

C.H.E.S.S.B.O.A.R.D.: An Interactive Chess Learning Aid

(Technical Paper)

The Effect of Game-Centered Socialization on Mental Health With a Focus on Analog vs. Digital Games

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The mental health crisis of the last few years poses difficult challenges for our society: depression, anxiety, social isolation, and suicide are occurring at increasing rates. The cause of this crisis is complex, involving social media, pandemic lockdowns, cyberbullying, and many other factors. While the complexity of the problem renders it insurmountable by simple solutions, it is possible that relatively minor changes could help to mitigate some of the effects of the comparatively intractable root causes. I believe that my team's capstone project could assist with one such minor change: facilitation of games (specifically, chess) that involve social interaction.

In the wake of the pandemic, mental health has become a greater concern: depression rates have increased by 25%, (World Health Organization, 2022) severe loneliness by 350%, (O'Sullivan et al., 2021) and deaths of despair by 29%. (Angus et al., 2023) The pandemic was especially difficult for those who lacked a strong community: the enforced isolation of the lockdowns worsened loneliness and isolation, leading to comprehensive mental health issues. The lockdowns have been lifted, but the scars on the public psyche remain.

It is my belief that games could play a significant role in helping isolated people to become more integrated with society, especially if those games require face-to-face social interaction. It has been shown more broadly that games, hobbies, and other forms of leisure have positive mental health benefits: Altschul and Deary (2020) found that analog (non-computer) games slow cognitive decline, Gonzalez-Torres (2024) studied the benefit of online games as a means of substitute socialization during the pandemic, and Egami et al. (2024) noted the benefit that video games had for the mental health of Japanese children. While there are many studies focusing on games and their effect on mental health, I theorize that in-person games specifically would be even more beneficial, as they include face-to-face social interaction, which is known to have a strong positive correlation with good mental health (Ono et al., 2011). I plan to review the literature on analog

games' effect on mental health and attempt to compare it to video games.

One notable advantage of digital games over analog games is the ease with which a prospective player can learn the rules: digital games tend to include specialized levels at the beginning of the game to introduce players to the rules and key mechanisms of the game. Analog games, by contrast, are left with less engaging methods of teaching their rules: generally, a rule-book. The complexity of many games' rules, combined with the relative difficulty of reading through a rule-book, can pose a barrier to players who are only casually interested in the game. My technical topic attempts to lower this barrier for one specific game (chess) by creating an interactive chessboard that will teach the player how to play the game. My STS topic will focus on the effect of analog games on mental health, specifically in comparison to digital games.

Technical Topic

To lower the barrier to social interaction through games, my capstone team will attempt to make a learning tool that intuitively teaches the user the basics of a game and helps them to develop into a skilled player. Given how well-known it is in western countries, chess is an ideal game for this purpose: most people would be at least familiar with the objectives of the game (and thus more willing to play a stranger) even if they are not certain of the rules.

Many of the most powerful chess teaching tools (Stockfish, for example) are narrowly focused on honing the skills of elite chess players and are not appropriate for introducing beginners to this complex game. While groups such as `chess.com` have improved the usefulness of such tools through excellent user interfaces (highlighting squares, portable web-based rendering), they all share a critical problem: the most popular tools for teaching chess at a beginner level are single-player and computer-based, making them less helpful for fostering social interaction; instead, they

create isolation.

To address the problems we have found in existing chess learning tools, we will recreate the intuitive user interface and powerful computational prowess of online chess engines in a physical prototype. On a player's turn, the chess board will illuminate the squares of the pieces that the player may move using colored light-emitting diodes (LEDs) embedded under the surface of the board. When a player lifts a piece, the board will illuminate the squares to which that piece may move. If the player makes a mistake, the board will detect the misplaced piece, and make the square glow red. The state of the pieces on the board will be detected by a complex system of magnetic sensors in the board and magnets in the pieces.

Some previous chess-based projects at UVA have included robotic components that allowed the user to play alone against an AI player (Portillo, 2023); after some consideration, we decided to exclude such a feature: we would strongly prefer that the user play with another human, and the technical complexity of such an autonomous system would distract our team from our focus on teaching the game intuitively. Our ultimate goal is that people will use our chess board to invite isolated acquaintances into a playful social environment and engage them in a fun and intellectually stimulating game.

There is more to enjoying a game than simply knowing how the pieces move: if players are unable to improve their skills, they may become bored or frustrated (Lazzaro, 2009) (Adams & Dormans, 2012). Kramer (2000) explains that a key to enjoyment of a game is the ability of a player to master the game's strategy. To help players grow, we have included two additional features: automatic transcription and an integrated hint function. The latter of the two is to improve the playing experience for beginner players who find themselves frustrated or trapped mid-game; the former is for intermediate players to keep logs of their game without the tedium of notating by hand. There exist many websites that will perform analysis on chess games, noting good moves,

blunders, and better options, but all such websites require a description of the played game in chess notation. The notation, while not particularly arcane, can pose another barrier to skill growth and decrease the enjoyment of the game: while expert players will be fluent in it, intermediate players tend to find it rather difficult. Our system will transcribe the game automatically onto a USB thumb drive plugged into a port the side. Our hope for this feature is that the two players will, after finishing a game, go to a computer to analyze and talk through the game together, allowing for more social interaction.

My capstone team consists of Paul Karhnak, Lourdes Leung, Liam Timmins, Kevin Dang, and myself. Our project will be completed under the technical supervision of Adam Barnes, a professor of Electrical and Computer Engineering (ECE). As with all ECE capstone projects, it will be done entirely in the fall semester. We will use a wide range of computer modeling and software design tools to aid us in creating a physical prototype. In accordance with the ECE department's requirements, our design includes multiple printed circuit boards and an embedded computer system to process and respond to sensor data in real time.

STS Topic

Throughout all of history, games have served critical functions in society: they have given opportunities and goals for self-improvement, fostered social connections, strengthened community ties, and provided leisure. Games have long been recognized for the benefit that they provide to mental health: Plato considered play to be the proper counterpart to serious work and saw the lack of play as a key failing of the sophists' philosophy (Ardley, 1967). He theorized that the supreme and ultimate pursuit of man was to combine the rigor and truth of inner contemplation (*theôria*) with the leisure of play (*scholê*).

In present times, more modern scientific methods have given substantial evidence for the thesis that games are good for the players' mental health: Leslie (2024) found that video games can have great psychological benefits, theorizing that this is similar to the mental benefits enjoyed by partakers in any hobby. As I mentioned earlier, Altschul and Deary (2020) found that playing analog games is associated with slower cognitive decline among elderly populations. After "controlling for age, cognitive function, and other confounders," the study noted a significantly reduced lifetime decline of cognitive function. Such results suggest that the regular exercise of critical thinking and social skills provided by games are beneficial for our minds.

In our modern era of ubiquitous computing, many of the games enjoyed are digital, taking place entirely through a computerized system. This comes with definite cost and portability advantages, and also allows game designers to create more complex, expansive, visually rich, and engaging games. Researchers have found many applications of video games to mental health: Roberts and Bailey (2023) studied the therapeutic use of physically-active video games (e.g. Just Dance) among patients with severe mental illnesses, finding that they provided a valuable benefit; Hazel et al. (2022) found that moderate use of video games provides a significant mental health benefit, with certain genres (music, role-playing, and survival horror) showing stronger correlations than others; and Egami et al. (2024) exploited a unique opportunity involving a PlayStation lottery to show a positive causal link between console ownership along with increased gameplay and mental well-being. The study notes that much of the previous literature has focused on correlations between video game use and depression, which could be causal in either direction or both caused by some independent factor; in contrast, this study was able to control for many of the effects that would prove confounding for their colleagues. The study noted, however, that the positive effect of video games plateaued after daily play time exceeded a few hours.

Unfortunately, video games' effects on mental health are not entirely positive. The enjoyment

provided by video games can create addictive patterns in gamers' lives, increase social isolation, and detract from in-person social activity. Furthermore, with the advent of online gaming, many of the social benefits supplied by games have been diminished: in an online context, opponents and teammates are faceless, making community rare except in games explicitly focused on player community (Kolo & Baur, 2004). The effectiveness of the addictive elements of video games has led to the designation of a new mental disorder: *internet gaming disorder* is now part of the DSM-5 and is particularly common among adolescent boys (Petry et al., 2015). For female gamers, the opposite problem is often true: rather than finding games enjoyable to the point of addiction, women often find themselves marginalized in online games - and in some cases, online gaming environments have become actively hostile to female players (Paaßen et al., 2017). Video games tend to be “created by men, for men, and this is why developers pander to a male consumer base with strong male characters and sexy female characters” (Paaßen et al., 2017).

It is possible that analog games could provide a more robust and consistent mental health benefit to players. Because they are unable to use computers to render complex landscapes or provide real-time interactivity, they are often less engaging than digital games. Incapable of rendering a beautiful world, they are limited to graphics printed on the game materials and rely on the imagination of the player to fill in the remainder. Analog games require increased social interaction, have lower addictiveness, and are incapable of creating toxic online environments by virtue of existing purely offline. A study by Cross et al. (2024) found that board games were an effective “alternative vehicle for forging social relationships” among autistic people. Analog games have also been used in a therapeutic role to improve mental health in children (Streng, 2008).

While the mental health benefits provided associated with analog games are significant, it is also possible that a substantial portion of the positive effects (specifically vs. video games) are caused by selection: analog games are much less accessible to those with mental struggles, because

they require existing friends with whom to play the game. Online games, by contrast, are extremely accessible: anyone with a computer and an internet connection can participate in the fun. The question of whether analog games provide greater causal benefit to their players is one that is difficult to answer. Unfortunately, there is comparatively little literature studying or analyzing analog games and their effects on mental well-being. However, digital games have been extensively studied because of the widespread alarm surrounding them over the last several decades.

Research Question and Methods

In my thesis, I intend to research the role that games play in the mental health of players, the social benefits of games, and the relative effectiveness of digital games compared to analog games in improving the mental health of the players. I plan to conduct a more extensive literature review, including print sources as well as digitized articles. My research for this paper was, somewhat ironically, limited to the sources I could find online. Consequently, I plan to conduct a small survey of students at UVA to measure public perception of the mental health effects of analog and digital games among college students.

Conclusion

By the end of this capstone project, we will have a technical deliverable in the form of an interactive chessboard that uses visual cues and automatic game transcriptions. This chessboard will have the functionality for teaching the rules of chess to beginner players and improving the skills of intermediate players. By the end of the 2025 Spring semester, I will have completed the STS literature review on the social and mental health effects of games (specifically comparing analog and digital games) and an analysis of the small survey on the perception of games among col-

lege students. This information should be valuable to community leaders as they work to improve and broaden the effectiveness of community events. Additionally, the results should be of benefit to parents seeking to help their children engage socially and to mental health professionals as they advise their patients. One final outcome of this chessboard prototype is its attractiveness for facilitating and promoting social interaction opportunities for children in isolated environments.

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