Use of Complimentary Actions Decreases with Expertise

Marc Destefano & Wayne D. Gray
[destem, grayw] @rpi.edu
Cognitive Science Department, Rensselaer Polytechnic Institute
110 8th Street
Troy, NY 12180 USA

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Complementary Actions and *Tetris*

We present data that show several differences between novice and expert skill in the real-time interactive video game *Tetris*. The most striking of these findings is that in direct contradiction to prior research (Maglio & Kirsh, 1996), the frequency of complimentary actions decreases with skill.

To find expert *Tetris* players, we held a "*Tetris* Tournament" at a local science fiction/anime/video game convention for cash prizes, which attracted players of various skill levels. All players used a custom-engineered version of the game, which logged game and player actions on a millisecond-by-millisecond basis.

We categorized players as playing at a novice, intermediate, advanced, or expert level according to their final score of the better of two games. Data was binned by the speed of the falling block, to fairly compare novice and expert data at a particular speed level. Many of the results were intuitive: the average time to place a block decreases with expertise, the average time between all actions decreases with expertise, and the average latency to first move a block decreases with expertise.

However, in terms of complementary (also known as *epistemic*) actions, the data show very different results than prior work. Complementary actions are a special category of actions that are neither pragmatic (e.g., moving a piece towards its final position), nor are they errors. The defining feature of complementary actions is that they are performed for the purpose of easing cognitive load, i.e., to make a problem easier to think about. As reported by Kirsh & Maglio (1994), complementary actions can apply to either of the two main player actions in *Tetris*: translation and rotation. With regards to translation, in order to avoid the perceptual challenge of verifying whether a block is in alignment with its intended position on top of the current accumulation, the player could move the piece all the way to the border of the game space, and then translate back the relevant number of spaces (see Figure 1). For rotation, to avoid the challenge of mentally rotating the block to determine its best placement, the player could physically rotate the block more than necessary, and determine the best place to put it visually.

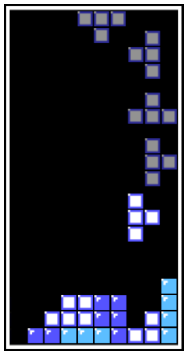

Figure 1: A complementary translation

Our data shows that this type of action decreases with expertise (see Figure 2), in contrast to Maglio & Kirsh (1996) who state that use of these actions increases with skill. Further work will make use of eye-tracking data to further classify these actions, as preliminary analysis has shown that many players will change their mind about where to place a block after they have already executed a motor plan. In other words, goal-switching can account for many of these extra actions.

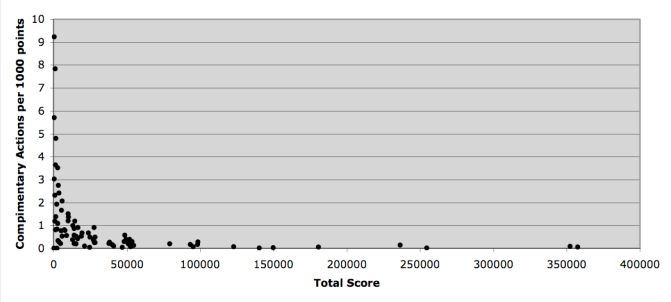

Figure 2: Use of Complementary Actions Decreases with Expertise

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References

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