Principles for AI Co-Creative Game Design Assistants

Alex Elton-Pym
The University of Sydney
alex.elton-pym@sydney.edu.au

Abstract
While human-AI co-creative game design assistants are a relatively new technology, clear paradigms for their design are emerging. Our research aims to investigate the AI techniques, heuristics, and design conventions that are key to effective co-creative game design assistants. We propose that now, during their infancy, a series of principles for the formulation of these systems is a timely contribution to the literature.

Introduction
The continual release of fun, original, and balanced content for competitive multiplayer games presents a difficult task for game designers. With the scale, complexity, and rapid release cycle of modern game content, designing for these simultaneous, interacting factors is particularly challenging for human designers. This argument for the necessity of computer-assisted game authoring tools is well established (Jaffe 2013). Our research will investigate best practices for the design and development of co-creative (i.e. human-AI collaboratively creative) game design assistants (CCGDAs). We will then develop a set of guidelines for the design of these systems, providing a robust framework for the development of future CCGDAs.

The use of CCGDAs is a relatively new concept, with preliminary experiments in real-time strategy level design (Liapis, Yannakakis, and Togelius 2013) (Figure 1), Super Mario worlds (Guzdial et al. 2017), and crowd-sourced puzzles (Charity, Khalifa, and Togelius 2020). While these early prototype systems demonstrate the viability of AI game design tools, there has been little research into principles and conventions for the design of such systems.

Our research will investigate the different AI techniques, gameplay heuristics, and interaction strategies that should be considered for the design of effective CCGDAs. Our research will use digital card games, such as Hearthstone, as a research platform due to some of the factors which make them popular in AI research (Hoover et al. 2020), including:

- Strategy-rich, turbulent metagames

Figure 1: Sentient Sketchbook, a prototype CCGDA featuring a prominent level editor and AI-powered suggestions (Liapis, Yannakakis, and Togelius 2013)

- The regular release of original game content
- The wide variety of feature-rich simulation software

Our research argues that effective CCGDAs would reduce labour costs and improve the quality of released content by improving fun, balance, and originality. Yet as there are no established standards for the creation of CCGDAs: we propose principles for the design of effective CCGDAs is a vital addition to the literature. To that end, our research has three primary objectives:

1. Evaluate heuristics for fun, balance, and originality
2. Explore different interaction strategies for CCGDAs
3. Develop a set of design principles for CCGDAs

Our research will follow an iterative research-through-design method (Zimmerman, Forlizzi, and Evenson 2007), whereby we will develop a series of prototypes aimed at exploring the specific heuristics and strategies that form effective CCGDAs. Informed by insights from these prototypes and associated user studies, we will establish provisional principles for the design of effective CCGDAs.

Existing Paradigms
Despite their infancy, common paradigms for the design of CCGDAs have emerged. Based on our review of the design
of existing CCGDAs, we have established initial principles
we aim to investigate. Some of the main paradigms we have
identified, and will study are:

- Mixed-initiative creative interfaces (Deterding et al.
  2017)
- Quality-diversity optimisation genetic algorithms, such as
  MAP-Elites (Gravina et al. 2019)
- Communicative and explainable AI (Gunning 2017)
- Simulation and recommender systems (Liapis, Yannakakis,
  and Togelius 2013)
- Prominent graphical content editors (Figure 2)

![Figure 2: Tanagra, a prototype CCGDA featuring a prominent
level editor and an AI-powered “Beat Timeline” assisting with
pacing (Smith, Whitehead, and Mateas 2010)](image)

**Research Methodology**

Following an iterative research-through-design (Zimmer-
man, Forlizzi, and Evenson 2007) methodology, we will
develop a series of prototype CCGDAs. Through associated
studies, we will evaluate these prototypes to gain valuable
insights into what makes them effective. These insights will
inform our principles for effective CCGDAs: the primary
contribution of our research. Using our prototypes in three
primary studies, we will investigate each of our primary
research objectives independently.

The first of these studies will involve the development
and testing of heuristics for fun, originality, and balance.
By conducting user studies with game designers, we will
evaluate the importance of these factors along with
effective algorithms for their implementation. We will also
investigate common algorithmic techniques such as quality-
diversity optimisation genetic algorithms and recommender
systems. The second study will focus on the interaction
strategies that communicate these heuristics such as the
mixed-initiative protocol.

Our final study will be aimed at refining our provisional
principles into a set of robust guidelines for the design
of CCGDAs. This will be a collation of insights gained
throughout our primary studies. Our final prototypes will
also act as communicative design artefacts (Zimmerman,
Forlizzi, and Evenson 2007) capable of demonstrating prac-
tical implementations of our guidelines.

**Conclusion**

The challenging task of designing for the often interact-
ing game design factors of fun, originality, and balance is
best solved by CCGDAs. During their infancy, these systems
need robust guidelines to act as a framework for future de-
velopment. Through a series of prototypes and studies, our
research will investigate common paradigms in the design
of effective CCGDAs thereby establishing these guidelines;
a timely and valuable addition to the literature.

**Acknowledgements**

My research wouldn’t be possible without the support of my
family, university, and of course my supervisor Dr. Kazjon
Grace and auxiliary supervisor Dr. Marcus Carter. Our stim-
ulating discussions, afforded by their multidisciplinary col-
aboration, provide invaluable ideas, insights, and advice.

**References**

Charity, M.; Khalifa, A.; and Togelius, J. 2020. Baba is y’all:
Collaborative mixed-initiative level design. *arXiv preprint

Mixed-initiative creative interfaces. In *Proceedings of the
2017 CHI Conference Extended Abstracts on Human Fac-
tors in Computing Systems*, 628–635.

Procedural content generation through quality diversity. In *2019 IEEE Conference on Games (CoG)*, 1–8. IEEE.


A general level design editor for co-creative level design.
In *Thirteenth Artificial Intelligence and Interactive Digital
Entertainment Conference.*


Jaffe, A. B. 2013. *Understanding game balance with quan-
titative methods.* Ph.D. Dissertation.


Zimmerman, J.; Forlizzi, J.; and Evenson, S. 2007. Research through design as a method for interaction design research
in hci. In *Proceedings of the SIGCHI conference on Human