



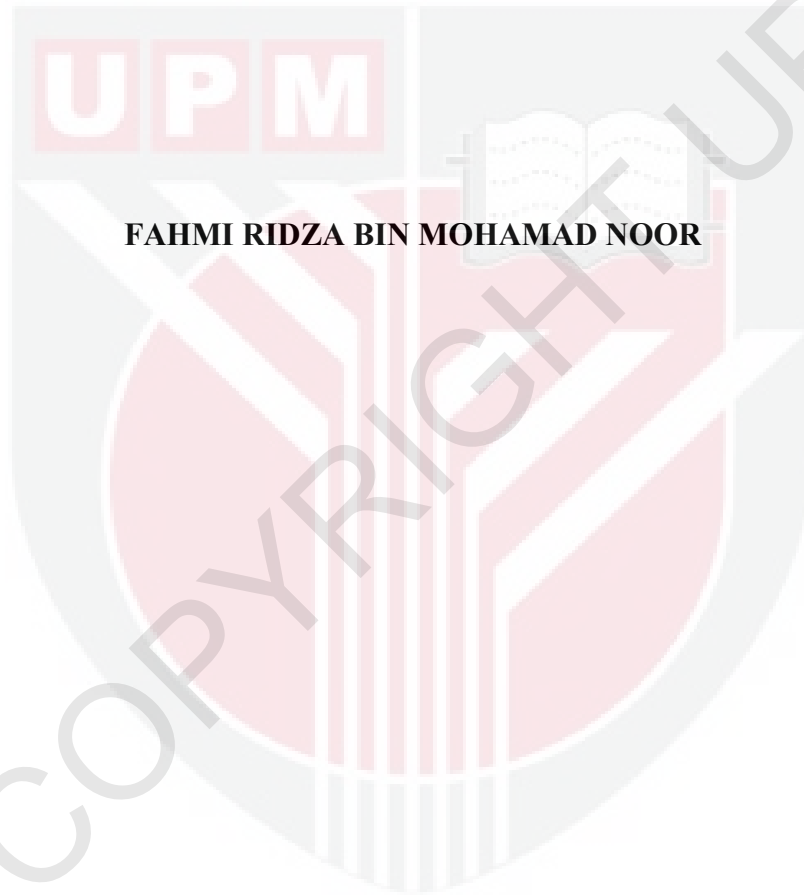
UNIVERSITI PUTRA MALAYSIA

**THE NATURE OF VISUAL SELF-RECOGNITION IN THE COCKATOO
(*CACATUA GALERITA*)**

FAHMI RIDZA BIN MOHAMAD NOOR

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FPV 2016 30**

THE NATURE OF VISUAL SELF-RECOGNITION IN THE COCKATOO (*CACATUA GALERITA*)



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FACULTY OF VETERINARY MEDICINE

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THE NATURE OF VISUAL SELF-RECOGNITION IN THE COCKATOO

(*CACATUA GALERITA*)

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It is hereby certified that we have read this project paper entitled “The nature of visual self-recognition in the cockatoo (*Cacatua galerita*)”, by Fahmi Ridza Bin Mohamad Noor and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement of the course VPD 4999 – Project.

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DEDICATION

I dedicated this thesis with love and appreciation to:

My parents

Mohamad Noor Zainuddin

Romlah Basri

My siblings

Shahrul, Khairil, Ashraf and Faris

My Supervisor

Dr. Hafandi Bin Ahmad

My Co-Supervisor

Assoc. Prof. Dr. Jalila Binti Abu

My course mates

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And to all my teachers who have committed themselves towards the

noble cause of education.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek.

**SIFAT SEMULAJADI VISUAL BAGI PENGENALPASTIAN DIRI DI DALAM
BURUNG KAKAKTUA (*CACATUA GALERITA*)****Oleh****Fahmi Ridza Mohamad Noor****2016****Penyelia: Dr. Hafandi Ahmad****Penyelia Bersama: Prof. Madya Dr. Jalila Abu**

Fungsi kognitif haiwan dihuraikan tentang keupayaan seekor haiwan untuk menerima sesuatu informasi visual, auditori atau olfaktori dan membuat penilaian terhadap persekitarannya. Ujian pengenalanpastian diri di hadapan cermin (MSR) adalah prosedur untuk mengenalpasti samada haiwan memiliki keupayaan pengenalanpastian diri di hadapan cermin atau tidak. Sehingga kini hanya manusia dan primat besar menunjukkan bukti pengenalanpastian diri yang kukuh. Oleh itu, tujuan kajian ini adalah untuk mengkaji tingkah laku pengenalanpastian diri bagi kakaktua (*Cacatua galerita*). Seekor burung kakaktua jambul sulfur dewasa dari Zoo Negara telah digunakan sebagai

subjek dan satu cermin akrilik (bersaiz 60cm x 84cm/A1) telah diletakkan di luar sangkar pemerhatian. Sepuluh slot ujian cermin di mana setiap satunya selama 15 minit telah dijalankan dalam seminggu waktu pemerhatian. Burung yang dianggap mampu untuk mengenalpasti dirinya di hadapan cermin lazimnya akan melalui empat tahap tingkah laku apabila berhadapan dengan cermin seperti respon sosial, pemeriksaan fizikal, tingkah laku berulang kali di hadapan cermin dan kesedaran melihat dirinya sendiri terhadap imej cermin. Tingkah laku tersebut telah direkodkan dengan menggunakan kamera video yang diletakkan di tempat yang selamat dan data pemerhatian telah dianalisis dengan menggunakan prosedur etogram. Hasil kajian menunjukkan burung tersebut mampu mengenali imej pantulan selepas diberi pendedahan berterusan terhadap imejnya pada cermin seperti menggaru muka, mencondongkan kepala dan membersihkan bulu dibadan dimana ini menunjukkan unsur positif dan berjaya di dalam ujian pengenalanpastian diri di hadapan cermin (MSR). Oleh yang demikian, penyelidikan terhadap pengenalanpastian diri di dalam spesis ini akan memberi kesan yang mendalam untuk memahami keupayaan kognitif burung kakaktua disamping sebagai usaha untuk membantu haiwan, seperti meningkatkan tahap pengurusan, reka bentuk tempat kurungan individu, pameran dan di dalam program untuk membina semula populasi spesis haiwan terancam.

Kata kunci: Kakaktua, ujian pengenalanpastian diri (MSR), kognitif dan tingkah laku

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial requirement for the course VPD 4999 – Project.

THE NATURE OF VISUAL SELF-RECOGNITION IN THE COCKATOO**(*CACATUA GALERITA*)**

By

Fahmi Ridza Mohamad Noor**2016****Supervisor: Dr Hafandi Ahmad****Co-Supervisor: Assoc. Prof. Dr. Jalila Abu**

Animal's cognitive function describes the ability of an animal to perceive sensory information such as visual, auditory or olfactory and make judgments about its environment. The mirror self-recognition (MSR) test is a procedure to determine whether animal possesses the ability of self-recognition in front of the mirror. Until today, only humans and great apes have shown convincing evidence of mirror self-recognition. Thus, the purpose of this study is to investigate the nature of visual on mirror-induced behavior (self-recognition) in the cockatoo (*Cacatua galerita*). An adult Sulphur-Crested cockatoo from Zoo Negara Malaysia was used and an acrylic mirror (60cm x 84cm/ A1 size) was placed at the outside of the observation cage. Ten slots of mirror tests at each for 15 minutes were carried out in a week of observation. Bird that is considered to be able to recognize itself through a mirror typically progress through four stages of behavior such as social response, physical inspection, repetitive mirror-testing

behavior and realization of seeing itself. The behavior was recorded by using a video camera which was mounted in an obscure location and the data was analyzed using the ethogram procedure. Results showed that the animal being able to recognize its own reflection such as scratching face, tilting face and preening, which indicates to positive and successful MSR. Thus, research on self-recognition in this species will have profound implications in understanding the cognitive ability as an effort to help animals, such as to enhance management, design of captive individuals' enclosures and exhibits, and in program to re-establish populations of endangered or threatened species.

Keyword: Cockatoo, mirror test self-recognition (MSR), cognitive behavior

1.0 INTRODUCTION

Animal cognition describes the mental capacities and the memory of animals in exploring the new environment (Whishaw and Kolb, 2014). Cognitive in animals are important for certain functions. Cognition is a process where knowledge and understanding is developed in the brain. Cognitive is the activity (Bakker *et al.*, 2003). In fact, cognitive is the activity or process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something. Studies carried out by Blood *et al.*, (2007) reported that cognitive is also the capacity to recall previously experienced sensations, information, data and ideas. In some animals, cognitive function provides some evidence for cognitive self-awareness, which described as the ability to recognize oneself as an individual separate from the environment and other individuals (Yang, 2005).

The mirror test of mirror self-recognition (MSR) test is a behavioral technique developed in 1970 by psychologist Gallup, G. to determine whether a non- human animal possesses the ability of self-recognition. In addition, the MSR test is the traditional method of measuring self-awareness which also described as the sense that one is as individual separate from the environment.

Animals that possess MSR typically progress through four stages of behavior when facing a mirror: social responses, physical inspection, repetitive mirror-testing behavior, and realization of seeing themselves. The final stage is verified if a subject passes the “mark test” by spontaneously using the mirror to touch an otherwise

imperceptible mark on its own body (Plotnik *et al.*, 2006). Few species of animals that have shown MSR are chimpanzees (Gallup, 1970), dolphins (Reiss and Marino, 2000), elephants (Plotnik *et al.*, 2006) and orang utans (Suarez *et al.*, 1981)). Few other species that have not express MSR are such as gibbons (Suddendorf *et al.*, 2009), gorillas (Suarez *et al.*, 1981), pandas (Ma *et al.*, 2008) and macaques (Anderson *et al.*, 1983). Until now, only few species of birds have been tested which are African Grey parrot, pigeon and Eurasian Magpie. However, only magpie shows convincing evidence of self-recognition behavior (Prior *et al.*, 2008). Grey parrot and pigeon have great potential to have abilities in recognizing themselves to since they are capable to differentiate objects through the mirror image (Pepperberg *et al.*, 1995; Epstein *et al.*, 1981). For our study, it is meant to measure mirror-induced behavior (self-recognition or self-awareness) in the cockatoo (*Cacatua galerita*). Sulphur crested cockatoo is a social animal, live in pairs or in flocks. It has a prominent white feathers and bright yellow crest. It is originated from northern and eastern Australia and New Guinea. In cockatoo, stereotypic behavior like feather picking is a serious problem. Mirror stimulation as for enrichment program could be a way to reduce the problem. Unfortunately, we cannot easily administer the same mark test or guided reaching tasks that have been used with apes and mokeys. Birds unlike apes and monkeys, do not often used their feet either to explore their bodies or to investigate items (Pepperberg *et al.*, 1995).

1.1 OBJECTIVE

The objective of this study is to investigate the nature of visual on mirror-induced behavior (self-recognition or self-awareness) in the cockatoo (*Cacatua galerita*)

1.2 HYPOTHESIS

This tests will show whether the bird being able or not to recognize its own reflection after prolonged exposure to its image in the mirror. Our hypothesis, the cockatoo is capable of understanding that the mirror image is belongs to its own body.

2.0 LITERATURE REVIEW

2.1 Cognitive function

Animal cognition describes the mental capacities and the memory of animals in exploring the new environment (Whishaw and Kolb, 2014). There are few cognitive function in animals. Cognition is a process where knowledge and understanding is developed in the brain. Cognitive is the activity (Bakker *et al.*, 2003). According to Merriam-Webster's dictionary, cognitive the activity or process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something. In fact cognitive is also the capacity to recall previously experienced sensations, information, data and ideas (Blood *et al.*, 2007). In some animals, cognitive function provides some evidence for cognitive self-awareness, which described as the ability to recognize oneself as an individual separate from the environment and other individuals (Yang, 2005).

2.2 Mirror Self-Recognition Test (MSR Test)

Mirror self-recognition (MSR) is the ability of animals to recognize oneself in a mirror and considered a potential index of self-recognition and the foundation of individual development (Ma *et al.*, 2015). The MSR paradigm has been applied to evaluate self-awareness in a wide range of species (Gallup, 1970). The ability to recognize oneself in a mirror is an exceedingly rare capacity in the animal kingdom. Until today, only humans and great apes have shown convincing evidence of mirror self-recognition (Reiss and Marino, 2001). Based on study conducted by Prior (2008) reported animal that express MSR tend to reduce social behavior and increase in use of

the mirror for exploration of its own body. Fairly clear evidence of this has been obtained for chimpanzees, orang-utans, and pygmy chimpanzees. In gorillas and gibbons, some authors reported failure of self-recognition whereas others reported positive findings in at least one individual. It should be mentioned that even in the chimpanzee, the species most studied and with the most convincing findings, clear-cut evidence of self-recognition is not obtained in all individuals tested. Findings suggestive of self-recognition in mammals other than apes have been reported for dolphins and elephants. In monkeys, non-primate mammals, and in a number of bird species, exploration of the mirror and social displays were observed, but no hints at mirror-induced self-directed behavior have been obtained (Prior *et al.*, 2008). The chimpanzees has been said to show signs of “self- recognition,” “self-awareness,” and a “self-concept” because it can use a mirror to locate an object on its body which it cannot see directly (Gallup, 1970).

2.3 Self-recognition in birds

Based on Prior *et al* (2008) who is study about comparative studies suggested that at least some bird species have developed mental skills similar to humans and apes. Magpies showed spontaneous mark-directed behavior when provided with a mark in a mark test. The findings for the test gives the first evidence of mirror self-recognition in a non-mammalian species. However, they also mentioned that a number of bird species, exploration of the mirror and social displays were observed, but no hints at mirror-induced self-directed behavior have been obtained. In another test as in for pigeons, they

have found that a pigeon (*Columba live domestica*) is also capable of using a mirror to locate an object on its body which it cannot see directly (Epstein *et al.*, 1981). In Grey parrots, overall data suggested that they indeed process mirror information. They differentiate reflective versus no reflective information and use a representation to locate hidden objects. Nevertheless, whether Grey parrots will ultimately succeed on more complex mirror tasks (mirror- guided reaching, mark tests) remains to be seen. Unfortunately, we cannot easily administer the same mark test or guided reaching tasks that have been used with apes and monkeys. Birds unlike apes and monkeys, do not often use their feet either to explore their bodies or to investigate items. (Pepperberg *et al.*, 1995). As in research in dolphins (Marino *et al.*, 1994), the work must therefore focus on conceptual rather than technical similarities in tests among species.

2.4 Sulphur Crested Cockatoo

The sulphur crested Cockatoos, *Cacatua galerita*, are noisy and conspicuous parrots and in the wild are wary and difficult to approach and it was said originated from Australia and can live in urban areas. They live in flocks and may maintain a permanent roosting site and may occupy it for many years (Lamm & Calaby, 1970). In south-eastern Australia they roost in various trees including eucalypts, casuarinas, melaleucas and leptospermums (Lamm & Calaby, 1970). Veterinarians reported that the most common behavior problems presented to them were feather picking, chronic egg laying, aggression, and screaming, in that order (Gaskins *et al.*, 2011). According to IUCN red list 2016, Sulphur crested cockatoo species has an extremely large range, and hence

does not approach the thresholds for Vulnerable under the range size. Even the fact that the population trend seems to be reducing, the decline is not sufficient for rapid approach to the thresholds for Vulnerable under the population trend IUCN criterion.

3.0 MATERIALS AND METHODS

3.1 Animal

A male adult bird (10 years old; n=1) Sulphur-Crested cockatoo (*Cacatua galerita*) from Zoo Negara was used in this experiment. Animal was kept alone in an individual aviary with branches for perching and was fed with mixed grains, papayas and some green vegetables. According to Attending Veterinarian, the bird had a history of stereotypic behavior such as feather picking and repetition body movement. However, no serious medical sickness or disease has been reported for the bird.

3.2 Experiment set up and equipment

A camera (GoPro Hero 3+; GoPro, USA) was put hidden under a box for camouflage and was placed higher right in front of the experiment cage at about distant from the cage of 1 meter and a half to reduce the anxiety and stress of the bird during the observation (Figure 3). During the experiment, the bird was temporarily moved into a new small cage (observation cage) which is size around 60cm x 84cm x 90cm approximately (Figure 1 and 2). The daily time of experiment usually on morning to afternoon which starting around 10am to 4pm in order to have a more consistent result.

In mirror test simulation, an acrylic mirror sized of 60cmx 84cm (A1 sized) was placed outside, at the right wall of the cage. The mirror was fixed tightly on the side of the cage by using an elastic rope so that the mirror was in full contact with the cage wall to allow the bird to have contact with the mirror.

The experiment was conducted in an isolated room where observer and the staffs are away from the bird's sight. The hidden camera was used to record all the bird's activity while keeping the bird stress level reduce by keeping the observer away during the trials.



Figure 1: Observation cage without mirror



Figure 2: Mirror position at one side of the cage wall

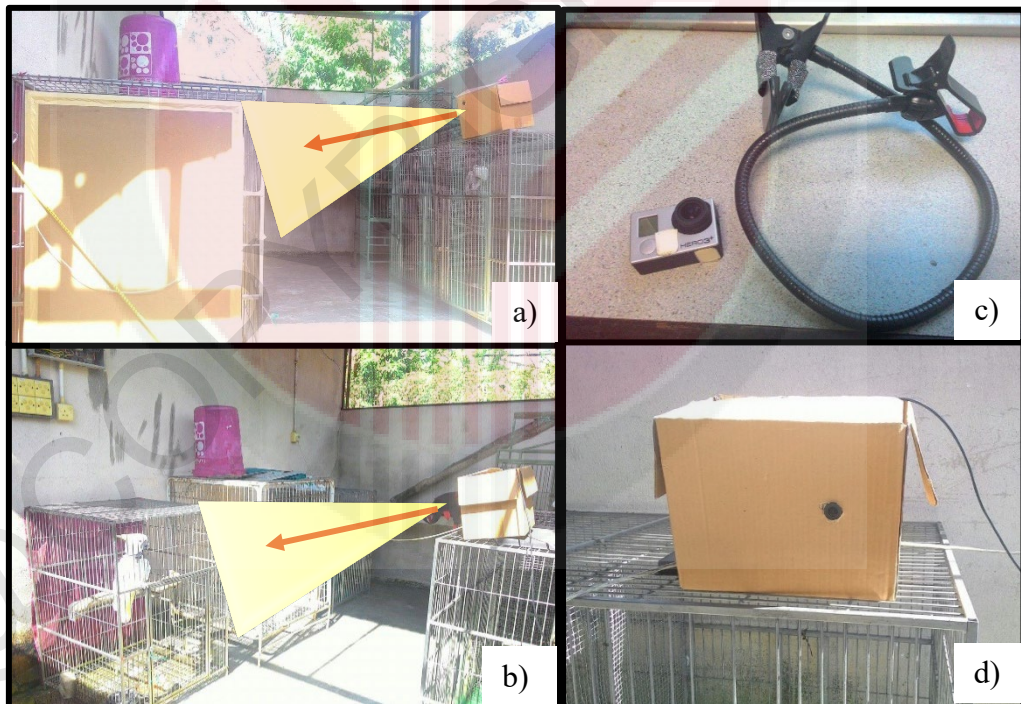


Figure 3: a) Camera box position with mirror placement. b) Camera box position without mirror placement. c) Hidden camera with holder. d) The camera was placed inside a box for camouflage.

3.3 Ethogram, Mirror tests and sampling

There are three major phase for the experiment. First, the *ad libitum* behavior observation such as normal behavior and mirror behavior were identified using the ethogram procedures. The second phase is to do the mirror test itself and followed by last phase which is data tabulation and result interpretation.

On first day, two simple of *ad libitum* observations were done for about 15 minutes each. First observation was meant to identify all the bird activities in normal environment; which without mirror stimulation. On second observation, the bird was kept left with mirror presence and any response and activity will be recorded as mirror induced behavior. Another purpose for *ad libitum* slots is to identify whether the bird has stereotypic behavior or not during throughout the observation.

After successful gathered the behavior list, a three straight consecutive days for mirror test program was done. The three days were occupied for 10 slots of trials, each consists of 15 minutes in length. Every trial slot had a rest session of 15 minutes to reduce error in data frequency due to boredom or over stimulation of the bird for the mirror. The video taken is closely observed, and ethogram for mirror trials were done and tabulated in a table. There were two behavior perimeter were taken during the mirror test. The first perimeter is the self-recognition behavior, which is any behavior that is responsive to its own self-image, in other words self-exploratory behavior. This include cresting position, head shaking, lift foot towards mirror, mirror scratching, head tilting, face scratching and preening (Helmut *et al.*, 2008). The second parameter is mirror-induced behavior which is any other behavior due to mirror image stimulation

including social response like communicating or fighting. This perimeter consist behavior like curios look on mirror, aggression, mirror pecking, screaming and vocalizing, move towards or away from the mirror and fluff and ruffles of feathers (Helmut *et al.*, 2008).

3.4 Statistical analysis

The behavior data were analyzed completely using ethogram pattern chart and excel program. A standard deviation graph was used to assist the data interpretation. Presentation of self-recognition behavior during the observation can be a qualitative data to support the presence of self-recognition behavior in the bird.

4.0 RESULTS

The behavior frequencies were observed and recorded into percentage table according to the day and few other variables such as mirror and non-mirror factor. Standard deviation was used in the data tabulation since the sample size is too small.

A) Self-recognition behavior pattern

Self-recognition behavior	Day 1	Day 2	Day 3
Cresting position	3.6	2.4	0.0
Head shaking	1.8	0.0	0.0
Lift foot toward mirror	3.6	0.0	0.0
Scratching mirror	1.8	0.0	0.0
Tilting head	5.4	12.2	12.1
Scratching face	0.0	12.2	3.0
Preening	0.0	17.1	34.8

Table 1: Self-recognition behavior frequency table

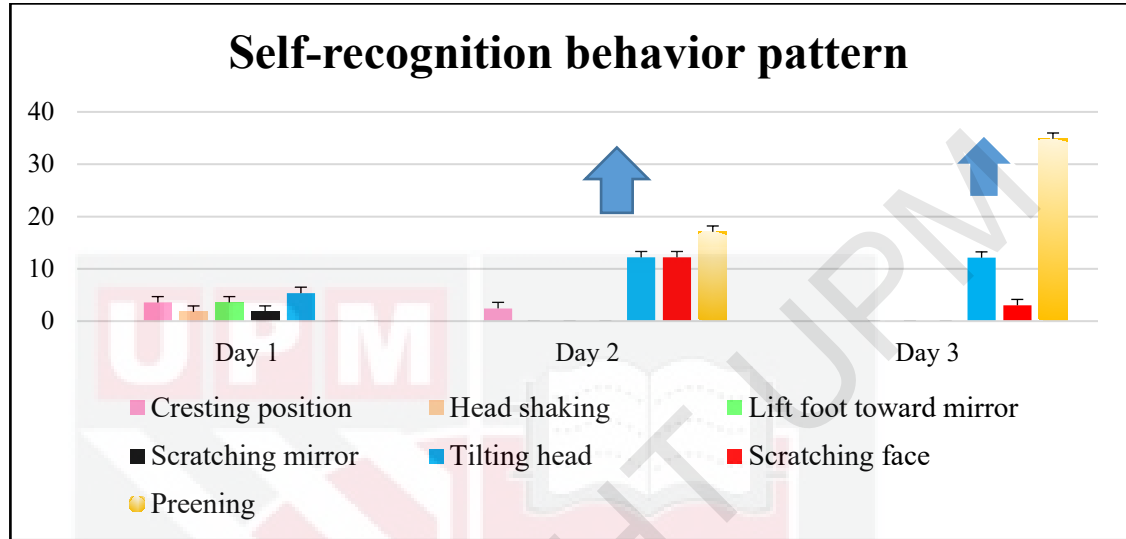


Figure 4: Self-recognition behavior pattern graph.

B) Mirror-induced behavior

Mirror inducing behavior	Day 1	Day 2	Day 3
Curious look on mirror	55.4	19.5	33.3
Aggression, peck and tap mirror	5.4	7.3	0.0
Screaming and vocalizing	8.9	2.4	1.5
Fluffs and ruffles	7.1	17.1	7.6
Move towards mirror	7.1	2.4	3.0
Move away mirror	0.0	7.3	4.5

Table 2: Mirror-induced behavior frequency table

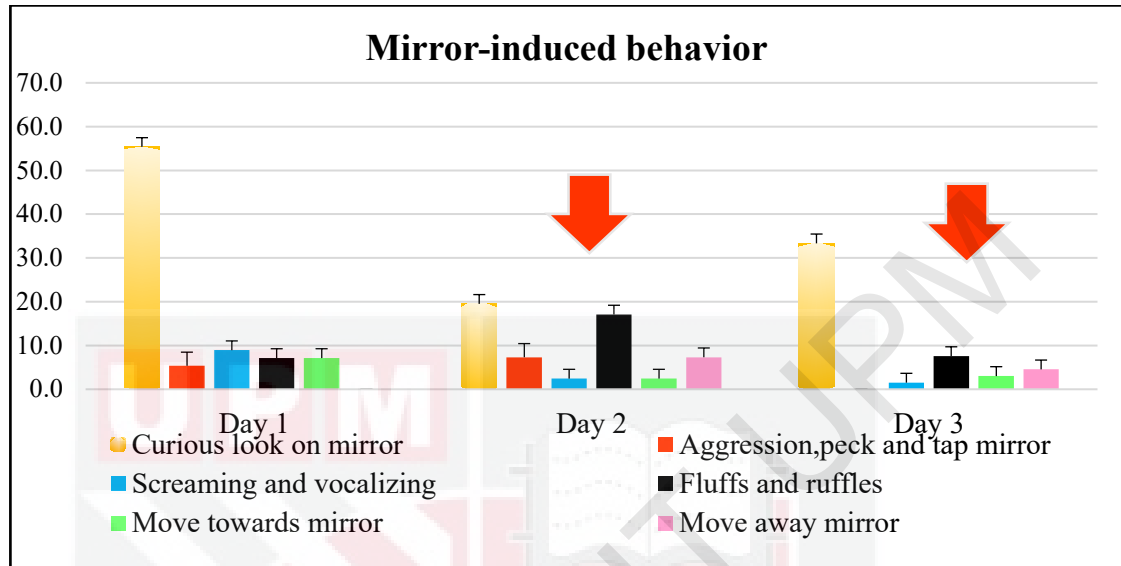


Figure 5: Mirror- induced behavior pattern graph.

C) No mirror vs Mirror behavior pattern

	No mirror	Mirror
Self-Recognition	11.1	36.8
Mirror-induced	88.9	63.2

Table 3: No mirror vs Mirror behavior pattern table

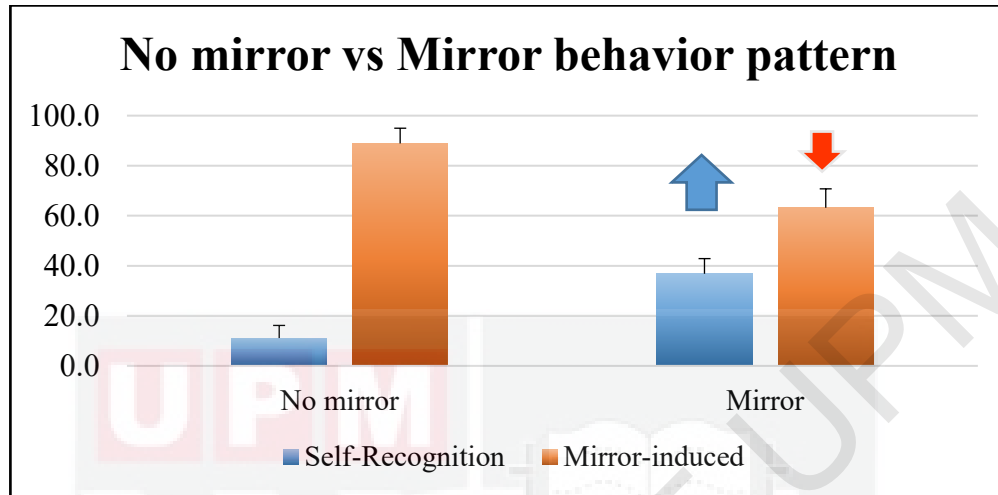


Figure 6: Graph comparing between non mirror test and mirror test in relative to self-recognition and mirror-induced behavior frequency.

5.0 DISCUSSION

In self-recognition behavior pattern such as head tilting, face scratching and preening were prominent towards the end of the experiment as shown in the Figure 4. Based on the result, this could indicate that the bird has shown interest to the image not as a separate individual image but as an image of itself. Increasing frequency of these kind of behaviors might also be an indicator that the bird was testing for image movement repetitively which is usually occur at stage three of the MSR. Through the increasing time contact of the bird with the mirror, the bird seemed to realize the mirror image on the surface was belongs to its body.

For mirror-induced behavior pattern, behavior such as aggression, mirror pecking, screaming and vocalizing and other social behavior reduce gradually compared to the

first attempt as shown in Figure 5. This pattern indicate that there was reduction of interest to fight with the image while realization of his self-image on the mirror at the end of the experiment. In birds, curios look to the mirror, fluff and ruffles could be both as self-induce behavior and social response (Pepperberg, 1995). These behaviors may not conclusive for the graph, however in could be a positive indicator that the bird showed interest to the image and had response towards the image movement.

The third graph was meant to study the difference of behavior pattern between non mirror test and mirror test (Figure 6). In self-recognition study, there was increase in self-recognition behavior frequency during mirror stimulation. While in mirror-induced behavior, there was decrease in mirror-induced behavior frequency during mirror stimulation. The combination of these pattern revealed that the bird was focusing on self-induced behavior which also compatible with self-recognition study. The reduction of mirror-induced behavior is because the bird was capable in differentiating the image belongs to himself rather than communicating as such in aggression and vocalizing towards the image as if in towards different separate individual image.

To see whether the bird has visual interaction towards the mirror, the Figure 7 (in appendix) was used to study the overall behavior during the observation with concern with other non-mirror behavior as well such as biting the cage, defecate, biting objects such as the frame holder, look down on the legs, stretching and biting mirror frame. In the result, the bird tend to spend more time with the mirror and less time in other behavior, suggesting that the bird has interaction with the mirror during the observation.

In general discussion, it is hard to identify the self-recognition in birds compared to other mammals especially in primates. Previous studies suggested that the administration of the same mark test or guided reaching tasks that have been used with apes and monkeys is not the same in birds (Pepperberg *et al.*, 2008). For instance, as in Grey parrots, unlike apes and monkeys, do not often use their feet either to explore their bodies or to investigate items. However, parrots have a great potential in cognitive ability which is very closely related to the capability of voice recognition and self-recognition studies due to the presence of FoxP genes (Afiah and Hafandi, 2015). The FoxP2 is the first identified gene that is specifically involved in speech and language development in humans (Webb *et al.*, 2004). Apart from that, these genes are important in cognitive development as well for voice production as in song birds. Other factors like stereotypic behavior, human attachment, and duration of experiment may also become few factors that contribute to the difference in the result. Animals' personality may also be one of the main factors that will control the result as in every individual they have different kinds of reactions. Thus, even increasing the sample size we will still have the challenge to have a standardized behavior pattern. In order to reduce this kind of risk, we have referred to previous studies (Helmut *et al.*, 2008) in order to have a standardized list of ethogram behavior in birds as shown in the appendix on Table 5.

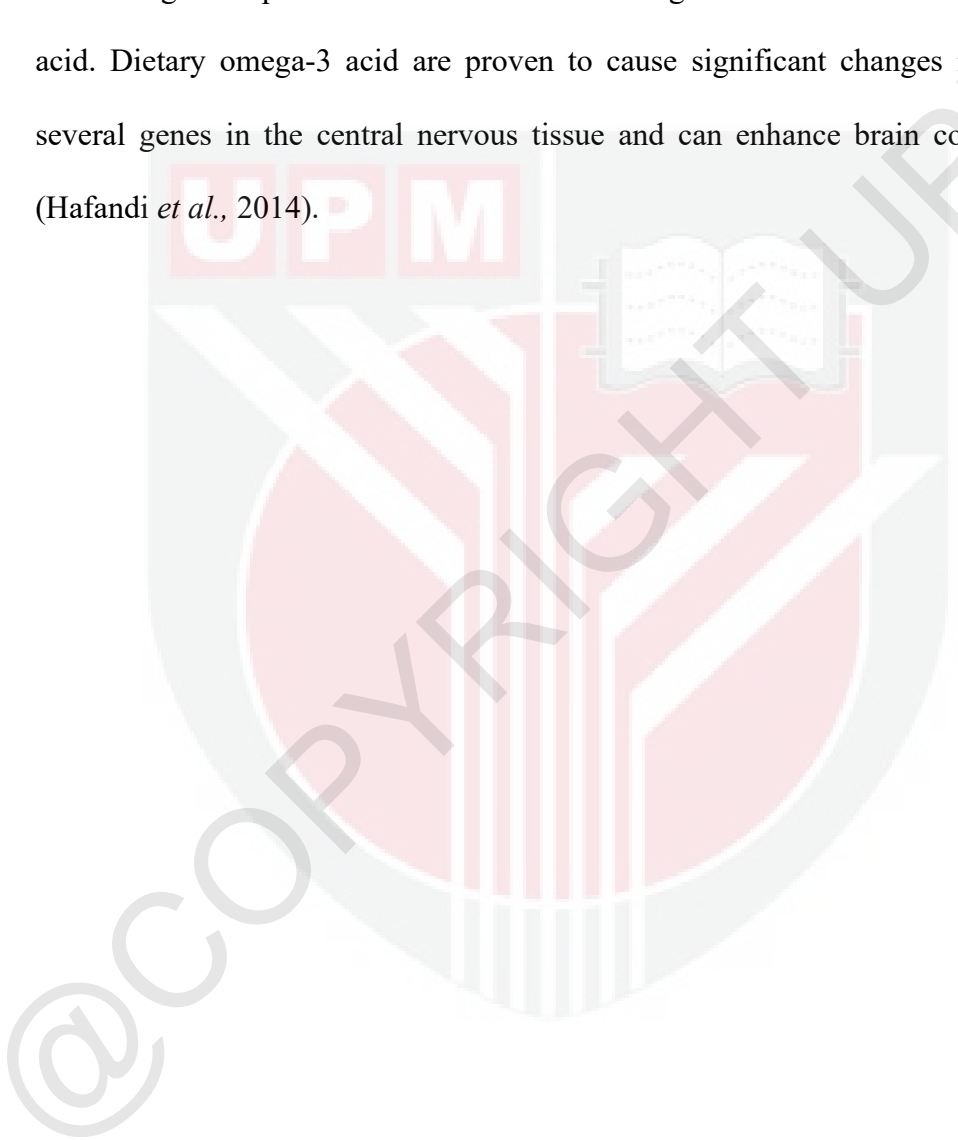
6.0 CONCLUSION

Based on the result, the bird had experienced the four stages of mirror self-recognition. In addition, the bird shows reduction in social response frequency and increase in self-exploratory behavior gradually towards the end of the trials which is similar finding as suggested by Helmut *et al.*, (2008). Thus, parrots as in cockatoo has the cognitive function and capable to understand that the mirror images belongs to their own body. Visual interaction between the bird and the mirror is important in determining the self-image as well as learning mechanism. The FoxP1 gene is also one of the reason for this bird to have high potential in recognizing itself from the mirror image. Further research in the area of sensory perception and self-recognition of cockatoos will expand our knowledge and likely enable us to improve the lives of these magnificent creatures. In short, the bird had passed the MSR test.

7.0 RECOMMENDATIONS

As recommendation, this study result can be supported by mark test as for further study. Mark test allow us to measure the self-recognition level by measuring the mark directed behavior as the bird have interaction with the marking on its chest during the experiment. A bigger sample size is recommended to reduce statistical error and few observer should be available to avoid observation bias during behavioral interpretation. To have a precise result, the animals should be selected from a flock, or from wild and

any stereotypic behavior should be identified before the experiment. Other than that, this study can be extended further by applying treatments on the cockatoo that may enhance the brain gene expression associated with the cognitive function such as omega-3 fatty acid. Dietary omega-3 acid are proven to cause significant changes in expression of several genes in the central nervous tissue and can enhance brain cognitive function (Hafandi *et al.*, 2014).



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APPENDIX

D) No mirror vs Mirror (including other behavior)

	No mirror	Mirror
Self-Recognition	9.7	25.2
Mirror-Induced	9.5	43.3
Other	89.3	31.5

Table 4: No mirror test vs Mirror test behavior frequency with concern of other behavior

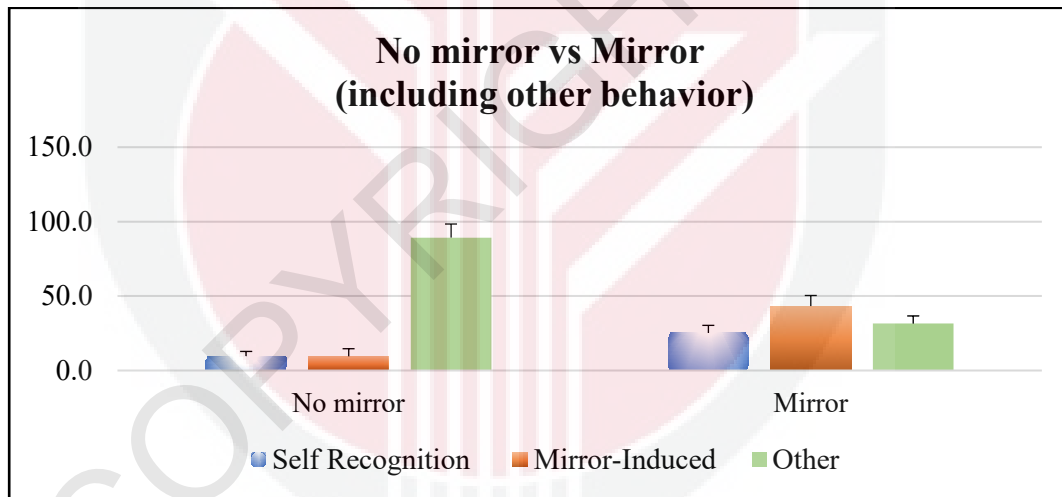


Figure 7: Graph comparing between non mirror test and mirror test in relative to self-recognition and mirror-induced behavior frequency with concern of other behavior.

	Behavior	Description
Self-induced behavior	Cresting position	Expanding the crest for various kind of interaction
	Head shaking	Moving the head in many direction quickly
	Lift foot toward the mirror	Lifting feet in front of the mirror while looking at the image
	Mirror Scratching	Uses feet for scratching/tap on mirror surface
	Head tilting	Tilting head near 90 degree to test the mirror image
	Face scratching	Use feet to scratch head area including crest
	Preening	Uses feet/beak to clean and preen feathers
Mirror-induced behavior	Curios looks at mirror	Staring at the mirror image for 2-3 seconds or more
	Aggression	Fast peck, directed to the object
	Screaming/vocalizing	Making loud, high pith sound using mouth
	Towards/away from mirror	Marching away or towards mirror
	Fluffs and Ruffles	Erects feathers, ruffles and shakes body

Table 5: Guide list for behavior in bird etogram study