Influence of sex on snake detection in visual search in adult humans: reaction times to target matrices

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Differential Parental Investment Theory (**DPIT**) (Trivers, 1972) predicts sex-differences in the domain of human antipredator-defensive behavior. When coping with predators, failures in defense would imply, on average, greater reproductive costs for women than men (Daly & Wilson, 1988). As a consequence of such putative differential selection pressures**, women are expected (when compared with men) to have developed a defensive-behavior system that is more efficient dealing with predators**. This report focuses on the attentional component of such system, and how it deals with **snakes**, a recurrent predatory pressure during primate evolution, that, according to **Snake Detection Theory** (**SDT**) (Isbell, 2006), **are expected to receive preferential processing**.

Following the **seminal work by Arne Öhman** (Öhman et al., 2001), examining **selective visual attention with fear-relevant stimuli** (viz., snakes and spiders), I designed a **visual search task** where men and women were exposed to stimulus matrices of different sizes (2 x 2 and 3 x 3), containing color photographs of snakes and/or flowers. The matrices were either homogenous (i.e., all pictures belonged to the same categoy, e.g., all flowers) or heterogenous (i.e., a picture belonged to a different category, e.g., a snake among flowers). Participants were instructed to judge if each matrix was homogenous or not.

Method

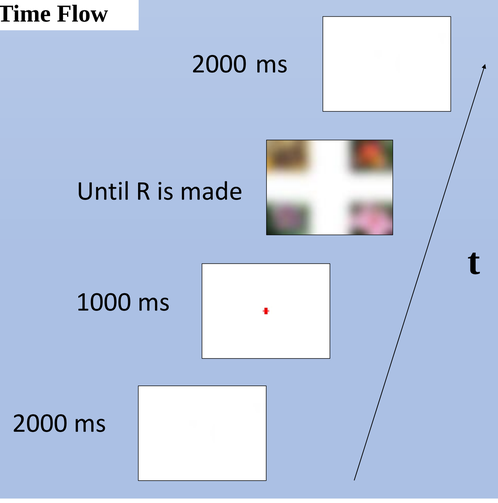
Participants

A total of 134 individuals (65 men, 69 women), most of them first year college students, participated voluntarily in the experiment after informed consent. The ethical guidelines of the American Psychological Association were followed. All participants had normal or corrected vision.

Apparatus

Each participant was individually housed in an isolated cubicle. A Pentium D computer, with a 33.6 cm (w) x 27.0 cm (h) monitor screen size, was used for stimuli presentation and data recording. The experiment was programmed and run using Inquisit 1.33 (Millisecond Software).

Trial Time Flow



Stimuli

-Four types of 2 (rows) x 2 (columns) stimulus matrices were built using a set of 8 color photographs (4 instances of snakes and 4 instances of flowers). Two types (viz., the target matrices) presented a target (either a snake or a flower) among 3 different instances of distractors of the opposite category (i.e., a snake among flowers, or viceversa). The other 2 types (viz., the distractor matrices) were built only with photographs from the same category (i.e., either 4 different snakes or 4 different flowers).
-Four types of 3 x 3 matrices were arranged according to the above mentioned rationale. A set of 18 photographs (9 snakes and 9 flowers) was used. The target matrices displayed a target among 8 different distractors. The distractor matrices displayed 9 different pictures belonging to the same category.
-The position of the photographs in each type of matrix was balanced (it should be noted though that a different photograph was employed for each target position). This led to 4 different configurations for each of the 4 types of 2 x 2 matrices, and to 9 different ones for each of the 4 types of 3 x 3 matrices. Thus, in total, 16 matrices of small size (4 configurations x 4 types) and 36 matrices of large size (9 configurations x 4 types) were presented.
-Photographs dimensions: 8.4 cm (w) x 6.3 cm (h)
-Matrices dimensions: 25.2 cm (w) x 18.9 cm (h).
-Photographs in the 2 x 2 matrices were displayed only in the corner positions, in order to equate the visual angle occupied by matrices of both sizes.

Procedure

-See Trial Time Flow diagram.
-Participants were instructed to judge if each matrix was homogenous (i.e., all of its components were distractors) or not (i.e., one of its components was a target). They were asked to respond --pressing designated keys for each option in the keyboard-- as rapidly (but accurately) as possible.
-Each session started with 4 practice trials involving 2 x 2 matrices, and another 4 practice trials involving 3 x 3 matrices.
-Afterwards, the experimental phase started. It consisted of 52 trials (16 with 2 x 2 matrices, 36 with 3 x 3 matrices).
-Photographs of the practice phase were different from those used in the experimental phase. All of them were downloaded from the Internet.
-For both practice and experimental phases, trials were blocked by matrix size condition. Order of block presentation and sequence of matrices within blocks were randomly assigned to each participant.

Results

ANOVA: 2 (Sex) x 2 (Target) x 2 (Size)

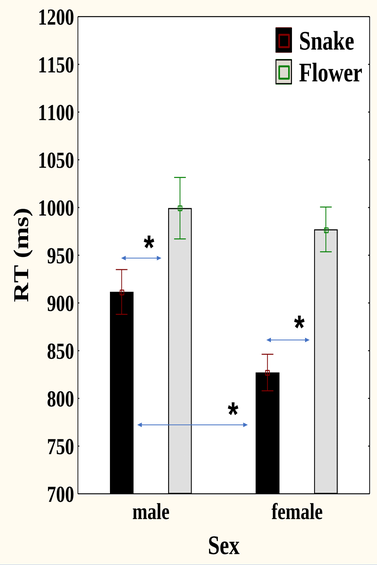
To reduce the effect of outliers and to promote normal distribution → Log_{10} transformation of row data points

Fisher´s LSD tests were conducted for post-hoc comparisons

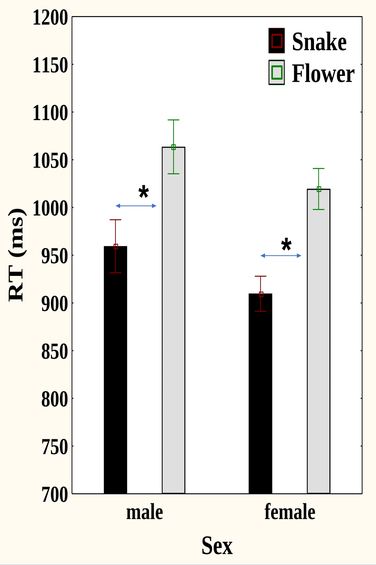
Main effects:
*Target: $F(1, 132) = 135.3$, $p < .0001$, $\eta^2_p = .51$
*Size: $F(1, 132) = 28.1$, $p < .0001$, $\eta^2_p = .17$

Interactions:
*Target x Sex: $F(1, 132) = 5.4$, $p < .05$, $\eta^2_p = .04$
-Target x Size x Sex: $F(1, 132) = 3.7$, $p = .056$, $\eta^2_p = .03$

2 x 2 target matrices



3 x 3 target matrices



Slopes (ms/item)

Slope = $(RT_{3x3} - RT_{2x2}) : (Nitems_{3x3} - Nitems_{2x2})$

Parallel search: Slope ≤ 5-6 ms/item

	Snake	Flower
Male	9.56	12.85
Female	16.50	8.46

Discussion

-Both men and women were faster to detect snake-targets than flower-targets, regardless of matrix size. This observation is at consonance with previous findings (e.g., Öhman et al., 2001), and **it fits the prediction of SDT**.

-When exposed to 2 x 2 matrices, snake-targets were detected faster by women than men, but no sex-difference was found for flower-targets. This observation suggests that women show more efficient attentional processing than men when dealing with threatening stimuli (e.g., snakes), but not when dealing with non-threatening stimuli (e.g., flowers). Therefore, **this finding fits the prediction of DPIT**.

-When exposed to 3 x 3 matrices, no significant sex-differences were found. Yet, it is possible that the mechanisms underlying similar men and women reaction times to target matrices are not the same. Therefore, further analysis should also examine response accuracy to target matrices, and, regarding distractor matrices, both reaction times and accuracy.

-Steeper slopes were found in this study than in Öhman et al. (2001). Possible causes: (1) stronger role of serial search; (2) lower perceptual discrimination of the photographs displayed by the 3 x 3 matrices employed in this experiment.

Future directions

-Examine overt (i.e., to foveal direct target) and covert (i.e., to nonfoveal peripheral target) attention.

-Disentangle the roles of attentional capture ("pop-out") vs. delayed disengagement.

-Explore hormonal modulation of sex-differences.

References

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