Trade-offs between Responsiveness and Naturalness for Player Characters

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Character control from a third person perspective

Assassin’s Creed 3, Ubisoft, 2012
Star Wars, the Old Republic, Bioware, 2011
Uncharted 2: Among Thieves, 2009
FIFA, EA, 2014
Sleeping Dogs, Square Enix, 2012
Dark Souls II, FromSoftware, 2014

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Responsiveness

Delay between an input from the player and the associated response
Delay between when the application receives an input and the associated response
Conflicting Goals: Responsiveness vs. Naturalness

Realistic motion requires

- adjustments for balance
- limits on accelerations and forces
- parabolic COM trajectories in flight

Realistic restrictions on movement cause delays in executing player commands

- e.g. an extra step taking before a jump will kill the player!
What trade-offs should we make?

How does animation realism affect the player’s experience?

Will players tolerate more delay in exchange for greater naturalness?
Effect of delays in video games

Delays negatively affect

• **performance** [Beigbeder et al. 2004; Quax et al. 2004; Jörg et al. 2012; Beznosyk et al. 2011; Amin et al. 2013],

• **enjoyment** [Normoyle et al. 2014],

• **and perceived motion quality** [Normoyle et al. 2014]

Tolerable delay depends on game type [Claypool and Claypool 2006]

BUT players can adapt to delays [Normoyle et al. 2014] and even play well despite a large delay [Dick et al. 2005]
Viewers can detect subtle differences

Uncanny valley [Mori 1970; Hodgins et al. 2010]

Viewers easily detect emotion, gender, errors
[Cutting and Kozlowski, 1977; Atkinson et al., 2004; Hoyet et al. 2012; Jörg et al. 2010; Trutoiu et al. 2011]

Not clear that such findings apply to video games where players are not focused on motions
Focus on animation delay

Test animation controllers with varying realism and responsiveness

Participants experience only one controller type
Our Game

Platform game, three levels

Map Level 1 & 3

Map Level 2

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Experiments

Ideal: Keep responsiveness constant at different levels and vary naturalness

Motion type experiment

• Keep responsiveness constant but vary naturalness

Trade-off experiment

• Increase motion naturalness but decrease responsiveness
Animation controllers


Automatically constructed controllers [Arikan and Forsyth 2002; Kovar et al. 2002; Lee et al. 2002; Lee and Lee 2006; Gleicher et al. 2003; Treuille et al. 2007; McCann and Pollard 2007; Lee et al. 2010]
Animation controllers


FSM machines, cross faded transitions, IK to avoid footskate

Automatically constructed controllers [Arikan and Forsyth 2002; Kovar et al. 2002; Lee et al. 2002; Lee and Lee 2006; Gleicher et al. 2003; Treuille et al. 2007; McCann and Pollard 2007; Lee et al. 2010]
Animation controllers: NoMotion (N)

low naturalness, medium responsiveness
Animation controllers: Switch (S)

medium naturalness, high responsiveness
medium naturalness, medium responsiveness
Animation controllers: Cape (C)

medium naturalness, medium responsiveness
High naturalness, low responsiveness
Animation controllers overview

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Jump Comparison
(Half Speed)
Results: control

MoveTree (M) significantly more difficult to control than Blend (B) and Switch (S)

P < 0.05
P < 0.1
Results: enjoyment

Cape (C) enjoyed significantly less than Blend (B)

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Results: satisfaction

Participants most satisfied with their own performance in the NoMotion (N) condition

P < 0.1
Results: performance

Participants required significantly less time to reach the goal in the Switch condition.

P < 0.05
Results: performance

Participants lost significantly fewer lives in the Switch condition.
Results: perception of game and character

No effect of controller in either experiment

![Bar chart showing motion quality for different conditions in both experiments.](image)
Summary

Least **responsive** controller negatively effected performance and perceived control

Players most satisfied using our least **natural** controller

Non-significant motion quality ratings from **players**, but significant naturalness ratings from **viewers**

Animation effects **enjoyment** but not satisfaction, ease of control, and performance
How and when does animation effect enjoyment and satisfaction?

Does game genre and type affect ratings of quality and naturalness?

How do player’s game experience and expectations affect ratings?
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We wish to thank Alla Safonova, our participants, and the anonymous reviewers.
## Animation controller responsiveness

<table>
<thead>
<tr>
<th>Transition</th>
<th>Switch (S)</th>
<th>Blend (B) NoMotion (N) Cape (C)</th>
<th>MoveTree (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand to jump</td>
<td>0.03 s</td>
<td>0.37 s</td>
<td>0.10 s</td>
</tr>
<tr>
<td>Stand to jog</td>
<td>0.03 s</td>
<td>0.36 s</td>
<td>1.30 s</td>
</tr>
<tr>
<td>Jog to jump</td>
<td>0.02 s</td>
<td>0.33 s</td>
<td>0.23 s</td>
</tr>
<tr>
<td>Jog to stand</td>
<td>0.03 s</td>
<td>0.36 s</td>
<td>0.24 s</td>
</tr>
<tr>
<td>Turn 90</td>
<td>0.03 s</td>
<td>0.31 s</td>
<td>1.41 s</td>
</tr>
</tbody>
</table>

Values obtained with simulation

Animation frame rate = \( \sim 0.03 \text{s} \)

Blend window default = 10 frames
Animation controller naturalness

12 participants

5 conditions x 5 clips x 3 repetitions = 75 randomized clips

All ratings significant except Blend and Cape (p < 0.0001)
## Results

<table>
<thead>
<tr>
<th>Condition</th>
<th>Participants</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>NoMotion (N)</td>
<td>14</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Blend (B)</td>
<td>13</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Cape (C)</td>
<td>10</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Switch (S)</td>
<td>18</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>MoveTree (M)</td>
<td>13</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>