What is the airspeed velocity of an unladen swallow?

Modeling quantitative judgments of complex stimuli with unknown cue structure

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INTRODUCTION

There exist many established computational models describing different quantitative judgment processes (e.g., *rule-based models*, *exemplar-based models* and combinations of both).[1,2,3,4,5]

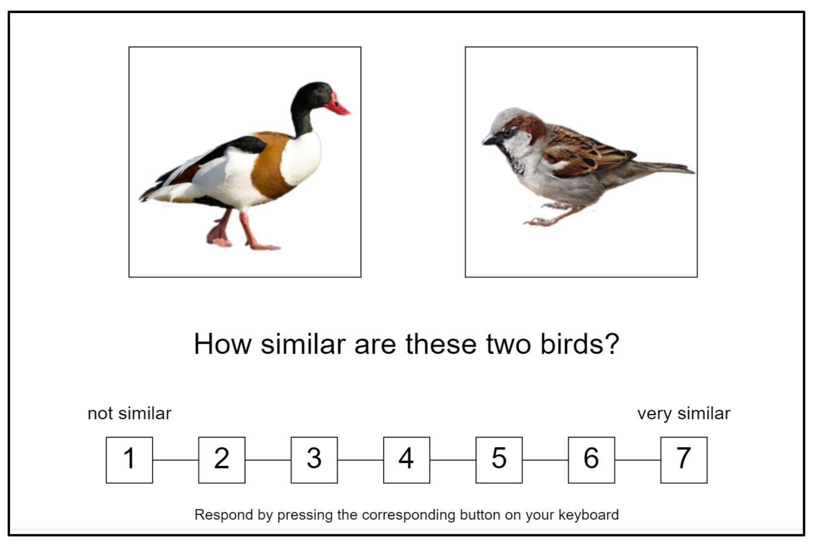
Problem: All these models require *known cues and cue values* of the judgment objects, which are often unknown for realistic stimuli.

General Aim: Based on previous research[e.g., 6,7], show how *multidimensional scaling*[8] can be used to generate cues which then can be used to model people's judgments of real-world objects.

Study Aim: Replicate findings of Pachur and colleagues [9,10] with naturalistic judgment objects and criterion (flight speed of birds).

OVERALL PROCEDURE

Step (1): Collecting Pairwise Similarity Ratings
of K = 32 Birds (N = 101)



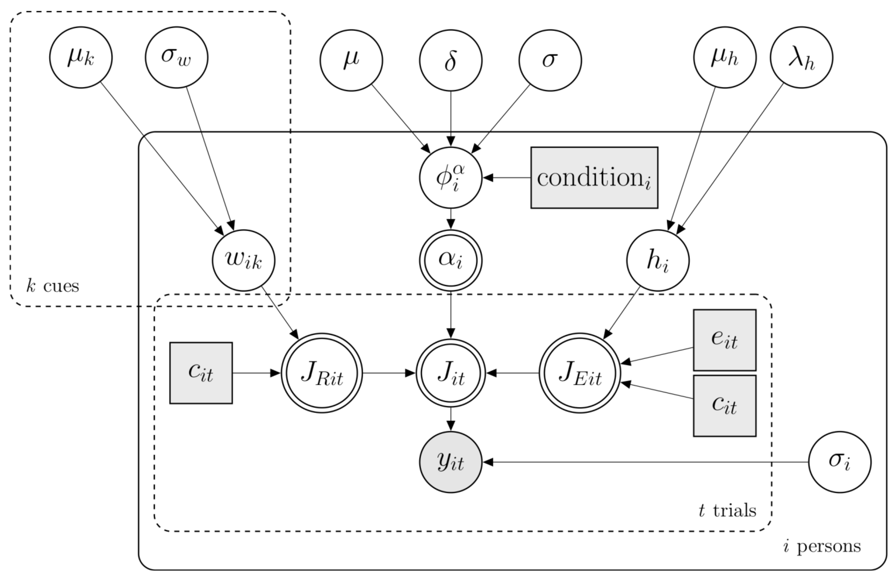
input

Step (2): Multidimensional Scaling

Bird	Dim. 1	Dim. 2	Dim. 3
	0.1	-0.2	0.3
	0.2	-0.3	0.4
		...	
	1.4	-0.1	1.2

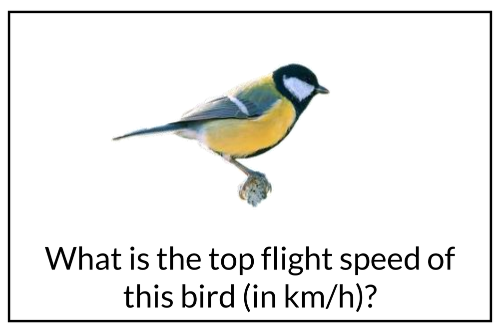
use as cues in

Step (3): Cognitive Model (*RulEx-J*[5])



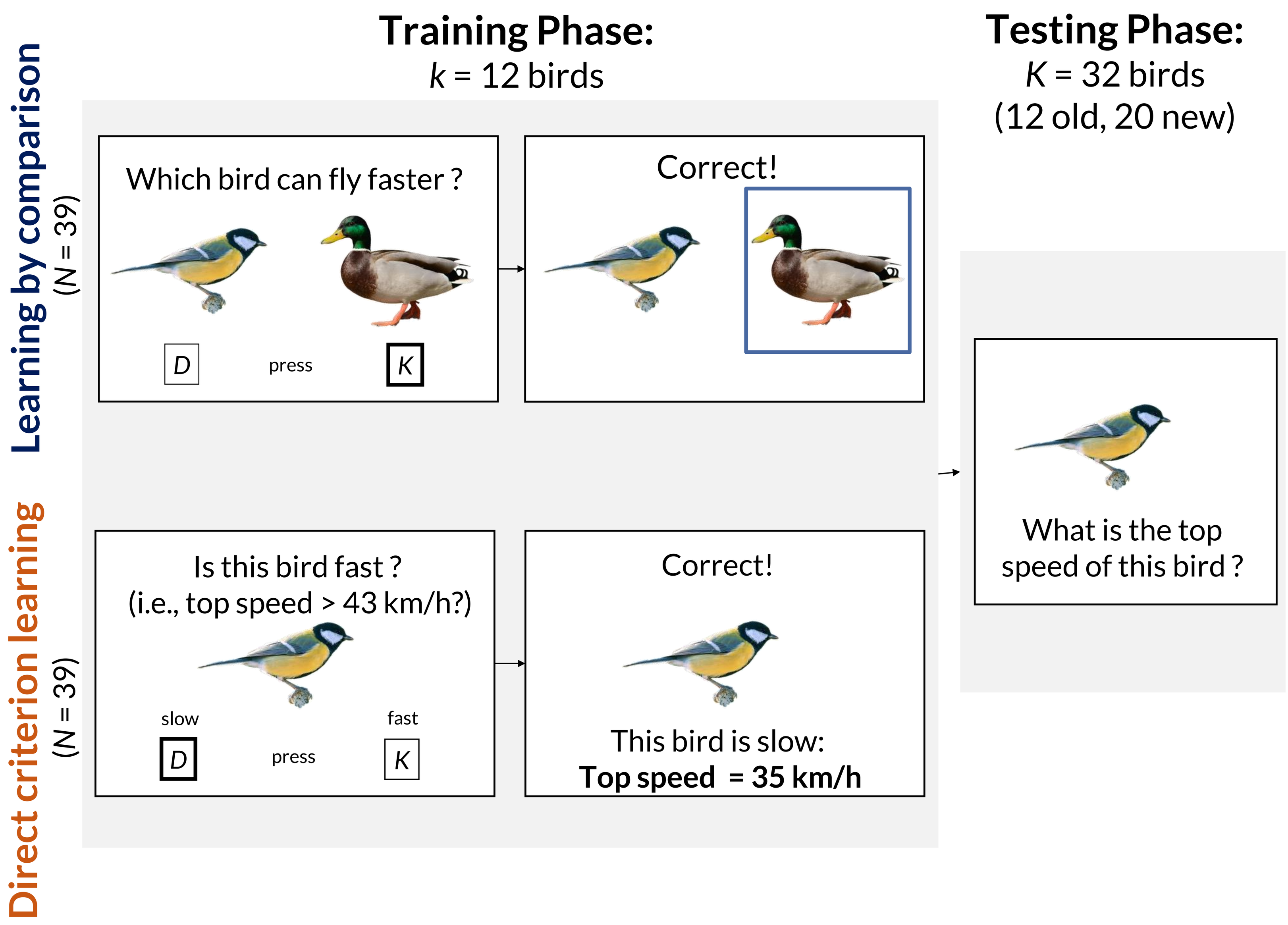
analyze

Step (4): Judgment Experiment

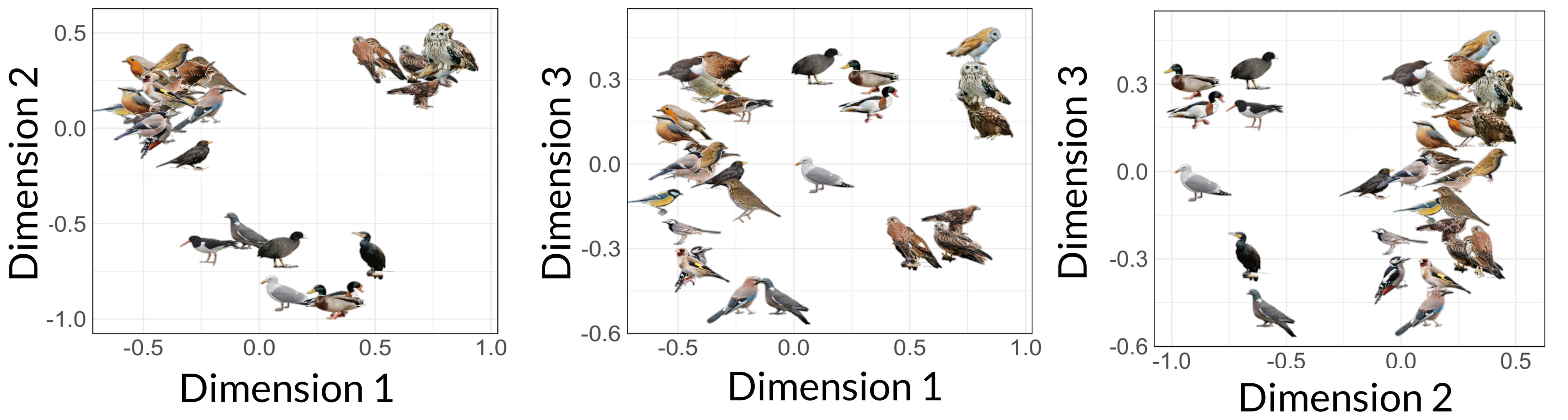


Step (4) JUDGMENT EXPERIMENT

Procedure based on Pachur and colleagues[9,10]



RESULTS – MDS (Step 1 & 2)

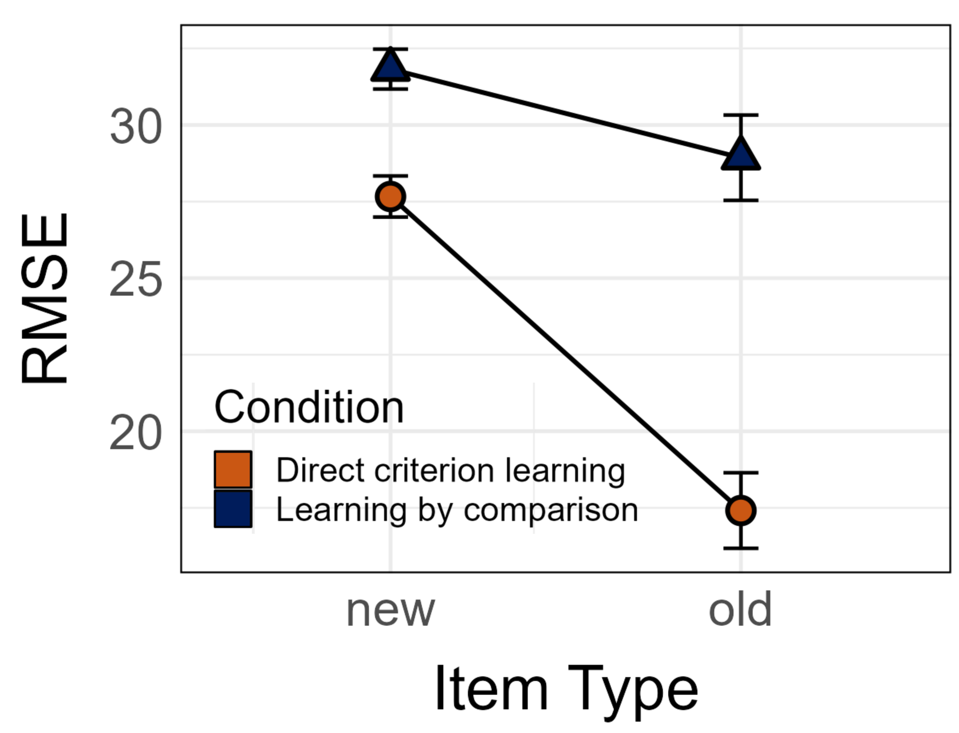


Based on the cross-validation procedure (Step 2) **three dimensions** best describe the aggregated pairwise similarity ratings.

High correlation between the observed and predicted pairwise distances (r(494) = .93, p < .001).

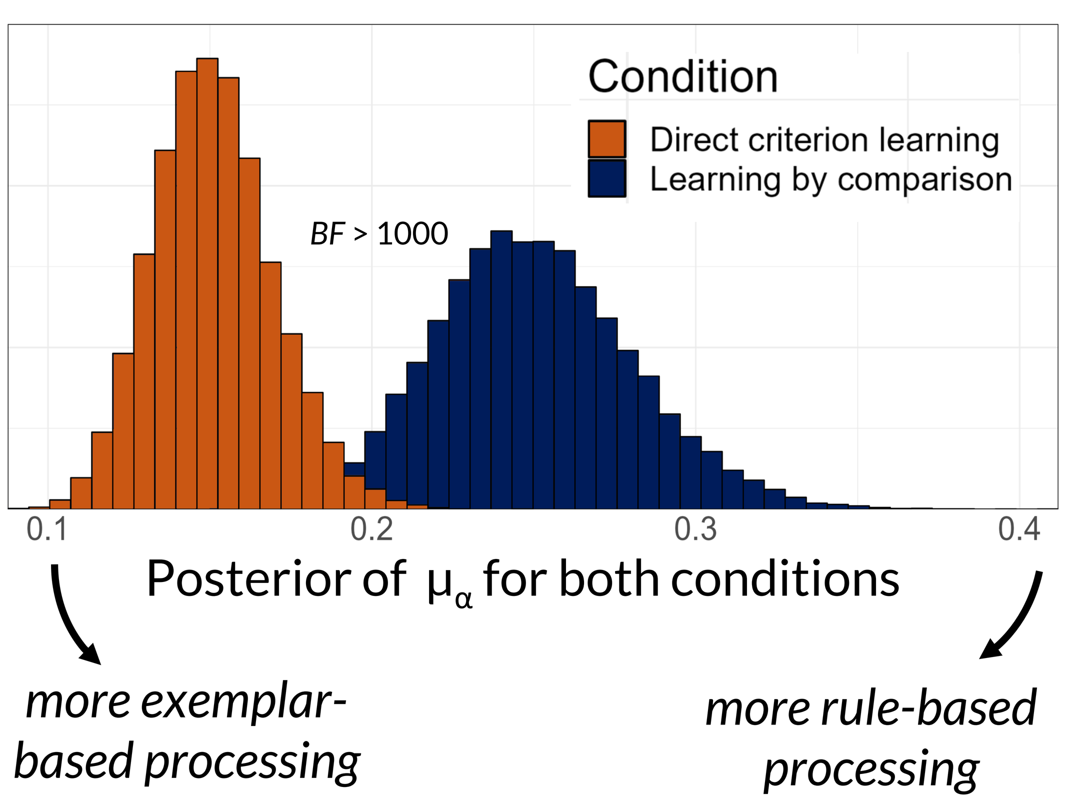
RESULTS - Experiment (Step 3 & 4)

Judgment Performance in Testing Phase
Step (4)



Better performance (i.e., lower RMSE) for **old items** (F(1, 76) = 67.18, p<.001, $\hat{\eta}^2_G$ = .208) and in the **direct criterion learning condition** (F(1, 76) = 40.31, p <.001, $\hat{\eta}^2_G$ = .272)

Cognitive Modeling
Step (3)



As in Pachur & Olsson (2012) and Trippas & Pachur (2019): **More rule-based processing** when trained with **learning by comparison** than with **direct criterion learning**

Discussion

Goldstein and Hogarth (1997, p.37): *"To what extent can we generalize from laboratory studies with abstract tasks [and artificial stimuli] to behavior in the real-world domains?"*

General Results:

- Able to model judgments of complex stimuli when MDS-generated cues are used in cognitive models of quantitative judgments
- Replication of previous experiments[9,10] with complex naturalistic stimuli

(Some) Open Questions:

- Quality of extracted cues
- Differences between methods to extract features or collect similarity ratings
- Improvable model fit (for some participants)

Literature:

[1] Juslin, P., Olsson, H., & Olsson, A. C. (2003). 10.1037/0096-3445.132.1.133
[2] Hoffmann, J. A., von Helversen, B., & Rieskamp, J. (2016). 10.1037/xlm0000241
[3] Einhorn, H. J., Kleinmuntz, D. N., & Kleinmuntz, B. (1979). 10.1037/0033-295X.86.5.465
[4] Nosofsky, R. M. (1984). 10.1037/0278-7393.10.1.104
[5] Bröder, A., Gräf, M., & Kieslich, P. J. (2017). 10.1017/S1930297500006513
[6] Shin, H. J., & Nosofsky, R. M. (1992). 10.1037/0096-3445.121.3.278
[7] Nosofsky, R. M., Sanders, C. A., Meagher, B. J., & Douglas, B. J. (2018). 10.3758/s13428-017-0884-8
[8] Shepard, R. N. (1962). 10.1007/BF02289630
[9] Pachur, T., & Olsson, H. (2012). 10.1016/j.cogpsych.2012.03.003
[10] Trippas, D., & Pachur, T. (2019). 10.1037/xlm0000696

Link to Paper