Is the motion of a child perceivably different from the motion of an adult?

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Motivation

Children and adults seem to move differently, is it perceivable?

“Run as Fast as You Can”

p921 – adult – run fast

p290 – child – run fast

Motivation

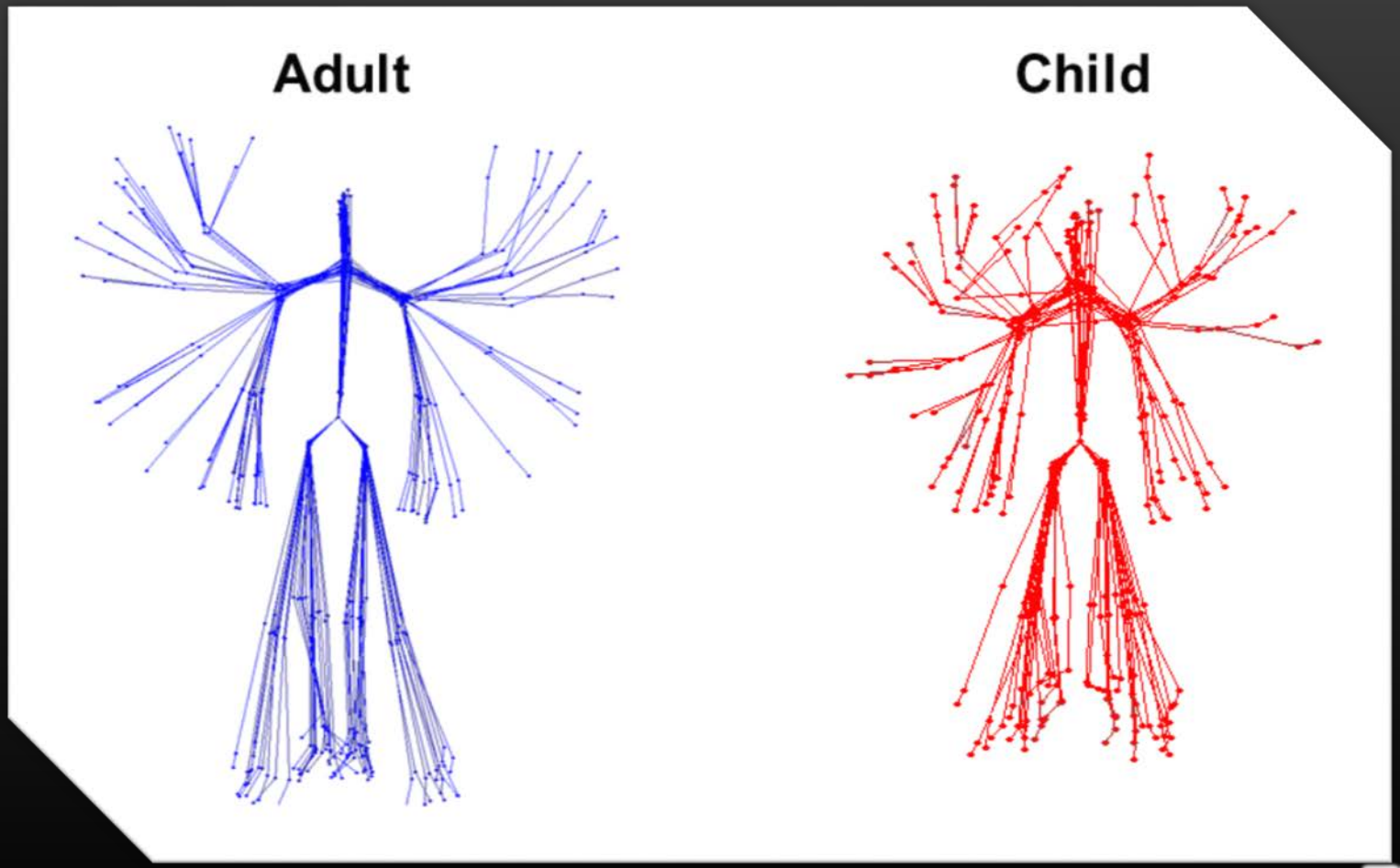
Understanding child motion can improve animation, interaction applications

Disney Pixar's Inside Out with 11 year old Riley

Exercise games for children, e.g., http://init.cise.ufl.edu/?q=Kinect

Motivation

Motion data for Jumping Jacks for an adult and a child

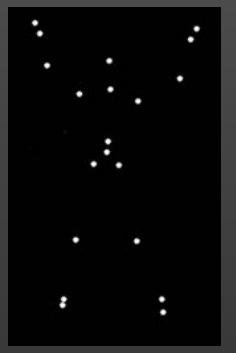


not scaled, pelvis locked

Related Work

- Studies of child motion (motion capture)
  - Quantifying and detecting **sensorimotor impairments** in children and teens
    [Delp et al, 2007; Rosengren et al, 2009; Sandlund et al, 2009; Sakuma et al, 2012; Chia et al, 2013]
  - Comparing **kinesthetic characteristics** of child and adult motion
    [Davis, 2001; Ivanenko et al, 2013]

Related Work



point light display

- Studies of child motion (motion capture)
  - Quantifying and detecting **sensorimotor impairments** in children and teens [Delp et al, 2007; Rosengren et al, 2009; Sandlund et al, 2009; Sakuma et al, 2012; Chia et al, 2013]
  - Comparing **kinesthetic characteristics** of child and adult motion [Davis, 2001; Ivanenko et al, 2013]
- Perception of human motion (point light displays) [Johansson, 1973]
  - Identification of **gender** [Cutting, 1978; Barclay et al, 1978; Pollick et al, 2002; Brooks et al, 2008]
  - Identification of **emotion** [Dittrich et al, 1996; Atkinson et al, 2004]
  - Identification of **self, friends, strangers** [Cutting & Kozlowski, 1977; Beardsworth & Buckner, 1981; Loula et al, 2005; Wellerdiek et al, 2013]
  - Perception of human motion **by children** [Fox & McDaniel, 1982; Pavlova et al, 2001; Golinkoff et al, 2002; Klin et al, 2009]

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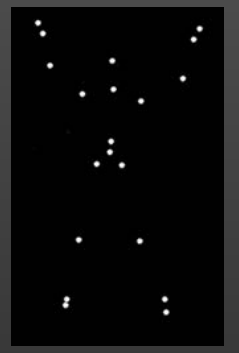

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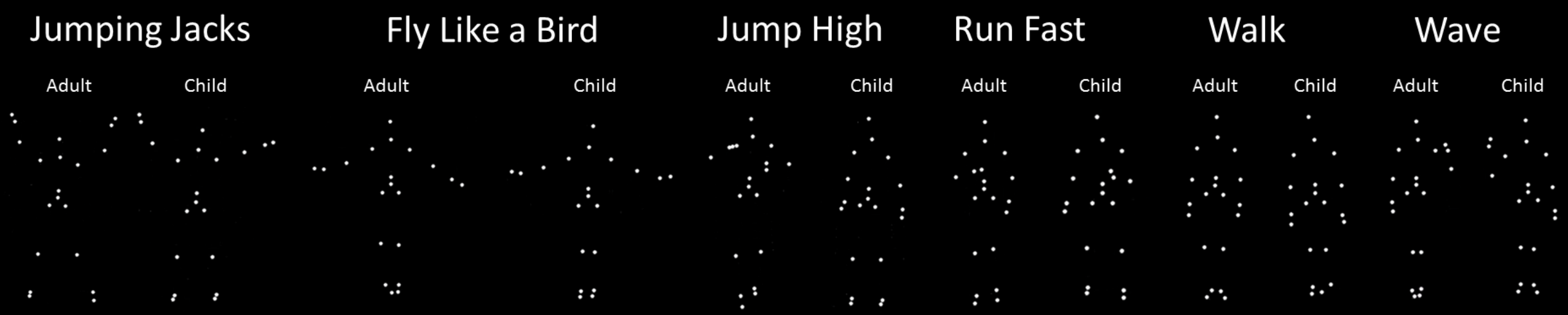
What's missing? Perception of child motion.

Research Question

- Is the motion of a child perceivably different from the motion of an adult?



frames from our point light display videos for each action type

Stimuli Preparation

Motion data from 4 adults (ages 22-32, male) and 4 children (ages 5-9, 2 female)

Hip CenterX	Hip CenterY	Hip CenterZ	…	Foot RightZ
-0.17374	-0.30287	3.197146	…	3.195797
-0.16883	-0.30114	3.200149	…	3.198999
-0.16739	-0.30105	3.201977	…	3.200875
…	…	…	…	…
-0.21039	-0.27464	2.879612	…	2.823143

sample of joint data from Kinect

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$$\mu_y = \frac{\sum_{i=1}^{N} \sum_{j=1}^{20} y_i^j}{20 * N}$$

height scaling formula (moves camera)

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$$\mu_y = \frac{\sum_{i=1}^{N} \sum_{j=1}^{20} y_i^j}{20 * N}$$

height scaling formula (moves camera)

p337 – child – jumping jacks

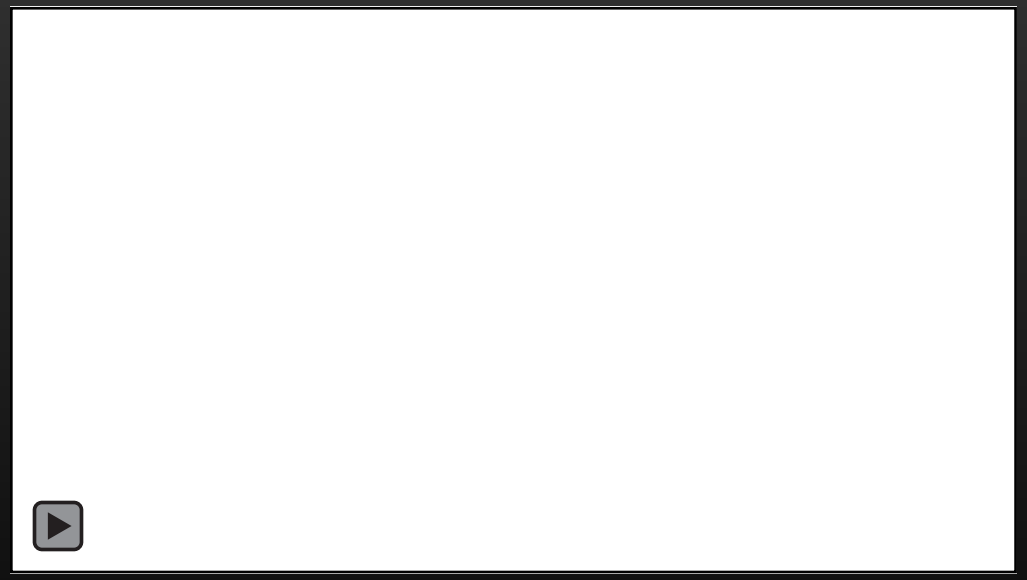
Stimuli Dataset

- 48 point light display videos
  - 8 actors (4 adults, 4 children) x 6 actions
  - Available for download at **http://jainlab.cise.ufl.edu/pose-perception.html**

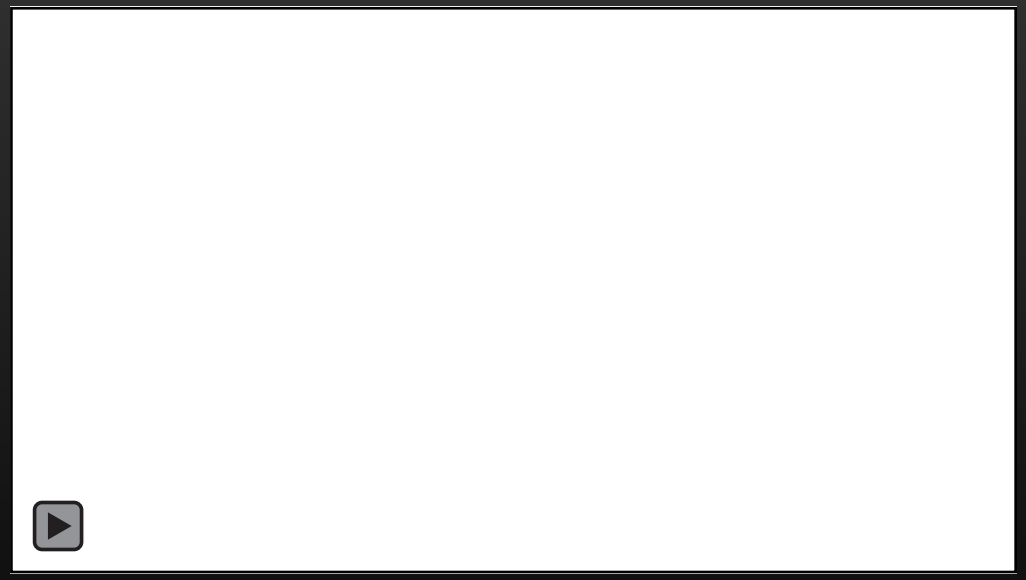
Studying “natural motion”

Number of repetitions were similar but children’s actions were shorter in duration: children were more rapid in their motions

“Run as Fast as You Can”



p921 – adult – run fast



p290 – child – run fast

Studying "natural motion"

Number of repetitions were similar but children's actions were shorter in duration: children were more rapid in their motions

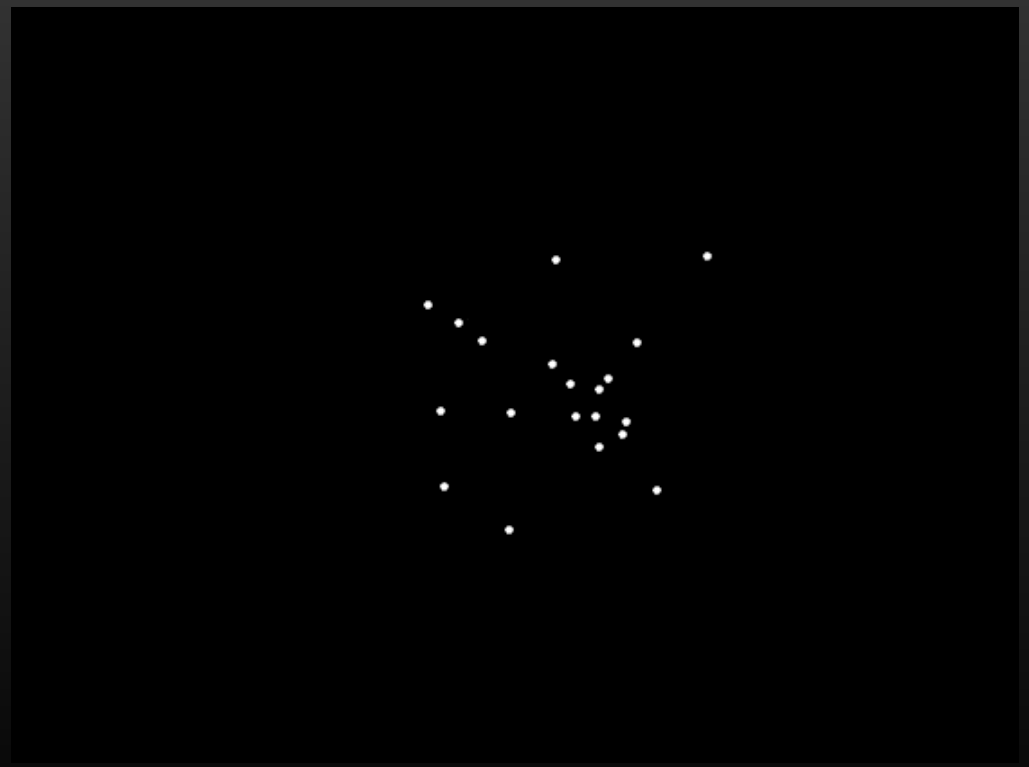
Actions	Mean Time (seconds)			Mean No. Repetitions		
	Children [SD, *N* = 4]	Adults [SD, *N* = 4]	Overall [SD, *N* = 8]	Children [SD, *N* = 4]	Adults [SD, *N* = 4]	Overall [SD, *N* = 8]
Fly Like a Bird	4.7 [1.2]	5.6 [1.3]	5.1 [1.3]	5.75 [1.0]	5.50 [0.6]	5.63 [0.7]
Jump High	2.8 [0.8]	2.4 [0.4]	2.6 [0.7]	2.25 [1.5]	1.00 [0.0]	1.63 [1.2]
5 Jumping Jacks	5.0 [0.3]	5.8 [0.6]	5.4 [0.6]	5.00 [0.0]	5.25 [0.5]	5.13 [0.4]
Run Fast	3.5 [1.0]	4.1 [0.9]	3.8 [1.0]	9.50 [1.0]	10.25 [1.3]	9.88 [1.1]
Walk in Place	6.6 [1.1]	7.4 [1.0]	7.0 [1.0]	10.0 [0.0]	10.25 [1.3]	10.1 [0.8]
Wave	4.1 [0.9]	5.0 [1.0]	4.6 [1.0]	5.25 [0.5]	5.25 [0.5]	5.25 [0.5]

"Jump high" motion only one with different numbers of repetitions for children / adults

Prelim Study: Person-Not-a-Person

Q: is our dataset sufficient to conduct a perception study?

- “random” stimuli videos

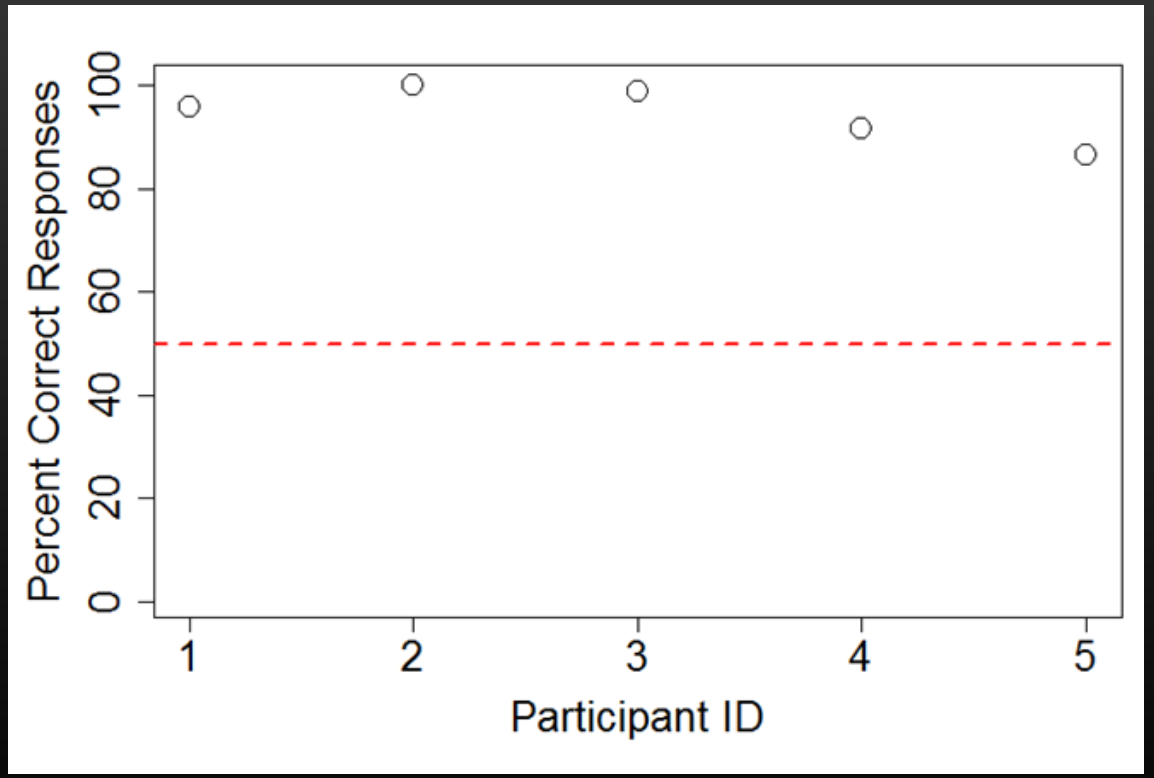


p921 – adult – jumping jacks

Prelim Study: Person-Not-a-Person

Q: is our dataset sufficient to conduct a perception study?

- 5 participants (ages 19-26, 2 male)

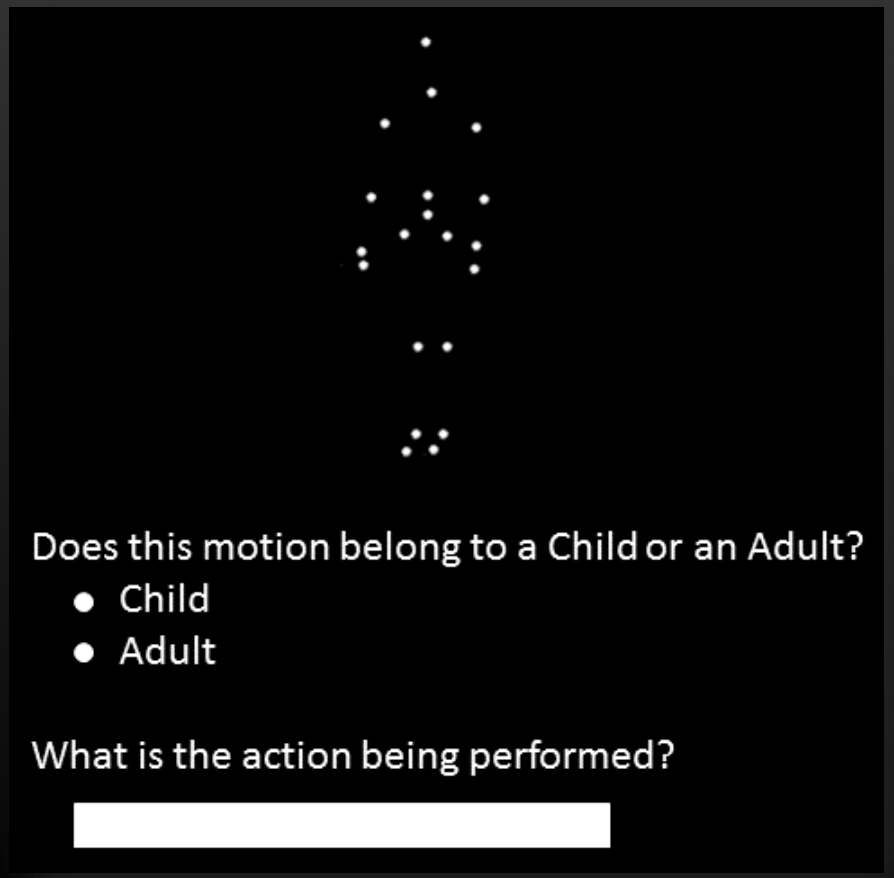


accuracy above 90% for all survey participants

Main Study: Child vs Adult

Q: are child and adult motion perceived different, w/o appearance, absolute scale?

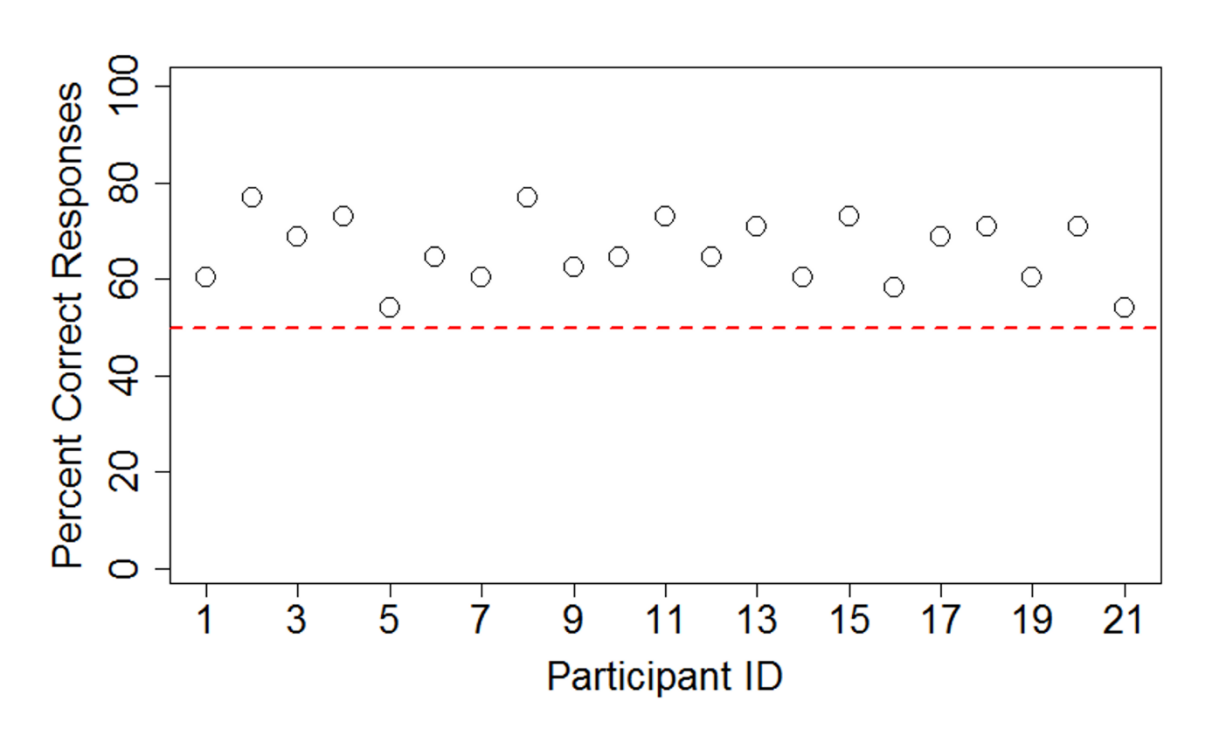
- 24 participants (ages 20-37, 3 female)



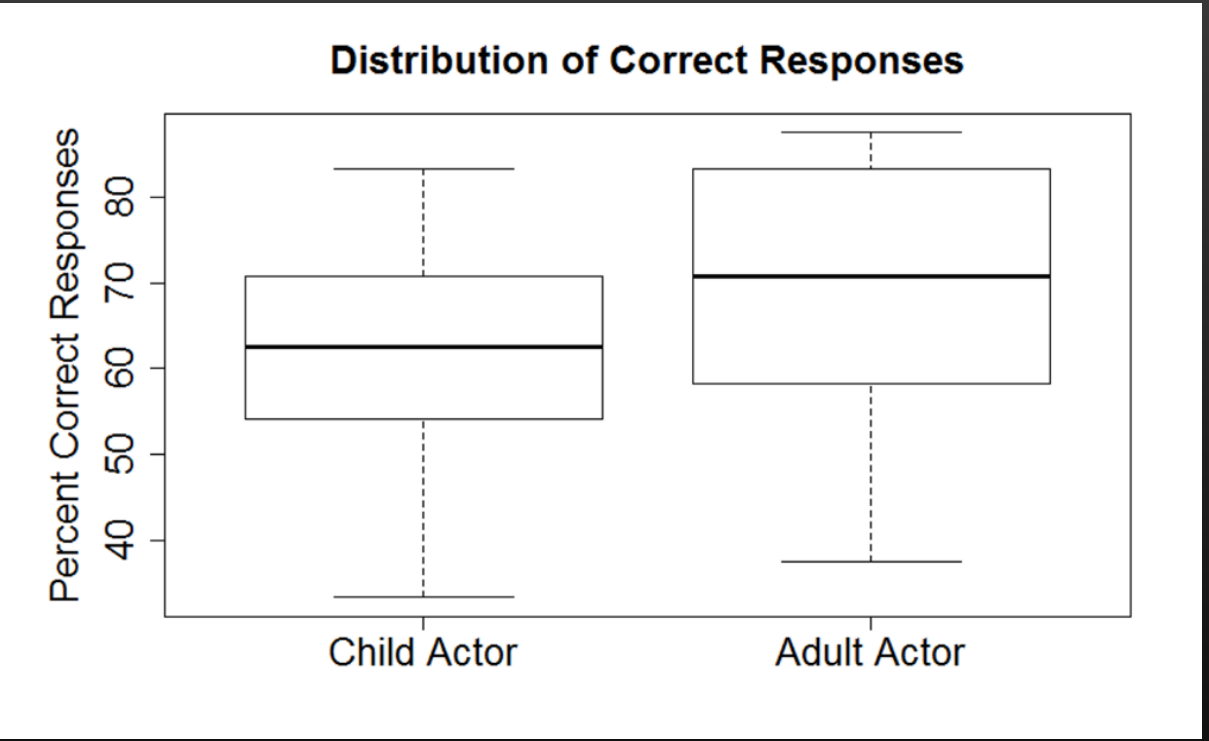
online survey

Findings

People can accurately identify motion as belonging to a child or adult



accuracy above 50% chance for all survey participants



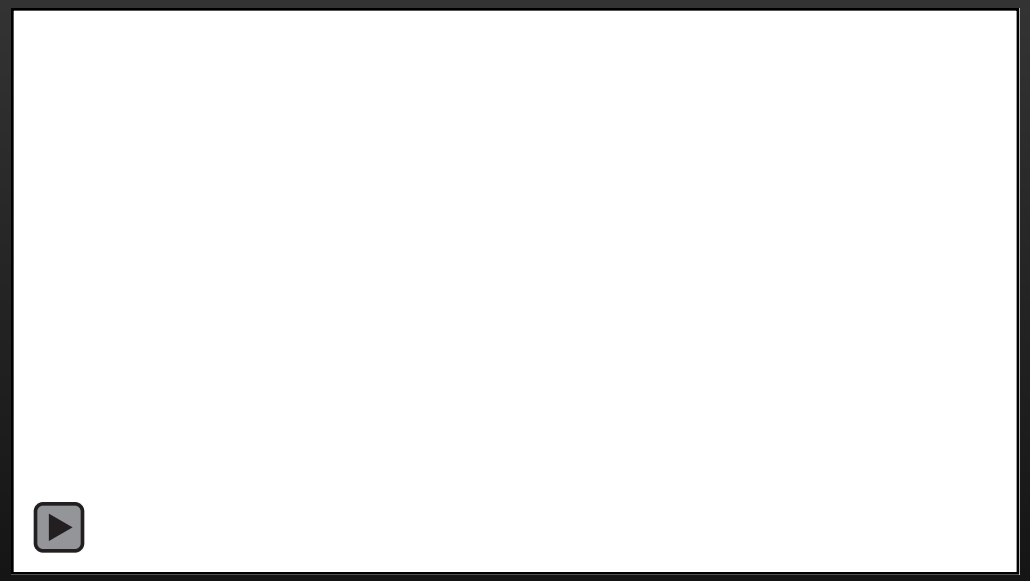
adult and child both significantly above chance ($p < .05$)

Findings: Video

People can accurately identify motion as belonging to a child or adult

“Jumping Jacks”

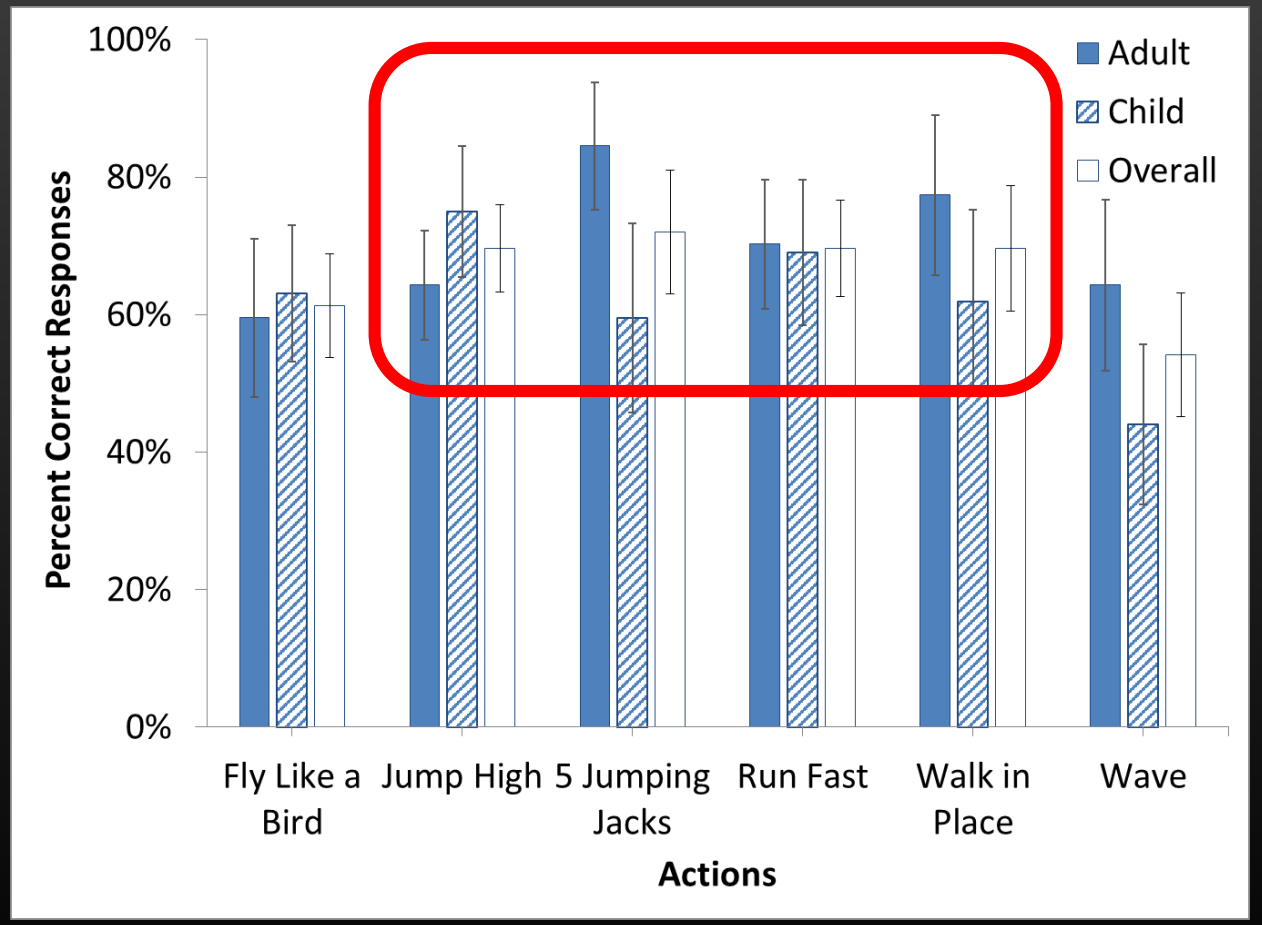
p921 – adult – jumping jacks



p644 – child – jumping jacks

Findings

Dynamic actions involving the whole body are more readily distinguished

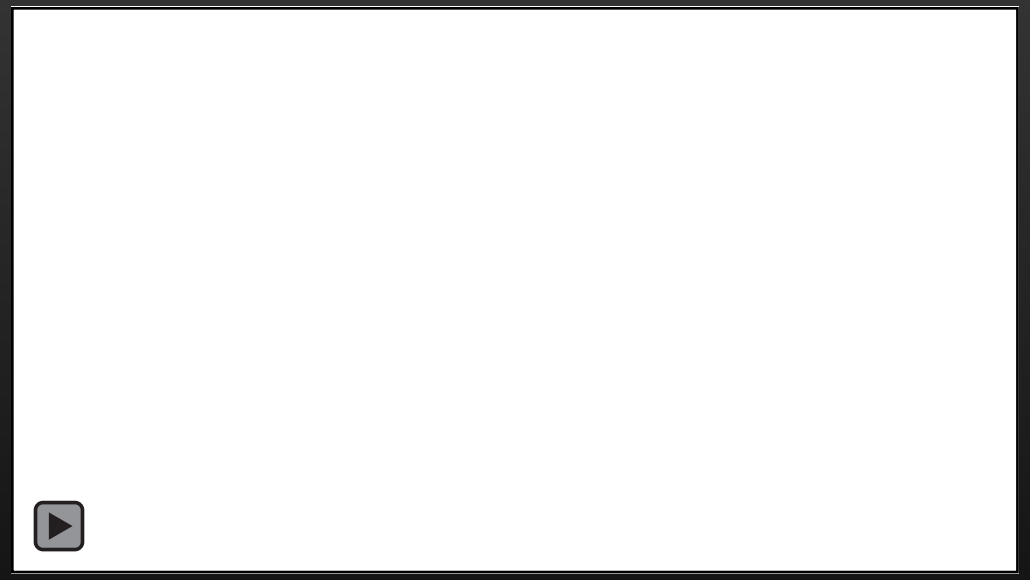


accuracy above 90% for all survey participants

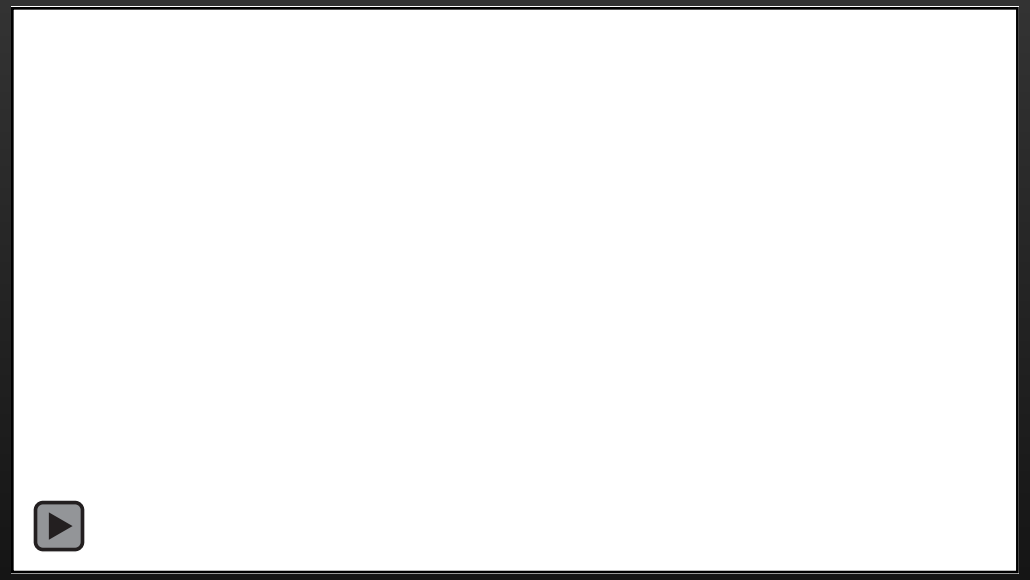
Findings: Video

Dynamic actions involving the whole body are more readily distinguished

“Fly Like a Bird”



p921 – adult – fly like a bird

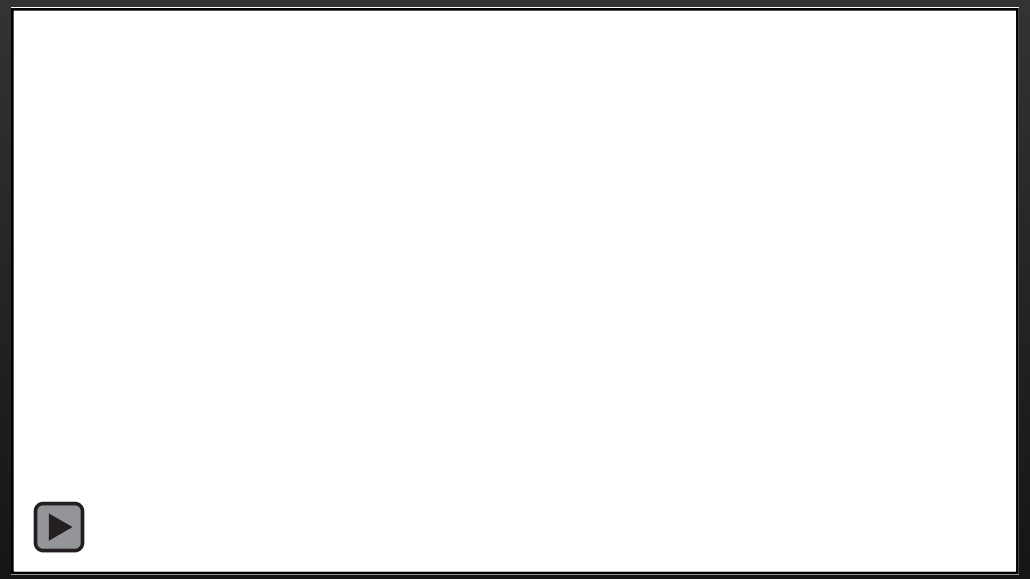


p290 – child – fly like a bird

Findings: Video

Dynamic actions involving the whole body are more readily distinguished

“Run as Fast as You Can”



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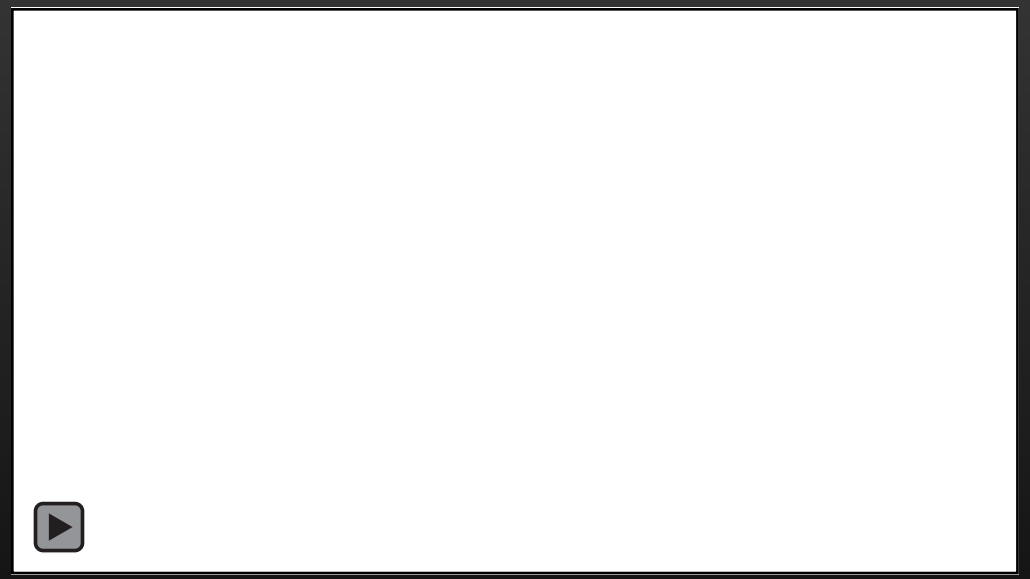
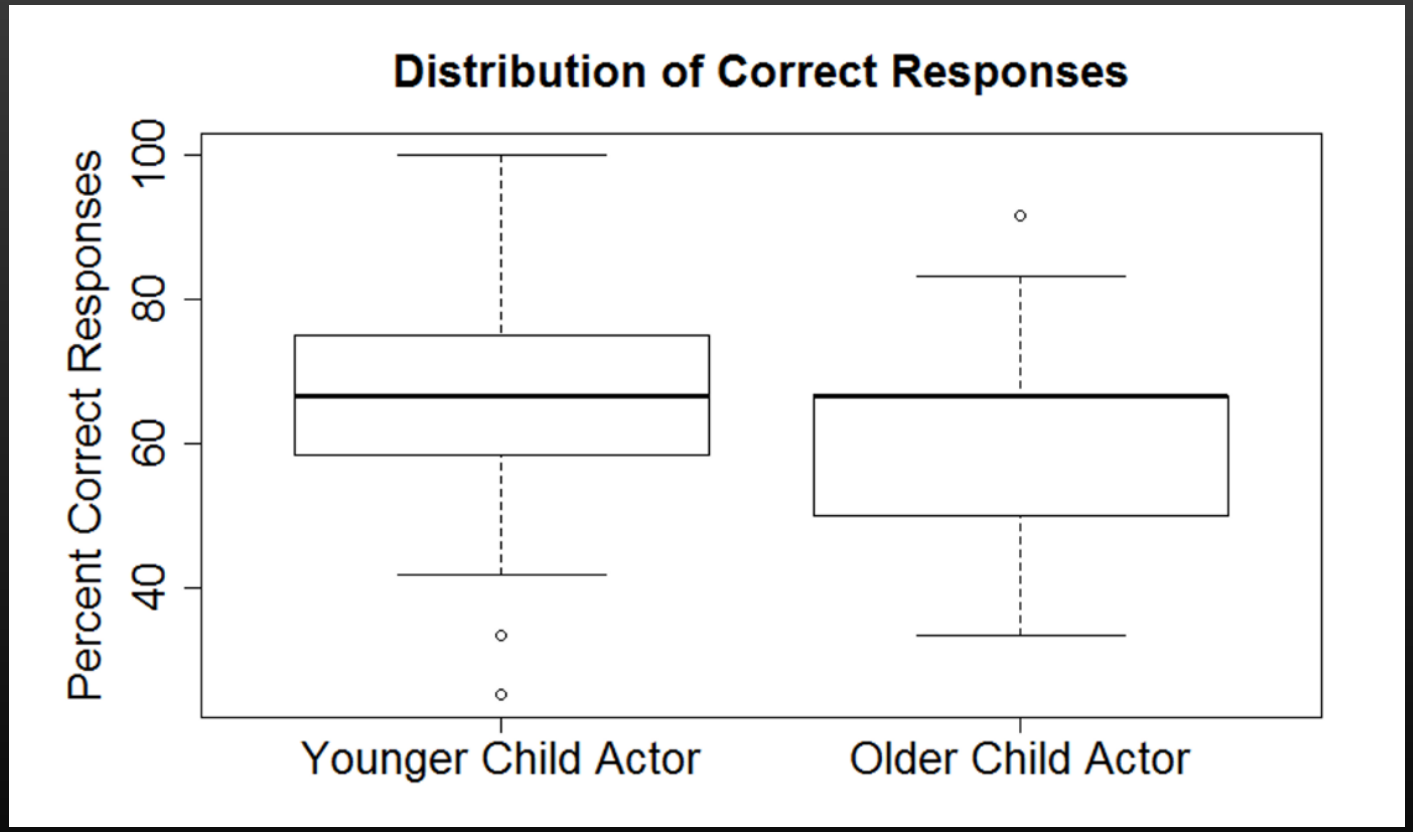


p290 – child – run fast

Findings

Younger and older children show perceivable trends as well

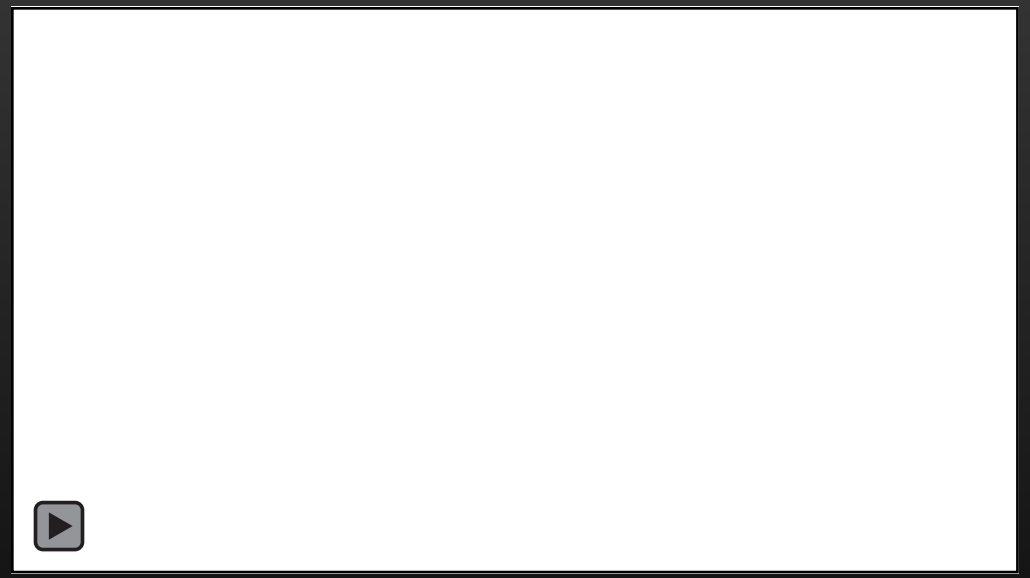


younger and older both significantly above chance ($p < .05$)

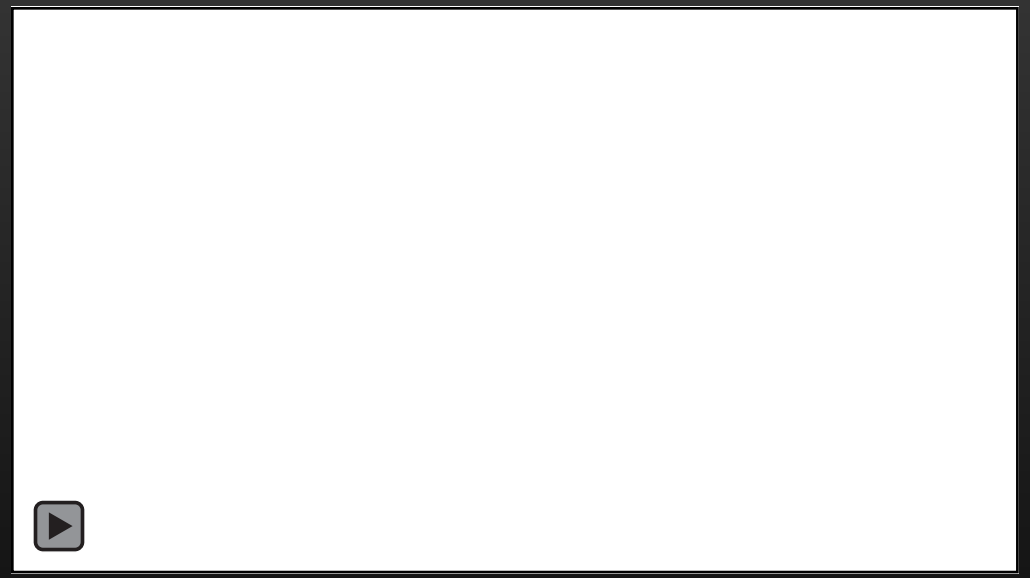
Findings: Video

Younger and older children show perceivable trends as well

“Jumping Jacks”



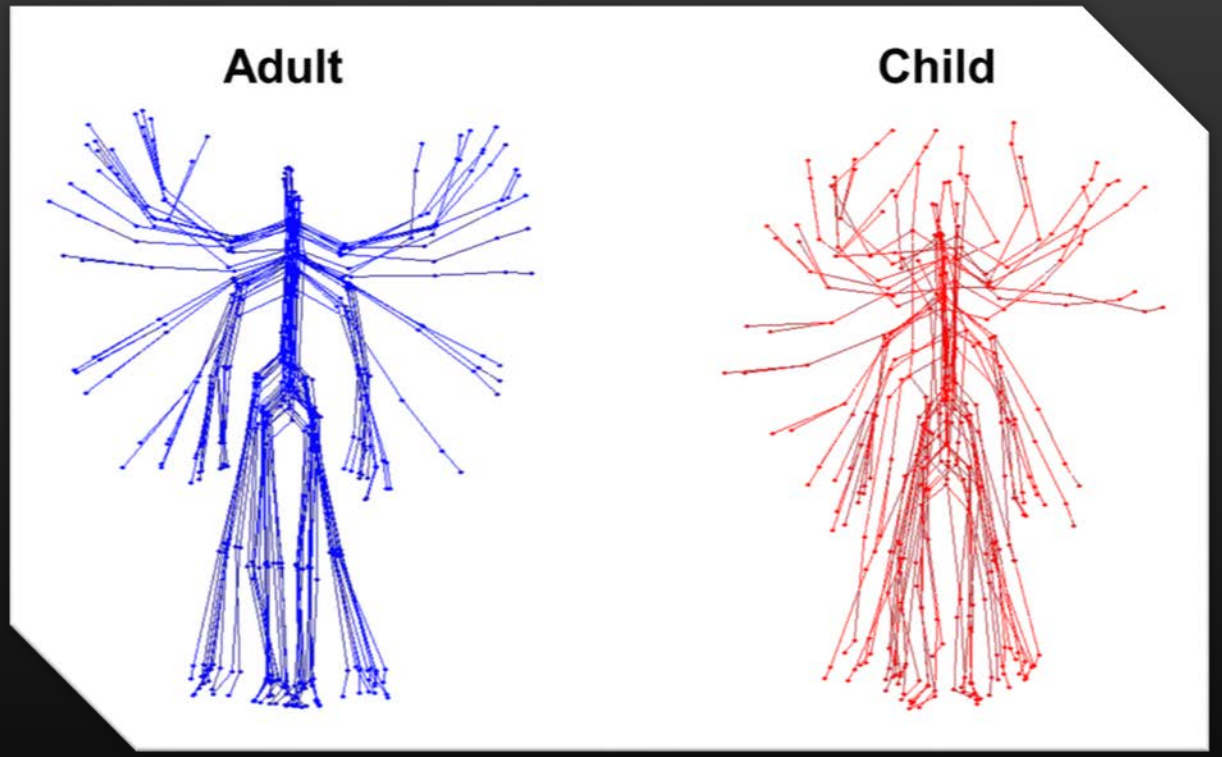
p644 – older child – jumping jacks



p290 – younger child – jumping jacks

Summary

- First study of the **perception of child motion** compared to analogous adult motion:
  - application of the **point light display paradigm towards studying the movement of young children** and adults performing the same actions
  - finding that **naive viewers can identify a motion as belonging to a child actor or an adult actor** in a two-alternative forced choice task at better-than-chance levels



scaled, pelvis locked

Future Work

- **Expansion of study** to more actions, other actors, older or younger children actors, participants more familiar with child motion
- Investigation of **quantitative differences** that characterize the perceivable child-like motion characteristics

Thank you!

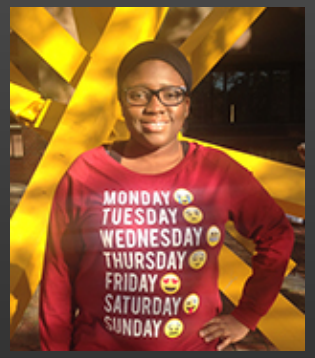
For more information:

- **Eakta Jain: ejain@cise.ufl.edu**
- **Lisa Anthony: lanthony@cise.ufl.edu**

- Website: **http://jainlab.cise.ufl.edu/pose-perception.html**


Eakta Jain


Lisa Anthony



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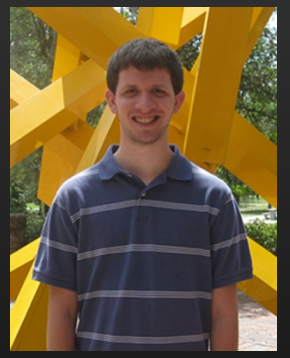
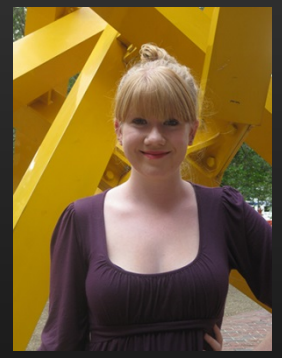

Alex Shaw


Julia Woodward

- *The authors wish to thank University of Florida students Nathan de Krey and Zsolt Szabo, who both worked on early versions of the Microsoft Kinect skeleton tracking and data collection software.*