Introduction: Digital Games as a Context for Cognitive Development, Learning, and Developmental Research

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Abstract

The authors present reasons why developmental psychologists should care about children's and adolescents' digital game play. These reasons may be identified as: a) digital game play is an integral aspect of children's and adolescents' lives; b) digital game play contributes to learning and cognitive development; and c) developmental research has the potential to contribute to effective educational game design. The authors expand on these reasons with the goal of introducing or reintroducing to developmental psychologists a rich and very relevant context in which to examine children's and adolescents' applied cognitive development. © 2013 Wiley Periodicals, Inc.
Why should developmental psychologists care about children’s and adolescents’ digital game play? This question motivated this volume and our 2012 Society for Research in Child Development symposium, on which many of the following chapters are based. As reflected in the chapters here, we argue that developmental psychologists should care, as digital game play provides a window into applied cognitive development and a continually expanding context in which children and adolescents spend their recreational and academic time. In fact, given greater movement toward the inclusion of digital games in academic settings (e.g., the Quest to Learn school in New York City), we further argue that developmental research can contribute to the design of effective educational games. We explicate our points below.

Digital Games Are an Integral Part of Children’s Environments

On the broadest level, as developmental psychologists are interested in environmental influences on developmental trajectories, we must acknowledge that digital games have become an integral aspect of children’s and adolescents’ lives. For example, a 2009 Kaiser Family Foundation survey found that, on average, 8- to 18-year-olds spent approximately 90 minutes per day playing digital games (Rideout, Foehr, & Roberts, 2010). Findings internationally also point to extensive digital game play among children and adolescents in other developed countries, such as the United Kingdom and Germany (see Livingstone & Bober, 2005; Feierabend & Klingler, 2008). Given the increasing reach of cell phones and handheld devices as platforms for gaming, time spent playing digital games most likely has continued to rise. For example, recent findings indicate that most U.S. adolescents (58%) owned a smartphone (Nielsen-wire, 2012) on which, on average, many may play about 15 hours of games per month (Carlozo, 2012).

The appeal of digital game play has been linked to several features, such as curiosity, challenge, and fantasy, as cited by Malone in his seminal 1981 article on the motivations for digital game play. More recently cited features that contribute to those noted by Malone include interactivity, which pertains to players’ opportunity to initiate and receive feedback about their actions, which then influences the course of game play (Renkl & Atkinson, 2007; Ritterfeld, Shen, Wang, Nocera, & Wong, 2009); agency or control, which refers to players’ ability to manage aspects of their game play, such as the use of the control mechanisms or flow of the story line (Wood, Griffiths, Chappell, & Davies, 2004; Qin, Rau, & Salvendy, 2009); identity, which refers to the player’s opportunity to form relationships and linkages with characters within the game or become a game character via avatar construction (see Blascovich & Bailenson, 2011); feedback, which refers to the information players receive about the efficacy of their game actions and furthers interest in continuing game play.
via scaffolding of that play (Liao, Chen, Cheng, Chen, & Chan, 2011; Lieberman, 2006); and immersion, which refers to players’ sense of presence or integration within the game (see Tamborini & Skalski, 2006). This feature, in particular, is often noted as the hallmark of digital games (Kickmeier-Rust & Albert, 2010) and has been linked to attainment of the highly pleasurable state of flow during game play (Csikszentmihalyi & Csikszentmihalyi, 1988; Sherry, 2004; Weber, Tamborini, Westcott-Baker, & Kantor, 2009). Collectively, these features contribute to engaging game experiences that promote sustained and repeated play.

**Digital Games Contribute to Learning and Development**

The persistent draw of digital game play and its clearly captivating nature has given rise to the development of academic/educational games and apps (See Deater-Deckard, Chang, & Evans, this volume) that capitalize on the features of recreational games (Moreno-Ger, Burgos, Martinez-Ortiz, Sierra, & Fernandez-Manjon, 2008), and to greater interest in exploring the cognitive benefits of digital game play (see Gee, 2003; Salonius-Pasternak & Gelfond, 2005; Squire, 2006). This interest, in turn, has contributed to the changing face of digital game research. For example, until fairly recently, the most widely known psychological research regarding digital game play concerned the potential negative impact of violent games (see Gentile, 2009; Gentile, Lynch, Linder, & Walsh, 2004; Weber, Ritterfeld, & Kostygina, 2006). However, evidence has been steadily accruing that attests to the positive ramifications of game play. For example, Bavelier, Green, and colleagues (Bavelier, Green, Pouget, & Schrater, 2012; Green & Bavelier, 2003; Green, Pouget, & Bavelier, 2010) have reported compelling evidence that frequent action digital game play promotes neural plasticity and cognitive abilities underlying one’s ability to effectively learn in general. Indeed, under some conditions, even violent game play can carry benefits, although these benefits must be weighed against the risks of such play (Bavelier et al., 2012; Ferguson, 2010). For example, Ferguson and Garza (2011) recently demonstrated that adolescents who played more violent action games and had parents who were involved in their game play showed higher scores on a measure of civic attitudes and behaviors than their peers who played fewer such games and experienced less parental involvement in that play.

Data on the cognitive benefits of children’s recreational play is consistent with findings linking video game play to enhanced reasoning and problem solving in older players and within educational games (e.g., Blumberg & Altschuler, 2011; Fisch, Lesh, Motoki, Crespo, & Melfi, 2011; Moreno, 2006; Schmidt & Vandewater, 2008). For example, research with college-age adolescents and adults has shown that playing digital games contributes to enhanced metacognition (VanDeventer & White, 2002), spatial reasoning (Green & Bavelier, 2006a, 2006b; Okagaki & Frensch,
1994), and speed of processing (Dye, Green, & Bavelier, 2009). Fewer studies have been conducted with children or adolescents, as Blumberg and colleagues address in their chapter. However, the findings from this steadily expanding body of work suggest that the potential for analogous contributions to younger children’s cognitive development also exists (e.g., De Lisi & Wolford, 2002; Papastergiou, 2009; Salonius-Pasternak & Gelfond, 2005).

Developmental Research Can Inform the Design of Better Educational Games

Decades of empirical research and practical experience have shown that developmental research and developmental researchers can play a vital role in the creation of educationally effective television series, such as *Sesame Street* (Fisch & Truglio, 2001; Sherry, in press). *Effective* in this context refers to viewers’ ability to comprehend, acquire, and apply information gained via the screen. There are also ways in which developmental researchers can contribute to the design of effective educational digital games (see Revelle, this volume). Just as games can contribute to cognition and development, various aspects of cognition and development have an impact on children’s interactions with games. For example, physical development has an impact on children’s interaction with computer games, as mouse control is often difficult for young children who are still developing fine-motor coordination (Hourcade, Bederson, Druin, & Guimbretiere, 2004). Cognitive constraints, as reflected in attention (e.g., Calvert, 1999) and in working memory (e.g., Mayer & Johnson, 2010), also impact children’s comprehension of onscreen material. Collectively, these findings have ramifications for the design of digital games to ensure age-appropriateness and usability for the age groups for which the games are intended.

Games as a Window into Applied Cognitive Development

Overall, digital games can be seen as a context for applied cognition. Specifically, these games are essentially cognitive puzzles (see Boyan & Sherry, 2011; Sherry, Lucas, Greenberg, & Lachlan, 2006) that encourage problem-solving approaches which are impacted by a wide range of developmental factors. In turn, they also present opportunities for players to practice and enhance cognitive skills. However, despite a substantial, emerging body of research examining the nexus of digital game play and children’s and adolescents’ cognitive skill enhancement, developmental psychologists are not the primary contributors to this literature. Similarly, too many educational games are developed for players of wide age ranges with little consideration of the differing levels of cognitive sophistication of those players (see Tüzün, 2007; Van Eck, 2006). To address these gaps, this volume explores children’s and adolescents’ interaction with digital
games from the perspectives of both research and practice. Through reviews of the existing literature and newly emerging theoretical approaches, this volume highlights new work and thinking on the impact of digital game play on children's and adolescents' skills, development, and academic attainment, and ways in which principles of developmental psychology are applied to inform the creation of effective games.

**Overview of the Volume**

The volume opens with two chapters that review models regarding factors that contribute to the potential effectiveness of educational games.

Sherry's model draws on uses and gratifications theory as based in communication science, and findings from developmental science and cognitive science. According to Sherry, children's and adolescents' genre preferences and psychological needs hold ramifications for their engagement during educational game play. By taking these factors into account, educational game designers can create games that succeed in engaging children by matching the games with children's and adolescents' needs, goals, and game experience.

Deater-Deckard, Chang, and Evans' model focuses specifically on engagement states, seen as cognitive, behavioral, and affective in nature, and the relevance of these states to student learning during educational game play. As part of their discussion, the authors propose tools to measure engagement in the context of their newly developed educational game app to promote middle school students' algebra readiness.

Revelle provides an overview of the contributions of developmental theory and research to the design of effective educational games among preschool and elementary school–age players. For example, according to sociocultural views of developmental theory, learning is promoted via adult scaffolding of children's learning. As applied to educational games, established principles of scaffolding can be incorporated into the design of successive levels of difficulty within a game, and through the inclusion of developmentally appropriate hints and feedback that are triggered by a child's correct or incorrect response.

Blumberg, Altschuler, Almonte, and Mileaf survey the small but growing body of research concerning the cognitive benefits of digital game play among children and adolescents. They also review recent work detailing children's and adolescents' impression of the linkage between digital game play and school learning. Collectively, this research has ramifications for the development of effective educational games that engage their players and potentially promote the transfer of cognitive skills, strategies, and content attained and used during game play to more academic tasks.

Calvert, Staiano, and Bond provide an overview of the positive and negative impact of digital game play on the pressing problem of childhood obesity. Traditionally, digital game play has been seen as fostering
sédentary behavior and as linked to consumption of high fat-, sugar-, and salt-based foods and beverages. However, Calvert and colleagues illustrate potential benefits of game play as reflected in the relatively recent genre of exergames for the promotion of physical activity and weight loss, and in mobile games and advergames for the promotion of healthy eating habits and practice.

The final chapter reaches beyond digital games, in keeping with current industry trends toward producing material that spans multiple media platforms, such as a related television series, digital game, hands-on activities, and even a live stage show. Fisch draws on several recent studies to explore the nature of *cross-platform learning* (i.e., learning from combined use of multiple media platforms) and how such learning compares to that of learning from a single medium. One key benefit appears to lie in transfer of learning, which allows the content learned from one medium to support richer learning from a second medium. This situation may be reflected in the acquiring of problem-solving strategies from a television series and the application of these strategies to the playing of an educational game in a more sophisticated fashion.

Levine and Vaala provide a closing commentary that examines key thrusts, governmentally and societally, in the push to use games as vehicles for informal and formal learning. They also highlight cross-cutting themes across the chapters, such as the role of student engagement in learning, the need to consider the developmental appropriateness of games designed for child and adolescent audiences, and their ramifications for advancing research and development concerning games as a vehicle for educational enhancement.

As these chapters illustrate, there are many substantive answers to the question, “Why should developmental researchers care about children’s and adolescents’ digital game play?” Such games have become an integral part of many children’s and adolescents’ environments, and they can be used to promote learning and development. We hope this volume will open this emerging body of research to the attention of a broader audience of developmental researchers, demonstrate the potential of games as a context for applied developmental research, and stimulate further theory and research to advance the field. Digital games may be “child’s play”—but they are a form of “child’s play” that is certainly worthy of substantive study.

**References**


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