Building an ecological knowledge of virtual worlds.

Pierre-Olivier Montiglio[1*], Julien Céré[2]

Affiliations

[1] FQRNT post-doctoral fellow.

[2] Département des Sciences Biologiques, Université du Québec à Montréal, Québec, Canada, cere.julien.2@courrier.uqam.ca.

*Correspondence to: mrmontiglio@ucdavis.edu

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Abstract

Virtual worlds supporting massively multiplayer games have become so complex that they exhibit temporal and spatial dynamics mostly driven by interactions between players. In this respect, virtual worlds resemble closely natural ecosystems. Studying the ecology of virtual worlds is an outstanding opportunity for ecologists as well as the game industry to collaborate in order to test several aspects of ecological theory difficult to study in nature, and build manageable, resilient virtual worlds.

Main Text

Massive Multi-player Online Games (or MMOG), such as World of Warcraft, Second life, or EVE Online typically support real time interactions among a hundreds of thousand or millions of players within virtual worlds of increasing complexity (1). Over the years, the content and design of MMOG have come to rely to a large extent on the emergent properties of the behavior of players and their interactions (2) within virtual worlds that display vibrant economic, sociological, political, and artistic activity (1, 3). These dynamics are now so complex that they are studied in their own right (1, 2), but also represent great opportunities to understand real life phenomena (4, 5).

At the heart of this complexity sits player behavior and its unpredictability. Hence, designing and maintaining stable virtual worlds has become very challenging (2). For example, players' behavior and interactions drove a wide scale plague, killing thousands of characters and perturbing the game World of Warcraft for months (4, 6). An emerging discipline – game analytics – even uses telemetry, GIS, and detailed quantitative analysis to inform game design. Game analysts categorize the behavior of players, and monitor dynamics of virtual worlds to optimize gameplay (2), very much as ecologists analyze how interactions among organisms drive their diversity and abundance to manipulate or preserve ecosystem functioning (7). Avatars, like living organisms, are long lived (years), and exhibit fascinating ecologies. In response to resource distribution and competition, they even express alternative strategies to acquire resources that are similar to producers, consumers, and decomposers (e.g. EVE Online).

MMOG design would greatly benefit from the tools already developed to study living organisms. Ecologically informed game design, like conservation ecology, would enable us to build virtual worlds supporting a higher diversity of players, or show more stable interaction dynamics. Game design impacts how much, how frequently, and how long players will stick to the game, ultimately determining the impact and value of these virtual worlds. Game analytics already applies telemetry methods to monitor player's in-game activity, space use and longevity (2). Such methods may also be applied to track how avatar interactions determine player density, or diversity over space and time. Such patterns of abundance and density could help identify meta-population dynamics within virtual worlds and sink habitats, where players lose interest and decrease their in-game activity.

The density and diversity of players may also be driven by the distribution of resources over the landscape. Clumped resource distributions will favor the emergence of strategies involving territorial behavior, with players restricting access to resources. More even resource distributions should favor players aiming at acquiring resources more efficiently or rapidly than their competitors, without defending them (8). Eventually, instead of competing for resources, some players often predate each other, leading to complex trophic food webs. Such strategies may even end up excluding one another. At the landscape scale, the coexistence of players with different strategies or characteristics will depend on the availability of different habitats (8). Manipulating the heterogeneity of the habitat to allow a greater diversity of strategies is a central aspect of game design, and it needs to be informed by ecological knowledge.

Players, like animals, also dispose of a limited quantity of time spent in the game. Time may vary from a few hours per week, spent in game sessions of a few minutes each to the equivalent of a full time job, spent in long game sessions. Such patterns of time availability will typically have huge effect on the strategies expressed by players. Animals with little time will specialize in a limited set of key strategies to win, whereas other animals with the possibility to allocate more time may adopt a 'Jack of all trade' strategy (9). The specific type of strategy expressed by these animals will likely lead to radically different patterns of survival: whereas specialists will be overall more efficient per unit of time, they may either do very well or very badly, 'jack of all trade' strategists will be less competitive but have higher chances of success in the long run. Figuring out how player's time constraint shapes their strategy would be a nice application of optimal foraging theory and surely help optimize games for different types of gamers.

Implementing changes throughout the games' life (in so called patches and releases) is also a major challenge, as it needs to balance change and consistency of the virtual world. Whereas not enough change may prevent the game from staying dynamic, too many perturbations may destabilize the interactions among players, and prevent them from persisting in the environment (10). Through these changes, game companies typically aim at retaining the players already attached to the game while recruiting new players, often with different time constraints, or strategies. Striking a balance between habitat changes and stability within virtual worlds, like managing real habitats (and perturbations), is another challenge that should be informed by ecological knowledge.

Virtual worlds have become amazingly complex. They are now an integral part of our social lives, and are no longer strictly used as entertainment (1). They are among the last ecosystems in need of ecologists' attention, and a great opportunity to apply fundamental scientific knowledge to an important aspect of our society. We believe an ecological approach is necessary if we are to build richer, more stable and resilient virtual environments. They also represent an outstanding opportunity to expand our understanding of ecological processes that are hard to quantify in real ecosystems.

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