An examination of the effect of temporal and spatial arrangement of stimuli on spatial choice behavior with pigeons

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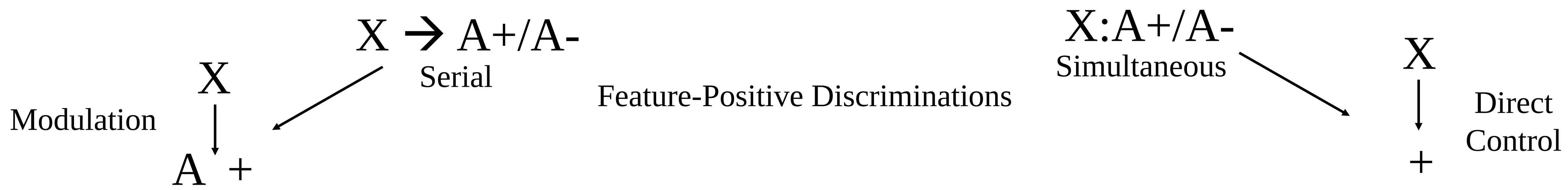
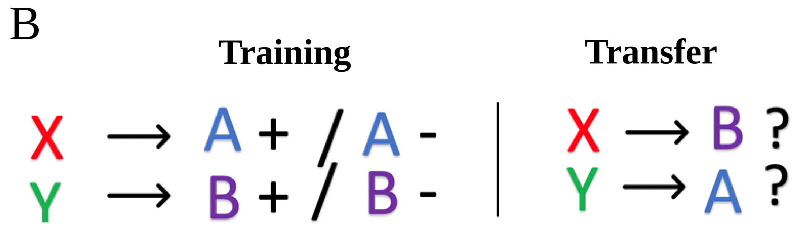
Introduction

- Animals in nature must learn to discriminate stimuli that are relevant to their survival. For example, an animal may learn to discriminate between nutritious and nonnutritous berries.
- One stimulus can modulate how an animal responds to another stimulus. For example, an animal might experience the location of berries (stimulus A) that taste ripe (+, reinforcement) when they forage in the morning (X), but not at other times when the most nutritious berries (A-, no reinforcement) have already been eaten.
- If the stimuli are encountered one after the other (serially), then they could learn that the value of berries at that location (A) is dependent on the time of day (X). However, if they are encountered together (simultaneously), then they are likely to only learn about the more noticeable stimulus (X).



- After training, we can present another stimulus (B) with stimulus X. Stimulus B has also signaled ripe berries in the same temporal relationship (serial or simultaneous), but at a different spatial location. If there is direct control, then animals should go to the site of berries paired with X. If there is modulation, then animals should go to the site of berries signaled by B.

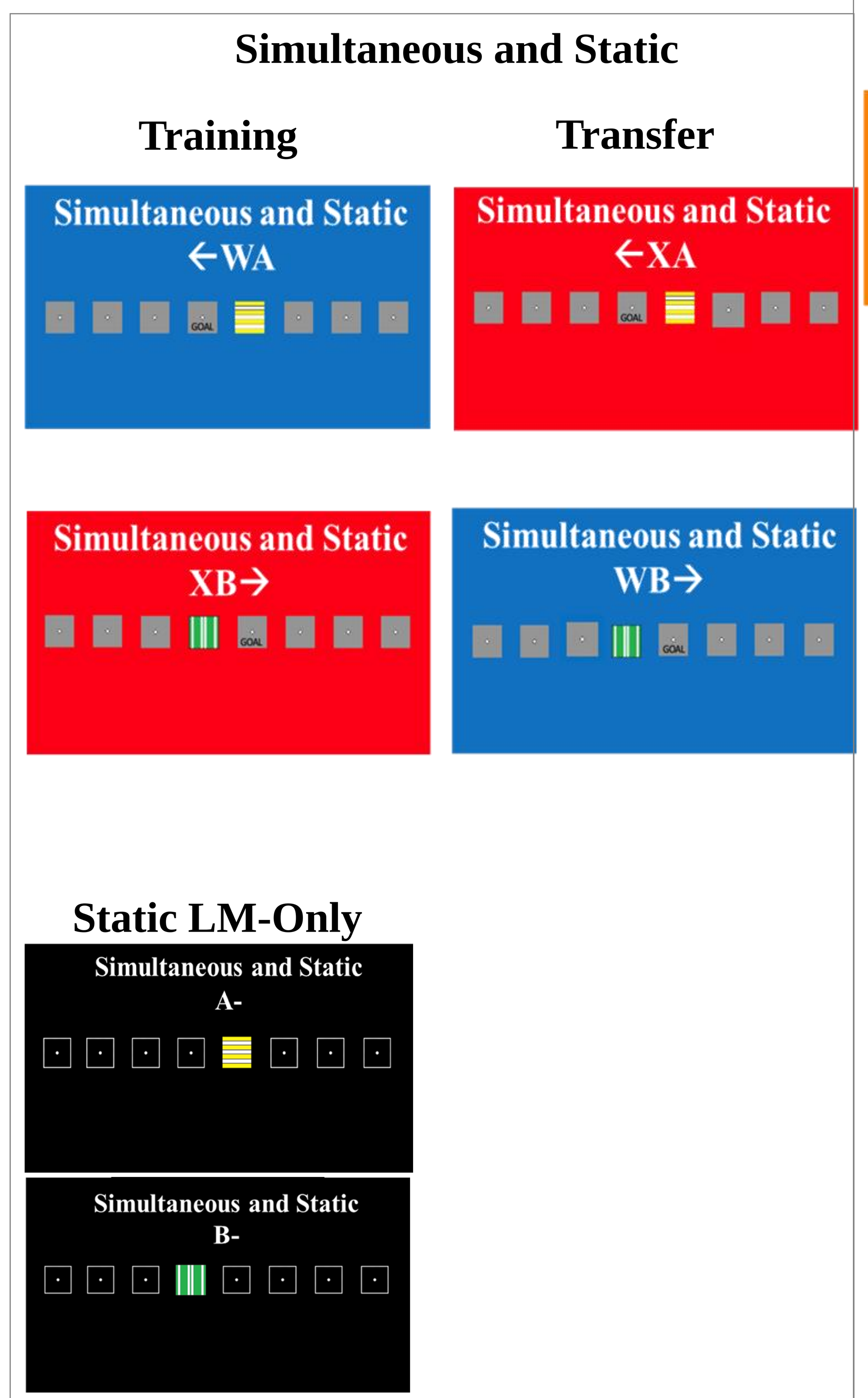


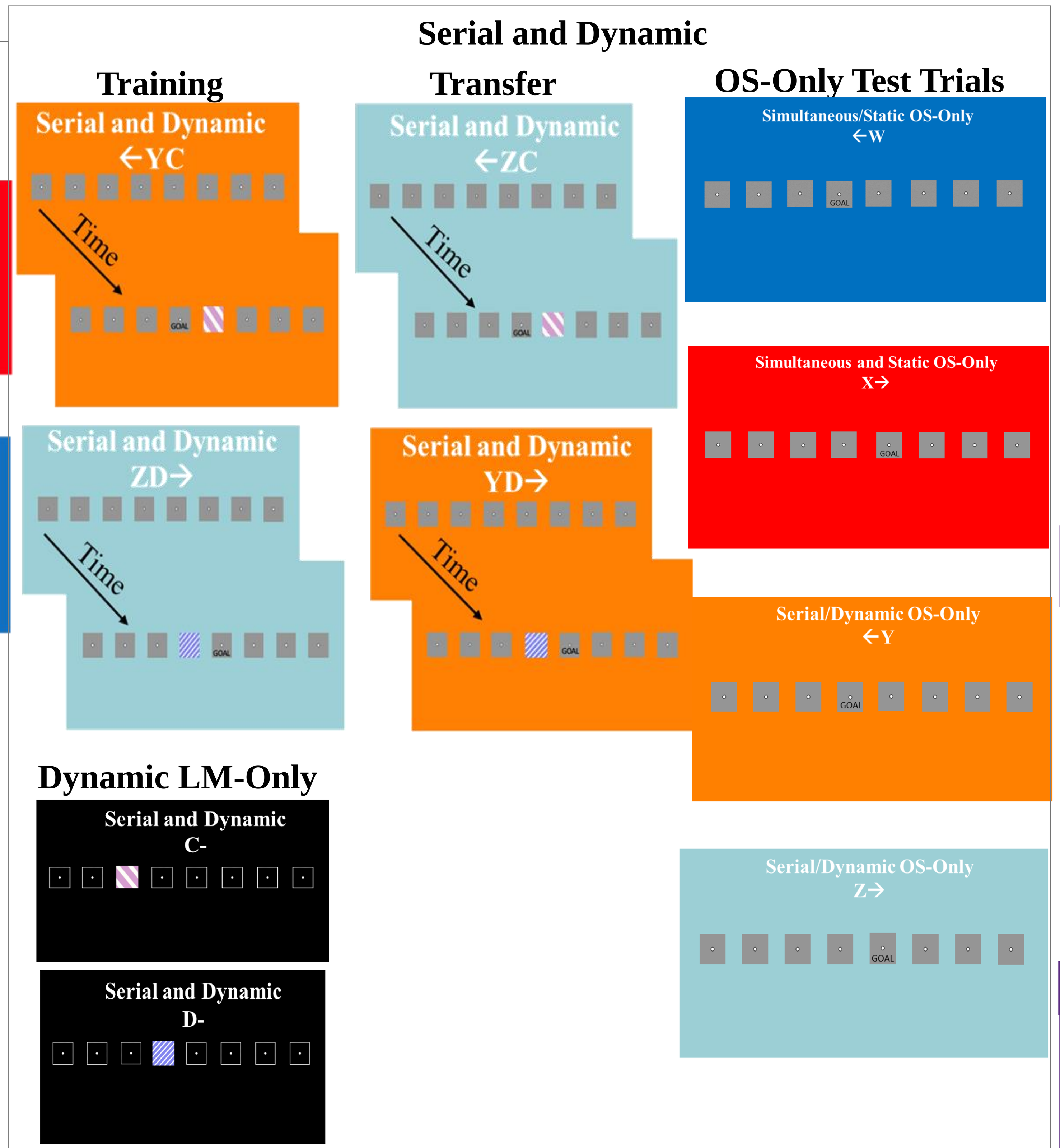
- The present experiment utilizes this procedure to determine whether X (a diffuse colored background) could modulate responding to A using visual stimuli on a touchscreen display. We examined whether manipulations to the temporal presentation of X and A (i.e., serial vs. simultaneous presentations) and the stability of the spatial relationship between X and the reinforced location (i.e., dynamic vs. static) would result in modulation or direct control.

Method

Subjects. Three white Carneau pigeons (*Columbia livia*).

Apparatus. Subjects were trained and tested in a flat-black plexiglass chamber. The front wall of the chamber was composed of an LCD computer monitor equipped with an infrared sensor frame that was capable of detecting responses to the screen.





Results

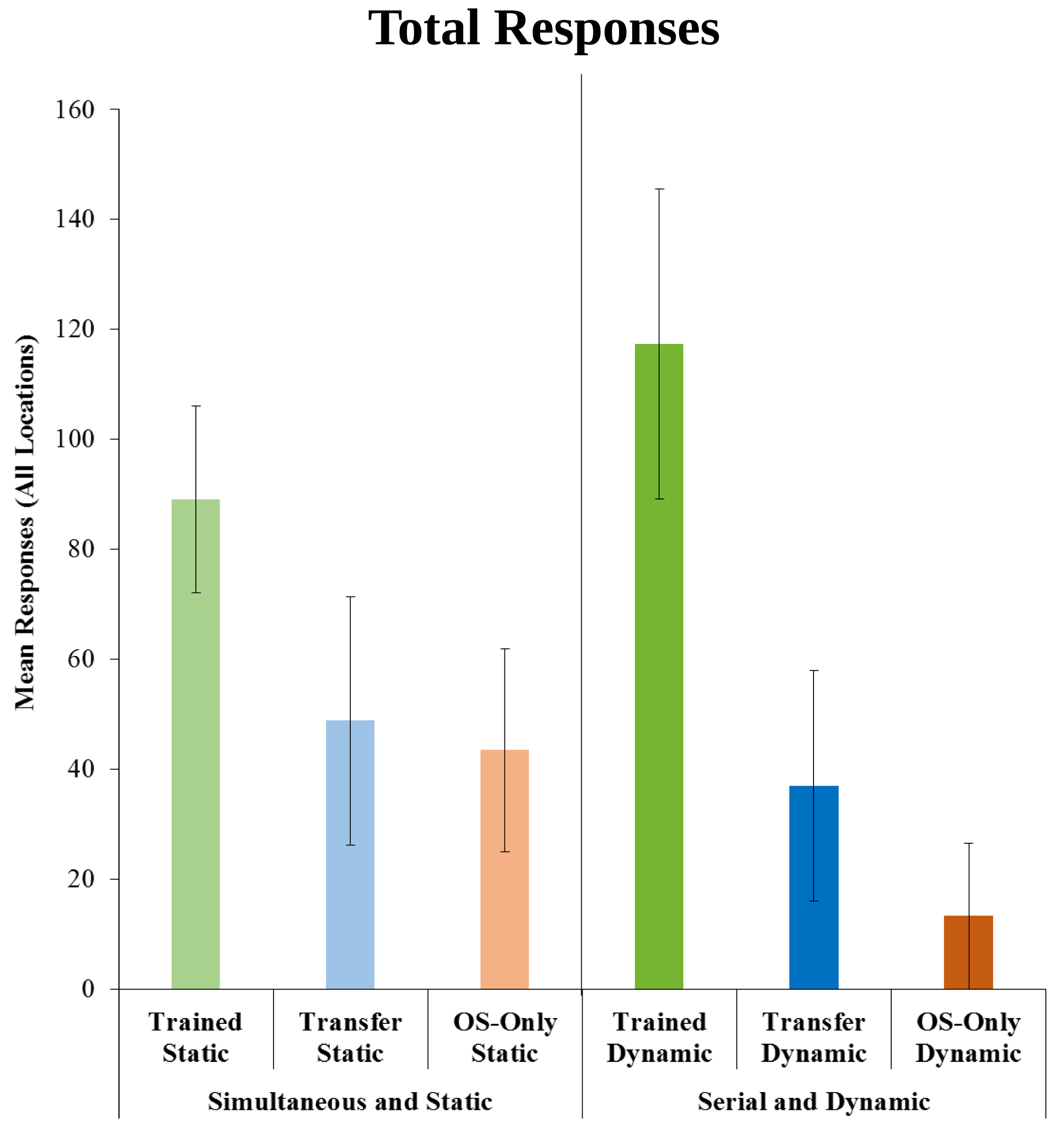


Figure 3. Two repeated measures ANOVAs were performed on Number of Responses (All Locations) with Trial Type (Simultaneous/Static [left panel] and Serial/Dynamic [right panel]: Trained, Transfer, vs. OS-Only) and Session (1-4) as repeated measures. For Simultaneous and Static, there was a main effect of Trial Type, $F(2, 4) = 23.90$, $p = .006$. The main effect of Session and the interaction were nonsignificant, *p*s >.48. For the main effect of Trial Type, follow-up tests using Bonferroni's adjustment revealed a marginally significant difference between Trained and OS-Only trial types, $p = .07$. All other comparisons were nonsignificant, *p*s > .16. For Serial and Dynamic, there was a main effect of Trial Type, $F(2, 4) = 53.02$, $p < .001$, of Session, $F(3, 6) = 6.62$, $p = .03$, and the interaction, $F(6, 12) = 3.26$, $p = .04$. Follow-up tests using Bonferonni's adjustment were conducted on the main effects and interaction. For the main effect of Trial Type, there was a significant difference between trained and transfer trial types, $p = .02$, and a marginal difference between trained and OS-Only trial types, $p = .06$. All comparisons for the main effect of Session were nonsignificant, *p*s > .28. For the interaction, there were no differences in responding for trained and OS-Only across sessions, *p*s > .92. For transfer trial types, responding was lower in sessions 3 and 4 compared to session 1, *p*s < .03.

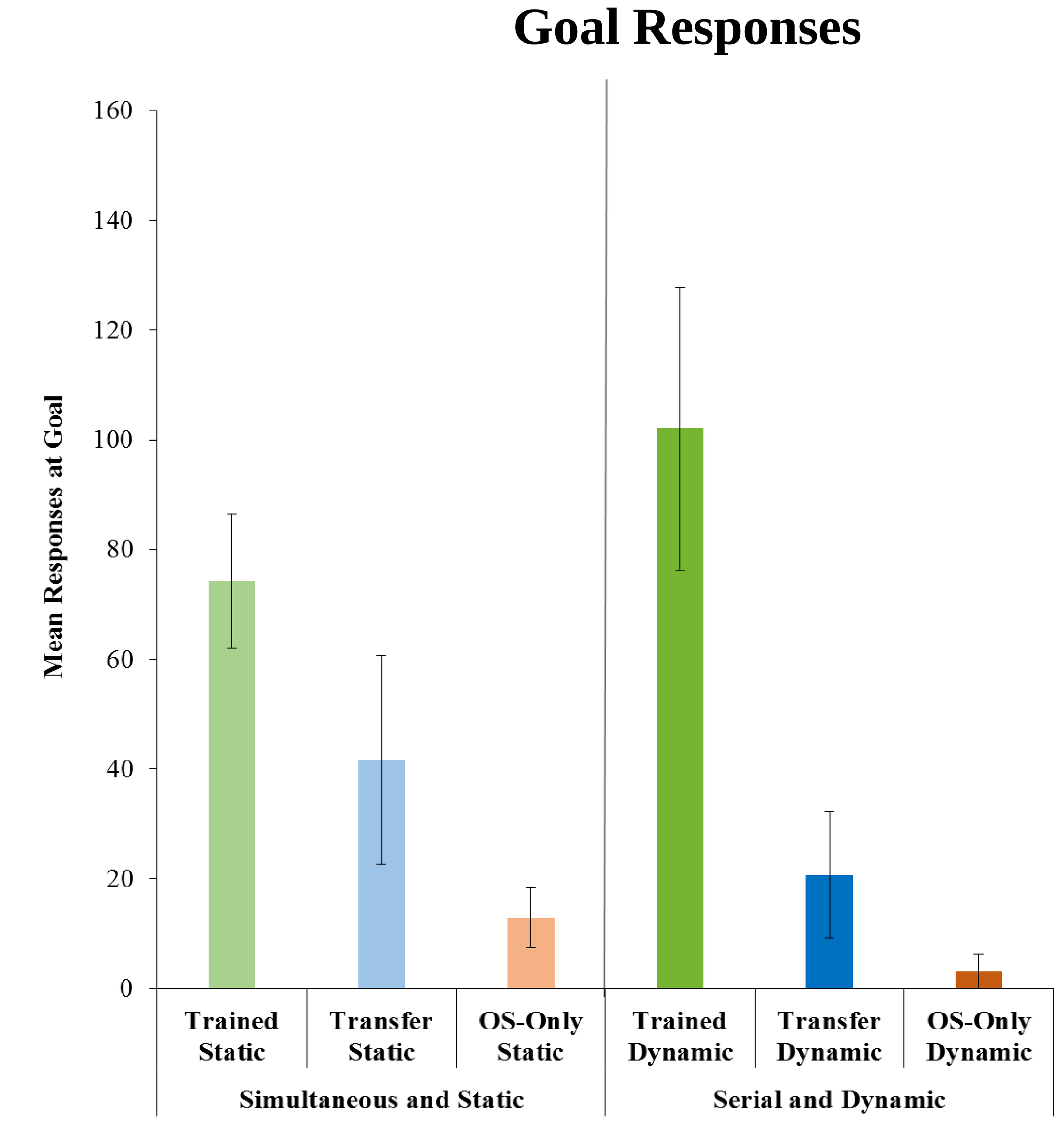


Figure 4. Two repeated measures ANOVAs were performed on Number of Responses at the goal location with Trial Type (Simultaneous/Static [left panel] and Serial/Dynamic [right panel]: Trained, Transfer, vs. OS-Only) and Session (1-4) as repeated measures. For Simultaneous and Static, there was a main effect of Trial Type, $F(2, 4) = 14.70$, $p = .01$. The main effect of Session and the interaction were nonsignificant, *p*s >.35. For the main effect of Trial Type, follow-up tests using Bonferroni's adjustment revealed that there were no differences between trained and transfer trial types, $p = .28$, or between transfer and OS-only trial types, $p = .58$. There was a significant difference between trained and OS-only trial types, $p = .04$. For Serial and Dynamic, there was a main effect of Trial Type, $F(2, 4) = 20.62$, $p = .008$, and a main effect of Session, $F(3, 6) = 18.06$, $p = .002$, but no significant interaction, $p = .34$. Follow-up tests using Bonferroni's adjustment were conducted on the main effects. All comparisons were nonsignificant for the main effect of Trial Type, *p*s > .10. For the main effect of session, there was a marginal difference between sessions 3 and 4, $p = .07$, with fewer responses at the goal in session 4.

Discussion

- Temporal arrangement and spatial stability altered how much pigeons responded. In both conditions, they responded more when the original pairs (e.g., WA) were presented than when Stimulus W, X, Y, or Z (OS-only) were encountered alone. Our current data indicate no difference between the original pairs and the transfer pairs (e.g., XA) with simultaneous and static paired stimuli, but there was a difference with serial and dynamic paired stimuli (YC).
- On simultaneous and static trial types, pigeons responded to the goal location as much on trained (e.g., WA) and transfer trials (e.g., XA) and responded more to the goal on trained trials than they did on OS-only trials. However, on serial and dynamic trial types, responses to the goal location did not differ across the different trial types.
- The current data only include three out of seven pigeons. As a result, the current data do not reveal any differences between trained and transfer, but more data will likely reveal that in both conditions, pigeons performed better with trained than transfer test trials. However, we do not expect that more data will reveal differences between simultaneous/static and serial/dynamic trial types which would indicate that both conditions resulted in the same learning.
- Feature-positive discriminations that include a spatial response led to different results than previous research. We have some hypothesis regarding why this may be the case. Further, additional tests, such as across-trial-type transfer (e.g., Simultaneous OS → Dynamic LM transfer) and OS extinction still need to be conducted.

References

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