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Color discrimination in Caspian pony

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Abstract: **Although an early and influential review led to the often-cited conclusion that color vision is rare among mammals, more recent findings suggest that it is actually widespread. According to Jacobs, all non-nocturnal mammalian species that have been adequately examined show some color vision capacity, although the degree varies enormously. Data on the presence and characteristics of color vision in the horse, however, remain sparse and none in the case of ponies. Eight Caspian ponies were presented with a series of two-choice color vs. grey discrimination problems. One mare pony was eliminated due to traumatic injury to the eye. Experiments were performed in a box of 3 × 3 meter containing a wall with two translucent panels that were illuminated from behind by light projected through color or grey filters to provide the discriminative stimuli. Ponies were first adopted to the stall (box) with two panels in it and then learned to push one of the panels in order to receive the food rewards behind the positive stimuli in an achromatic light-dark discrimination task. The ponies were then tested on their ability to discriminate between grey and four individual colors: red; 617 nm., yellow; 581 nm., green; 538 nm. and blue; 470 nm. The criterion for learning was set at 85% correct response, and final testing for all color vs. grey discrimination involved grey of varying intensities, making brightness an irrelevant cue. The ponies were tested with all four colors vs. grey discriminations. Except two ponies, the rest were successfully reached the criterion for learning blue color vs. grey discrimination. Only two ponies reached the criterion for learning green color vs. grey discrimination. Only tow ponies reached the criterion for discriminating red and yellow vs. grey. So the answer to the question "do the ponies see color" is yes, they can discriminate between the four selected color vs. grey.**

Key words: color, discrimination, Caspian, pony.

Introduction

Although an early and influential review (Brian, T., and Todd, M., 2001., Walls, 1942) led to the often-cited conclusion that color vision is rare among mammals, more recent findings suggest that it is actually widespread. According to Jacobs (1981, 1993), all non-nocturnal mammalian species that have been adequately examined show some color vision capacity, although the degree varies enormously. Data on the presence and characteristics of color vision in the horse, however, remain sparse and none in the case of Caspian Pony.

Grizmek (1952) investigated color vision in two mares, 4 and 6 year of age, in an instrumental discrimination paradigm. His stimuli were colored cards attached to boxes that contained oats as a reward for the correct choice. He concluded that his subjects could see color and not merely different shades of grey.

Popov (1952) described a variety of demonstrations of horse's abilities to discriminate between different visual and auditory conditioned

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Table 1. Breed, age, sex and work classification of all subjects.

Pony	Breed	Age	Sex	Type of work
Masoleh	Caspian	5 Y	Mare	Light work
Sharareh	Caspian	8.5Y	Mare	Light work
Homa	Caspian	12Y	Mare	Light work
Nasir	Caspian	16Y	Stallion	Light work
Hormoz	Caspian	11Y	Stallion	Light work
Shahin	Caspian	9Y	Stallion	Light work
Vahid	Caspian	5Y	Stallion	Light work

Table2. Percentage of correct response on light-dark discrimination.

Subject	Positive stimulus	Session 1	Session 2
Masoleh	Light	61	88
Sharareh	Light	75	86
Homa	Light	58	89
Nasir	Dark	59	91
Hormoz	Dark	72	94
Shahin	Dark	63	89
Vahid	Dark	76	86

Table 3. Percentage of correct response to discrimination for Ponies used in this experiment.

Horse	Ble	Green	Red	Yellow
Masooleh	85.2	68.8	70	67.6
Sharareh	96.7	56.7	59.1	49.7
Homa	85.8	79.4	69.4	79.4
Nasir	97.9	69.1	80	88.8
Hormoz	88.2	89.1	80	68.5
Shahin	52.5	69.1	86.4	58.2
Vahid	71.6	98.8	69.1	78.8

stimuli in a classical conditioning of a leg withdrawal response, including a brief report of a demonstration that one horse was able to respond differently to red, green, yellow and violet light projected on a screen.

In light of no data on Caspian Pony color discrimination ability, the discrepancy between findings, and the inconclusiveness of the most recent study, further investigation seemed warranted. The present study was designed to explore color vision in an instrumental discrimination paradigm with light transmitted through filters as discriminative stimuli and proper control for brightness. To the authors' knowledge, this study is the first report on the color discrimination in the Caspian pony. This result was founded by Agricultural Research and Education Organization (AREO).

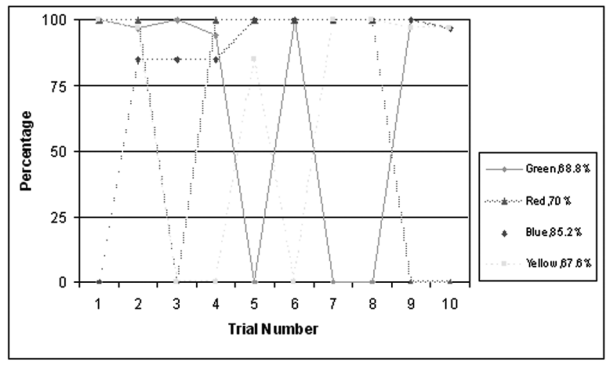

Figure 1: Discrimination Percentage For Masooleh.

Materials and Methods

Participants: A total of eight Caspian ponies of both sex (4 each) with the age range between 4-16 years old were selected for this experiment (Table 1). The ponies were prechecked for any abnormalities in the eyes. All ponies began the pre-test training, but one mare pony was eliminated due to traumatic injury to the eye. The remaining 7 ponies began the preliminary light -dark discrimination training and were used as subjects for color discrimination training (table 2). The ponies were housed in four (two each) 3.5 × 4.5 meter paddock and fed the formulated alfa alfa pellets three times a day with water available ad libitum. The ponies were in their regular training program, but were not exercised on the test days.

Apparatus: The ponies were tested in a modified designed stall (figure1) measuring 3.5m × 3.5m × 2m (high). The floor of the box (stall) was concrete covered with wood shavings, and three of the walls were made from blocks (covered with dark clothing). One of the walls contained a push back door that allowed controlled entrance to the box from the adjourning paddock.

The testing apparatus has built into the wall adjoins to the push back door. Two 0.75m × 0.75m

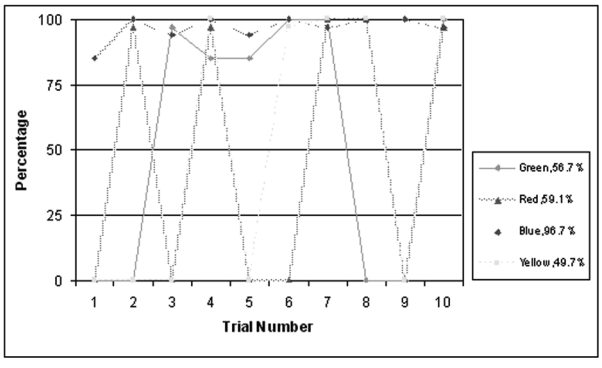

Figure 2: Discrimination Percentage For Sharareh.

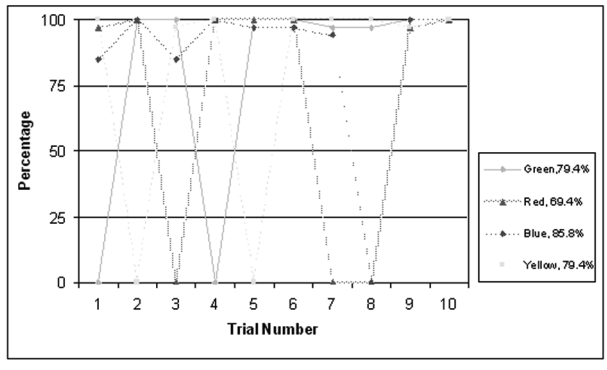

Figure 3: Discrimination Percentage For Homa.

stimulus panels were positioned in the wall 0.65m from the ground, 1.10m apart and 0.6m from the wall and 0.65m from the push back door. These panels were hinged at the top and swang inward, away from the pony, when the ponies pushed against the panels with its nose, allowing access to a food bowel mounted just behind the lower edge of each panel. The two stimulus panels were constructed of sheets of translucent plastic, and were illuminated from the opposite box (stall) by two projectors (Unimatt, 2000 w, Japan).

Colors were presented by use of gelatin plastic films, standardized for spectral and total transmittance that could be easily interchanged in front of each panels. The four color used were red; 617 nm., yellow; 581 nm., green; 538 nm. and blue; 470 nm.. The wavelengths were measured by the Light laboratory of the Physic's Department of the Sharif University of Technology (Tehran). The grey filter was used to provide non-color stimuli in order to prevent confounding of the hue and the brightness.

Procedure: Adaptation and pre-training; During a 2 days pre test training period, the ponies were habituated to the testing box and trained to eat from the test panels. On the first day of adaptation, the test box was wide open and the ponies were allowed to move around and learn to go towards the panels and eat from each panel. The food bowels were provided behind the panels during the pony's presentation in the box. This procedure was repeated every half an hour for each pony.

On day 2, the stimulus panels were covered with simple plastic and the ponies were learned to push the plastic covering of the panel and eat from the food bowels, already behind each panel. This procedure was repeated several times, with the stimulus panels covering gradually lowered as the ponies accepted the apparatus.

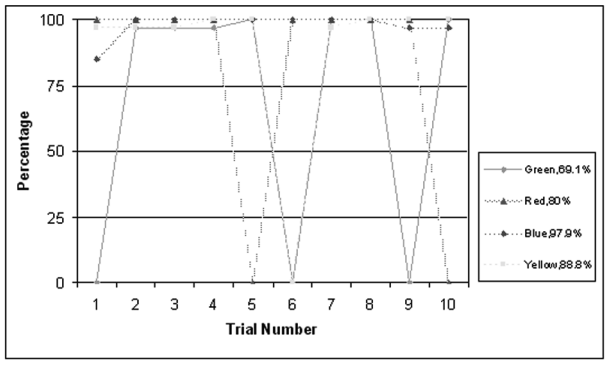

Figure 4: Discrimination Percentage For Nasir.

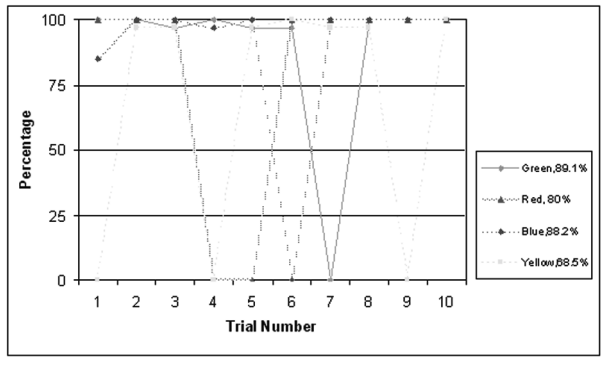

Figure 5: Discrimination Percentage For Hormoz.

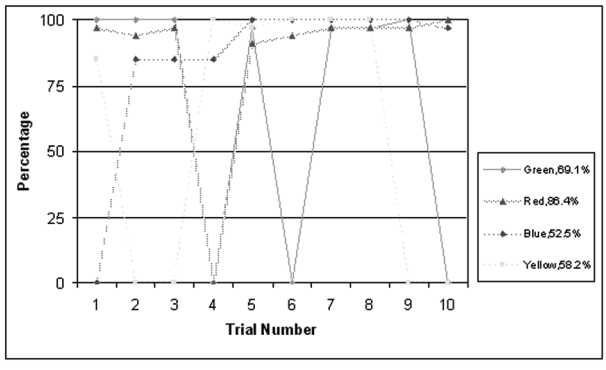

Figure 6: Discrimination Percentage For Shahin.

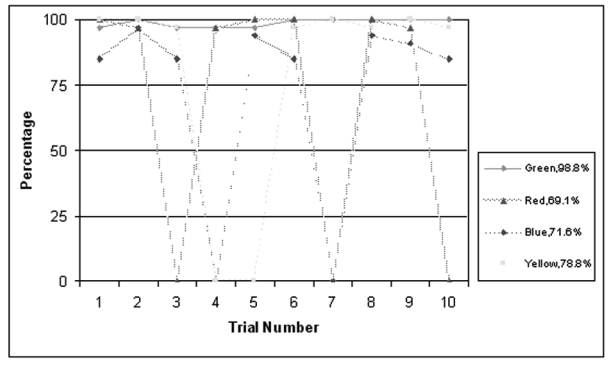

Figure 7: Discrimination Percentage For Vahid.

Light-dark discrimination: Ponies were divided in to two groups (four each, one of the mare ponies was eliminated due to eye injury) for counter balancing. Each pony was first taught a simple light-dark discrimination in order to establish the basic pattern of responding differential to one of the two stimuli. The light stimulus was an achromatic (white) light and the dark stimulus was no light at all. Two ponies from each group were conditioned to the light stimulus as the positive stimulus and the remaining two ponies were conditioned to the dark stimulus as positive. If the pony could successfully perform the discrimination test, then error committed during color testing could not be attributed to a basic inability to learn two-choice discrimination.

The ponies were fasted for 12 hours before each test. The test was performed mostly at the evening time, to increase visibility of the stimuli.

Before each trial, an assistant prepared the stimuli and reward from behind the panel, while the handler or other assistant turned the ponies around in the paddock between trials. To eliminate the odor as a cue a light deodorant was sprayed before each trial. The position in which the two stimuli were presented was varied randomly over trials, with two constraints; the positive (correct) stimulus was presented an equal number of times on the left and right panels over the sessions, and was never on the same side for more than four consecutive trials. The criterion for discrimination learning was set at 85% correct responses.

Color-discrimination training: After each participant reached criterion on light-dark discrimination, color discrimination training began using the same procedure. Stimulus consisted of one illuminated through a colored filter and another panel illuminated through a grey filter. Ten trials for each pony for each color (40 trials for each pony for four color) were performed and when each pony discriminated the respective color from grey and reached the criterion of 85% or more, it was proposed as positive discrimination, but if the discrimination percentage was below 85% it was marked as negative discrimination.

Results

The performance of all subjects on the preliminary light-dark discrimination is summarized in table 2. The ponies which met the criterion level of 85% did so on the day two (session 2) of the experiment.

The graphs shows each pony's data from each color with percent correct for each session plotted on the Y-axis and trial number on the X-axis. The graphs are presented in the order the colors were used for that pony.

Blue *vs*. grey: All ponies learned this task reasonably and soon had ten consecutive trials above 85% correct (except Shahin which was 52.5%), even when it was the first condition they experienced (table 3, fig. 6).

Green *vs*. grey: Except Vahid (table 3, fig. 7) and Hormoz (table 3 fig. 5) which with 98.8% and 89.1% (respectively) crossed the criterion level, none of the ponies reached the criterion level. Homa with 79.4% (table 3, fig. 3) correct response got closed to the criterion, but once again she could not make this discrimination as well as she had blue vs. grey (85.8% in that case). Masoleh, Sharareh, Nasir and Shahin with 68.8, 56.7, 69.1 and 69.1% discrimination rate (respectively) could not reach the criterion level (tables 3, figs. 1, 2, 4, and 6).

Red *vs*. grey: Except Shahin with 86.4% discrimination rate (table 3, fig. 6) none of the ponies managed to reach above 80% correct response.

The discrimination rate for Masoleh, Sharareh, Homa and Vahid were 70%, 59.1%, 69.4% and 69.1% respectively (table 3, figs. 1, 2, 3 and 7) . Nasir and Hormoz with 80% discrimination rate got close to the criterion (table 3, figs. 4 and 5), but once again they could not this discrimination as good as they had blue vs. grey.

Yellow *vs*. grey: This was not so easy. The average discrimination percentage for this color was about 71% (below the criterion level!). Nasir with 88.8% discrimination rate crossed the criterion level (table 3, fig. 4), Homa and Vahid (79.4% and 78.8% discrimination rate) got close, showing they could do the task to some extent (table 3, figs. 3 and 7), but they could not make this discrimination as easily as they had blue vs. grey. The rest of the ponies could not cross more than70% discrimination rate.

Discussion

Except Shahin and Vahid, remaining five subjects could discriminate blue from grey. Only Hormoz and Vahid could discriminate green from grey where as other five subjects could not reach the criterion (85%).

Except Shahin none of the subjects could discriminate red from grey. Only Nasir could discriminate yellow from grey. All seven subjects could discriminate at least one color from grey.

Although Grizmek (1952) reported that subjects learned the discrimination involving yellow and green most easily, had more difficulty with blue and had the most difficulty with red, the result of the present study showed that the subjects learned the discrimination of blue from grey most easily (in contrast with Grizmek's findings) and had more difficulty discriminating red and yellow from grey.. Masoleh, Sharareh, Homa and Nasir were not able to discriminate green and red from grey even though they were successful with blue, suggesting a possible color blindness affecting medium-wave length receptors.

The present findings thus provide evidence for color vision in pony, which can respond differently to blue, green, yellow and red vs. grey.

In Conclusion, So what is the answer to this question; do ponies see color?

The answer is yes, they could definitely see the differences between blue vs. grey, green vs. grey, red vs. grey and yellow vs. grey. They can tell blue from grey most easily, green and red to some extent but they find much more difficult to tell yellow from grey.

More research is now needed to answer the question this work has raised. Can ponies tell various colors apart? We will have to wait and see!

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تشخیص رنگ در اسبچه خزر

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اگرچه نتایج مطالعات اولیه بیانگر این موضوع بوده است که تشخیص رنگ در اسب از جمله صفاتی است که کمتر مورد پذیرش بوده است، تحقیقات اخیر نشان داده است که توانایی تشخیص برخی از رنگها توسط اسب وجود دارد. البته این تحقیقات نشان داده اند که این ویژگی (تشخیص رنگ) بصورت کامل و تکامل یافته در اسب دیده نمی شود، بلکه تشخیص رنگ در اسب بصورت نسبی می باشد. علیرغم مسائل ذکر شده اطلاعات در خصوص وجود و یا چگونگی تشخیص رنگ در اسب، هنوز کمیاب و در خصوص اسبچه خزر (موضوع این تحقیق) نایاب می باشد. برای بررسی چگونگی تشخیص رنگ در اسبچه خزر این تحقیق برای اولین بار در ایران صورت گرفته است، برای انجام این تحقیق تعداد هشت راس اسبچه خزر (۴ مادیان و ۴ سیلمی) انتخاب شدند. یکی از اسبچه های ماده در ابتدای کار بدلیل جراحات وارد شده به چشم از گروه تحقیق حذف گردید. برای انجام آزمایش از دوباکس مجاور (به ابعاد ۳×۳ متر) استفاده شد در یک باکس دو دریچه به فاصله ۶۰ سانتی متر از زمین و به فاصله ۱۱۰ سانتی متر از یک دیگر، جهت نصب فیلترها تعبیه شد. از باکس دیگر جهت نصب پروژکتور و تابش نور به فیلترها استفاده گردید. در ابتدا پونی ها با وضعیت تاریکی مطلق باکس و سپس تابش نور به دریچه ها، تطابق پیدا کردند. طول موج فیلترهای رنگی با در نظر گرفتن طول موج قابل دید توسط اسب و توسط آزمایشگاه نور، دپارتمان فیزیک دانشگاه صنعتی شریف، اندازه گیری شد. تشخیص رنگ در تمام پونی ها برای چهار رنگ اصلی (قرمز، سبز، زرد و آبی) انجام شد. دو راس از پونی ها قادر به تشخیص رنگ آبی شدند. دو راس از پونی ها توانستند رنگ سبز را از خاکستری تشخیص دهند تنها دو راس از پونی ها قادر به تشخیص رنگ قرمز شدند. با توجه به نتایج بدست آمده از این تحقیق پاسخ این سئوال که آیا اسبچه ها خزر قادر به تشخیص رنگ ها می باشند، مثبت است.

واژه‌های کلیدی: اسبچه خزر، رنگ.

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