





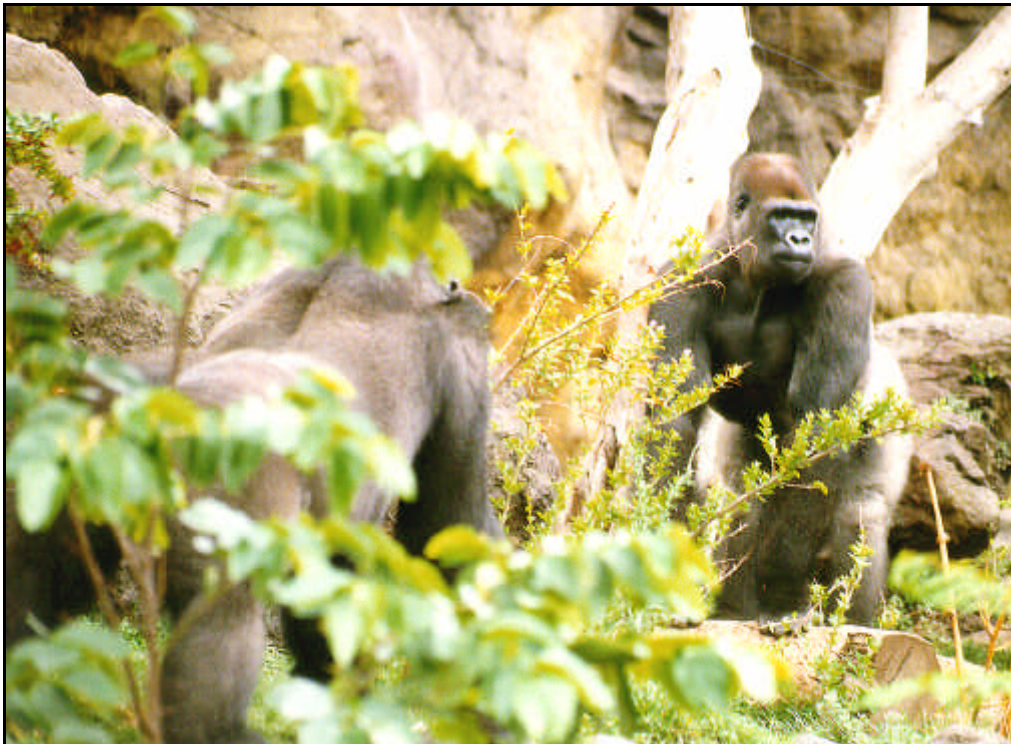


Fig. 39: Noel (right, facing away) and Ivo (left, staring) standing opposite to each other.

### 4.3.3 Utilization of the enclosure at Loro Park

As described in chapter 3 (page 29), the outdoor enclosure consists of two parts (see Fig. 17. on page 31 for an overview) covering a total area of 3700 m<sup>2</sup>.

By looking at the overall use of both enclosure terraces, it becomes apparent that, with the exception of Noel, all males prefer the larger terrace (Fig. 40). Schorsch, Ivo, Maayabu and Rafiki spent highly significant more time at the larger terrace (Fig. 40 and Table 9) than at the smaller one (Mann-Whitney-U,  $p < 0.001$ ). Whereas Noel spent highly significant more time at the smaller terrace than at the larger terrace (Mann-Whitney-U,  $p < 0.001$ ). Only Polepole was seen at both terraces almost equally. Thus, the two opponents, Noel and Ivo preferred to stay at opposite terraces, with Noel preferring the larger and Ivo the smaller one.

Although, Schorsch and Rafiki spent more than 70 % in the larger enclosure, they preferred different sections for each other. As denoted in Table 9, Schorsch almost exclusively preferred (72.8 %) the area right at the public viewing window, whereas Rafiki spent the majority of his time (42.7 %) in the upper area (above cascading waterfall).

Noel and Ivo preferred to stay in the opposite enclosure as noted in the highlighted sections, as can be seen in Table 9. The highlighted portions denote the significant preferences for one particular location for each of the group members, with the exception of Maayabu and particularly Polepole who utilized both terraces evenly.

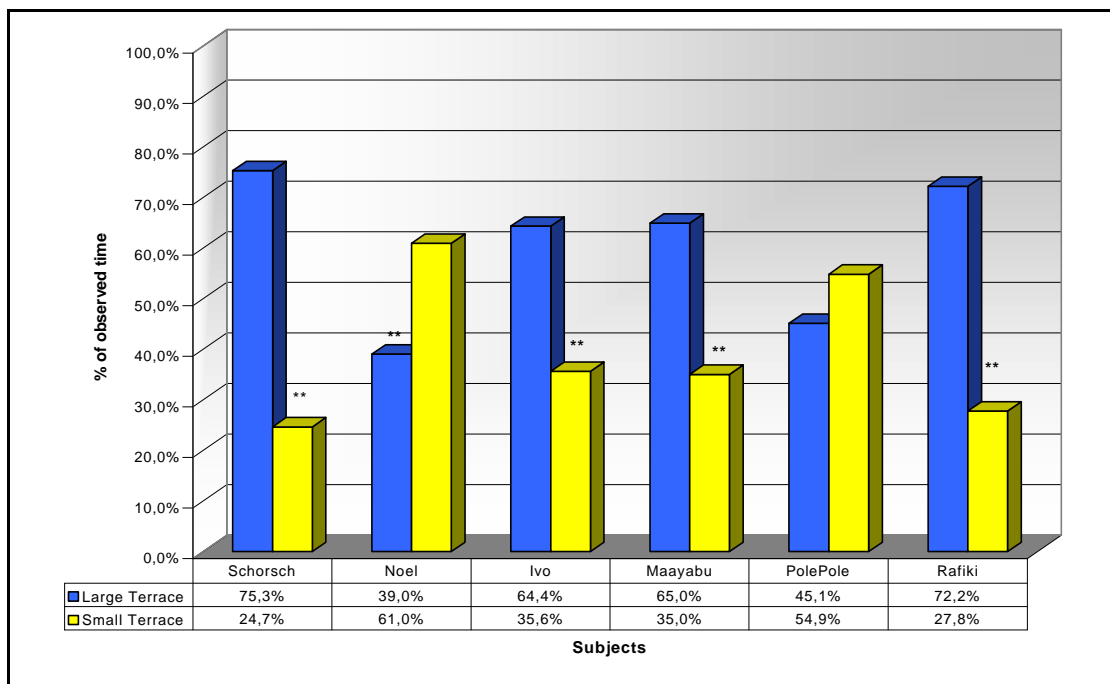


Fig. 40: Enclosure Utilization of the Individuals at Loro Park, Tenerife.

(% of observation time) \*\*  $p < 0,001$

Table 9: Detailed enclosure utilization of the individuals at Loro Park.

(% of observation time)

Legend: LTPW (Public Window west terrace), LTC (West terrace centre area), LTW (West terrace near the rear wall), LTUL (West terrace upper level), LTRA (West terrace rear area near cascading waterfall); STPW (Public Window east terrace), STC (East terrace centre area), STW (East terrace near the rear wall), STPO (East terrace near pool), STPA (East terrace rear area around palm tree)

	Schorsch	Noel	Ivo	Maayabu	Polepole	Rafiki
LTPW	72.8 %	-	3.3 %	2.5 %	2.6 %	7.2 %
LTC	2.0 %	3.9 %	7.7 %	20.4 %	10.8 %	13.4 %
LTW	0.6 %	18.7 %	5.2 %	16.5 %	10.7 %	8.8 %
LTUL	-	16.5 %	45.2 %	24.3 %	19.9 %	42.7 %
LTRA	-	-	3.0 %	1.3 %	1.2 %	0.2 %
STPW	17.8 %	5.4 %	4.0 %	7.9 %	9.3 %	6.3 %
STC	2.5 %	7.1 %	7.0 %	6.1 %	13.0 %	6.7 %
STW	1.1 %	42.6 %	16.8 %	15.9 %	18.0 %	9.2 %
STOP	3.3 %	1.0 %	3.8 %	1.3 %	6.4 %	3.1 %
STPA	0.0 %	4.9 %	4.0 %	3.8 %	8.2 %	2.4 %