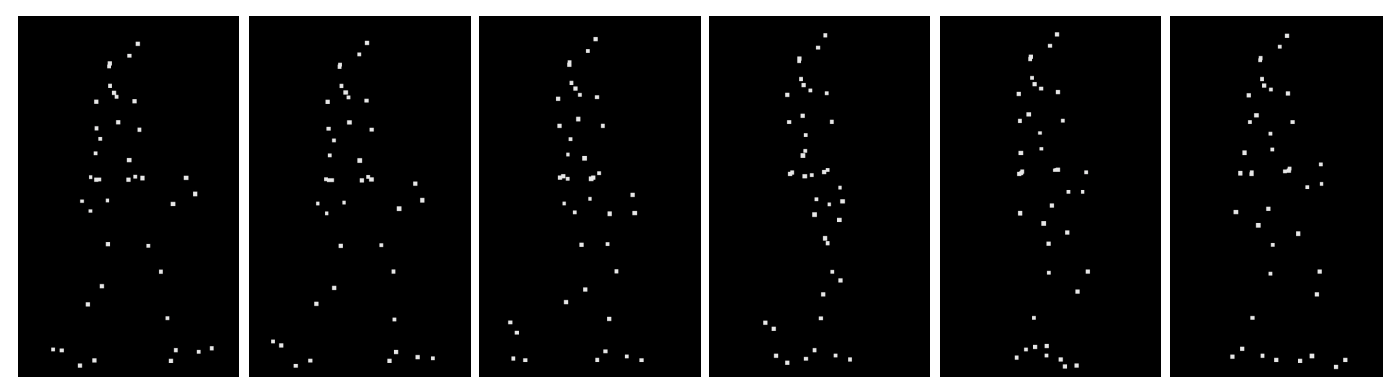


Background

Biological Motion: patterns of motion
→ characterize humans & animals in motion



Point Light Displays (PLDs)¹:

- attenuate body-shape cues
- isolate motion patterns → “sparse pictorial form-information about human body”¹

From PLDs, perception of:

- actions^{1,2}, gender³, & facial expression⁴
- American Sign Language⁵
- recognition of identity
 - self⁶ & familiar people^{7,8,9}
 - **However, weak support for familiar person recognition**
 - **No support for perception of identity from unfamiliar people**

Problem - Can we use identity cues in PLDs for unfamiliar person recognition?

- **identity-matching task for unfamiliar people**—relies on **perception** rather than **memory**
- **test conditions**
 - same-action** (identity comparisons based on body form cues; idiosyncratic aspects of particular action; & more general manner of motion e.g., flexibility, fluidity, expressiveness)
 - different-action** (eliminates idiosyncratic aspects of particular action style, reduces direct access to body form features)

Point Light Display Database

Motion Capture Data (C3D) from Carnegie Mellon University¹⁰

actions: walk, run, forward jump, box, jump in place, walk slowly, exaggerated walk, kick a ball

stimuli: 11 male actors for experiment

9 actors → same-action condition

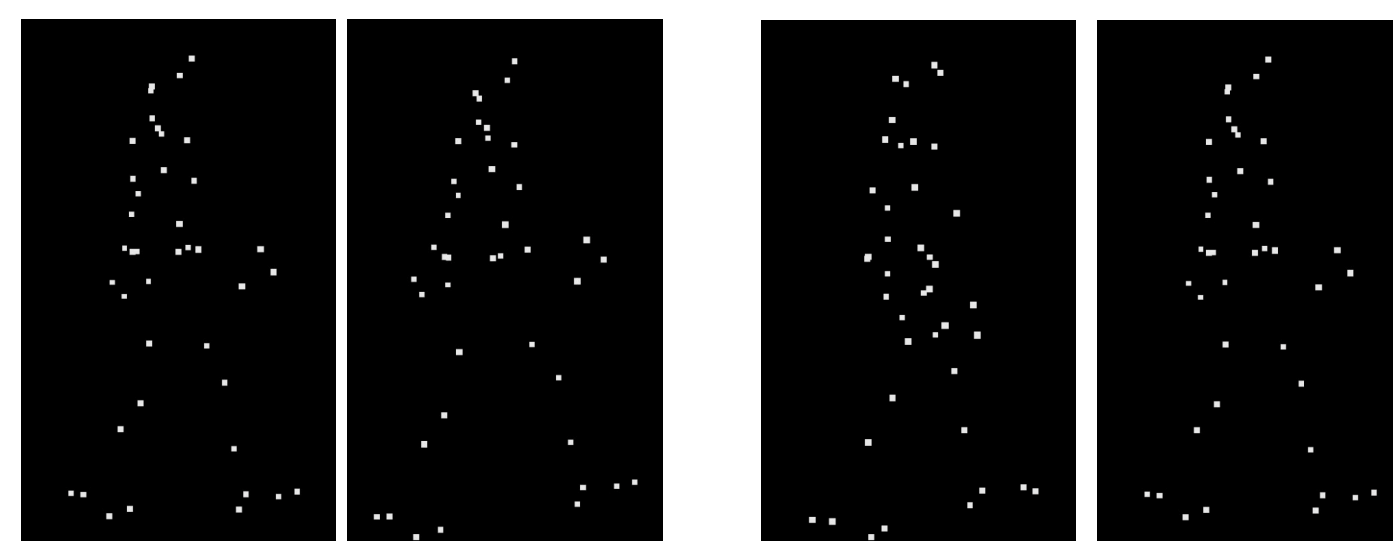
10 actors (8 actors were in same-action +2 “other”) → different-action condition

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- <http://mocap.cs.cmu.edu>

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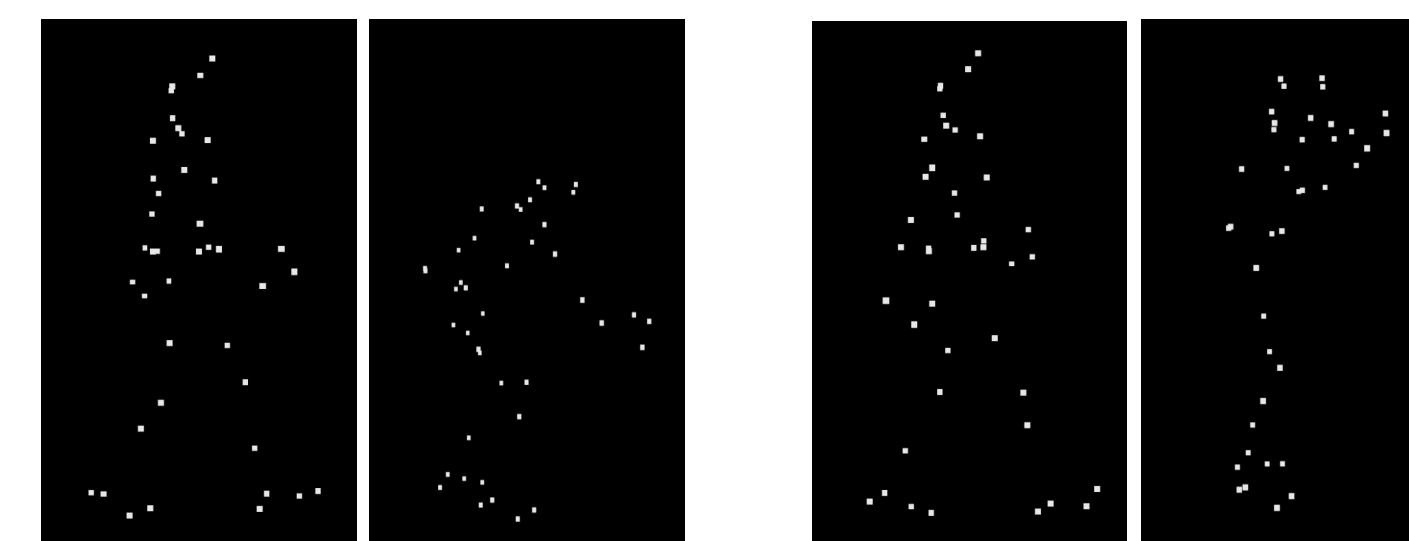
Same-Action Condition



Matched Identity

Non-Matched Identity

Different-Action Condition



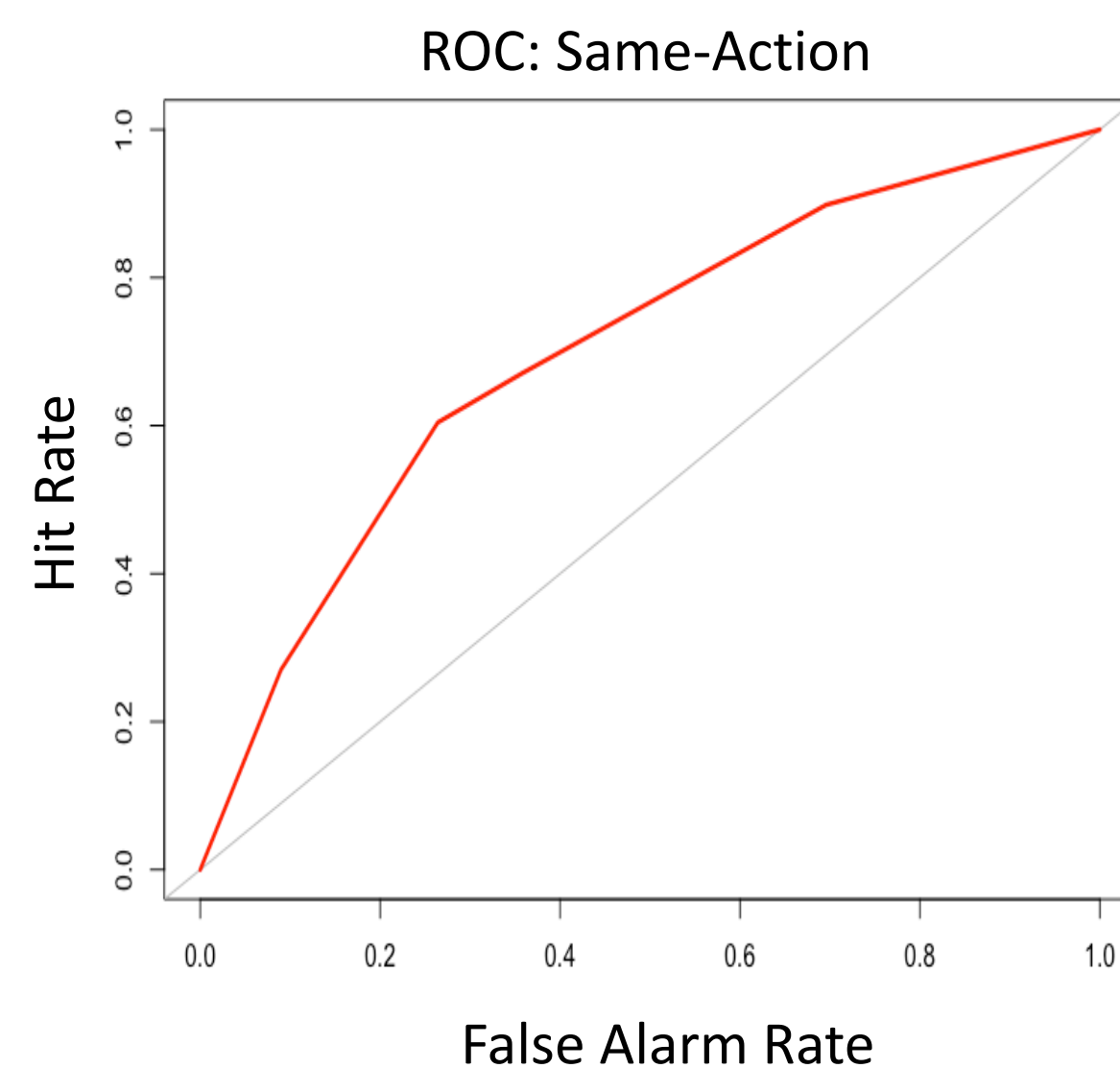
Matched Identity

Non-Matched Identity

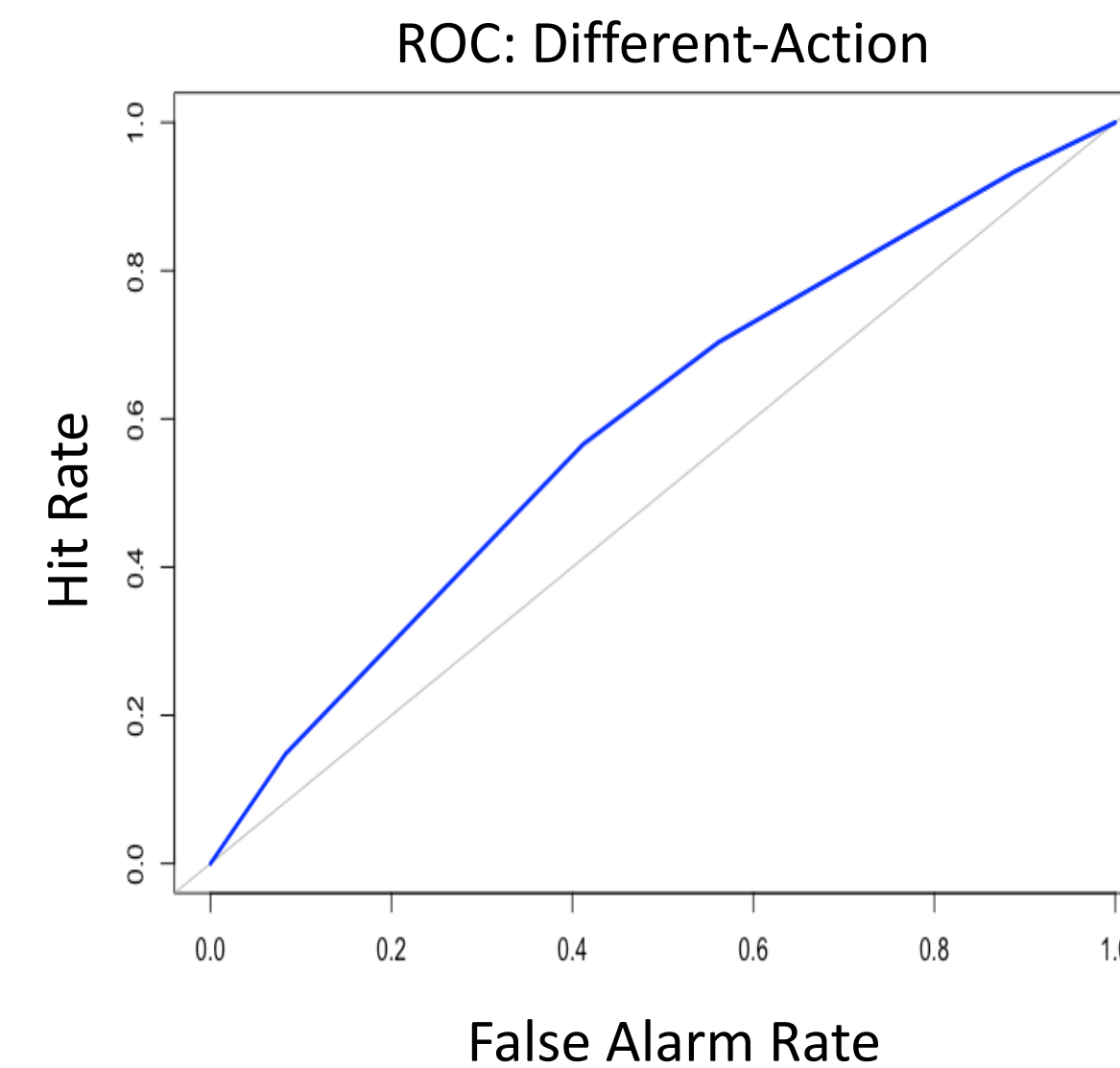
Experiment

- design:** one-factor repeated measures (within subjects)
- IV:** action pairing (same-action, different-action)
- DV:** area under the ROC curve (a-ROC)
- 5-pt rating scale (1: sure same identity ... 5: sure different identity)
- participants: $n = 39$ (23 female)
- mean age: 22.12
- 120 PLD pairs (60 matched- and 60 non-matched-identities)
- replayed x3
- counterbalanced conditions

- Same-action pairs:** walk ($n=42$), run (14), forward jump (6), box (3)
- average duration of videos = 3.01s
- Different-action pairs:** walk-run ($n=15$), walk-box (9), walk-forward jump (9), box-forward jump (6), walk-kick a ball, run-walk slowly, forward jump-walk slowly, run-jump in place (each 3), 7 other combinations (each 1–2 pairs)
- average duration of videos = 2.51s



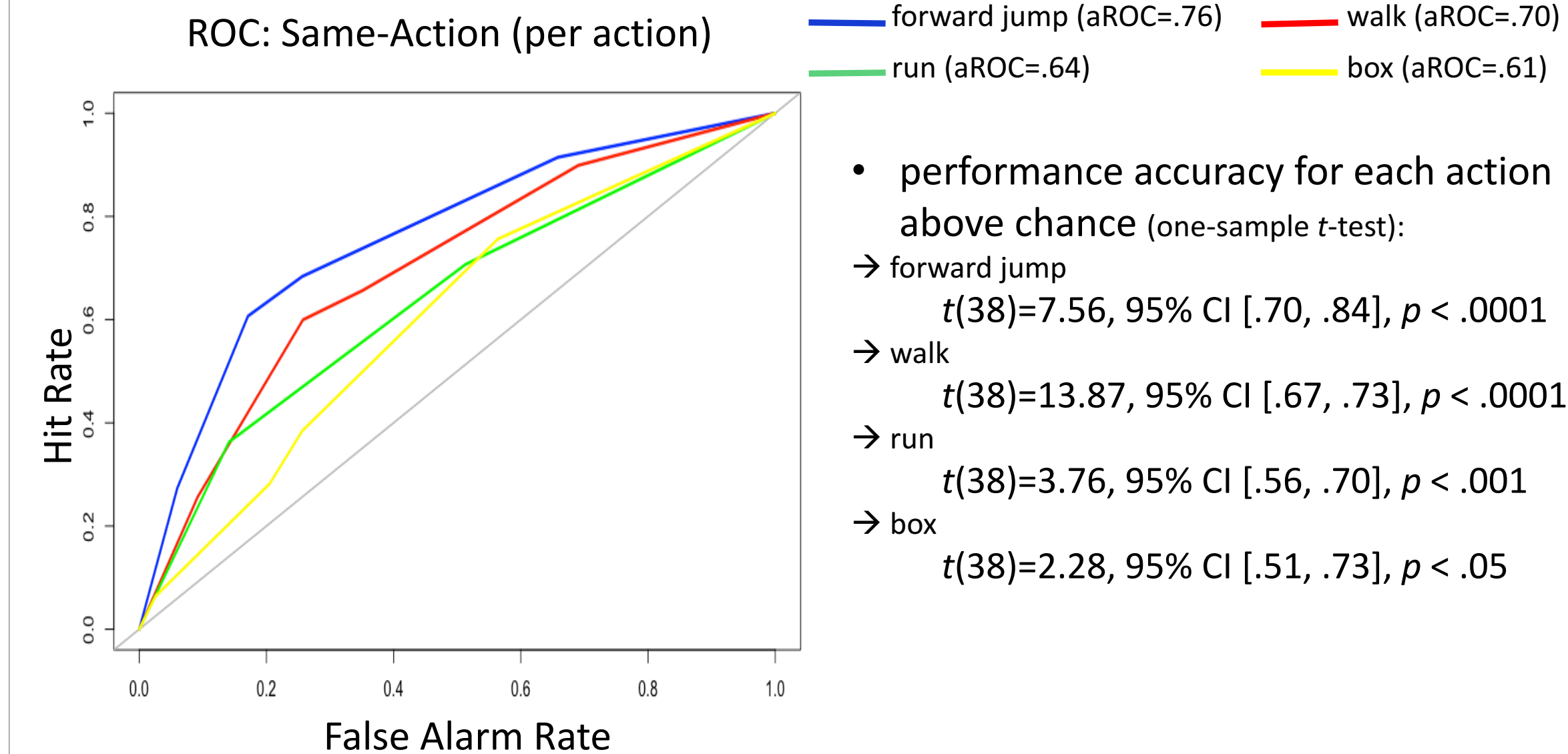
- mean a-ROC=.70, Min=.55, Max=.83
- performance accuracy above chance (one-sample t -test)
 $t(38)=17.53$, 95% CI [.68, .73], Cohen's $d = 3.98$, $p < .0001$



- mean a-ROC=.59, Min=.46, Max=.83
- performance accuracy above chance (one-sample t -test)
 $t(38)=7.06$, 95% CI [.57, .62], Cohen's $d = 1.6$, $p < .0001$

- Significant main effect of action pairing (paired t -test)
 $t(38)=6.47$, 95% CI [.074, .14], Cohen's $d = 1.3$, $p < .0001$

Same-Action & Performance



- performance accuracy for each action above chance (one-sample t -test):
- forward jump
 $t(38)=7.56$, 95% CI [.70, .84], $p < .0001$
- walk
 $t(38)=13.87$, 95% CI [.67, .73], $p < .0001$
- run
 $t(38)=3.76$, 95% CI [.56, .70], $p < .001$
- box
 $t(38)=2.28$, 95% CI [.51, .73], $p < .05$

Conclusion

- PL Biological Motion → identity-specifying information for same-and different actions
- cues → can be used to discriminate unfamiliar identities
- performance accuracy in same-action condition > different-action condition
 - same-action → cues to body form + specific action style + general movement
 - different-action → cues to body form + general movement
- quality of identity information varied with action type (cf.⁸):
 - performance accuracy for all was above chance
 - walking and running at chance⁸

Summary

- In combination with previous work^{5,4,6}, the current results suggest that PLDs cues not only provide information reliable for discriminating the identity of familiar people, but also for discriminating unfamiliar identities.

Future Work

- Study neural mechanism underpinning biological motion perception from PLD:
→ **fMRI-Adaptation experiment:** Neural processing of identity & action aiming to examine discriminability of neural response patterns for a single identity over different actions & for a single action over different identities

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