

THE PRELIMINARY STUDY OF MIRROR SELF-RECOGNITION (MSR) ON MALAYAN SUN BEAR (*Helarctos malayanus*)

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SUMMARY

The mirror self-recognition (MSR) is a behavioral technique to determine whether an animal has the ability to identify themselves in front of a mirror. A Malayan sun bear (*Helarctos malayanus*) was selected from Zoo Negara Malaysia and an acrylic mirror is placed outside of the cage to observe interaction of the animal to the mirror. This study showed that the bear's behaviour was inconsistent due to the inability of the animal to recognize its own reflection after exposure to the close and open mirror tests. These results suggest that when keeping Malayan sun bears in captivity, putting a mirror as enrichment may promote communication and familiarity between conspecific.

Keywords: mirror self-recognition (MSR), self-recognition, Malayan sun bear (Helarctos malayanus)

INTRODUCTION

Animal cognition describes the learning and memory function of an animal. Self-recognition is defined as the ability of animals to identify itself as an individual distinguished from the surrounding and other animals or species. The mirror self-recognition (MSR) test or mark test is a behavioural technique to determine whether an animal has the ability to recognise its image in front of the mirror (Gallup, 1970). Theoretically, animals that are considered to be able to recognise themselves in a mirror typically progress through four stages of behaviour when facing a mirror; (i) social responses, (ii) physical inspection, (iii) repetitive mirror-testing behaviour and, (iv) realisation of seeing themselves (Gallup, 1970; Hecht *et al.*, 2017; Ma *et al.*, 2015). The final stage can be verified if the animals recognize the mark by spontaneously using the mirror to touch or investigate the mark on its own body (Hecht *et al.*, 2017; Plotnik *et al.*, 2006; Prior *et al.*, 2008; Reiss and Marino, 2001). Several studies have shown convincing evidence of mirror self-recognition on chimpanzees (Gallup, 1970; Hecht *et al.*, 2017), dolphins (Reiss and Marino, 2001), Asian elephants (Plotnik *et al.*, 2006), ants (Cammaerts and Cammaerts, 2015) and magpies (Prior *et al.*, 2008). However, the degree to recognise the mirror image is still debatable for some animals, in which they fail to progress beyond social response and physical inspection stages.

Malayan sun bear (*Helarctos malayanus*) is a threatened wild species in Malaysia. It has been classified as Data Deficient in the 1996 by IUCN due to lack of detailed knowledge and information of species distribution and population trends (IUCN, 1996). Previous studies reported on the understanding of the biological and ecological of the sun bear (Frederick *et al.*, 2010; Wong *et al.*, 2004), however they have

provided limited information on the behaviour of this animal. The behavioural physiology of the sun bear is relatively with large brain and has complex intelligence quotient skills (Deaner *et al.*, 2007). In fact, animals that demonstrated on MSR have larger relative brain sizes and more highly evolved social cognition abilities than those that show no MSR (Reiss and Marino, 2001). This might imply that animal self-recognition is beneficial in appreciating the common values that rule the cognitive evolution and the mechanism underlying the neurological aspects (Hecht *et al.*, 2017).

To address this issue, we conducted MSR tests in captive Malayan sun bear. It has been established that the MSR studies were focused on social or wild animals (Ma *et al.*, 2015; Plotnik *et al.*, 2006). However, limited finding reported on the captive animals due to the lack of scientific data on Malayan sun bear has been identified hindering any efforts towards conservation. A lot of benefits could arise from this study which includes extending the understanding of MSR in animals, increasing the knowledge on cognitive ability of the Malayan sun bear and enhancing the management and design of enclosures and exhibits of the Malayan sun bear. Indeed, animal's cognitive research has contributed in understanding behaviour of the Malayan sun bears as an effort to enhance bear conservation. The Malayan sun bear population is in serious decline and research on this species should be of the highest priority for any bear species worldwide.

MATERIAL AND METHODS

Three-years old of captive female Malayan sun bear from the Zoo Negara Malaysia was selected. The animal was kept in its enclosure consisting of two cages. The first cage was used for playing or resting area and the second cage was used to provide food and shelter. In the playing area, there were hanging rope, few wooden logs and a rattan basket, whereas the second cage was kept empty. The diet consisted of fruits such as papayas in the morning

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and rice, carrots and tapioca in the evening. For the purpose of this study, the playing cage was assigned as observation cage and the second cage as holding cage. The observation cage was used to record the sun bear behaviour during interaction with the mirror whereas holding cage was used during resting time. A manual gate separates each cage where the animal is transferred to holding cage through it. The fence was made up of thick stainless steel wire mesh with each gap between wires approximately about 10 cm wide. Thus, it provides enough view for the observation purposes.

The apparatus used in this study was a one-way acrylic mirror made of highly durable and anti-shatter material (150 X 120 cm) and supported 45 cm above the ground by a wooden stand. It was placed 10 cm away from the outside of the wire mesh fence of the indoor cage, beyond the bear's reach. The camera was placed on top of the mirror to detect facial expression and mirror-directed behaviour.

In this study, two different tests were conducted which is close mirror (baseline) and open mirror tests. The

test was performed for 6 days from 10.00 am until 12.00 pm. During this period, the animal was less distracted with the human intervention and feeding time, thus allowing natural behaviour to be recorded. During the close mirror test, the mirror is covered with a black A1 sized paper and observation was done for 3 days.

In the open mirror test, the mirror was placed outside the cage at day 4, 5 and 6 and the animal was then released from the holding cage into the observation cage. The mirror-directed behaviours of the animal were recorded in 20 minutes intervals, for 6times per day. The animal was transferred into the holding cage for 10 minutes in between the 20 minutes observation period.

All behaviours were recorded by a digital video camera (GoPro Hero 3) throughout the recording session. All data were tabulated using Microsoft Office Excel. The total time spent of a mirror directed-behaviour was presented by percentage and the definition of the mirror-directed behaviours is listed in Table 1 as suggested by Gallup (1970) and Ma (2015).

Table 1. Definitions and categorizations of mirror-directed behaviours

Behaviour	Definition
Social response	The eyes target the mirror for two or more seconds, bobbing and vocalization.
Physical investigation	Attempt to touch and sniff the object for a period of more than 5 sec
Repetitive mirror behaviour	Attacking: Aggression toward mirror by swiping its paws and trying to bite Threatening: Snout wrinkled upwards with mouth open, showing canines, and often vocalising loudly Backwards walking: Retreating five or more steps Foot scraping: Scraping the substrate with a backward motion of the hind paws
Self recognition	Playing: Attempting to interact with the mirror in an amicable manner

RESULT AND DISCUSSION

Results showed that there was no significant difference between an animal and the close mirror test. This could indicate that the sun bear is not sensitive to the novelty of the apparatus near the cage. In fact, the animal took some time to investigate the nearest novel object during social and playing activities (Sasaki *et al.*, 2005). In the open mirror test, the sun bear spent 58.9% of the time for viewing, 39.7% of the time for investigating and 26.1% of the time playing. This indicates the ability of the animal to interact with reflective image. However, only 13.0% of the time was spent on aggressive behaviour (e.g vocalisation) in front of the mirror. Our data suggest that the sun bear has the capability to interact with the image; nevertheless the data was inconsistent to confirm that the animal could recognize the image because the animal did not clearly undergo the four stages of MSR. Due to little known physiological study in this species, few information regarding interaction and social structure causes limitation in understanding the behavioural pattern (Tan *et al.*, 2013). In addition, the results suggest that when keeping sun bears in confinement, habitually switching the animal between enclosures may promote communication and familiarity between conspecific.

The Malayan sun bear appear to be incapable of self-recognition by failing to comply with the four stages of MSR. Furthermore, it could be suggested that the imaged

posed no threat and reduced its vigilance due to the fact that sun bear became habituated to the image along the study. This study may be related to or determined by the living style of Malayan sun bear used to be solitary in the wild unless there is mating season and yet the season is still undefined (Frederick *et al.*, 2010; Schwarzenberger *et al.*, 2004). Besides, the Malayan sun bear is believed to have limited vision compared to its olfactory and auditory cues (Vickery and Mason, 2004), especially in the forest where the sun bear use its olfactory ability to search for foods (Wong *et al.*, 2004). Interestingly, the preliminary findings from this study may be useful for both captive breeding and reintroduction of captive sun bear into the wild. Whether the sun bear can recognize the image is belonging to themselves or the image is just illusory or conspecific, the further study need to be continue to provide better results for growing research field of MSR.

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CONFLICT OF INTEREST

All authors declare no conflict of interest. There are no directly related manuscripts or abstracts, published or unpublished, by any authors of this paper.

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REFERENCES

- Cammaerts M-C. & Cammaerts R. (2015). Are ants (hymenoptera, formicidae) capable of self-recognition? *Journal of Science*,5: 521-532.
- Deaner, R. O., Isler, K., Burkart, J. & van Schaik, C. (2007). Overall brain size and not encephalization quotient, best predicts cognitive ability across non-human primates. *Brain Behavior Evolution*, 70: 115-124.
- Frederick, C., Kyes, R., Hunt, K., Collins, D., Durrant, B. & Wasser, S. K. (2010). Methods of estrus detection and correlates of the reproductive cycle in the sun bear (*Helarctos malayanus*). *Theriogenology*,74:1121-1135.
- Gallup Jr, G.G. (1970). Chimpanzees: self-recognition. *Science*, 167: 86-87.
- Hecht E.E., Mahovetz L.M., Preuss T.M., Hopkins W.D. (2017) A neuroanatomical predictor of mirror self-recognition in chimpanzees. *Social Cognitive Affective Neuroscience*, 37–48.
- IUCN. (1996). Red List of Threatened Animals. IUCN, Gland, Switzerland and Cambridge, UK.
- Ma, X., Jin, Y., Luo, B., Zhang, G., Wei, R. & Liu, D. (2015). Giant pandas failed to show mirror self-recognition. *Animal Cognition*,4.
- Plotnik, J. M., de Waal, F. B. M. & Reiss, D. (2006). Self-recognition in an Asian elephant. *PNAS*, 103 (45):17053–17057.
- Prior, H., Schwarz, A. & Gunturkun, O. (2008). Mirror-induced behaviour in the magpie (*pica pica*): Evidence of self-recognition. *Plos Biology*,6: e202.
- Reiss, D. & Marino, L. (2001). Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *PNAS*, 98:5937–5942.
- Sasaki, M., Endo, H., Wigg, O., Derocher, A. E., Tsubota, T., Taru, H., Yamamoto, M., Arishima, K., Hayashi, Y., Kitamura, N. & Yamada, J. (2005). Adaptation of the hindlimbs for climbing in bears. *Annals Anatomy*, 187: 153-160.
- Schwarzenberger, F., Fredriksson, G., Schaller, K. & Kolter, L. (2004). Fecal steroid analysis for monitoring reproduction in the sun bear (*Helarctos malayanus*). *Theriogenology. International Journal Animal Reproduction*,62:1677-1692.
- Tan, H. M., Ong, S. M., Langat, G., Bahaman, A. R., Sharma, R. S. K. & Sumita, S. (2013). The influence of enclosure design on diurnal activity and stereotypic behaviour in captive Malayan Sun bears (*Helarctos malayanus*). *Research Veterinary Sciences*, 94: 228-239.
- Vickery, S. & Mason, G. (2004). Stereotypic behavior in Asiatic black and Malayan sun bears. *Zoo Biology*, 23: 409–430.
- Wong, S. T., Servheen, C. W. & Ambu, L. (2004). Home range, movement and activity patterns, and bedding sites of Malayan sun bears (*Helarctos malayanus*) in the Rainforest of Borneo. *Biology Conservation*, 119:169-181.