UNIVERSITI SAINS MALAYSIA

PEJABAT PENGURUSAN & KREATIVITI PENYELIDIKAN

LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA PENDEK

FINAL REPORT OF SHORT TERM RESEARCH PROJECT

Sila kemukakan **dua (2) salinan** laporan akhir ini melalui Jawatankuasa Penyelidikan di Pusat Pengajian dan Dekan/ Pengarah/ Ketua Jabatan kepada Pejabat Pengurusan dan Kreativiti Penyelidikan (RCMO)

1. Nama Ketua Penyelidik:
Name of Research Leader

☐ Profesor Madya/ *Assoc. Prof.* ☑ Dr./ *Dr.* ☐ Encik/Puan/Cik *Mr/Mrs/Ms*

2. Pusat Tanggungjawab (PTJ):
School/Department

School of Biological Sciences

3. Nama Penyelidik Bersama:
Name of Co-Researcher

4. Tajuk Projek:
Title of Project

Colour effect on the counting abilities and number sense in birds

304/PBIOLOGI/6311071

5. Ringkasan Penilaian/*Summary of Assessment*:	Tidak Mencukupi *Inadequate* 1	2	Boleh Diterima *Acceptable* 3	Sangat Baik *Very Good* 4	5
i) **Pencapaian objektif projek:** *Achievement of project objectives*	☐	☐	☐	☑	☐
ii) **Kualiti output:** *Quality of outputs*	☐	☐	☐	☑	☐
iii) **Kualiti impak:** *Quality of impacts*	☐	☐	☐	☑	☐
iv) **Pemindahan teknologi/potensi pengkomersialan:** *Technology transfer/commercialization potential*	☐	☐	☑	☐	☐
v) **Kualiti dan usahasama :** *Quality and intensity of collaboration*	☐	☐	☐	☑	☐
vi) **Penilaian kepentingan secara keseluruhan:** *Overall assessment of benefits*	☐	☐	☐	☑	☐

6. Abstrak Penyelidikan
(Perlu disediakan di antara 100 - 200 perkataan di dalam **Bahasa Malaysia dan juga Bahasa Inggeris**. Abstrak ini akan dimuatkan dalam Laporan Tahunan Bahagian Penyelidikan & Inovasi sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti & masyarakat luar).

Abstract of Research
(An abstract of between 100 and 200 words must be prepared in Bahasa Malaysia and in English). This abstract will be included in the Annual Report of the Research and Innovation Section at a later date as a means of presenting the project findings of the researcher/s to the University and the community at large)

Lihat lampiran.

7. Sila sediakan laporan teknikal lengkap yang menerangkan keseluruhan projek ini.
[Sila gunakan kertas berasingan]
Applicant are required to prepare a Comprehensive Technical Report explaning the project.
(This report must be appended separately)

Lihat lampiran

Senaraikan kata kunci yang mencerminkan penyelidikan anda:
List the key words that reflects your research

Bahasa Melayu: *Corvus splendens, Acridotheres tristis*, kebolehan mengira, kesan warna

English: *Corvus splendens, Acridotheres tristis*, numerical ability, colour effect

8. Output dan Faedah Projek
Output and Benefits of Project

(a) * **Penerbitan Jurnal**
Publication of Journals
(Sila nyatakan jenis, tajuk, pengarang/editor, tahun terbitan dan di mana telah diterbit/diserahkan)
(State type, title, author/editor, publication year and where it has been published/submitted)

Journal : Numerical Competency of Two Species Of Birds, Corvus Splendens And Acridotheres Tristis. Nor Amira Abdul Rahman & Nik Fadzly N Rosely. 2013. Tropical Life Sciences Research, USM (under review).

Conferences : 1) 7th International Symposium in Science and Technology, 30 & 31 August 2012, USM.

2) 2nd Seminar on Sustainable Agriculture and Natural Resources, 9 April 2013, USM.

Final year theses.

1. Nur Hazwani Binti Zulkifli. 2012. Counting abilities and number sense in House Crows, Corvus splendens. Final Year Theses. Universiti Sains Malaysia.
2. Najibah Binti Mohd Dzakwan. 2012. The numerical competency of Mynas (Acridotheres tristis & Acridotheres cristatellus) Final Year Theses. Universiti Sains Malaysia.

(b) **Faedah-faedah lain seperti perkembangan produk, pengkomersialan produk/pendaftaran paten atau impak kepada dasar dan masyarakat.**
State other benefits such as product development, product commercialisation/patent registration or impact on source and society.

Hasil kajian membuktikan kebolehan kedua-dua burung yang dikategorikan sebagai burung perosak untuk pengiraan mudah. Warna juga dapat mempengaruhi kelakuan serta kebolehan burung ini. Adalah diharapkan masyarakat supaya tidak menggunakan plastik berwarna (terutamanya warna merah) untuk membuang sampah.

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(c) **Latihan Sumber Manusia**
Training in Human Resources

i) Pelajar Sarjana: Nor Amira Rahman
Graduates Students
(Perincikan nama, ijazah dan status)
(Provide names, degrees and status)

P-BM0021/12(R) - Zoologi, status - aktif.
Dalam penyediaan penulisan.

ii) Lain-lain:
Others

1. Nur Hazwani Binti Zulkifli. 2012. Counting abilities and number sense in House Crows, Corvus splendens. Final Year Theses. Universiti Sains Malaysia.
2. Najibah Binti Mohd Dzakwan. 2012. The numerical competency of Mynas (Acridotheres tristis & Acridotheres cristatellus) Final Year Theses. Universiti Sains Malaysia.

9. **Peralatan yang Telah Dibeli:**
Equipment that has been purchased

—

Dr. Nik Fadzly Bin Nik Rosely
Pensyarah
Pusat Pengajian Sains Kajihayat
Universiti Sains Malaysia

9/9/2013

Tandatangan Penyelidik
Signature of Researcher

Tarikh
Date

Komen Jawatankuasa Penyelidikan Pusat Pengajian/Pusat
Comments by the Research Committees of Schools/Centres

Tutup Geran.

6/11/13

PROF. MADYA AMIRUL AL-ASHRAF ABDULLAH
Pemangku Timbalan Dekan
(Akademik)
Pusat Pengajian Sains Kajihayat
Universiti Sains Malaysia
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TANDATANGAN PENGERUSI JAWATANKUASA PENYELIDIKAN PUSAT PENGAJIAN/PUSAT
Signature of Chairman
[Research Committee of School/Centre]

9/9/13
Tarikh
Date

Abstrak dan laporan teknikal

Abstract

We conducted a series of experiments to test the numerical competency of two species of bird; *Corvus splendens* and *Acridotheres tristis.* Both species were tested to choose seven different food proportions with the mealworms as food items. We considered the bird made a correct choice when it selects the food item with the highest number. We conducted three types of experiment. Experiment 1 is a normal choice test, where the birds must differentiate which container has the highest food item. Experiment 2, violation of expectancy, where the birds are shown the food items being drop in the container, but we concealed the food items in a hidden compartment at the bottom of the container. In experiment 3, we repeated the same procedure from experiment1 and added the colour component (the food items were dyed with non-toxic food colouring dye). Experiment 1 shows that the common myna is much more intelligent even though they showed a slow performance at the beginning. The mynas' became increasingly capable of numerical sense for the remainder of the experiment (four from seven food items proportions are above-chance expectations). Although House Crows mostly choose the cup with more mealworms, from seven food items proportions, only one proportion is above-chance expectations. For experiment 2, house crow shows a great enhancement from previous experiment where from seven proportions, two proportions are above-chance expectations. Experiment 3 suggests that red colour marginally influences the crow's numerical ability compared with green colour.

Abstrak

Kami telah menjalankan beberapa siri eksperimen untuk menguji kebolehan mengira bagi dua spesies burung: *Corvus splendens* dan *Acridotheres tristis*. Kedua-dua spesies burung diuji samada boleh membuat pilihan tepat jika burung memilih barang makanan yang mempunyai kuantiti banyak. Kami menjalankan tiga jenis eksperimen. Eksperimen 1 ialah ujian pilihan biasa di mana burung mesti dapat membezakan bekas makanan yang mempunyai bilangan makanan paling banyak. Eksperimen 2 ialah ujian melanggar jangkaan, di mana perbuatan meletakkan makanan ditunjuk kepada burung tapi bahan makanan di sorok di dalam ruangan terlindung dalam bekas makanan. Pada eksperimen 3, kami mengulang langkah-langkah eksperimen 1dan menambah elemen warna (bahan makanan diwarnakan menggunakan pewarna makanan tanpa toksik). Eksperimen 1 menunjukkan burung *Common Mynah* adalah lebih bijak walaupun menunjukkan prestasi yang agak lambat pada permulaan eksperimen. Burung *Mynah* menjadi semakin berkebolehan untuk mengira (empat dari tujuh set pembahagian makanan yang melebihi jangkaan peluang). Walaupun gagak pada kebanyakkanya memilih bahan makanan dengan bilangan lebih tinggi, dari 7 set pembahagian makanan hanya satu set sahaja yang melebihi peluang jangkaan. Bagi eksperimen 2, gagak menunjukkan sedikit peningkatan di mana dua dari 7 set pembahagian makan yang melebihi peluang jangkaaan. Eksperimen 3 menunjukkan bahawa kemungkinan warna merah mempengaruhi kebolehan gagak untuk mengira dibandingkan dengan warna hijau.

Color Effect on the Counting Abilities and Number Sense in *Corvus splendens* and *Acridotheres tristis*.

Nik Fadzly N Rosely

School of Biological Sciences, Universiti Sains Malaysia

Abstract

We conducted a series of experiments to test the numerical competency of two species of bird; *Corvus splendens* and *Acridotheres tristis.* Both species were tested to choose seven different food proportions with the mealworms as food items. We considered the bird made a correct choice when it selects the food item with the highest number. We conducted three types of experiment. Experiment 1 is a normal choice test, where the birds must differentiate which container has the highest food item. Experiment 2, violation of expectancy, where the birds are shown the food items being drop in the container, but we concealed the food items in a hidden compartment at the bottom of the container. In experiment 3, we repeated the same procedure from experiment1 and added the colour component (the food items were dyed with non-toxic food colouring dye). Experiment 1 shows that the common myna is much more intelligent even though they showed a slow performance at the beginning. The mynas' became increasingly capable of numerical sense for the remainder of the experiment (four from seven food items proportions are above-chance expectations). Although House Crows mostly choose the cup with more mealworms, from seven food items proportions, only one proportion is above-chance expectations. For experiment 2, house crow shows a great enhancement from previous experiment where from seven proportions, two proportions are above-chance expectations. Experiment 3 suggests that red colour marginally influences the crow's numerical ability compared with green colour.

Keywords: House Crow, Common Mynah, counting ability, behavior, number sense, color

Introduction

Pest or nuisance species disturbs or interacts either directly or indirectly with humans. Pest/nuisance species will mostly cause various problems such as noise, pollution, waste problems and health issues. As a developing county, Malaysia also faces the same problems. Insect pest, small mammals, and birds are the contributing elements to this problem. As for the birds, *Corvus splendens* and *Acridotheres tristis* are the top two nuisance species in Malaysia. The population for both species is increasing especially in urban and development area.

There are several population control programs that had been implemented, but the results are not satisfactory. This is because both species of birds are well adapted to urban areas as well as suburban due to the fact that they are anthropogenic dependence and human settlements provide them with high opportunities for habitat (Cunningham, 1948). The house crows are well adapted to rapidly changing conditions. They are successful in or near urban areas and agricultural centre mainly because of their diet. With a wide climatic tolerance and the ability to feed on alien vegetation common myna can also adapt to almost everywhere. Both species also can be considered as an intelligent species.

The objective of this study is to determine the intelligence level of both species of birds by evaluating their counting abilities. In recent years, study of counting and other related numerical skills have been investigated across a range of non-human species. Studies showed the potential for numerical discrimination in a wide variety of species from honey bees, (Dacke & Srinivasan 2008), monkeys (Addessii et al. 2008) to ants (Reznikova & Ryabko 2011). Nonhuman primates show a more advance numerical skills compared to other animal species (Tomonaga 2008).

Report

House crow were considered as pest due to the aggressive and destructive behavior. They prey on the chicks and eggs of native birds and destroy nests (Kitabu, 2011) and they harass other birds and animals (Behrouzi-Rad, 2010). Crows also damage the crops, and orchards and most of the scattering rubbish and damaged electrical wiring are because of them (James, 2007). The Common mynas on the other hand, are common among Asian countries. In Australia, the bird was introduced in order to reduce insect pest, ironically turning into a pest later on. The common mynas are seen as an agricultural pest particularly in Singapore and are closely associated with agricultural areas, feeding on fruits and crops (Lim et al., 2003).

House crows are famous for their intelligence and boldness, which has sparked a lot of attention and interest. They are capable of using and making tool in catching prey (Bayern *et al.* 2009). Crows will use sticks and even make it thinner if needed to acquire bugs, or other arduous food from crevices and small cracks (Kenward *et al.* 2006). Even when they are required to obtain the food, crows were successfully bent a piece of wire into a hook (Weir *et al.* 2002). Common myna is also considered as an intelligent bird since they can recognize trees and people in pictures and also identification signaling through vocal utterance (Kak 2000). Heptonstall (2010) stated that Myna also has the ability to mimic human speech along with other environmental sounds, especially the Hill Mynah (*Gracula religiosa*).

The exact process of counting among non-human is still unclear and controversial. Most basic calculations among animals (non-human) follow Weber's Law. It states that as numerical magnitude increases, a larger difference of amount is needed to obtain the same level of discrimination (Hunt *et al.* 2008). Most animals could differentiate the magnitude difference between one versus two, two versus three, but have difficulty comparing five versus six, six versus seven. Subitizing is a type of numerical process that allows the observers to understand rapidly and accurately the numerosity of small sets of objects usually within the range of 1-4 items (Balakrishnan & Ashby 1992; Kaufman *et al.* 1949; Piazza *et al.* 2002). Counting is when the enumeration is slower and more prone to errors when more than four items are involved (Egeth *et al.* 2008; Piazza *et al.* 2002). Counting can occur in a variety of forms such as verbal, tally marks or finger counting. As for verbal counting, usually it's either speaking the number out loud or mentally to keep track of the number.

Although number counting is common among human and primates, but there is little evidence about counting in birds. Birds are considered as promising subjects for the study of numerical competence based on previous experimental studies (Bayern & Emery 2009; Hunt *et al.* 2008; and Shaw & Clayton 2012).

Materials and Method

Six House Crows (*Corvus splendens*) and six Common Mynas (*Acridotheres tristis*) were used as the subject of the experiments. The House Crow were obtained from the local municipal authority, Taman Tun Sardon, Pulau Pinang. The Common Mynas were captured using the mist-net around the USM campus. Mealworms (the food item for the experiments) were supplied from a nearby pet shop. White lab coat, breathing mask, and rubber gloves were worn throughout the experiments for safety.

This study were conducted from April 2012 and completed in April 2013 in the Floral Garden. The Floral Garden is located in School of Biological Sciences, University Science of Malaysia (USM) (5°21'N, 100°18'E). All individuals were kept in a cage in the garden with a floor area of 1.26 m^2. The cage has three compartments where the middle is the experimental area cage and the other two are the holding cage. Cage was regularly cleaned and food was given twice a day. Foods for the birds consist of bread, fruits such as banana and watermelon and other supplements.

Following the protocols described in Hunt et al. (2008b), all the trials were conducted via a choice test experiments. Experiments were performed 3 times per week on every Monday, Wednesday and Friday to prevent stress to the birds and the experiments usually started sharp at 4 p.m.

For Experiment 1, we presented mealworms as the food items to the bird in the experimental area, besides the confinement area. The mealworms were placed in two paper cups with the top and bottom diameter each 70 mm and 50 mm and the height of the cup is 97 mm. Both cups were set apart approximately 50 cm apart on a black cardboard. All birds were trained to observe the experiments process in order to familiar with the food items and the researcher's presence. Mealworms were placed in each cup in increasing order, at rate of 3 second per item. Seven number combinations were randomly chosen; 1 versus 3, 1 versus 4, 2 versus 5, 3 versus 7, 5 versus 8, 6 versus 9, and 8 versus 10 and were presented to all 12 birds from both species. The combination pairs are also tested randomly to control for observational learning behavior. The left or right combinations are also randomized to prevent preference bias. For each experiment, we used one bird and replicate the experiments for each variable for three times. The whole experiments and the bird's behavior were recorded through a video recorder with a stand

(Panasonic Legria). The bird was given (minimum) 15 second and (maximum) 5 minutes to choose from both paper cups. We define their decision as they start to eat the mealworms in the first cup. We considered the bird had made the "correct choice" if the bird chose the food item with the highest number. If the bird did not show any reaction/did not chose any food item, the trial considered as failure and excluded from the overall result.

In experiment 2, violation of expectancy experiment, all aspects of this experiment were similar to the first except in this experiment, the food items were hidden under the false bottom cup (Figure 1) after being shown to the subject (approximately at rate of 3s). The food items were shown to all 12 subjects and they were allowed to retrieve none (all food items were hidden in the outer paper cup). The same set variables as in the experiment 1 were used for this experiment (1 versus 3, 1 versus 4, 2 versus 5, 3 versus 7, 5 versus 8, 6 versus 9, and 8 versus 10). The trial was considered as success only if the bird chooses and eats the mealworms from the first cup. The amount of time the bird spent to search the food items were also recorded.

In experiment 3 (color preferences), the same methods in previous experiment were followed. Same set of variables were used but with the addition of color. The colors used in this third experiment were green and red. The reason why both colors were chosen is be green indicates the color of leaves and red indicates the color of fruits. In addition to this experiment, we test all 12 birds to choose between both colors (after done with both color variables experiments). Different variables set were used for this experiment ; 1 versus 1, 2 versus 2, 3 versus 3, 4 versus 4, 5 versus 5, 6 versus 6 and 7 versus 7. It compared which colors (between green and red) that attract the bird's more efficiently.

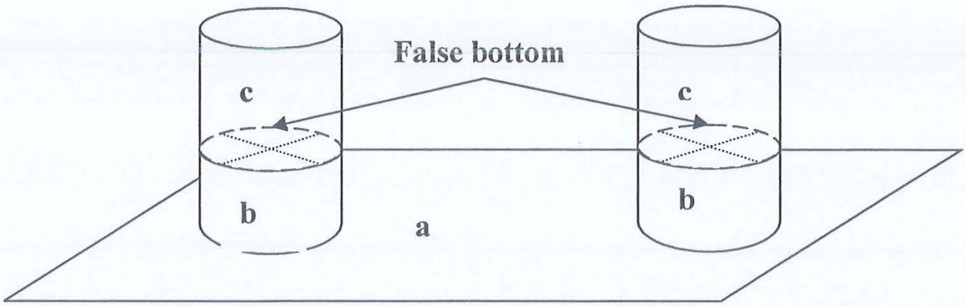

Figure 1 Schematic representation of the experimental apparatus. **a.** cardboard base, **b.** outer paper cup, **c.** inner paper cup. The *dashes line* shows the bottom of the inner paper cup while the *dotted line* is the cutting line.

Results

Experiment 1

For *Corvus splendens*, from the seven food proportions, only one food combination (one versus four) was significantly different where the birds selected the cup with more mealworms at frequencies above-chance expectation (Figure 2a). Cumulatively, crows frequently made a successful choice. *Acridotheres tristis* numerical competency is better than crows. In four out of seven food combinations (one versus four, two versus five, six versus nine and eight versus ten), birds made successful choices with above-chance-expectations (Figure 2b).

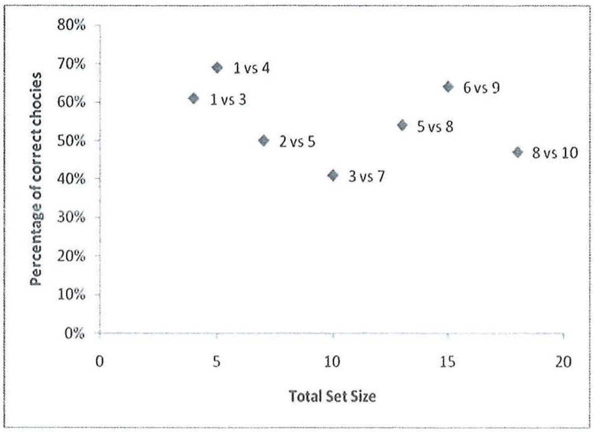

Figure 2a: Percentage of correct choices for *C.splendens*

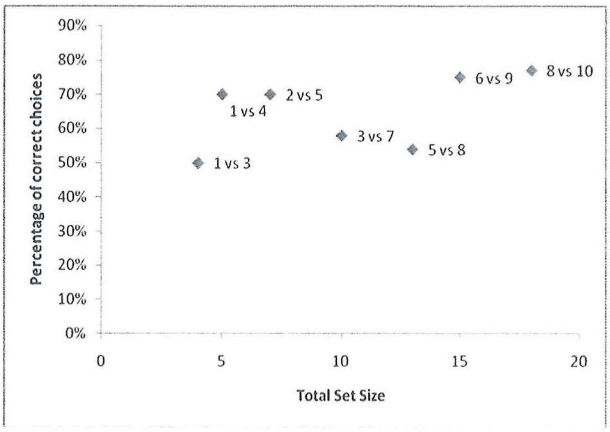

Figure 2b: Percentage of correct choices for *A.tristis*

Experiment 2

For experiment 2, house crow showed improvement from previous experiment where from seven proportions, two proportions are above-chance expectations (Figure 3); one versus three and eight versus ten. This indicates that even though the food items were hidden under the first cup, they still can find the mealworms. It should be noted that experiment 2 and 3 were only conducted on *C. splendens* due to the limited availability of *A. tristis.*

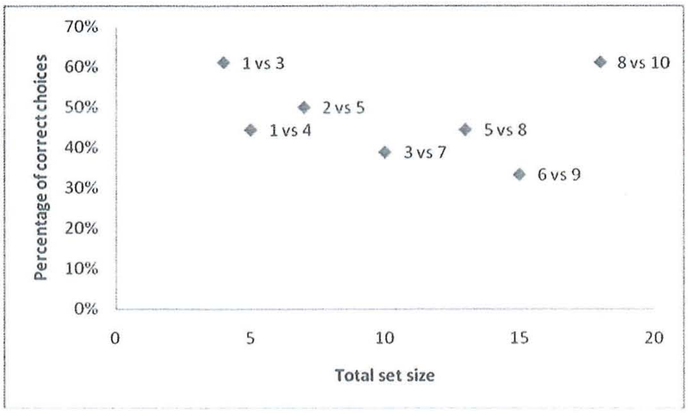

Figure 3: Result from violation test for *C.splendens* where the food items were hidden beneath the first cup.

Experiment 3

In experiment 3 which is for red color mealworms versus normal color mealworms (Figure 4a), there are two proportions (one versus four and five versus eight) that show significant results. As for green color mealworms versus normal color mealworms experiment (Figure 4b), only one food item proportion (one versus four) shows above-chance proportions. And from the result from the later experiment where red food items color versus green food items color experiment (Figure 4c), it shows that red color affect the counting behavior of house crows compared to green color.

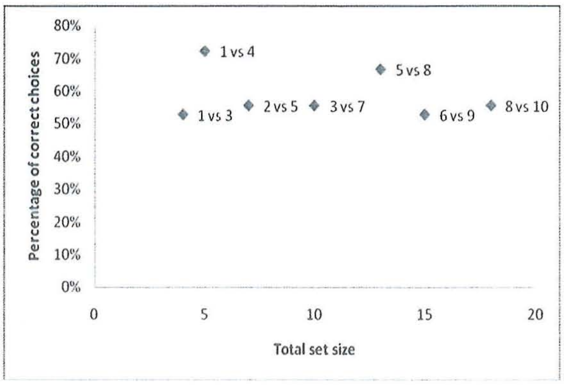

Figure 4a: Percentage of correct choices (red colour vs normal) of *C.splendens*

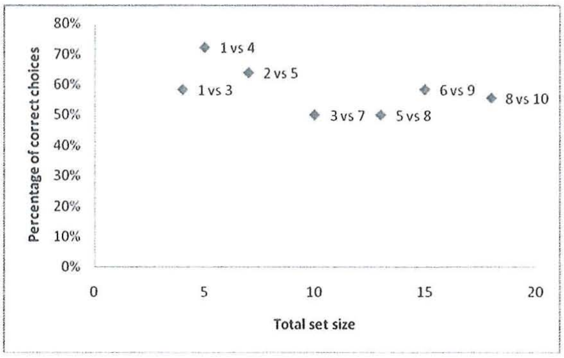

Figure4b: Percentage of correct choices (green colour vs normal) of *C.splendens*

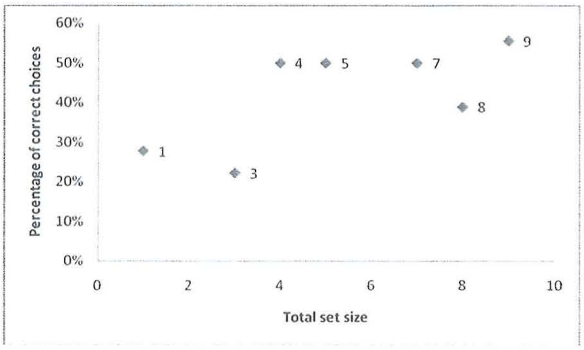

Figure 4c: Red food items versus green food items. The percentage of *C.splendens* that chose the cup with red color food items is shown on the y-axis.

Conclusion

From our observation, house crows are capable discriminating large numbers items against smaller numbers. Although considered as a fast learning and intelligent birds (Yosef et al. 2012), our results indicate that their numerical learning capacity might be lacking where the total limit in making numerical discriminations was less than four for crows. We suggest that mynah use memory cognition in counting abilities rather than subitizing. At the same time, this study provides evidence that numerical competency can be further improved by observational learning. Further studies therefore should use different procedures such as using operant conditioning involving both active and passive reinforcement can also be done in order to observe for different performance in both species. These can provide new understanding of how animals solve mathematical actions and problems.

Acknowledgement

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<u>References</u>

Addessi, E., Crescimbene, L. & Visalberghi, E. (2008). Food and token quantity discrimination in capuchin monkeys (*Cebus apella*). Animal Cognition. 11(2): 275–282.

Dacke, M., Srinivasan, M. V. (2008). Evidence for counting in insects. Animal Cognition. 11(4): 683–689.

Reznikova, Zh. & Ryabko, B. (2011). Numerical competence in animals, with an insight from ants. Behaviour. 148(4): 405-434.

Tomonaga, M. (2008). Relative numerosity discrimination by chimpanzees (*Pan troglodytes*): Evidence for approximate numerical representations. Animal Cognition. 11(1): 43-57.

Behrouzi-Rad, B. (2010). Population Estimation and Breeding Biology of the House Crow *Corvus splendens* on Kharg Island, Persian Gulf. Podoces. 2(5): 87-95.

James. (2007). Some Information Regarding House Crows in East Africa. Birdman. Retrieved from http://birds.intanzania.com/fighting-house-crows

Kitabu, G. (2011). Indian House crows: Threat to biodiversity and human health, Ipp Media.

Bayern, A. M. P. v., and Emery, J.N. (2009). Jackdaws Respond to Human Attentional States and Communicative Cues in Different Contexts. Biology. 19(7): 602-606.

Kenward, B., Rutz, C., Weir, A.A.S., and Kacelnik, A. (2006). Development of tool use in New Caledonian crows: inherited action patterns and social influences. Animal Behaviour. 72(6): 1329-1343.

Weir, A. A. S., Chappell, J., & Kacelnik, A. (2002). Shaping of Hooks in New Caledonian Crows. Science. 297(5583): 981.

Kak, S. (2000). Grading intelligence in Machines: Lessons from Animal Intelligence. In A. Meystel, and E. R. Messina (ed). Measuring the Performance and Intelligence Systems. Proceedings of the 2000 PerMIS Workshop August 14-16. Washington, DC : Gaithersburg, Md., 331-334.

Heptonstall, R. A. E. (2010). The distribution and abundance of Myna birds (*Acridotheres tristis*) and Rimatara Lorokeets (*Vini kuhlii*) on Atiu, Cook Islands. MSc diss., UK: Leeds University.

Hunt, S., Low, J. & Burns, K.C. (2008). Adaptive numerical competency in a food-hoarding songbird. Proceedings of the Royal Society of London, Series B. 275(1649): 2373-2379.

Balakrishnan, J. D., & Ashby, F. (1992). Subitizing: Magical numbers or mere superstition? Psychological Research. 54(2): 80-90.

Kaufman, E.L., Lord, M.W., Reese, W., & Volkman, J. (1949). The Discrimination of Visual Number. The American Journal of Psychology. 62(4): 498-525.

Piazza, M., Mechelli, A., Butterworth, B., & Price, C.J. (2002). Are subitizing and counting implemented as separate or functionally overlapping process? Neurolmage. 15(2): 435-446.

Egeth, H. E., Leonard, C. J., & Palomeras, M. (2008). The role of attention in subitizing: Is the magical number 1? Visual Cognition. 16 (4): 463-473.

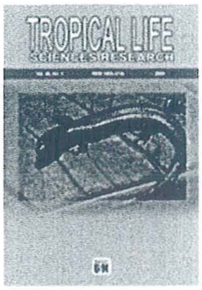
Bayern, A. M. P. v., and Emery, J.N. (2009). Jackdaws Respond to Human Attentional States and Communicative Cues in Different Contexts. Biology. 19(7): 602-606.

Shaw, R.C. and Clayton, N.S. (2012). Eurasian jays, *Garrulus glandarius* flexibly switch caching and pilfering tactics in response to social context. Animal Behavior. 84(5): 1191-1200.

Lim, H. C., Sodhi, N. S., Brook, B. W. & Soh, M. C. K. (2003). Undesirable aliens: factors determining the distribution of three invasive bird species in Singapore. Journal of Tropical Ecology. 19: 685–695.

Yosef, R., Zvuloni, A., and Yosef-Sukenik, N. (2012). House Crow (*Corvus splendens*) attempt to Cooperatively Kleptoparasitize Western Osprey (*Pandion haliaetus*). The Wilson Journal of Ornithology. 124(2): 406-408.

Tropical Life Sciences Research



Numerical Competency of Two Species Of Birds, Corvus Splendens And Acridotheres Tristis.

Journal:	*Tropical Life Sciences Research*
Manuscript ID:	TLSR-OA-04-2013-0028
Manuscript Type:	Original Article
Keywords:	Bird, Feed, Malaysia

Universiti Sains Malaysia Press, Universiti Sains Malaysia, 11800 Penang, Malaysia

Introduction

Numerical knowledge refers to the ability to count objects in order to understand the relationship between numbers either in small or large amount. Found only in adult humans, distinctively human numerical competence consists in a variety of precise, stimulus-independent numerical capacities. Shared numerical competence on the other hand, consists in a variety of approximate, stimulus-dependent numerical capacities that are found in non-human animals, human infants, and also human adults (Katz 2007).

According to Tennesen (2009) counting number by animals may be an innate ability among them. Without using numbers, they can count and summing sets of objects. Since they do not wield the linguistic sense of numbers, they have not been able to count verbally. The ability of counting might have evolved for territorial animals. They need to determine whether to stay in one area by the time invested to find the food versus the amount of food (Tenessen 2009).

The exact process of counting among non-human is still unclear and controversial. Most basic calculations among animals (non-human) follows Weber's Law. It states that as numerical magnitude increases, a larger difference of amount is needed to obtain the same level of discrimination (Hunt *et al.* 2008). Simply put, most animals could differentiate the magnitude difference between one versus two, two versus three, but have difficulty comparing five versus six, six versus seven. Subitizing is a type of numerical process that allow the observers to understand rapidly and accurately the numerosity of small sets of objects usually within the range of 1-4 items (Balakrishnan & Ashby 1992; Kaufman *et al.* 1949; Piazza *et al.* 2002). Counting is when the enumeration is slower and more prone to errors when more than four items are involved (Egeth *et al.* 2008; Piazza *et al.* 2002).

In recent years, study of counting and other related numerical skills have been investigated across a range of non-human species. Studies showed the potential for numerical discrimination in a wide variety of species from honey bees, (Dacke & Srinivasan 2008), monkeys (Addessii *et al.* 2008) to ants (Reznikova & Ryabko 2011). Nonhuman primates show a more advance numerical skills compared to other animal species (Tomonaga 2008). Birds are considered as promising subjects for the study of numerical competence based on previous experimental studies (Bayern & Emery 2009; Hunt *et al.* 2008; and Shaw & Clayton 2012)

Crows are famous for their intelligence and boldness, which has sparked a lot of attention and interest. They are capable of using and making tool in catching prey (Bayern *et al.* 2009). Crows will use sticks and even make it thinner if needed to acquire bugs, or other arduous food from crevices and small cracks (Kenward *et al.* 2006). Even when they are required to obtain the food, crows were successfully bent a piece of wire into a hook (Weir *et al.* 2002).

Another species of bird, Mynah is also considered as an intelligent bird since they can recognize trees and people in pictures and also identification signaling through vocal utterance (Kak 2000). Heptonstall (2010) stated that Mynah also has the ability to mimic human speech along with other environmental sounds, especially the Hill Mynah (*Gracula religiosa*). Common Myna is a species that can easily be found in Malaysia and Penang. Crows are considered as pest while mynah are considered as nuisance species. Both species of birds are usually associated with dirty environment and noise pollution. This study will attempt to evaluate the intelligence level of both species of birds. The main objective of this study is to evaluate numerical competency in two species of birds, *Corvus splendens* (Family: Corvidae) and *Acridotheres tristis* (Family: Sturnidae).

Materials and Methods

Common Mynah is a small bird species with very distinct features. The body color is brown with grayish-black hood, whitish vent and yellow bill and yellow facial skin. With a slightly bigger size than the Common Mynah, House Crow color is black with pale, sharply contrasting grey collar than other species of crows. The bill is shorter and more slender. *Acridotheres tristis,* were captured using mist net around USM Campus. *Corvus splendens* were obtained from the local municipal authority, Taman Tun Sardon Pulau Pinang.

Experiments were conducted from April 2012 to June 2012 at School of Biological Sciences (5°21'N, 100°18'E), Universiti Sains Malaysia (USM), Pulau Pinang. A total of six mynah and six house crows were used for the experiment. All the birds were kept in a custom-made cage with a floor area of 12.6 m^2. The cage is divided into three compartments where the middle is designated as the experimental area and the other two is the holding cage. The cage is cleaned regularly to maintain a healthy and clean environment for the birds. Both species were fed with similar food and clean water once a day. Outside experimental sessions, the birds were fed with white bread, fruits, rice and mealworms. Trials were conducted three times per week every Monday, Wednesday and Friday. We allowed one day gap to prevent stress on the birds. The trials started at 1600 until 1800.

We evaluated the bird's numerical competency via choice test experiments. We use mealworms as the food choice item. Each trial was recorded by using a Sony Legria video recorder and following protocols described by Hunt *et al* (2008). The mealworms were placed in two non-translucent white cup container measuring 70 x 50 x 97 (mm). Both cups were placed on a plastic black board, 50cm apart. The researcher will show the mealworm to the birds for duration of five seconds before depositing the mealworms inside the container cup. The process was repeated several times in order to acclimatize the birds with the food dropping process and also the researcher's presence. The trial will be recorded when the birds are calm and attentive. To reduce recognition bias, the trial was conducted by two people (one to record the trials and the other to put the mealworms in the container) throughout the experiment. The researchers also wore a breathing mask, white gloves and white lab coats. This is for safety of the researchers and to reduce facial recognition bias. We then proceeded to test with different number of food items for each container cup. Seven food item combinations were presented to all 12 birds; one versus three, one versus four, two versus five, three versus seven, five versus eight, six versus nine, and eight versus ten. For each trial, we used one bird and replicated the experiment three times. The combination pairs are tested in random order to control for observational learning behavior. The left or right combinations were also randomized to prevent preference bias and to control for observational learning (Hunt *et al.* 2008).

To begin the trial, the bird was released from the holding cage into the experiment cage. Initially, most of the birds will perch at the highest position in the experiment cage, observing the researcher's actions. During the early stages of the trials, crows and mynahs needed approximately five minutes to choose the food item. However, after several repetitions, the birds learn to choose within one minute after the trial starts. Occasionally, the birds kept on searching for food items in the other cup after the first selection. Crows produced noisy vocalization and flew aggressively during the trials. Similar to Medina *et al* (2011), crows exhibited agonistic responses for the duration of whole trials. The crows might count or distinguished the number of mealworms in the paper cup. Comparatively, although Mynahs did produce noisy vocalization, they were quite passive and calm during the trials. Observation was conducted within five minutes time frame. If the bird chose the food item with the highest number, we then considered the bird had made the "correct choice". Selection of food item with the lowest number would be considered as the wrong choice. If the bird did not show any reaction/did not chose any food item after five minutes, the trial considered as failure and excluded from the overall result. The results were analyzed via binomial test using JMP 10 software.

Results and Discussion

For *C.splendens*, from the seven food proportions, only one food combination (one versus four) was significantly different where the birds selected the cup with more mealworms at frequencies above-chance expectation ($p=0.041$) (Figure 1a). Cumulatively, crows frequently made a successful choice. Results from Figure 2a suggests that crows are capable of discriminating larger numbers against smaller numbers where from the total of number selection, the number of successes exceed the number of failures (133 success over 108 failures).

Acridotheres tristis numerical competency is better than crows. In four out of seven food combinations (one versus four, two versus five, six versus nine and eight versus ten), birds made successful choices with above-chance-expectations (Figure 1b). Mynah can easily discriminate larger quantities over the smaller one based on the number of successful choices exceeding the number of failures (161 success over 86 failures) (Figure 2b).

Hunt (2008) stated that most animals can differentiate small quantities but after an excessive training (learning, observing and experience), animals also can distinguish larger quantities. For examples, after an extensive training, primates have the ability to discriminate more than four items (Beran 2004). The exact numerosity judgments which limited to four countable items have led to suggestions that different mechanisms may be responsible for the representation of large versus small number sets (Feigenson *et al.* 2004). The history of numerical competence involving sequentially presented items had so far evincing a set size limit of four items as far as it concerned on *Tenebrio* *molitor* males (Carazo *et al.* 2009). The similar cases also had been found in *Macaca mulatta* (Hauser *et al.* 2000).

Even though only one food proportion that is above-chance expectations, the House Crows often choose the larger of two quantities; 133 success over 108 failures (Figure 2a). This is similar to the studies by Brannon and Terrace (2000) and by Gallistel and Gelman (2000), where they stated that exactness in numerical judgments will decrease with increasing magnitude. Based on the result, the first trial was 1 versus 3, where crows did made more successful choices but it is below the above-chance expectation. The proportion is not significant because unfamiliarity and lack of learning experience might have affected the early portion of the trials. According to Werdenich and Huber (2006)., this could be attributed to the fear of trying something new (neophobia). Our result shows that crows did not process information about quantity in an efficient manner and perhaps choose the food item randomly. The crows might have developed a preferential selection on the order of the food where they first encountered the most number of foods. This is proven by Willson and Comet (1993) as they concluded that adult Northwestern Crow (*Corvus caurinus*) exhibited individual preferences in sugar content, lipid and the color of food. Another possibility is that crows remembered the first cup they choose and kept on choosing the same one because of observational spatial memory (Emery & Clayton 2004). They also have the tendency to select higher food items but in order to avoid extra energy used and greater handling cost; they strategically go for less (Hunt *et al.* 2008). We could infer that crows simply made their choices based on the fact that they knew both cups contains food and it is much more beneficial to select the most nearest to their perching position.

Comparatively, mynah showed a quite impressive number of successful choice selections; 161 success over 86 failures (Figure 2b). Weber's Law did not apply for mynah. Similar with crows, unfamiliarity and lack of experience could have affected the early results (one versus three). Unlike crows, mynahs managed to adapt and learn within a short period of time. The last two proportions (six versus nine and eight versus ten) showed significant results with the higher success count among all food items proportions. We assumed that this is caused by the in-between trial learning. There are actually other aspects of learning besides habituation and operant conditioning in which sometimes they are considered as part of instrumental learning (observational learning). This instrumental learning (observational) is made possible due to the fact that the test experiment area and the confinement area of mynah are located next to each other. We noticed that Mynah actually had the tendency to perform a successful choice after observing another individual performance of selecting larger quantity over smaller quantity of mealworms presented. This similar kind of case had been observed previously in ducks whereby it had been proven that they can actually learn their tasks by observation (Klopfer 1957). Mynahs numerical capacity improvement could be attributed to the fact that birds can be trained naturally and have the tendency to develop more advanced numerical abilities over an extended period of time (Hunt *et al.* 2008). Another possible explanation for their excellent performance is that extensive experiences enhance the formation of analog numerical representations in mynahs (Tomonaga 2008).

Even though House Crows is the invasive species in Malaysia (Nyari *et al.* 2006), both crow and mynah species are the common species in Malaysia especially in Penang. As both birds are considered as a pest (Nyari *et al.* 2006; Yap & Sodhi 2004). Both species of birds can successfully adapt in any environment especially in urban areas. House Crow mostly feed on insects, grains, seeds, and fruits. Common Mynah mostly preferred fruits, grains, seeds and insects. Which species is much more intelligent in adaptation to a new environment? How can they compete with each other? Our results show that mynah is might be more intelligent than crows. Mynah successful selection is 161, compared to crow's successful selection which is 133 (Figure 2a & 2b). Although both species of birds select more food items but apparently crows tend to make more wrong choices (108 failure) compared to mynahs (86 failure).

Conclusion

From our observation, house crows are capable discriminating large numbers items against smaller numbers. Although considered as a fast learning and intelligent birds (Yosef *et al.* 2012), our results indicate that their numerical learning capacity might be lacking. Our results also suggest that the total limit in making numerical discriminations was less than four for crows. We suggest further studies on numerical competency of house crows. These can provide new understanding of how animals solve mathematical actions and problems.

Based on our results, we suggest that mynah use memory cognition in counting abilities rather than subitizing. At the same time, this study provides evidence that numerical competency can be further improved by observational learning. Further studies therefore should use different procedures such as using operant conditioning involving both active and passive reinforcement can also be done in order to observe for different performance in mynah.

References

Addessi, E., Crescimbene, L. & Visalberghi, E. (2008). Food and token quantity discrimination in capuchin monkeys (*Cebus apella*). *Animal Cognition.* 11(2): 275–282.

Balakrishnan, J. D., & Ashby, F. (1992). Subitizing: Magical numbers or mere superstition? *Psychological Research*. 54(2): 80-90.

Bayern, A. M. P. v., and Emery, J.N. (2009). Jackdaws Respond to Human Attentional States and Communicative Cues in Different Contexts. *Biology.* 19(7): 602-606.

Bayern, A. M. P. v., Heathcote, R. J. P., Rutz, C., & Kacelnik, A. (2009). The Role of Experience in Problem Solving and Innovative Tool Use in Crows. *Current Biology*. 19(22): 1965-1968.

Beran, M. J. (2004). Chimpanzees (*Pan troglodytes*) respond to nonvisible sets after one-by- one addition and removal of items. *Journal of Comparative Psychology.* 118(1): 25–36.

Brannon, E., and Terrace, H. S. (2000). Representation of the numerosities 1–9 by rhesus macaques (*Macaca mulatta*). *Journal of Experimental Psychology. Animal Behavior Processes*. 26(1): 31-49.

Carazo, P., Font, E., Forteza-Behrendt, E., & Desfilis, E. (2009). Quantity discrimination in *Tenebrio molitor*: evidence of numerosity discrimination in an invertebrate? *Animal Cognition*. 12(3): 463-470.

Dacke, M., Srinivasan, M. V. (2008). Evidence for counting in insects. *Animal Cognition*. 11(4): 683–689.

Emery, N.J., and Clayton, N.S. (2004). The Mentality of Crows: Convergent Evolution of Intelligence in Corvids and Apes. *Science*. 306(5703): 1903-1907.

Egeth, H. E., Leonard, C. J., & Palomeras, M. (2008). The role of attention in subitizing: Is the magical number 1? *Visual Cognition*. 16 (4): 463-473.

Feigenson, L., Dehaene, S., & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences*. 8(7): 307-314.

Gallistel, C. R., and Gelman, R. (2000). Non-verbal numerical cognition: from reals to integers. *Trends in Cognitive Sciences*. 4(2): 59-65.

Hauser, M. D., Carey, S., & Hauser, L. B. (2000). Spontaneous number representation in semi-free ranging rhesus monkeys. *Proceedings of the Royal Society, London*. 267(1445): 829–833.

Heptonstall, R. A. E. (2010). The distribution and abundance of Myna birds (*Acridotheres tristis*) and Rimatara Lorokeets (*Vini kuhlii*) on Atiu, Cook Islands. MSc diss., UK: Leeds University.

Hunt, S., Low, J. & Burns, K.C. (2008). Adaptive numerical competency in a food-hoarding songbird. *Proceedings of the Royal Society of London, Series B.* 275(1649): 2373-2379.

Kak, S. (2000). Grading intelligence in Machines: Lessons from Animal Intelligence. In A. Meystel, and E. R. Messina (ed). *Measuring the Performance and Intelligence Systems. Proceedings of the 2000 PerMIS Workshop August 14-16.* Washington, DC : Gaithersburg, Md., 331-334.

Katz, M. A. (2007). *Numerical competence and the format of mental representation.* Phd diss., University of Pennsylvania.

Kaufman, E.L., Lord, M.W., Reese, W., & Volkman, J. (1949). The Discrimination of Visual Number. *The American Journal of Psychology.* 62(4): 498-525.

Kenward, B., Rutz, C., Weir, A.A.S., and Kacelnik, A. (2006). Development of tool use in New Caledonian crows: inherited action patterns and social influences. *Animal Behaviour.* 72(6): 1329-1343.

Klopfer, P. H. (1957). An Experiment on empathetic learning in ducks. *American Naturalist*. 91(856): 61-63.

Medina, F. S., Taylor, A. H., Hunt, G. R., & Gray, R. D. (2011). New Caledonian crows' responses to mirrors. *Animal Behaviour*. 82(5): 981-993.

Nyari, A., Ryall, C., & Peterson, A. T. (2006). Global invasive potential of the house crow, *Corvus splendens* based on ecological niche modelling. *Journal Of Avian Biology*. 37(4): 306-311.

Piazza, M., Mechelli, A., Butterworth, B., & Price, C.J. (2002). Are subitizing and counting implemented as separate or functionally overlapping process? *NeuroImage*. 15(2): 435-446.

Reznikova, Zh. & Ryabko, B. (2011). Numerical competence in animals, with an insight from ants. *Behaviour*. 148(4): 405-434.

Shaw, R.C. and Clayton, N.S. (2012). Eurasian jays, *Garrulus glandarius* flexibly switch caching and pilfering tactics in response to social context. *Animal Behavior*. 84(5): 1191-1200.

Tennesen, M. (2009). Animals by the Numbers. *Scientific American*. 301(3): 23-24.

Tomonaga, M. (2008). Relative numerosity discrimination by chimpanzees (*Pan troglodytes*): Evidence for approximate numerical representations. *Animal Cognition*. 11(1): 43-57.

Weir, A. A. S., Chappell, J., & Kacelnik, A. (2002). Shaping of Hooks in New Caledonian Crows. *Science*. 297(5583): 981.

Werdenich, D. and Huber, L. (2006). A case of quick problem solving in birds: string pulling in keas, *Nestor notabilis*. *Animal Behavior*. 71(4): 855-863.

Willson, M.F., and Comet, T.A. (1993). Food Choices by Northwestern Crows: Experiments with Captive, Free-Ranging and Hand Raised Birds. *The Condor*. 95(3): 596-615.

Yap, C. A. M., & Sodhi, N. S. (2004). Southeast Asian invasive birds: ecology, impact and management. *Ornithological Science*. 3(1): 57-67.

Yosef, R., Zvuloni, A., and Yosef-Sukenik, N. (2012). House Crow (*Corvus splendens*) attempt to Cooperatively Kleptoparasitize Western Osprey (*Pandion haliaetus*). *The Wilson Journal of Ornithology*. 124(2): 406-408.

Figure Caption

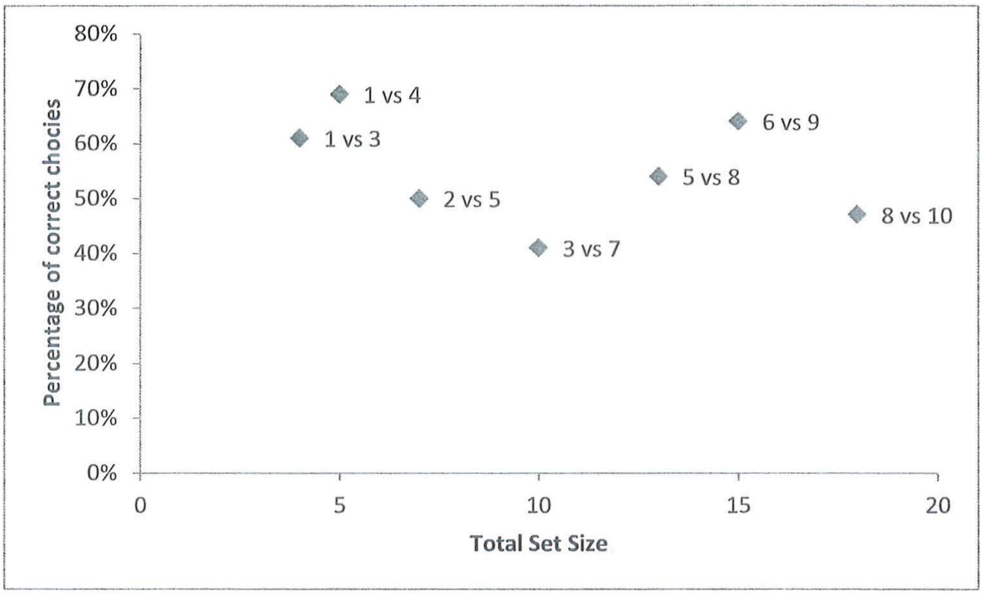
Figure 1(a): Results for *Corvus splendens* where the total of number of food items used in each treatment is shown on the *x*-axis and the percentage of birds choosing the greater food items is shown on the *y*-axis.

Figure 1(b): Results for *Acridotheres tristis* where the total of number of food items used in each treatment is shown on the *x*-axis and the percentage of birds choosing the greater food items is shown on the *y*-axis.

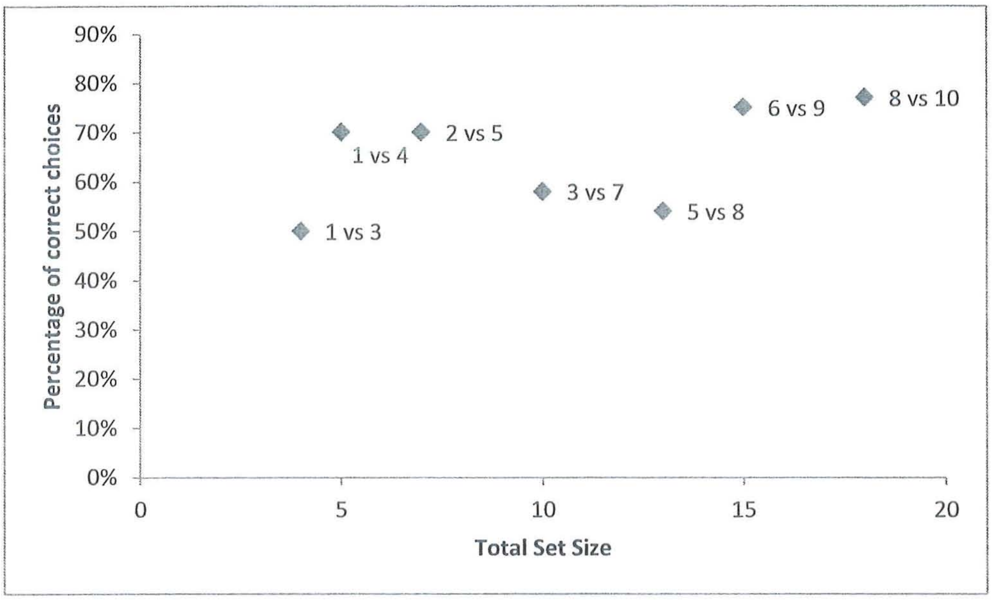
Figure 2(a): The number of success count for each food items proportions for *Corvus splendens.*

Figure 2(b): The number of success count for each food items proportions for *Acridotheres tristis*.

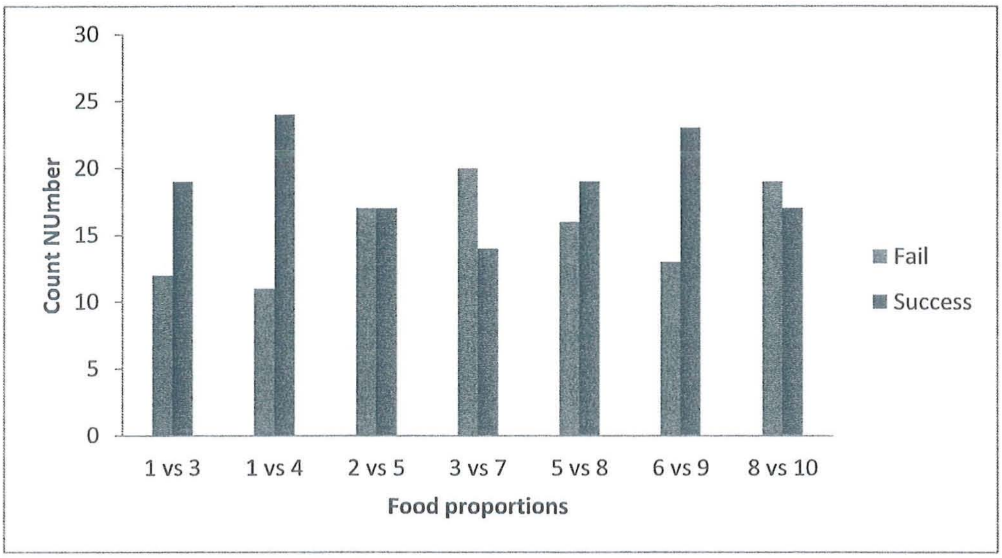
Crow (Figure 1a)



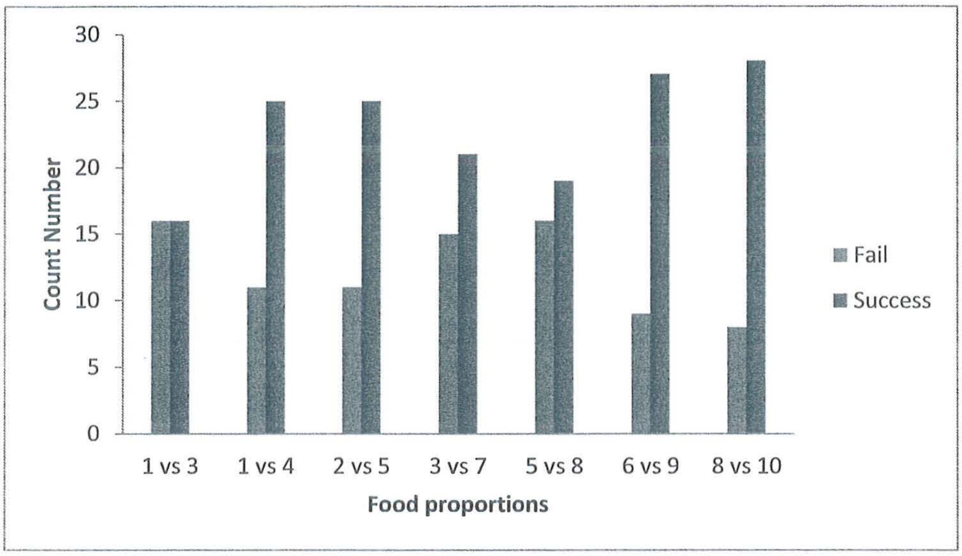
Myna (Figure 1b)



Crows (Figue 2a)



Mynah (Figure 2b)



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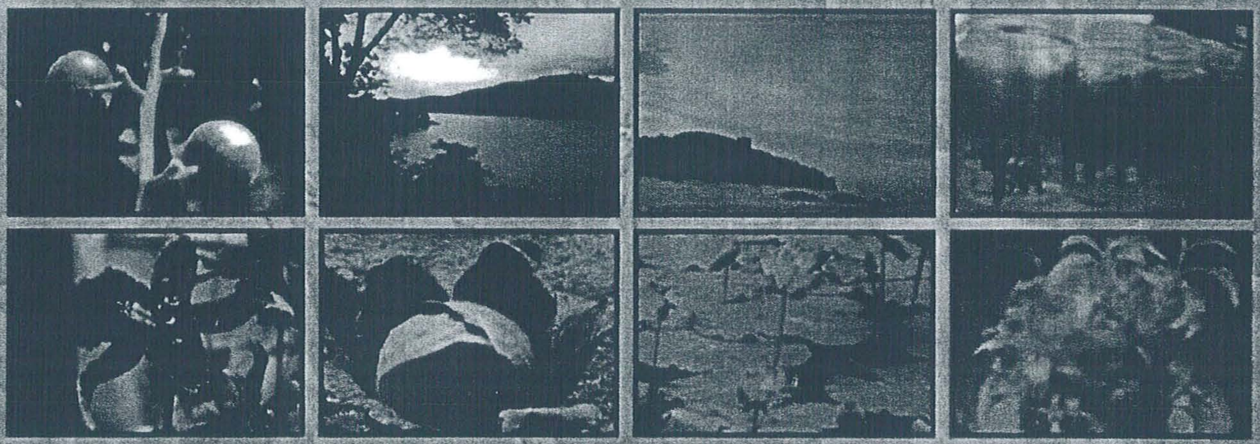

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ORQ06

The Roles of Olfaction and Vision in the Foraging Behavior of *Cynopterus brachyotis* (Pteropodidae)

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Abstract

We studied the foraging behaviour of two species of megachiroptera bats under captive conditions. *Cynopterus brachyotis* was examined to study the roles of olfaction and vision in their foraging behavior. We conducted the experiments by offering a fresh banana fruit, cotton soaked with banana juice and an artificial banana fruit for six hours duration from 6.00 to 12.00 pm. This species responded to fresh banana fruit and cotton soaked with banana juice, whereas, they ignored the artificial banana fruit. These results reveal that odour play as the primary roles for *Cynopterus brachyotis* in finding fruit.

ORQ07

Insecticide Resistance Status of *Aedes albopictus* in Three Localities in Penang Island

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Abstract

Insecticide resistance is the most important factor in the effectiveness of dengue control program and related to the transmission of dengue virus. The study has found that the resistance of Pyrethroid (permethrin and deltamethrin) and Malathion has been occurring in *Aedes albopictus* in Penang, Malaysia. The Flat Hamna strain showed incipient resistance to all three insecticides after 24 hour exposure with 87% on Malathion. However, the highest LT95 resistance ratio (RR) value was recorded by permethrin (1.93 fold). Kampung Sungai Gelugor strain was shown an incipient to permethrin but still susceptible to deltamethrin and Malathion however in Kampung Tanjung Tokong strain still susceptible to all of insecticide. The resistance may occur from the usage of the continuously insecticide in vector control management and this result can be used as a guidance to improve the resistance monitoring management and vector control activities in Penang, Malaysia.

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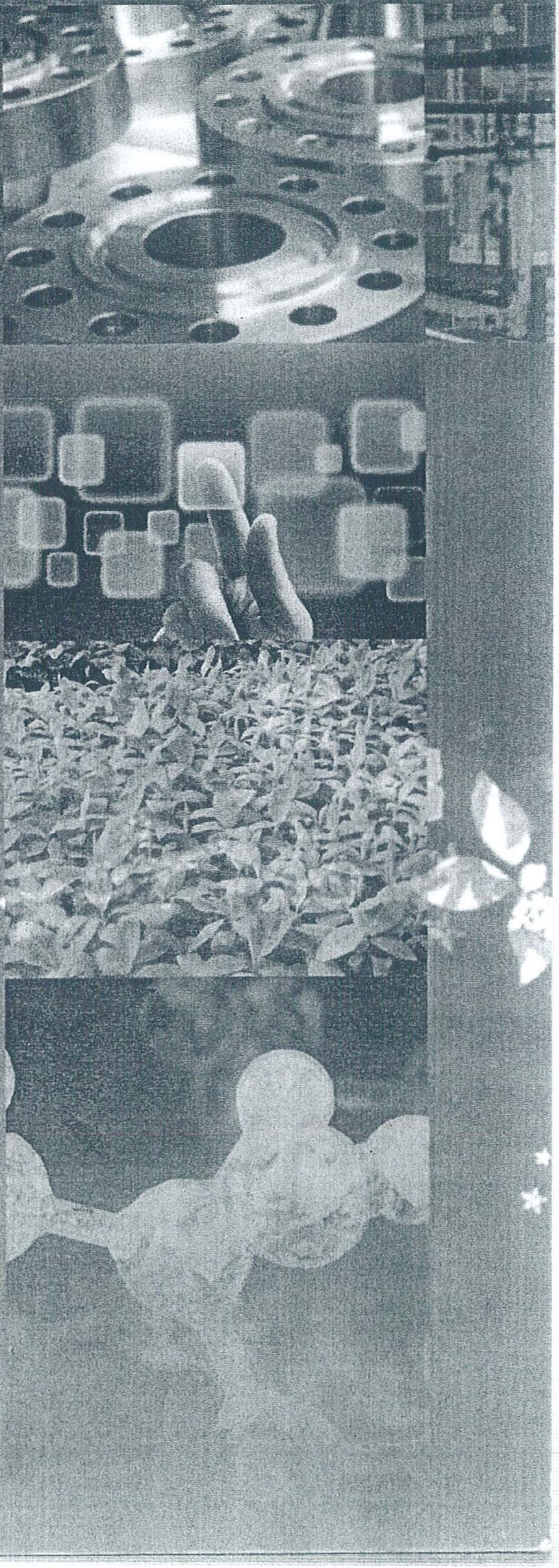

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Counting abilities and number senses in *Acridotheres tristis*

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Abstract

The exact process of counting is still unclear and controversial especially in avian. Most basic calculation among animals (non-human) follows an analog magnitude system that follows Weber's Law which states that as numerical magnitude increases, a larger disparity is needed to obtain the same level of discrimination. Simply put, most animals could differentiate the magnitude difference between one versus two, two versus three, but have difficulty comparing five versus six, six versus seven. Six common myna, *Acridotheres tristis* were tested to choose seven different food proportion. Correct choices occur when a bird chooses the food item with higher number. Results showed that from all seven food proportions, only three proportions did not showed significant differences while the other proportions were statistically significant.

1.0 INTRODUCTION

Numerical knowledge refers to the ability to count object in order to understand the relationship between numbers either the number amount is small or large. The exact process of counting is unclear and controversial. In simple words, subitizing is a type of numerical process that allow the observers to understand rapidly and accurately the numerosity of small sets of objects usually within range of 1-4 (Balakrishnan and Ashby, 1992; Piazza *et al.*, 2002). Enumeration gets slower and more error prone and for more than four items which is called as counting (Piazza *et al.*, 2002; Egeth *et al.*, 2008).

Tennesen (2009) wrote that counting number by animals may be an innate ability among themselves where they can do a rough sort of math by summing sets of objects without actually using numbers and Tennesen (2009) believes that the ability is innate. Animals do not have a linguistic sense of numbers, they are not counting "one, two, three" in their heads.

In recent years, study of counting and other related number skills have been investigated across a range of non-human species. Studies showed the potential for numerical discrimination in wide variety of species from honey bees (Dacke and Srinivasan, 2008), monkeys (Addessi *et al.*, 2008) to ants (Reznikova and Ryabko, 2011) and birds (Pepperberg, 1994). Non-human primates represent the 'higher' or advanced level of number related skills as compared to other animal species because studies on animal cognition with non-human primates of chimpanzee have yielded fascinating results so far (Tomonaga, 2008).

2.0 EXPERIMENTAL PROCEDURE

Experiments were performed 3 times per week every Monday, Wednesday and Friday to prevent stress to the birds and the experiments started at 4 p.m. The experiment was conducted via a choice test experiment. In this experiment, mealworms were presented to the subject in an experimental area in the cage with a floor area of 12,600 cm^2. The experiment was recorded and followed the protocols described by Hunt *et al.* (2008). The mealworms were placed in two white cup container measuring 10 x 5 x 5 cm. Both cup were placed on the black board and were set 50cm far apart. The birds were trained to watch and recognize the food items as we put the mealworms into the cup container at approximately 3 to 5 seconds per item. The process was repeated several times in order to acclimatize the birds with the food dropping process and also the human's presence. Then we proceed with a combination of food numbers in different cup containers. Seven number combinations were presented to all six birds in the following randomly selected order which are 1 versus 3, 1 versus 4, 2 versus 5, 3 versus 7, 5 versus 8, 6 versus 9 and 8 versus 10. Each subject was given about 5 min maximum to choose between the two cups. Correct choice refers to the situation where the birds choose food items with the highest number. The left or right combinations are also randomized to prevent preference bias and to control the observational learning (Hunt *et al.*, 2008).