Game Penalties Decrease Learning and Interest

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Abstract. Penalties are frequently used in games and rarely in tutors, creating a dilemma for designers seeking to combine games and tutors to maximize fun and learning. On the one hand, penalties can be frustrating and waste instructional time, on the other, they may increase excitement and prevent gaming. This study tested the effects of penalties on learning and interest. In a randomized, controlled experiment with a two-group, between subjects design, 100 University students played two versions of a game with an embedded tutor, with and without penalties that forced students to replay parts of the game. Results showed that penalties decreased learning and interest. These findings suggest a minimize penalties principle for designing cognitive games.

Keywords: intelligent tutoring, educational games, serious games, penalties.

1 Introduction

Can *cognitive games*—educational games with embedded intelligent tutors, promote learning as effectively as tutors [1] and be as fun to play as games? Unfortunately, tutors and games take conflicting approaches to assistance. Tutors provide more assistance than games, providing scaffolding and feedback on each *step*, providing hints and minimizing penalties. If an entertainment game like *Halo* adopted such tutoring strategies, it would look quite odd: not only would it tell you whether you've hit or been hit by an enemy, it would tell you what kind of weapon to choose, which enemy to target, how to point the weapon, when to shoot, the enemy's weakness, etc.; being hit wouldn't reduce your health; and after missing an enemy, the enemy would patiently wait for you try again. These conflicting approaches make it unclear whether cognitive games can simply combine tutors with games to maximize learning and fun—adding tutors may increase learning at the expense of fun.

To explore the cognitive game design space at the intersection of tutors and games, Easterday et. al. [2] compared two cognitive games: a high-assistance, low penalty *tutored game* and a low-assistance, high-penalties *hardcore game* (Figure 1). Intuitively, we might predict a tradeoff with the tutored cognitive game better for learning, and the hardcore-game generating greater interest. In fact, the tutored-game led to greater learning and competence, which in turn increased interest. So if hardcore game conventions are not effective (feedback is good for learning after all), how might a high penalties/high feedback *walkthrough* game fare? In this study, we examine the role of minimal and harsh penalties in cognitive games.

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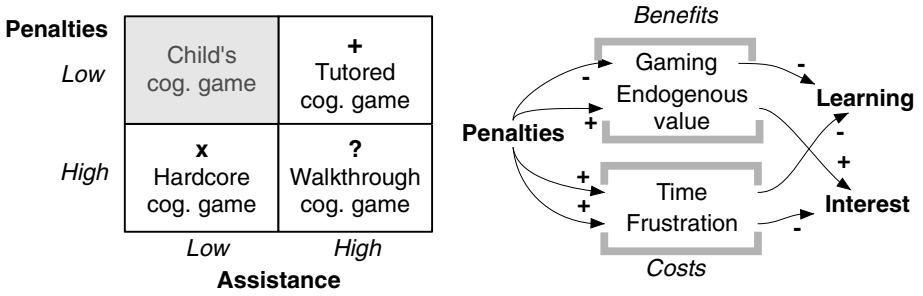

Fig. 1. Cognitive game design space (left) and possible causal effects penalties (right)

Hypotheses. In this study, we compared how two cognitive games with either *harsh* or *minimal penalties* affected learning and interest. The *harsh penalty* version required students to replay parts of the game after an error, while the *minimal penalty* version allowed immediate error correction. The outcome measures were *learning*, which measured the policy analysis skills taught by the game, and *interest*, as measured by the Intrinsic Motivation Inventory [3]. Assuming that penalties make games more challenging, there are several plausible hypotheses:

1. *Null*: Penalties have a minor, floor, or ceiling effect on learning and interest.
2. *Reduced gaming*: Penalties increase learning by reducing gaming (caused by low levels of interest), but have little effect on low levels of interest.
3. *Tutored game*: Penalties decrease learning and interest because they waste instructional time and are unnecessary for generating interest.
4. *Walkthrough game*: Penalties increase interest by making the game more challenging and do not harm learning because they do not affect the assistance provided.
5. *Hardcore game*: Penalties decrease interest by making the game too challenging.

We predicted support for either the *null* or *hardcore cognitive game hypothesis* based on the motivational importance game designers place on penalties and our previous finding that a *minimal penalties* version of the cognitive game increased learning and aspects of interest more than "game-like" version with minimal feedback and penalties [2]–possibly suggesting that lack of feedback in the game-like version decreased learning and masked the motivational effects of penalties.

2 Method

Design. Learners played the anime-adventure game *Policy World* that taught them 4 policy analysis skills: *comprehending* causal claims in text, *evaluating* evidence for claims, *diagramming* claims, and *synthesizing* evidence across claims. The study used a two-group, between subjects, randomized, controlled, experimental design that compared a *harsh penalties* version with a *minimal penalties* version of the game. During training, the harsh penalties version of Policy World erased learners' progress upon making a mistake. When the learners made errors on an analysis step for a particular causal claim, they were sent back to the first analysis step. When learners

received 5 debate strikes, they had to replay the level. The minimal penalties version allowed learners to correct errors with no loss of progress.

Participants. 100 university students were recruited through campus flyers and email. Students were compensated $16 for completing the study and an additional $4 for beating posttest 1 and an additional $4 for beating posttest 2.

Procedure. Students first took a pretest on either the drinking age (5 causal claims) or obesity (7 causal claims). During the pretest, students were allowed to search and analyze as many or as few reports as they liked before continuing to the debate. Students were then randomly assigned to the *harsh* or *minimal penalties* training. Each group completed 3 training problems on video game violence (4 causal claims), organic foods (5 causal claims), and vaccines (4 causal claims). During training, harsh penalties students received penalties for errors while minimal penalties students did not. Since it was possible that harsh penalties students might take much longer on training, they were allowed to advance to the test levels after 1 hour on the training levels. After training, students completed the intrinsic motivation inventory survey [3] with sub-scales measuring perceived competence, effort, pressure, choice, value and interest. Finally, students played two test levels without penalties or tutoring. The debate test (on cap-and-trade, with 8 causal claims) was a debate-only level that provided a completed diagram (to test hypotheses about debate skills outside the scope of this paper). Students then took a posttest identical to, and counterbalanced with, the pretest.

3 Results

Table 1. Both groups learned analysis but the minimal penalties group learned more

		Pretest		Posttest	
Analysis skill	**Penalties**	**M**	**SD**	**M**	**SD**
Comprehend	*Harsh*	2.68	1.92	3.50	1.79
	Minimal	2.24	1.82	4.26	1.64
Evaluate	*Harsh*	1.72	1.58	2.38	1.59
	Minimal	1.68	1.63	3.10	1.72
Diagram	*Harsh*	2.26	1.77	3.36	1.79
	Minimal	1.94	1.68	4.08	1.68
Synthesize	*Harsh*	2.76	2.19	4.00	2.06
	Minimal	2.66	2.50	4.60	2.34

Table 2. The ANOVA showed a significant increase on all analysis skills for both groups and a greater increase on 3 out of 4 skills for the minimal penalties group

	Test (pre/post)				Penalty				Test-penalty interaction			
	df	**F**	**p**	**GES**	**df**	**F**	**p**	**GES**	**df**	**F**	**p**	**GES**
Comprehend	1 98	53.4	7.5E-11 *	0.138	1 98	0.28	0.60	0.002	1 98	9.53	2.6E-03 *	0.028
Evaluation	1 98	36.4	2.9E-08 *	0.094	1 98	1.51	0.22	0.011	1 98	4.86	3.0E-02 *	0.014
Diagram	1 98	70.9	3.2E-13 *	0.183	1 98	0.48	0.49	0.003	1 98	7.31	8.1E-03 *	0.022
Synthesize	1 98	39.2	9.8E-09 *	0.110								

Analysis 1: Do penalties affect learning? To examine how penalties affect learning we examined students' pre/post test differences in analysis skills across the minimal/harsh penalties groups using a two-way, repeated measures (mixed) ANOVA. Both groups improved on all skills. The minimal penalty group showed significantly greater improvement than the harsh penalty group on comprehension, evaluation and diagramming and a (not significantly) greater improvement on synthesis, (Table 1-2).

Analysis 2: Do penalties affect intrinsic motivation? To examine how penalties affect interest we asked students to complete a well-validated interest questionnaire, the intrinsic motivation inventory [3], immediately after the three training levels and analyzed the results with pair-wise t tests. Table 3 shows that the minimal penalties group felt significantly more competent, found the game more interesting and more valuable for learning about policy.

Table 3. Penalties decreased perceived interest, competence and value

	Harsh		Minimal						
	M	**SD**	**M**	**SD**	**t**	**df**	**p**	**ll**	**ul**
Interest	3.44	1.32	3.93	1.24	1.89	97.62	0.061 .	-0.02	0.99
Effort	4.83	1.06	4.83	1.09	-0.02	97.88	0.985	-0.43	0.42
Choice	3.41	0.82	3.50	0.87	0.57	97.59	0.567	-0.24	0.43
Competence	3.45	1.43	4.17	1.20	2.71	94.91	0.008 **	0.19	1.24
Pressure	3.74	1.64	3.74	1.06	0.01	84.13	0.988	-0.54	0.55
Value	3.88	1.56	4.41	1.34	1.80	95.91	0.075 .	-0.05	1.10

4 Discussion

The results show that penalties decrease learning and interest in cognitive games. While these results contradict possible intuitions about the motivational effects of penalties, they are consistent with the effects on learning of previous work on combining tutors and games, which found that greater assistance also increased learning and motivation through similar mechanisms[2]. Thus, as the main contribution of this work, we propose a *minimize penalties principle*—that cognitive games should reduce penalties to increase learning and interest. This means that we can embed tutors in games to increases learning and interest with *no tradeoff*.

References

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