The Effect of Posture and Dynamics on the Perception of Emotion

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Emotional virtual characters are important for games

Dragon Age Origins, Bioware, 2009

Star Wars, Knights of the Old Republic, Bioware, 2013

Heavy Rain, Quantic Dream, 2010

Mass Effect, Bioware, 2010

The Last of Us, Naughty Dog, 2013

The Walking Dead, Telltale Games, 2013

Games primarily use motion capture for character animation

+ Efficient, computationally straightforward
+ Requires less manual effort
+ Faithfully translates performances

Relies on motion editing techniques to be adapted dynamically to game environments and scenarios

Star Wars, Knights of the Old Republic, Bioware, 2013

How does motion editing affect emotional content?

Do changes in pose and dynamics matter?

How can we preserve important aspects of a motion during editing?

Can we purposely increase, decrease, or change emotional content?

People are very good at recognizing emotions

Emotion recognition mostly invariant across cultures [Kleinsmith et al 2006; Ekman 1992] and across body types and level of realism [Pasche and Poppe 2007; McDonnell et al 2008]

McDonnell et al. 2008

Pasche and Poppe. 2007

Motion editing can affect emotion perception

Emotion simulation [Unuma et al. 1995; Amaya et al. 1996; Chi et al. 2000; Brand and Hertzmann 2000; Hsu et al. 2005; Hartmann et al. 2006; Shapiro et al. 2006; Torresani et al. 2007]

Discernible from static poses [Coulson 2004]

Sensitivity to changes in timing [Ryall et al. 2012; Reitsma and Pollard 2003; Vicovaro et al. 2012]

Joint flexion and dynamics differ between emotions [Roether et al 2009; Sawada et al 2003; Pollick et al 2001; Wallbot 1990]

Our Study

Body language, Free-form movements

6 Emotions


Anger


Disgust


Fear


Happiness


Sadness


Surprise

Three Experiments

1. Analyze poses and dynamics in captured emotions. Find clips with high recognition rates.

2. What parts of the body are important for conveying emotions?

3. How do changes in pose and dynamics affect the emotion recognition and intensity?

Experiment 1: Stimuli

Analyze poses and dynamics in captured emotions

Improvised performances

55 animated clips total

Experiment 1: Method

15 participants

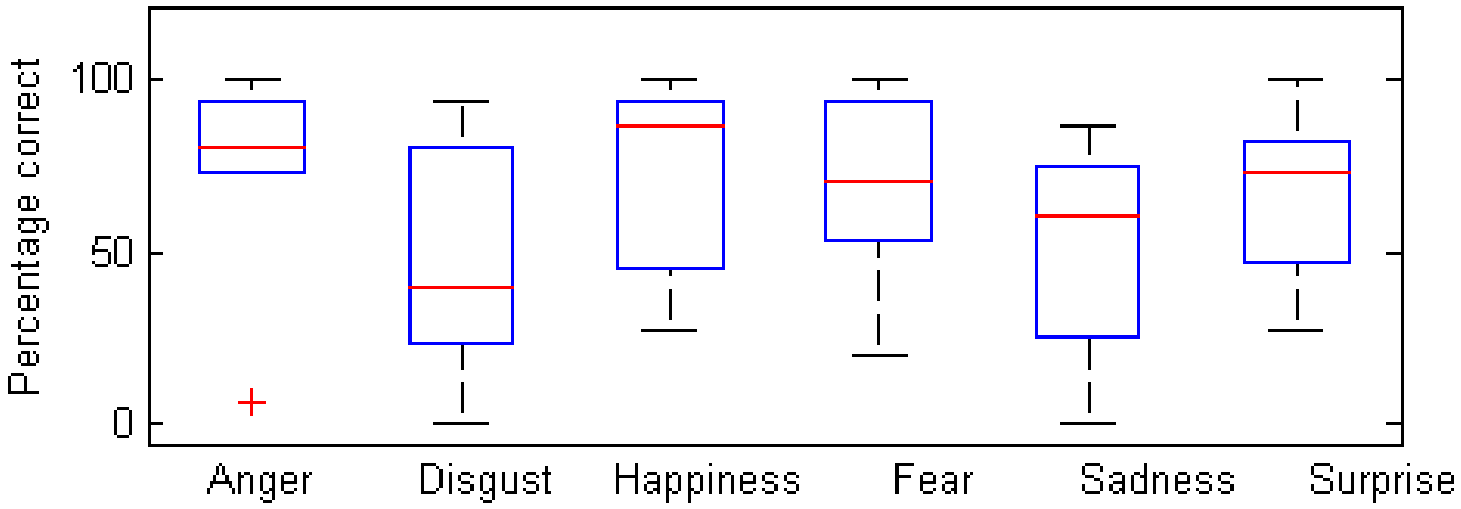
Online survey

Randomized order

2 Questions:

- Emotion
- Intensity

Experiment 1: Emotion Recognition



62.4% correct recognition across all clips

Disgust hardest to recognize, agrees with previous work [Ekman 1992; Atkinson et al. 2004]

Experiment 1: Best Recognized Clips

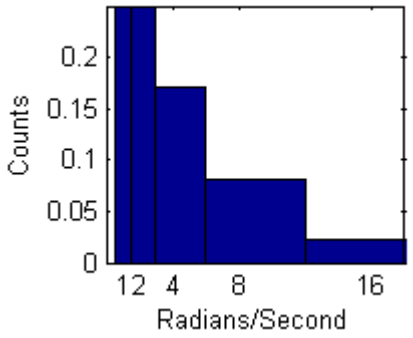
Clips with highest recognition rate for each emotion

Experiment 1: Motion Analysis

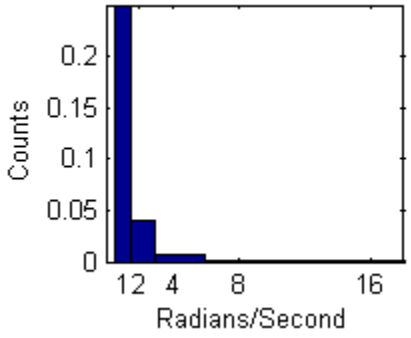
Anger, happiness have *faster* joint movements;
sadness, fear are *slower*

Anger, happiness have *larger* joint amplitudes;
sadness, fear have *smaller* amplitudes

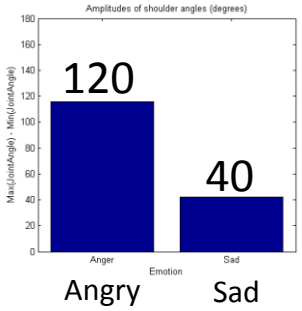
Anger



Sadness



Shoulder Amplitudes



Angry Sad

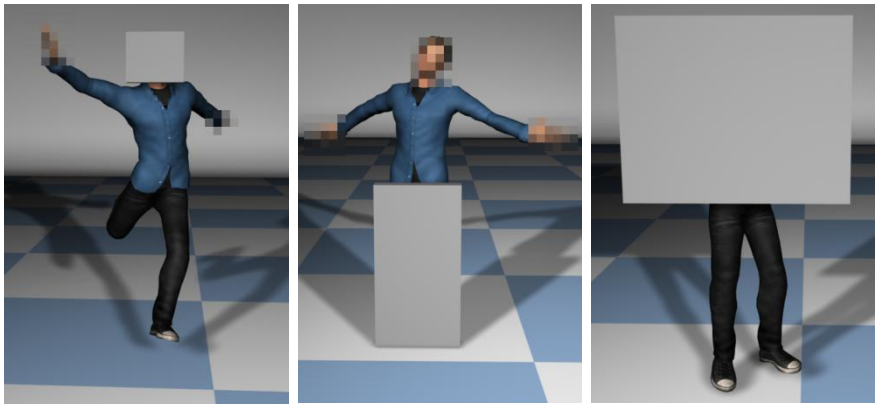
Thus, if we modify these aspects, does the perception of the emotion change?

Experiment 2

What parts of the body are important for conveying emotions?

Four conditions:

- No Head (NH)
- No Lower Body (NL)
- No Upper Body (NU)
- Original



48 clips, randomized, 6s/question, two fast-paced blocks

2 Questions:

- Emotion (forced choice)
- Intensity (5-point scale)

Experiment 2: Occluded Motion Examples

Experiment 2: Analysis

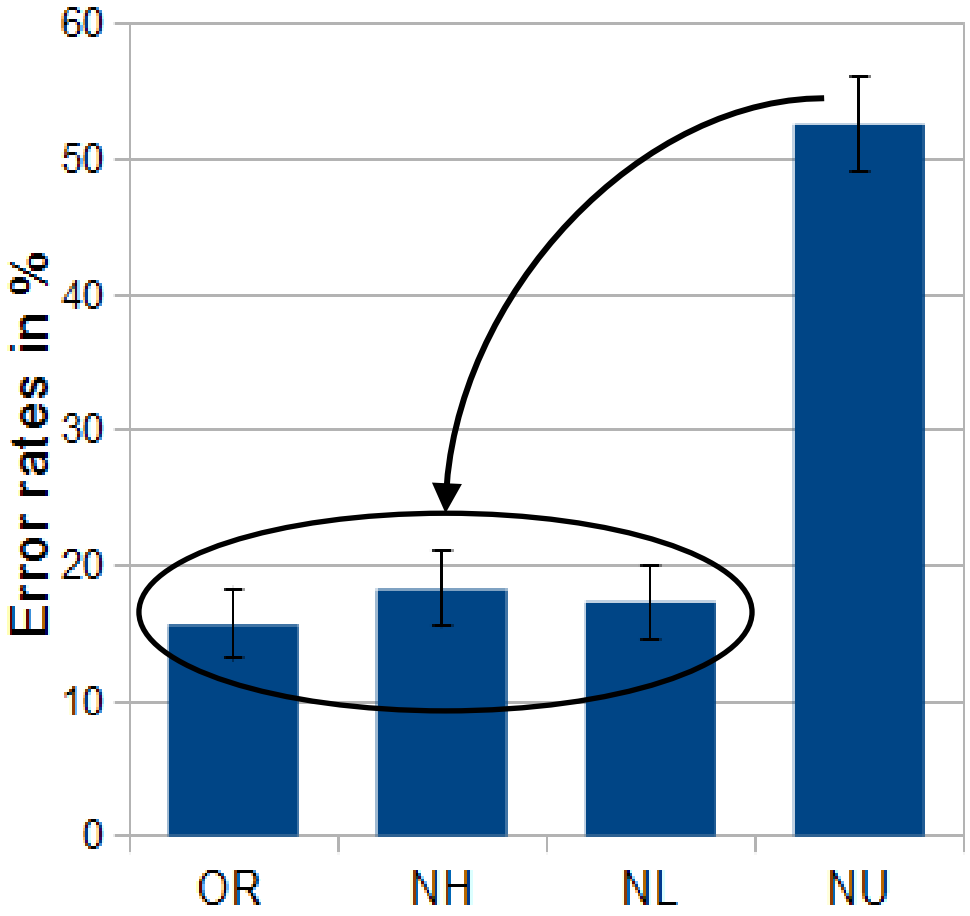
Two-way repeated measures ANOVA, factors Occlusion Type and Emotion

Main Effects of Occlusion Type ($p < 0.001$) and Emotion ($p < 0.001$)

Interaction effects between Occlusion Type and Emotion ($p < 0.001$)

Experiment 2: Emotion Recognition

13 participants



Upper body most important for conveying emotions

Experiment 2: Interaction Effects

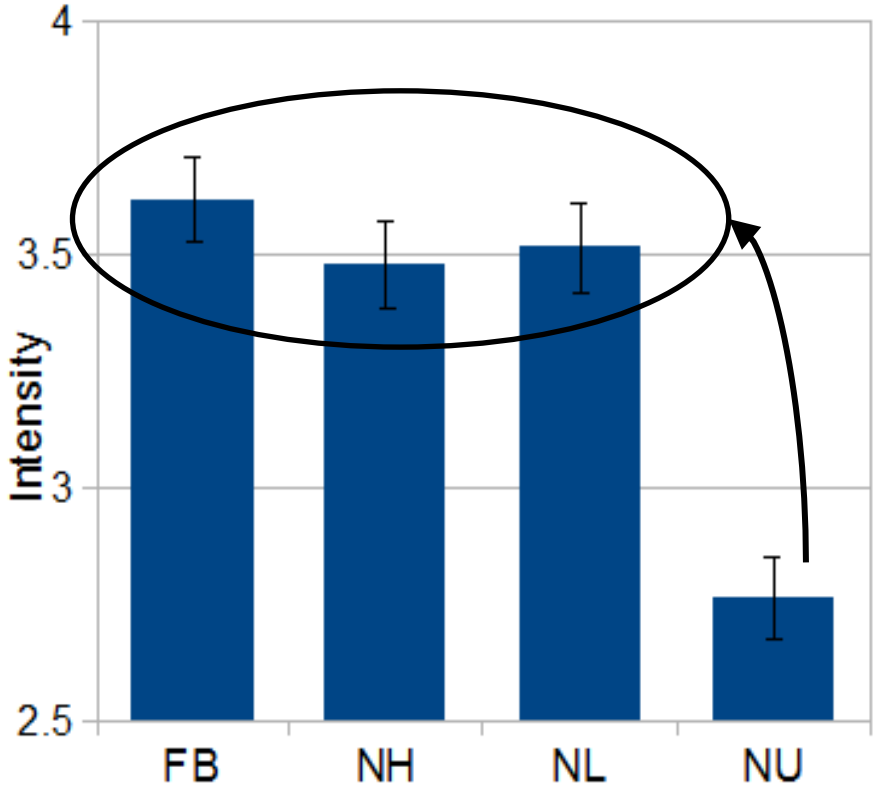
Fear had same error rates for all conditions

Sadness with NH recognized least well

Anger with NL recognized second least well

Experiment 2: Emotion Intensity

12 participants



Mirrors result for emotion recognition:

Emotions perceived as significantly less intense when upper body is missing

Intensity ranged from 1 (low) to 5 (high)

Experiment 3

How do changes in pose and dynamics effect emotion perception?

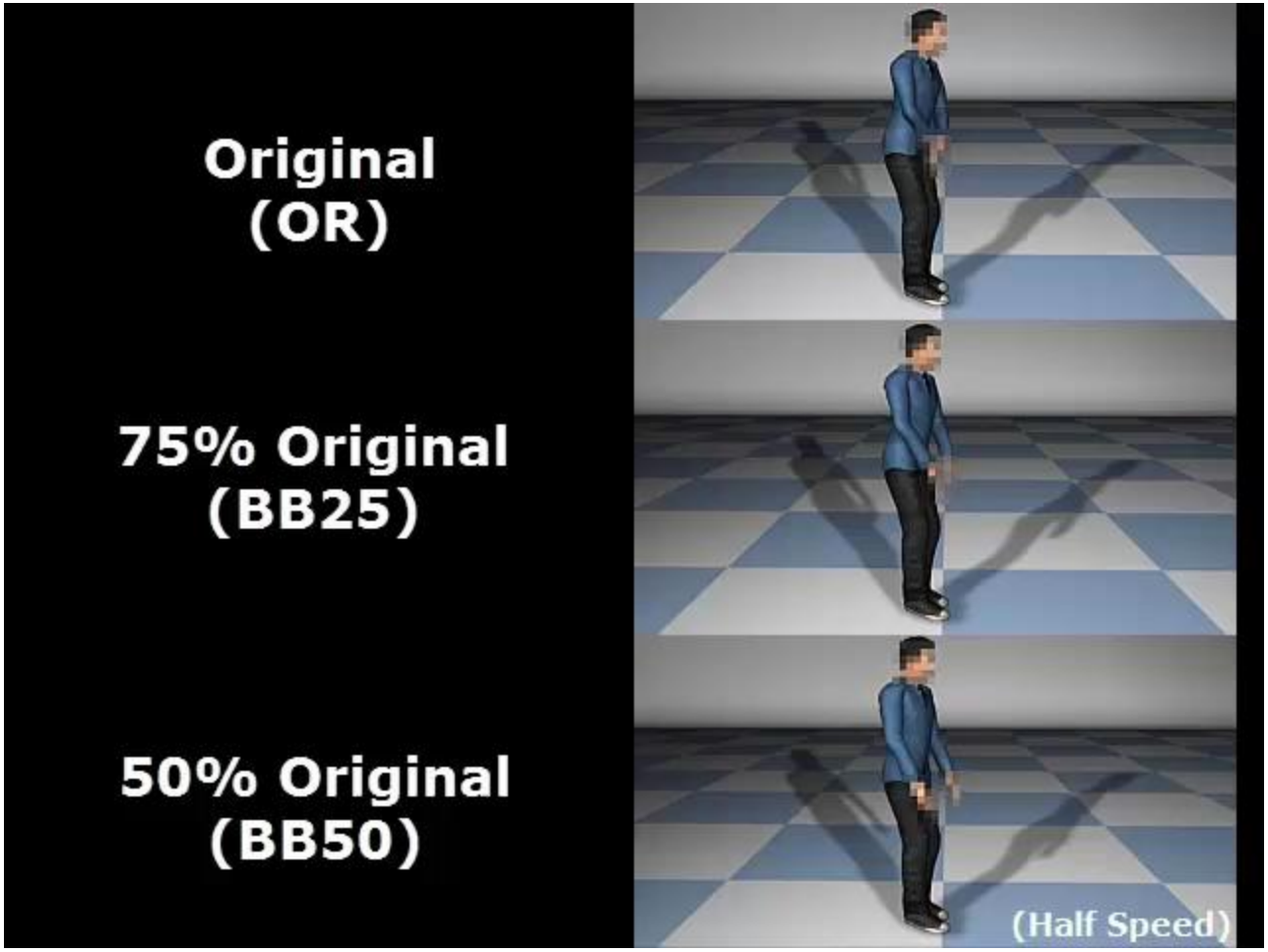
Five Conditions:

Condition	Body blend 25% (BB25)	Body blend 50% (BB50)	Offset (OFF)	Dynamic time warp (DTW)	Original
Changes dynamics	X	X		X	
Changes pose	X	X	X		

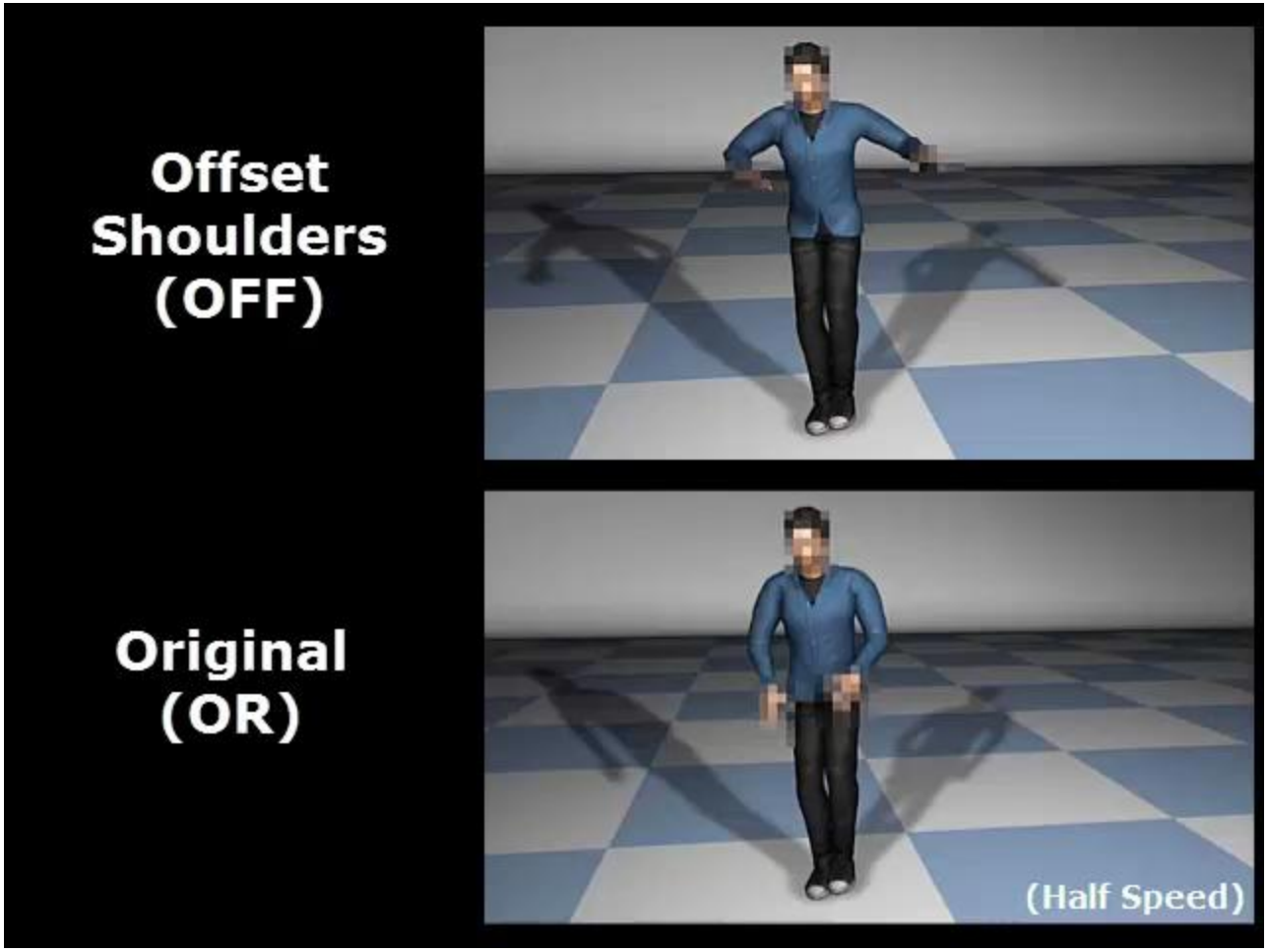
60 clips, randomized, 6s/question, watched twice in 2 fast-paced blocks

2 Questions: emotion recognition and intensity

Experiment 3: Body blend examples



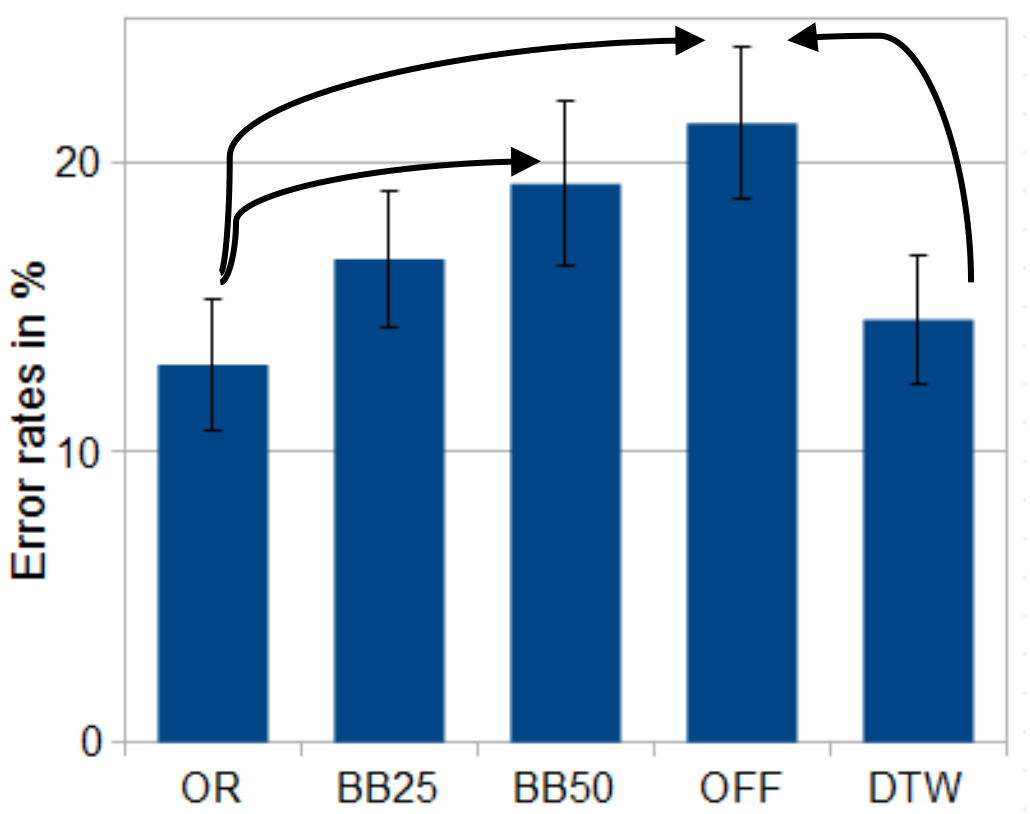
Experiment 3: Offset



Experiment 3: Dynamic time warping

Experiment 3: Emotion Recognition

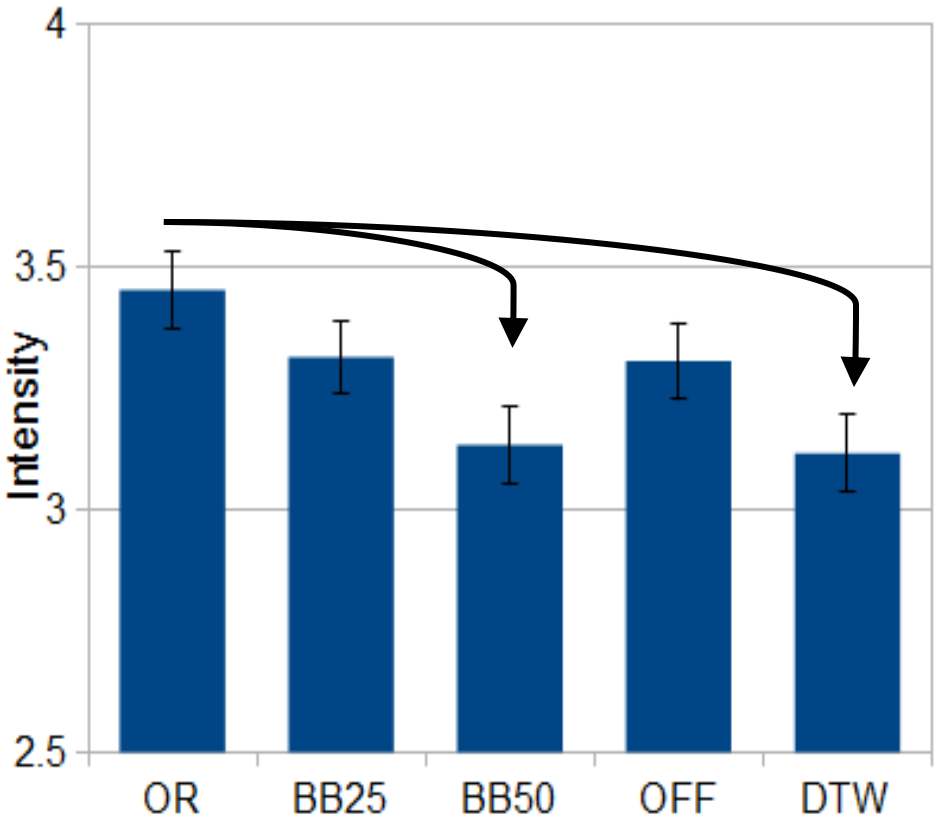
16 participants



Changing poses affected recognition rates

Experiment 3: Emotion Intensity

16 participants

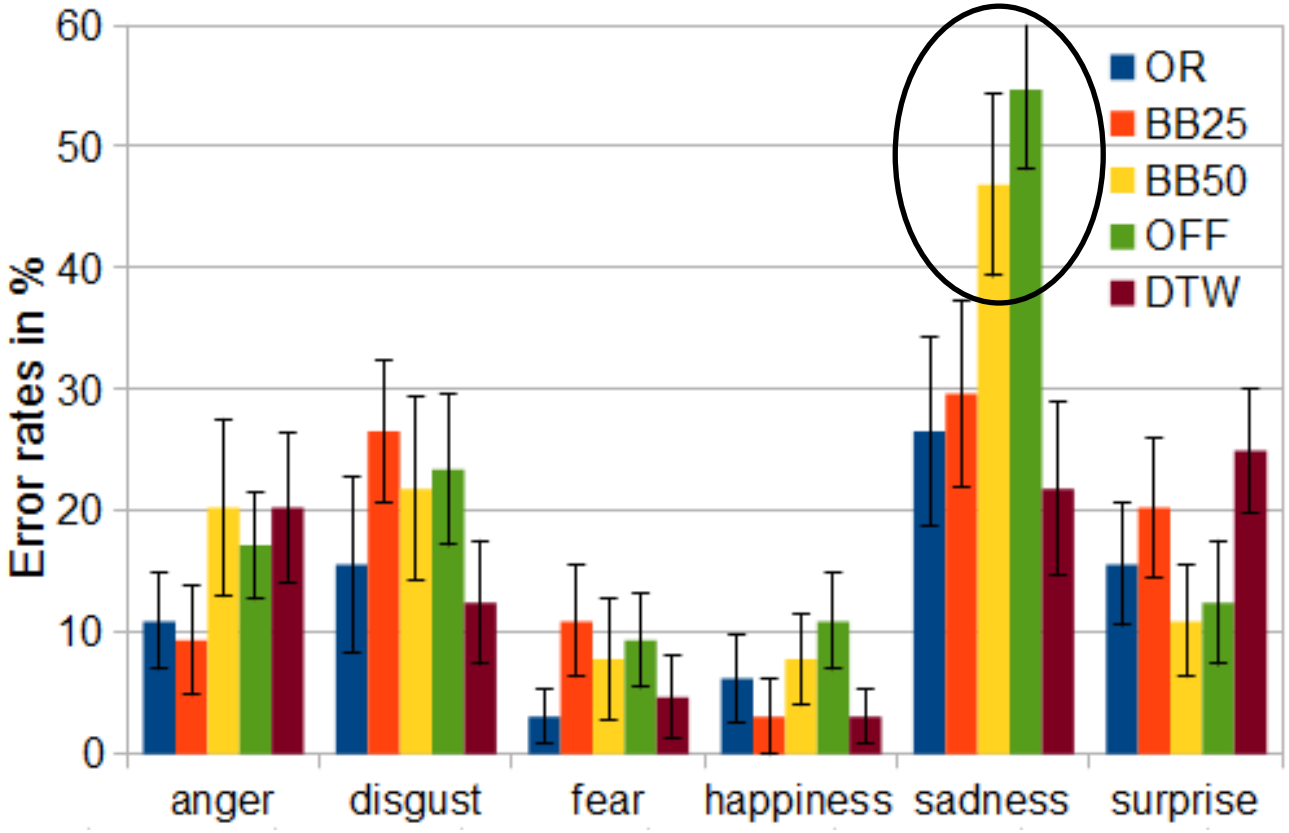


Timing changes affects intensity

Intensity ranged from 1 (low) to 5 (high)

Experiment 3: Results hard to generalize

Must be careful: Trends not true for every emotion



Conclusion: Changes to posture and dynamics matter

Upper body most important for conveying emotion

Perceived emotional intensity reduced by blending with a neutral motion

Posture changes altered the perceived emotion

Dynamics changes altered the perceived intensity

Future Work

Test whether these findings can enhance motion editing

Test effect of other timing changes

Understand when changes to pose affects recognition and when not

Questions?

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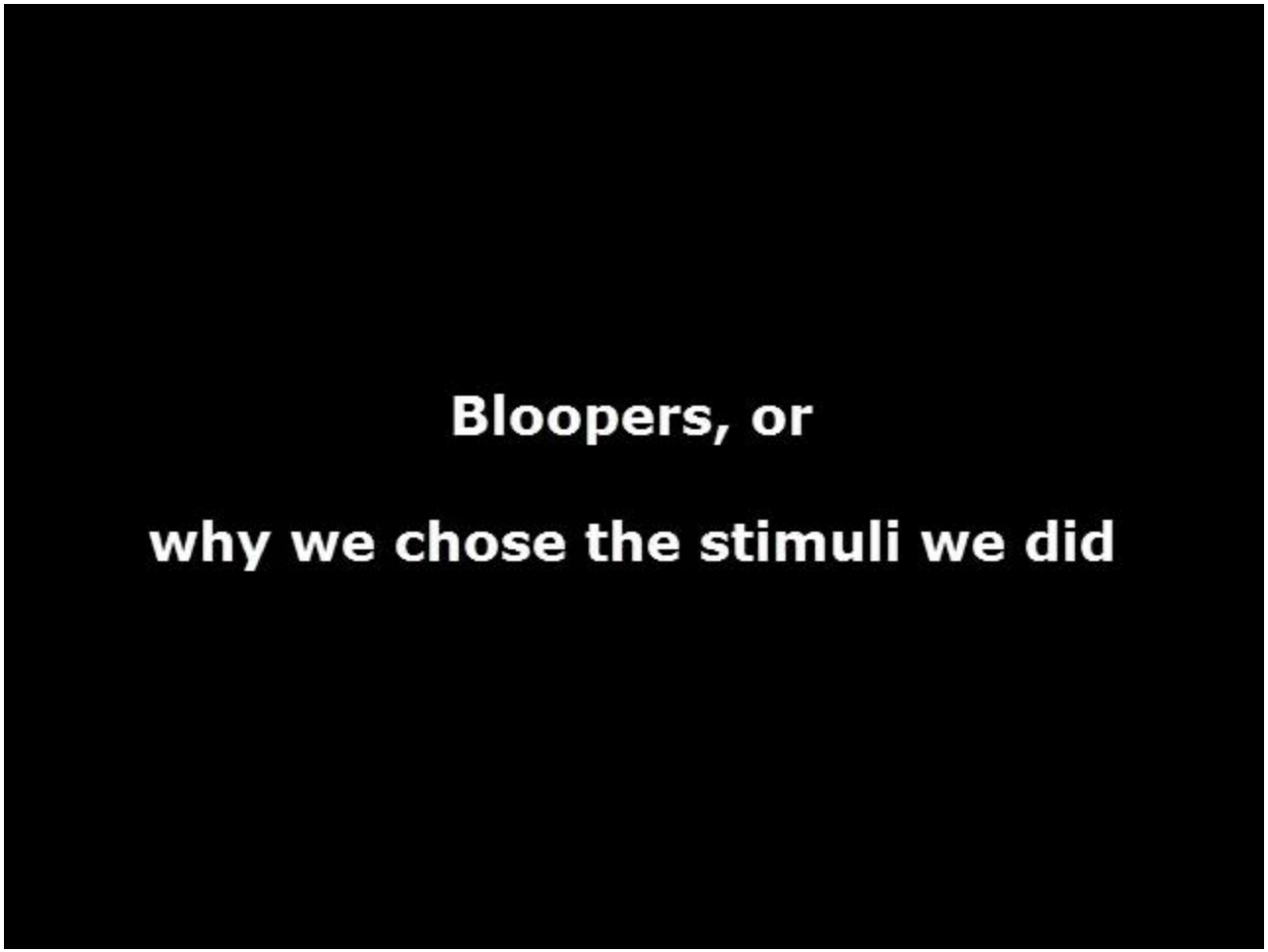
Bloopers

Sometimes the best choice of stimuli is not obvious



Performance Capture

Actor improvised 10 performances for each emotion

Optical motion capture

22 joints

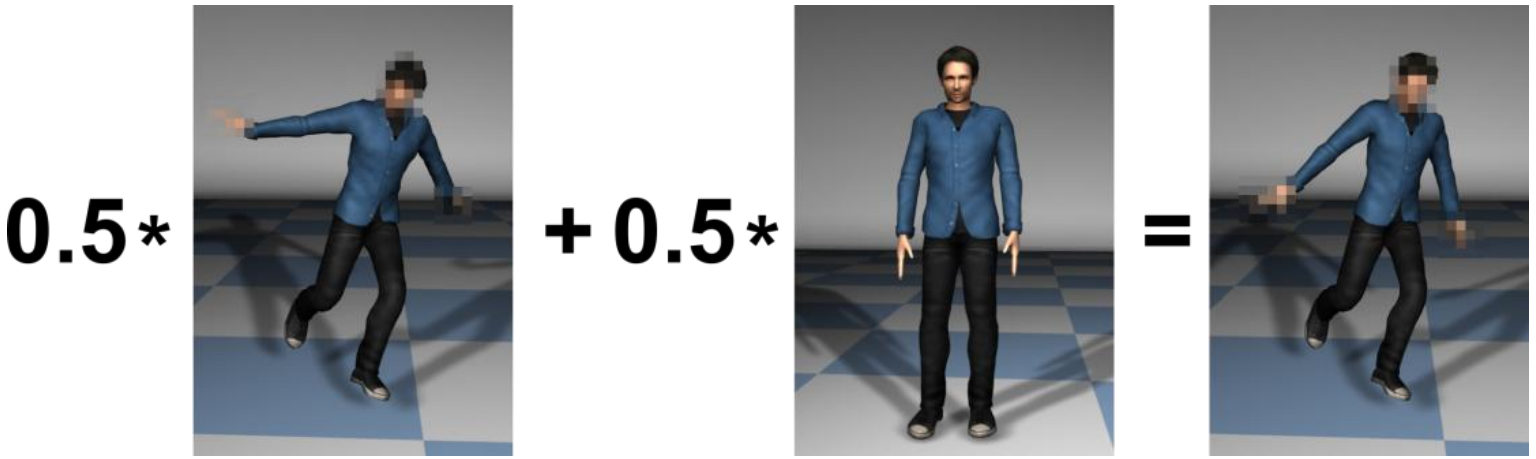
Box blur for face and hands

Experiment 3: Body blend

Changes pose and dynamics

BB25 retains 75% of the original upper body motion

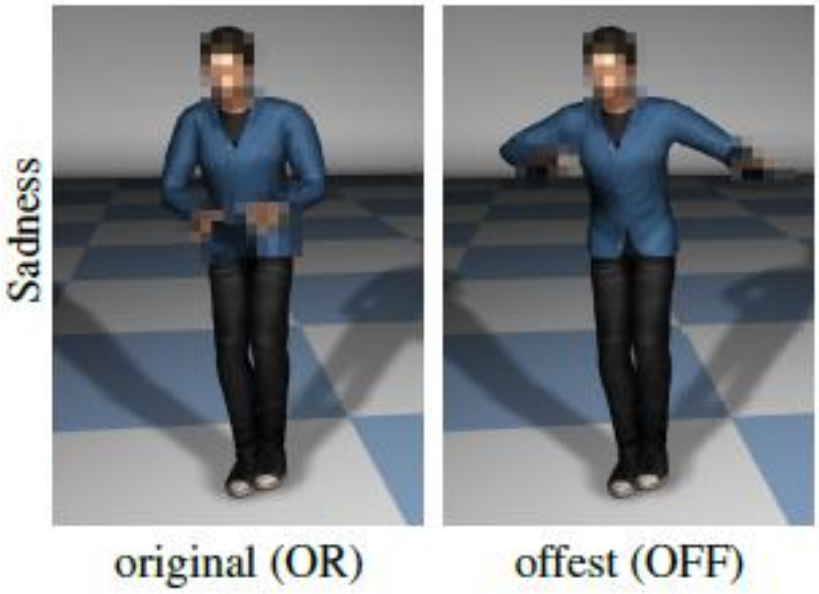
BB50 retains 50% of the original upper body motion

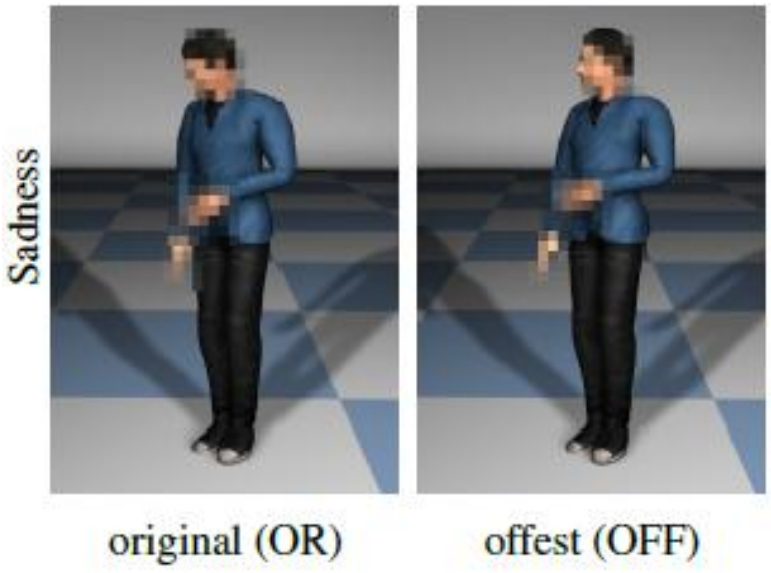


Experiment 3: Offset

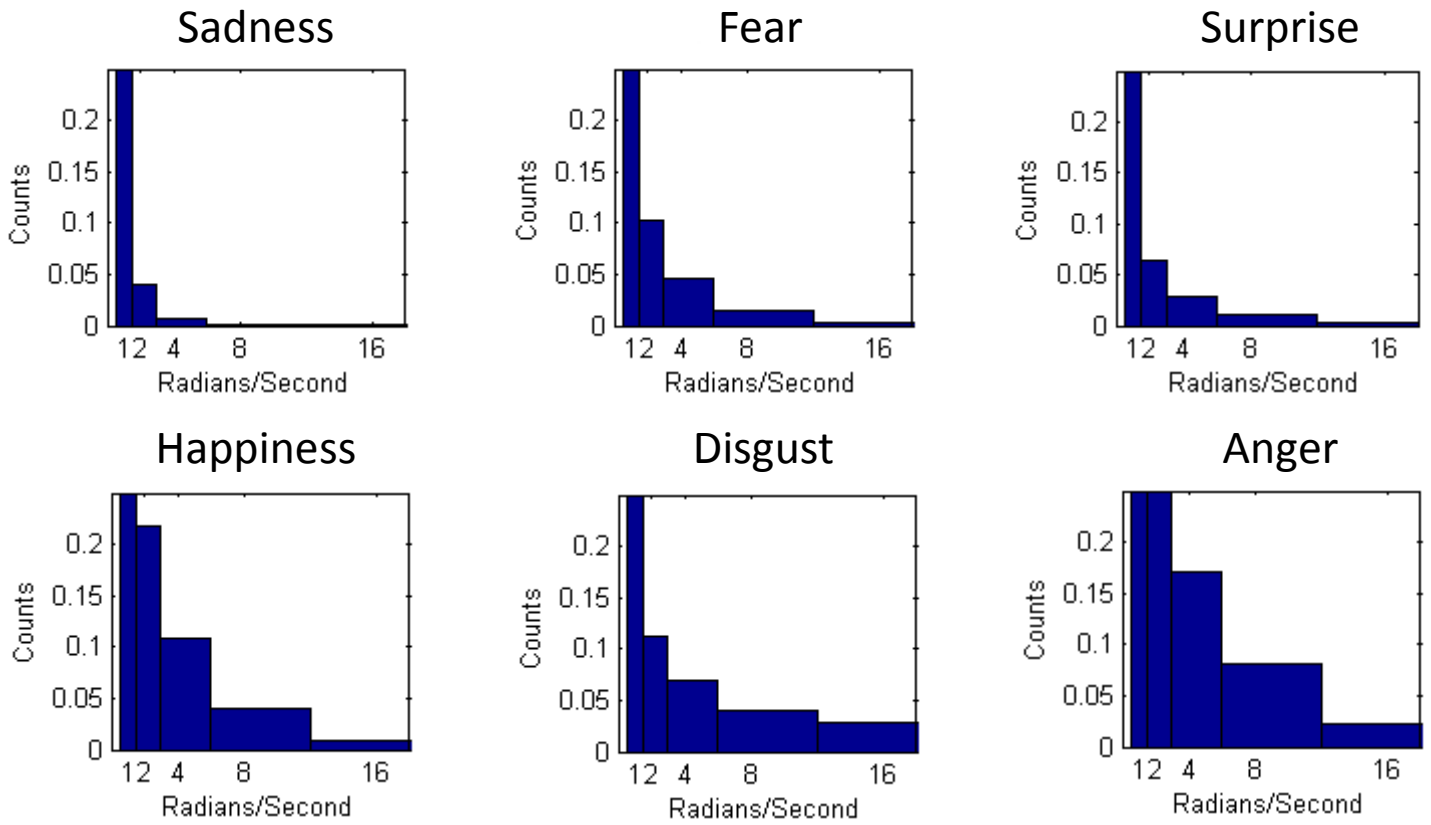
Changes pose, but not dynamics

Manually edit shoulders, elbows, spine, neck





Experiment 1: Motion Analysis



Anger, happiness tend to have larger, faster joint movements; fear, sadness less,

[Roether et al. 2009]