

## **Morphology of the tetromino-stacking game: The design evolution of Tetris**

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This essay presents a focused, comprehensive design study of the tetromino-stacking computer puzzle game known as Tetris, tracing the structural history and evolution of the game's subtle yet complex mechanics since its invention in 1985. Although the basic algorithm is quite simple and has remained essentially unchanged throughout its history, the enormous variety of implementations and the longevity of its success across many generations of computing platforms has made the tetromino game a diverse practice of evolutionary game design worthy of historical analysis. Instead of producing a full taxonomy or phylogenetic classification of the genre of computer puzzle games derived from or inspired by Tetris (see eg. Juul 2007), my analysis is intentionally restricted to implementations which recognizably reproduce the original basic algorithm. This approach is comparable to historical analyses of Chess, Go and Mancala which attempt to trace the evolution and distribution of a distinct, identifiable game-playing practice through various successive iterations while maintaining focus on a canonical form.

The journalistic history of Tetris (see Sheff 1993) is summarized and extended to the present day, noting the formation of the Tetris Holding IP-licensing entity in the United States, the enforced standardization and institutionalization of game rules through the official Tetris Guideline, and the successful commercial expansion to new platforms such as mobile phones and web applications. A second, parallel history is then introduced, focusing on the history and diversity of hundreds of unofficial tetromino games developed as free clone implementations, experimental variations and targeted training tools; the emergence of a highly-sophisticated technical vocabulary and boundary-pushing demonstrations of mastery within enthusiast tetromino game-playing communities; and tetromino game-oriented developments and experiments within applied mathematics, cognitive science, psychology, and computer science education and research. I assert that the ongoing rapid, yet coherent, evolution of tetromino-stacking game design is fueled by a precarious interplay (and constant struggle) between authoritative control and experimental freedom that emerges from these two histories.

The specific game mechanics described in detail in this historical analysis include: core rotational systems and associated combinatorial variations; timing and delays between piece movements and state transitions; introduction and standardization of color, sound and visual interface design to enhance gameplay cognition; adoption of constrained pseudo-random selection algorithms; careful tuning of difficulty curves and the design of distinct gameplay challenges and goals; various approaches to multi-player or team-based play; and variation and optimization of input methods across platforms and devices. Special attention is paid in particular to a Japanese arcade Tetris variant and the design improvements that enabled a skilled, sophisticated game-playing community to develop alongside the game's successive iterations.

Finally, I turn to traditional folklore studies as a compelling method of interpreting the diversity and longevity of tetromino game-playing practices, noting the critical difference that the defining elements of the game are essentially algorithmic

rather than narrative. As a result, the morphological variations are located in the game implementation's configurative responses to player action rather than in a sequencing of narrative events as in the folktale. However, just as the evolution of myths allow cultures to embed received wisdom, world-views and experience into shared narratives continually retold and reworked, the design evolution of digital game-playing practices such as Tetris incorporates key principles and practices of cognition and human-computer interaction, embedding them within a shared cultural form that is continually reprogrammed and redesigned as it is passed down to future generations of computing platforms and digital society.

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