Rebuttal

Claim: "Games" not defined

Rebuttal:

- Good digital games contain ≥ 7 core components.
- Games are not simulations, ITS's, CAI, etc.
  - In Sitzmann (in press) meta-analysis, 16% of "simulation games" were passive. **It's not a game if it uses passive techniques.**
  - Meta-analysis contains none of the current games I showcased, but does contain mostly simulations, from 1-2 decades ago.
  - Most (47/54 = **87%**) articles in Sitzmann review that are classified as "simulation games" are not games (e.g., Smithtown)

Should've Used Bricks

23. *Kinkade, R. E., Matthews, C. T., Draugalis, J. R., & Erstad, B. L. (1995). Evaluation of a computer simulation in a therapeutics case discussion. *American Journal of Pharmaceutical Education, 59,* 147-150.
24. *Korfiatis, K., Papatheodorou, E., & Stamou, G. P. (1999). An investigation of the effectiveness of computer simulation programs as tutorial tools for teaching population ecology at university. *International Journal of Science Education, 21,* 1269-1280.
25. *Kos, I. (1996). *Teaching clinically oriented embryology with computer simulations*. Unpublished doctoral dissertation, New York University, New York.
26. *Lawson, K. A., Shepherd, M. D., & Gardner, V. R. (1991). Using a computer-simulation program and a traditional approach to teach pharmacy financial management. *American Journal of Pharmaceutical Education, 55,* 226-235.
27. *Loar, R. S. (2007). *The impact of a computer simulated case study on nurse practitioner students' declarative knowledge and clinical performance*. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign.
28. *Mitchell, R. C. (2004). Combining cases and computer simulations in strategic management courses. *Journal of Education for Business, 79,* 198-204.
29. *Moshirnia, A. V. (2008). *The influence of information delivery systems in modified video games on learning*. Unpublished doctoral dissertation, University of Kansas, Lawrence.
30. *Moslehpour, S. (1993). *A comparison of achievement resulting from learning electronics concepts by computer simulation versus traditional laboratory instruction*. Unpublished doctoral dissertation, Iowa State University, Ames.
31. *North, M. M., Sessum, J., & Zakalev, A. (2003). Immersive visualization tool for pedagogical practices of computer science concepts: A pilot study. *JCSC, 19,* 207-215.
32. *Ortiz, G. A. (1994). Effectiveness of PC-based flight simulation. *The International Journal of Aviation Psychology, 4,* 285-291.
33. *Parchman, S. W., Ellis, J. A., Christinaz, D., & Vogel, M. (2000). An evaluation of three computer-based instructional strategies in basic electricity and electronics training. *Military Psychology, 12,* 73-87.
34. *Randell, T., Hall, M., Bizo, L., & Remington, B. (2007). DTkid: Interactive simulation software for training tutors of children with autism. *Journal of Autism and Developmental Disorders, 37,* 637-647.

Claim: Games don't support learning

Rebuttal:

- Games do improve content learning, cognitive skills, etc. over a variety of control conditions (e.g., Anderson & Bevelier, in press; Barab et al., 2010; Cherney, 2008; Coller & Scott, 2009; De Lisi & Cammarano, 1996; De Lisi & Wolford, 2002; Feng et al., 2007; Gentile et al., 2009; Kebritchi, Hirumi, & Bai, 2010; Li, Polat, Makous, & Bavelier. 2009; Squire et al., 2004; Terlecki et al., 2008).
- Real power of games – to elicit and support "21st century competencies." Studies that show no differences in content learning (games & control) are not leveraging potential of games.

Claim: No peer-reviewed studies for motivational effects of games

Rebuttal:

- Yes there are.
  - Barab, S. A., Gresalfi, M., & Ingram-Goble, A. (2010). Transformational play. ***Educational Researcher***, *39*(7), 525-536 (*same journal as KSC*!).
  - Coller, B. D., & Scott, M. J. (2009). Effectiveness of using a video game to teach a course in mechanical engineering. ***Computers & Education***, *53*(3), 900-912.
  - Coller, B. D., & Shernoff, D. J. (2009). Video game-based education in mechanical engineering: A look at student engagement. ***International Journal of Engineering Education***, *25*(2), 308-317.

Claim: Games too expensive

Rebuttal:

- **Game dev't costs have decreased dramatically.** Professional games can now be made with free s/w packages (e.g., Unity, Unreal engine, Panda3D, Blender, etc. (see YouTube: "best unity 3d games" and http://en.wikipedia.org/wiki/Category:Free_game_engines).
- **Games don't have to be created from scratch.** There are lots of off-the-shelf games that can support learning (e.g., *World of Goo*--Shute & Kim, in press; *Civilization*--Squire et al., 2004, etc.).
- **Games can be built by students**. Some amazing levels/games can be created as part of learning (e.g., LBP, G*M, NIU-Torcs <built on an existing open-source video game called Torcs>, Never Winter Nights ships with tools for custom game modules, etc.).
- **Military**. The military acknowledges the cost effectiveness of games in military training (Belenich et al., 2004).

Claim: Use traditional research design

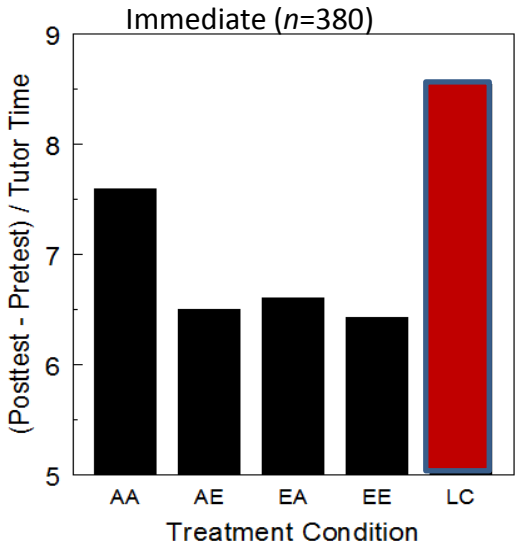
Rebuttal:

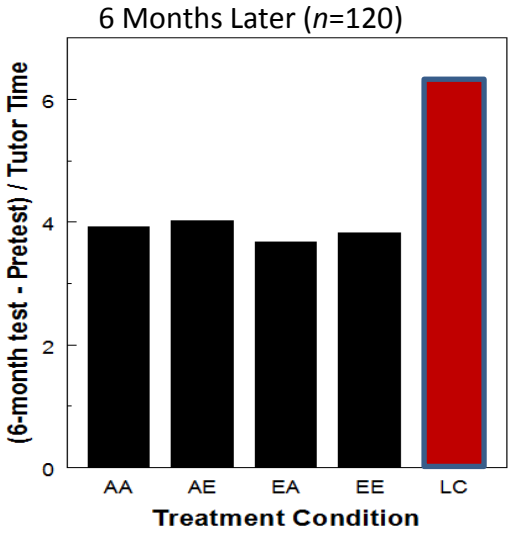
- *What exactly causes learning & motivation* from a game is an interesting question, but secondary to showing a game **as a whole** improves motivation *and* learning outcomes.
- Current efforts examining relationship(s) between game elements and learning (e.g., DeRouin-Jessen, 2008 ; Wilson et al., 2009), but good games are a system, and testing 1-2 elements is unnatural. Instead, test **degree** of elements in a game (but keep 7 together to not destroy game's integrity).
- Consider qualitative and design-based research approaches. Also longitudinal studies (for delayed effects and alternative outcomes).

Claim: Student control=bad (for novices)

Rebuttal:

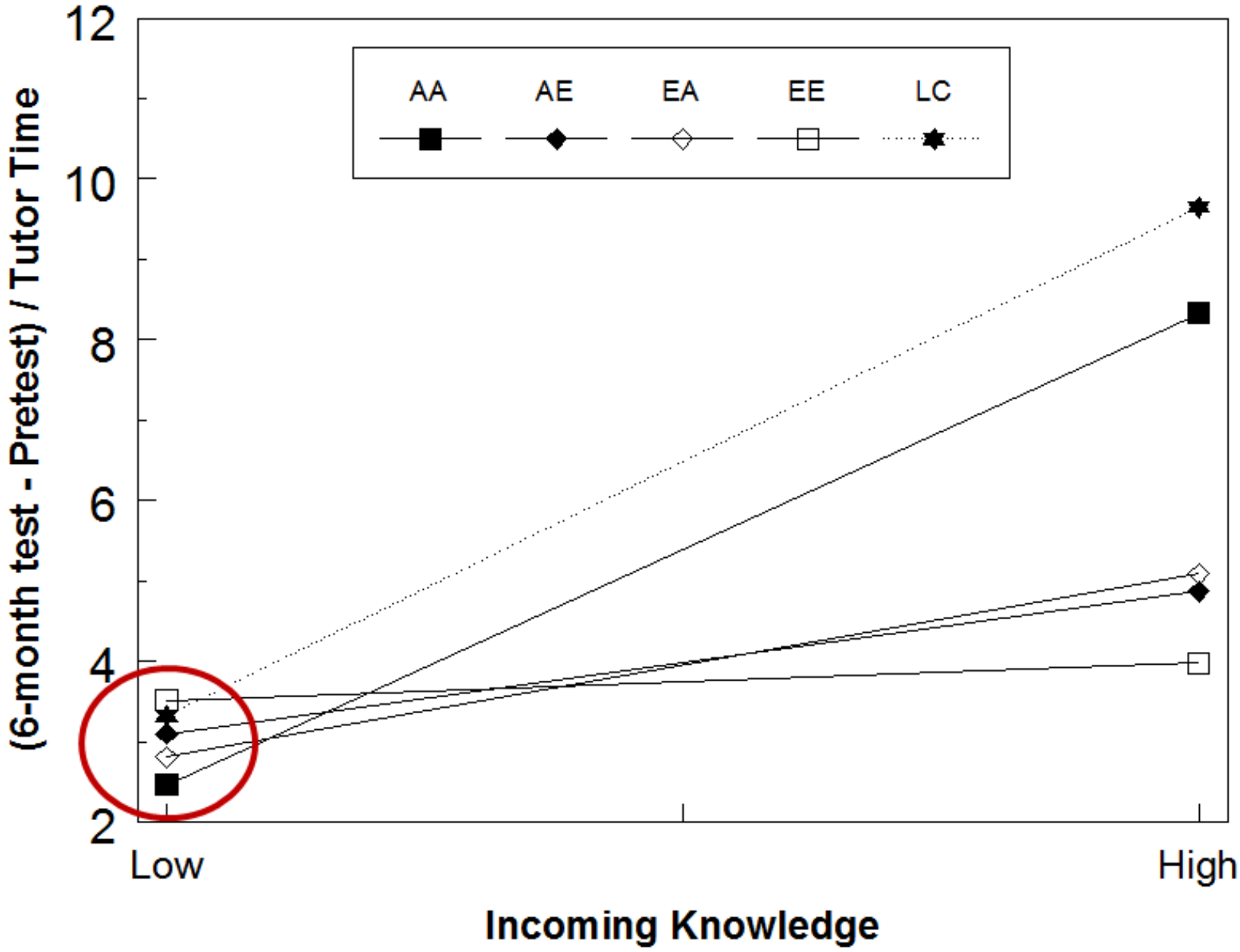
- **Another study** (Shute, Gawlick, & Gluck, 1998) looked at immediate & long-term effects of 4 fixed and one "learner control" condition (*n*=380).
- **Short-term gain**. Learners in the LC condition showed medium gain, relative to the other conditions (posttest). But LC was also faster to finish than other conditions.
- **Efficiency**. LC showed significantly greater efficiencies, for both short- and long-term gains, compared to the fixed-practice conditions.





Conclusion on Control

- We found interactions between prior knowledge with condition for both short- and long-term efficiency measures.
- Ss with *high incoming knowledge* assigned to LC condition scored more than *2 SD* above fixed-practice conditions on long-term efficiency index (in line w/literature where high-ability/knowledge Ss benefit most from LC treatments).
- But Ss with *low prior knowledge* did not differ in terms of short- or long-term efficiency by condition--efficiency indices the same across 5 conditions for immediate & delayed testing. This is not in line w/claim that low-ability/knowledge Ss perform better when computer or teacher has control.


12
10
8
6
4
2
(6-month test - Pretest) / Tutor Time
AA
AE
EA
EE
LC
Low
High
Incoming Knowledge

CLAIM: Games only for practice

Rebuttal:

- Certain digital games can improve certain cognitive skills (see Anderson & Bevelier, in press). Games should have a role in knowledge/skill development via deliberate practice.
- Games often played for hours they serve as an excellent tool for improving a variety of skills (including 21 C. competencies—like empathy w/Gentile's research on *prosocial* games).

CLAIM: Games only for practice (cont.)

Rebuttal:

- Games have also been found to improve spatial ability.
- In various studies (e.g., Cherney, 2008; De Lisi & Cammarano, 1996; De Lisi & Wolford, 2002; Feng et al., 2007; Okagaki & Frensch, 1994; Terlecki et al., 2008), participants who played *Tetris* (or similar dynamic puzzle game), showed significant increases on mental rotation tasks.

Claim: Games effects (if any) short-lived

Rebuttal:

- Li, Polat, Makous, & Bavelier (2009) developed a training program to improve contrast sensitivity using action games. Experimental group played an action game, control group played non-action game.
- Significant interaction between time of test × group ($F(1, 25) = 7.8$, $p = 0.01$, partial $\eta^2 = 0.24$), showing a sizeable benefit in *contrast sensitivity* ***remains for months to years*** (i.e., same subjects tested 5 months to 2.5 years later).

Claim: Games Don't Promote Perception, Attention, Spatial Skills

Rebuttal:

- Training non-video-game players (NVGPs) on an action game for as little as 10 hr significantly improved useful field of view (Green & Bavelier, 2003, 2006; Spence, Yu, Feng, & Marshman, 2009).
- Playing an action game for 10 hr improved significantly on attentional and spatial tasks, whereas participants who played a maze game for the same length of time showed no gains (Feng et al., 2007)

Claim: Games Don't Promote Discrimination Skill

Rebuttal:

- Playing action games for 30 hr significantly enhances ability to resolve small details in a crowded scene (Green & Bavelier, 2007) .
- Playing action games for 50 hr enhanced contrast sensitivity. Also, action game players required *significantly* shorter duration to detect a dim stimulus (Li, Polat, Makous, & Bavelier, 2009).

Claim: **If we overload our thinking with too much info it "crashes." We have to design multimedia so that it does not cause cognitive overload.**

Rebuttal:

- Most good games provide abundant cog load, and players eat it up and come back for more! There's likely an upper bound on cog load in instruction for novices; that's where game design comes in (*adaptive challenges*).
- Ang et al. (2006) conducted an exploratory study using qualitative methods to explore cog overloads in *Maple Story* (typical MMORPG). Results: several types of cog overloads emerge during the gameplay. Some overloads pose problems even to expert players, but (a) players develop strategies to overcome them, and (b) most forms of cog load are judged as *desirable* – making the game challenging & interesting.

Claim: If we overload our thinking with too much info it “crashes." We have to design multimedia so that it does not cause cognitive overload (Cont.)

Rebuttal:

- Nacke (2010) used EEG measures to examine complete mental absorption in a game, where flow occurs in situations with high cognitive load, accompanied by a feeling of pleasure. Significant correlation of alpha and negative affect: if players not adequately challenged, this can lead to negative affect.
- Neurophysiological studies (reported in Csikszentmihalyi, 1992) suggest that when people really concentrate on a hard task (e.g., in a game), their cortical activation level (measuring *mental effort)* actually decreases from baseline, instead of increasing—a neurological indication of *flow*. This allows one to concentrate more efficiently, *with less effort*.

Conclusion

Games are more than mere vehicles carrying instructional groceries. They're,

> "*magic in the way that first kisses are magic, the way that finally arriving at a perfect solution to a difficult problem is magic, the way that conversation with close friends over good food is magic*" (Zimmerman, 2008).

The magic comes from combo of elements--actively exploring the game, finding hidden connections, receiving "just right" challenges, timely feedback, etc. This makes for deeply profound experiences. *Deeply profound experiences stick with us.*

“Hey—games <u>are</u> powerful!”

“Yep!”