



Multi-level motion features drive animacy perception from biological motion



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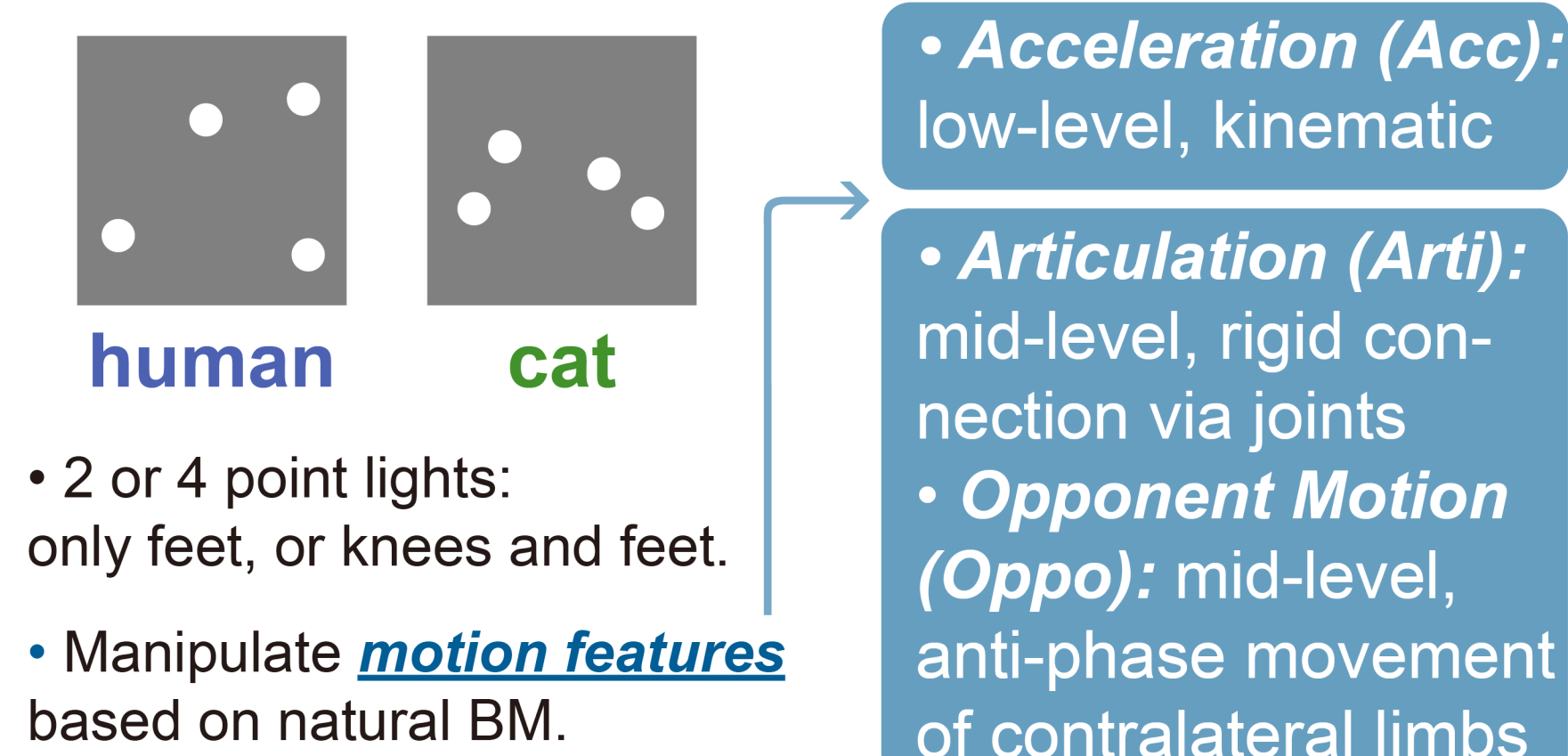
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Introduction

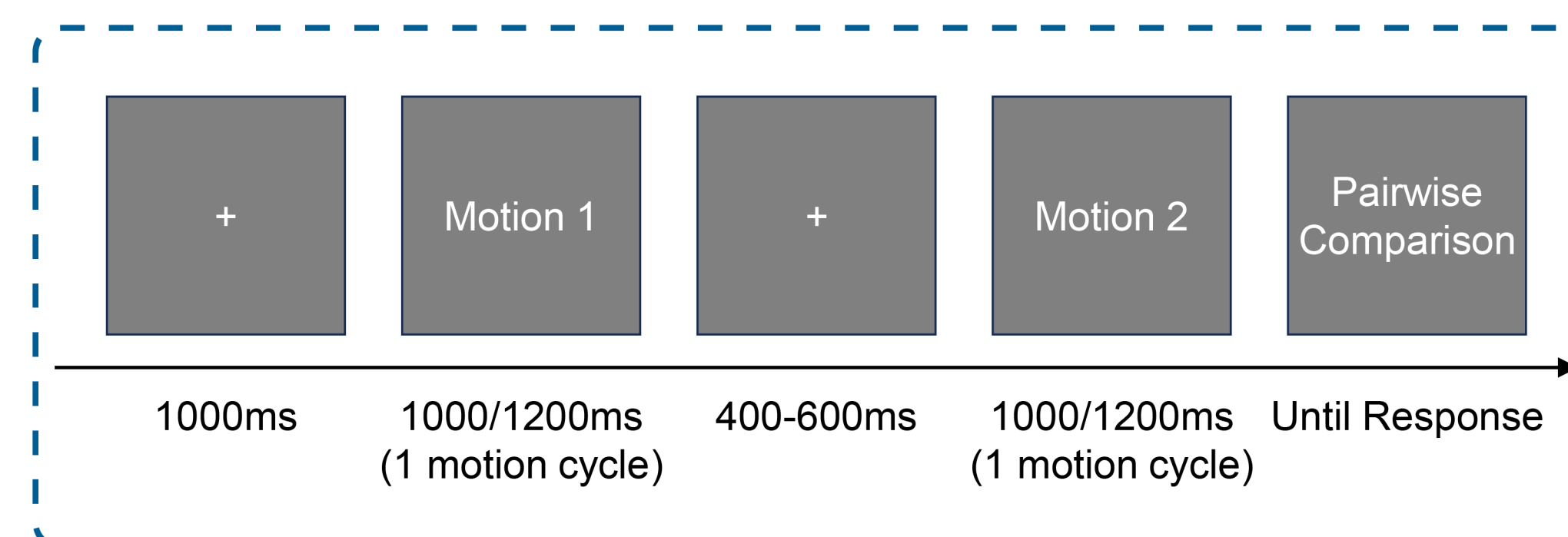
- Animacy Perception: perceiving an entity as alive or possessing a lifelike quality.
 - Biological Motion (BM), the movement produced by humans or other living creatures, can elicit rapid and spontaneous animacy perception.
- Question:** In the complex limb motion patterns of different species, are there any common and crucial motion features that drive animacy perception?

Methods & Results

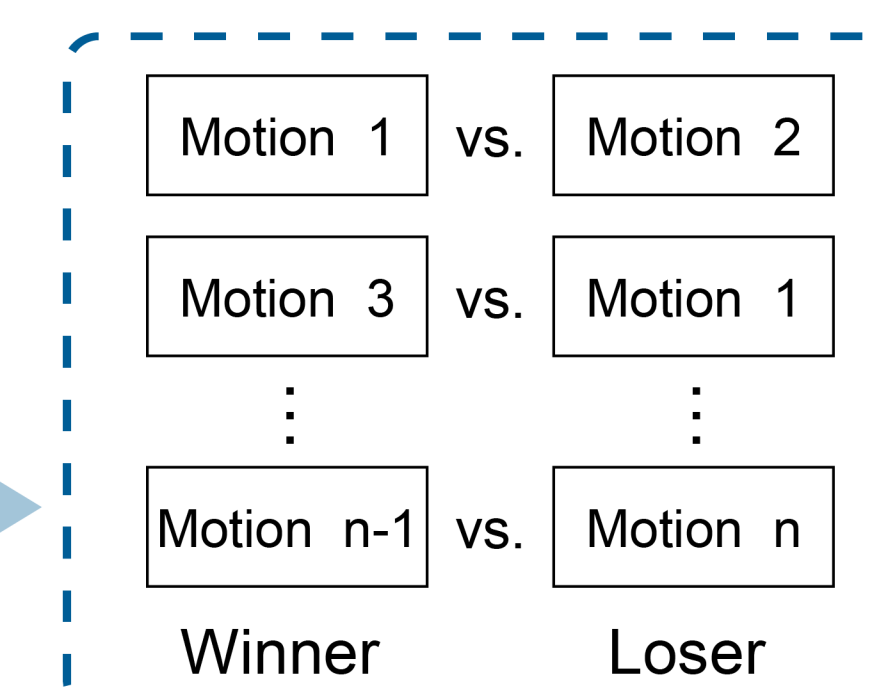
Stimuli



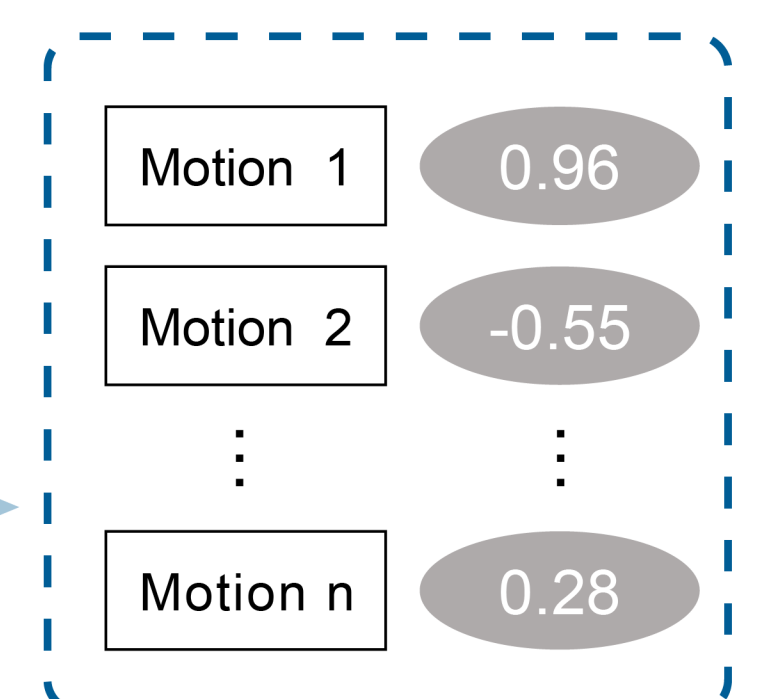
Pairwise Comparison Task: Which is more animated?



Comparison Results for Animacy

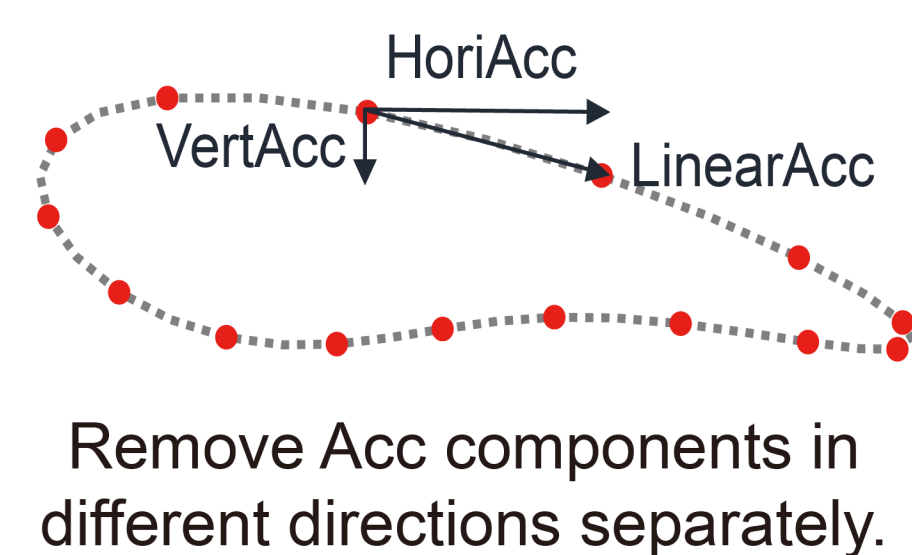
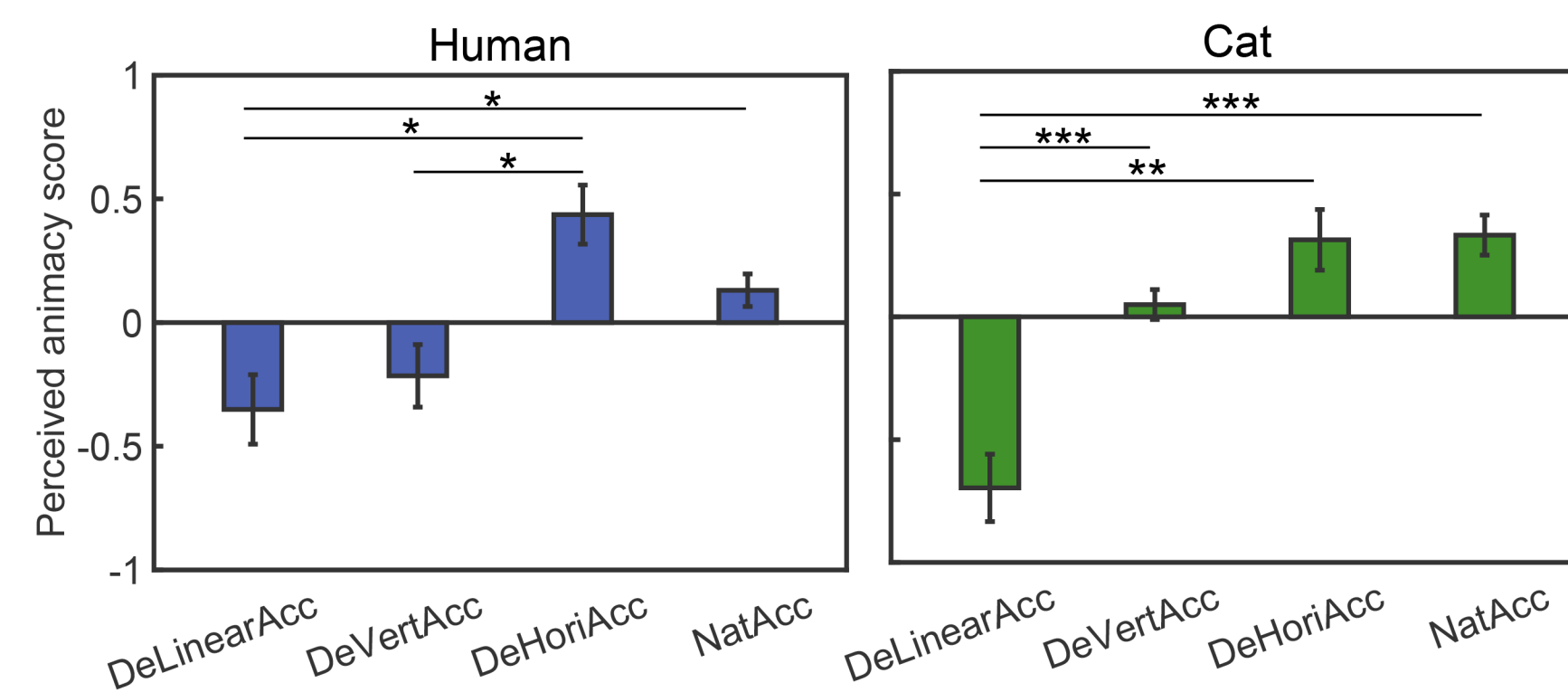


Perceived Animacy Scores



Exp.1 Foot Acceleration and its components

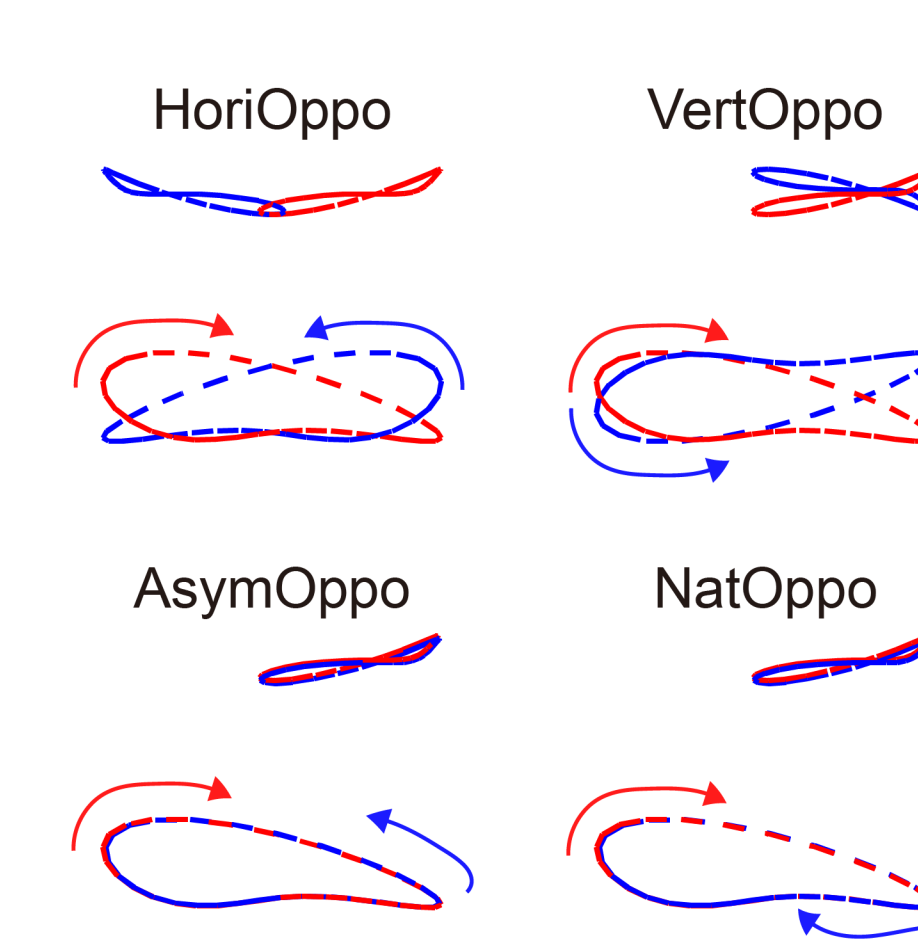
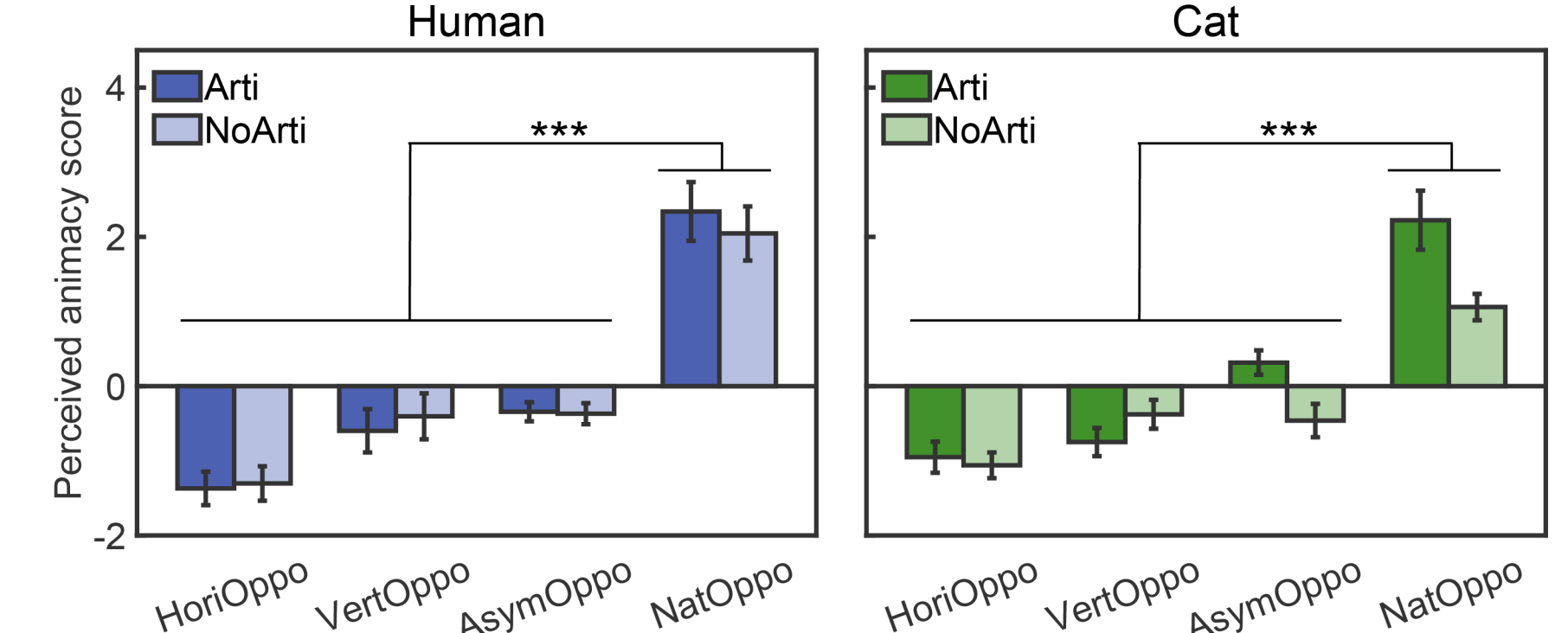
Foot Acc and its components:



- Foot Linear Acceleration plays a key role in animacy perception.
- Horizontal Acceleration has the weakest effect in animacy perception.

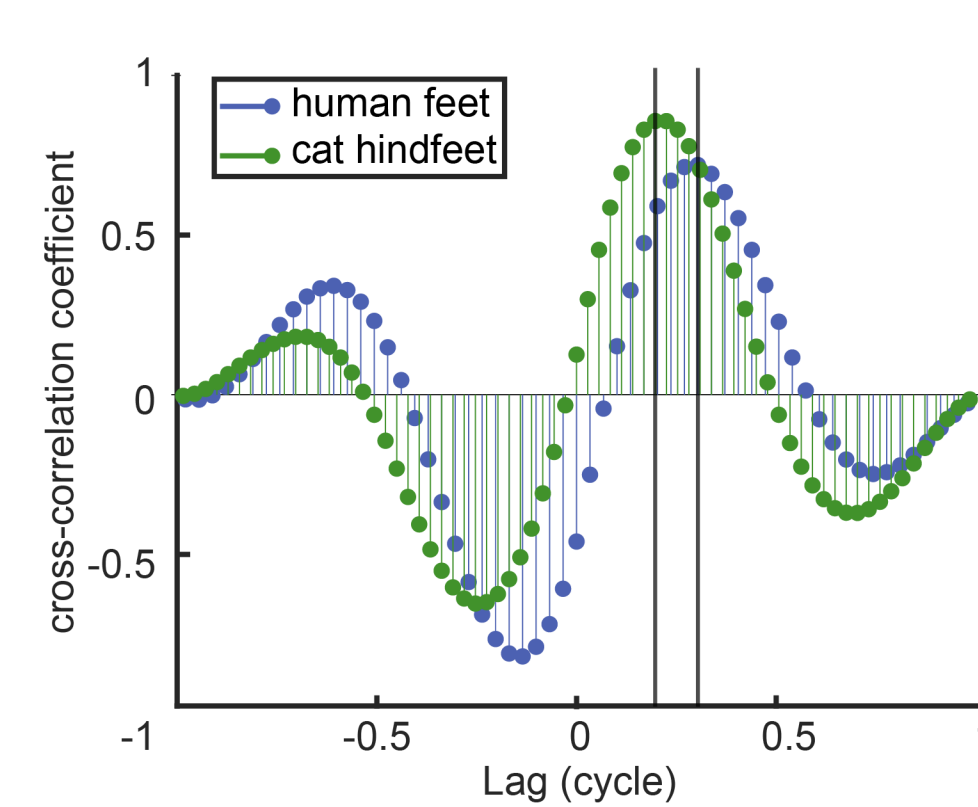
Exp.3a&3b Integration of Opponent Motion components

Exp.3a Different Oppo Components / Patterns:



- Horizontal and vertical Oppo components cannot drive strong percept of animacy alone or merely co-present (Asymmetrical Oppo), may require specific integration.

Exp.3b Phase Difference between Hori and Vert Oppo Components:

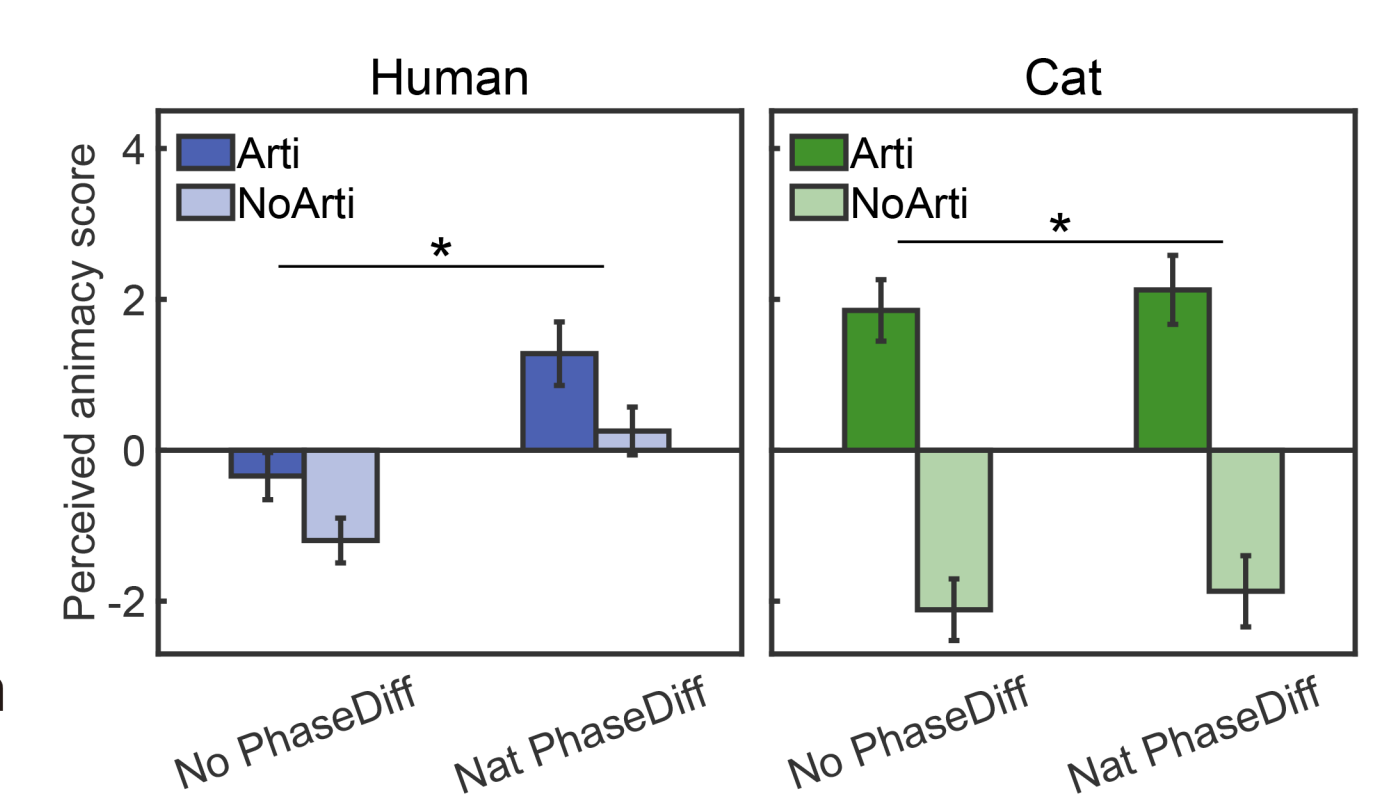


Natural Phase Diff:

Max cross-correlation between Hori and Vert Oppo components occurs at lag $\neq 0$.

No Phase Diff:

lag = 0 by adjusting phase relation between Hori and Vert Oppo.



Exp.2a&2b Interaction between Articulation and Opponent Motion

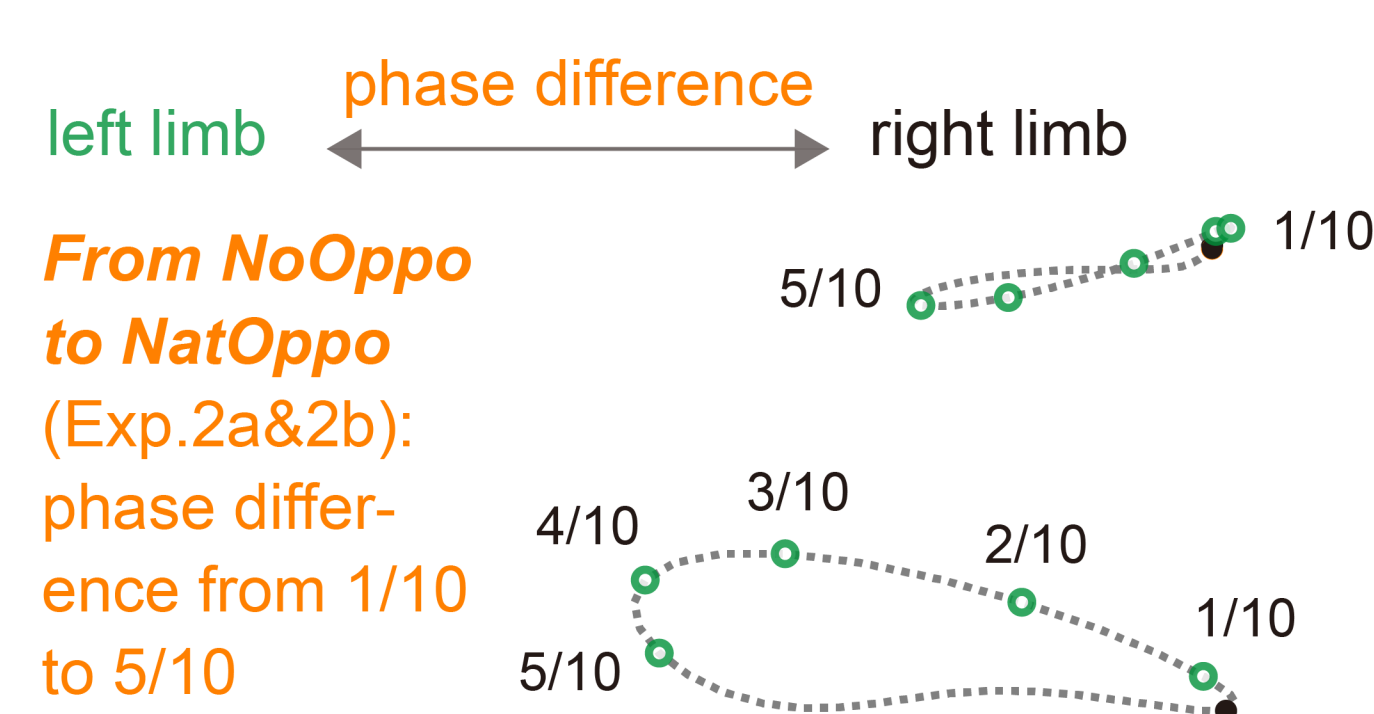
Manipulation of Arti:

Arti (Exp.2a&2b): natural knee-foot space and phase relations.

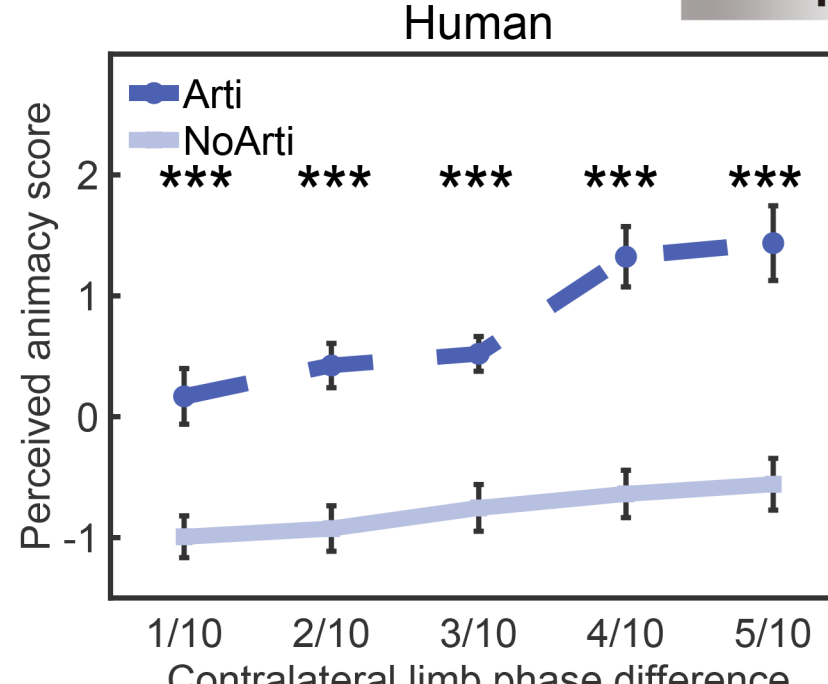
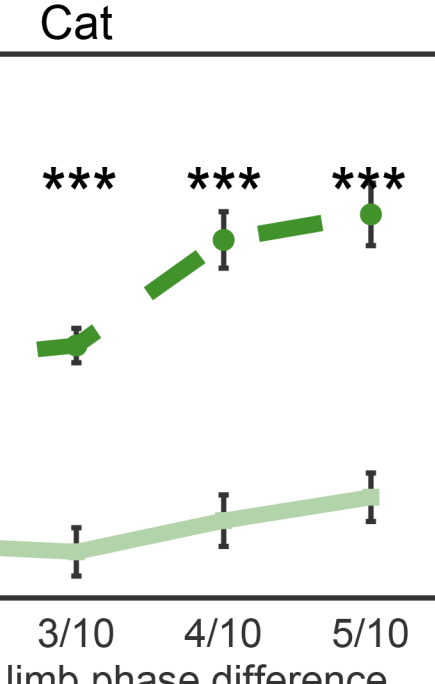
NoArti (Exp.2b): advance knee phase by 1/4 cycle to disrupt the natural knee-foot phase relationship.

NoArti (Exp.2a): vertically swap the positions of knee and foot.

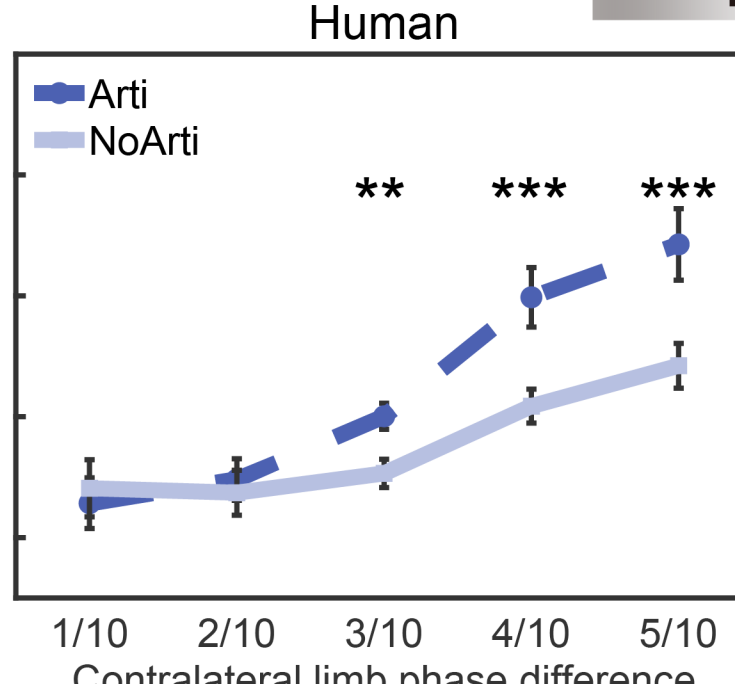
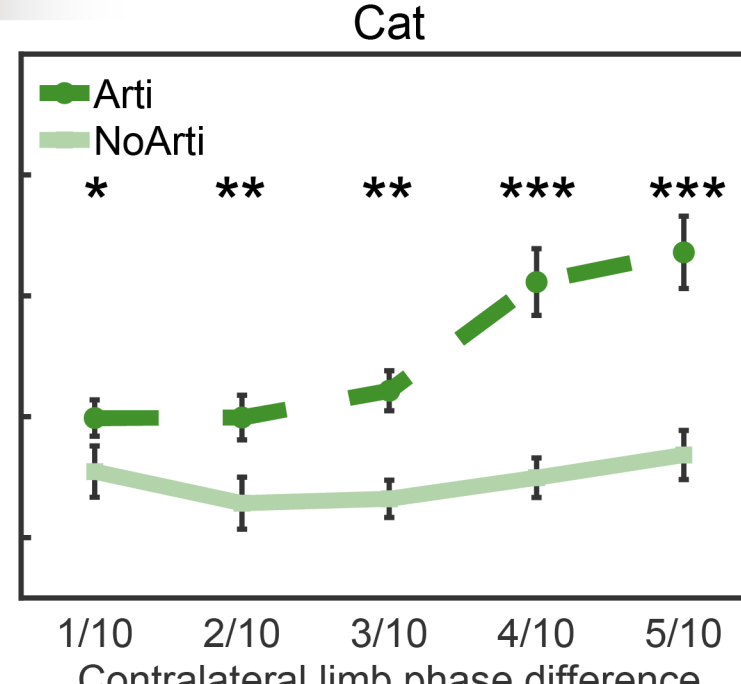
Manipulation of Oppo:



Exp.2a



Exp.2b



- Articulation and Opponent Motion contribute to animacy perception.
- A synergistic effect between these two features.

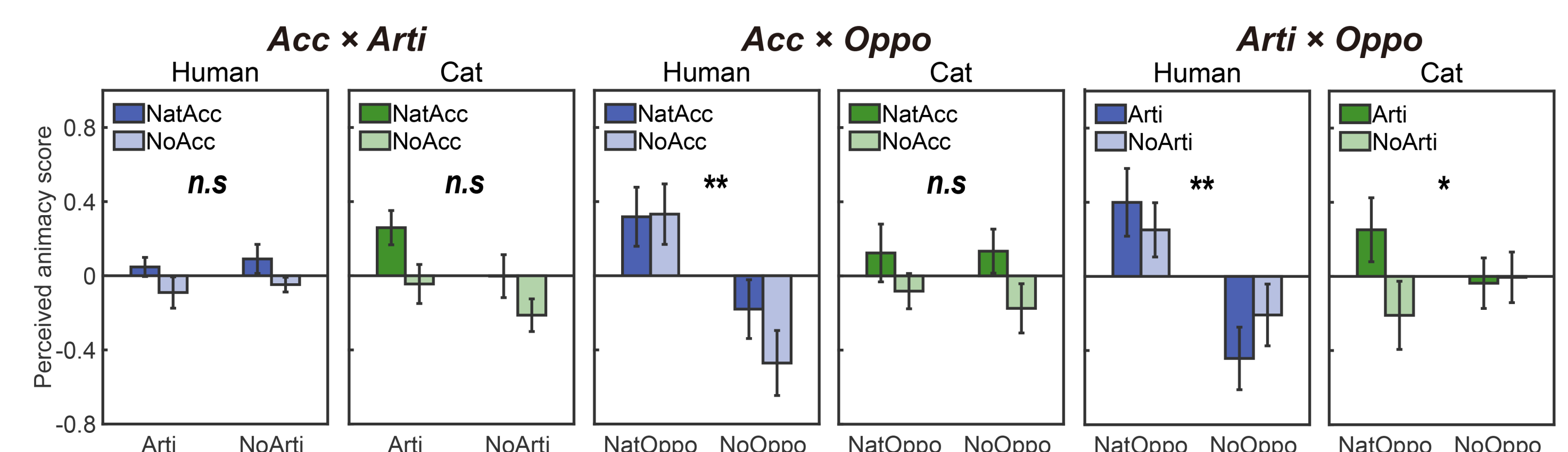
Conclusions

- Low-level (acceleration) and mid-level (articulation, opponent motion and phase difference between its components) motion features jointly drive animacy perception from cross-species biological motion.
- A synergistic effect between mid-level features and potentially distinct mechanisms for animacy perception from low- and mid-level features.
- These findings offer insights for establishing a theory of animacy perception integrating multi-level biological motion feature processing.

Exp.4 Relationships between multi-level features

2 × 2 × 2 Design:

- **NatAcc / NoAcc** (identical to DeLinearAcc in Exp.1)
- **Arti / NoArti** (identical to Exp.2b&3)
- **NatOppo / NoOppo** (identical to 1/10 Phase Difference in Exp.2)



- Low- (Acc) and mid-level (Arti, Oppo) motion features contribute largely independently to animacy perception.