LEARNING AT THE FARM: DEVELOPMENTAL PSYCHOLOGY IN PEEKABOO BARN

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Night and Day Studios' *Peekaboo Barn* is a cute little game about farm animals; the game can be played in its entirety in just a few minutes. But, it is also a giant in the toddler app market. When released in 2008, *Peekaboo Barn* was at the forefront of what has since become a growing market of games and apps for very young children. Despite growing competition, however, the game has retained its appeal and its visibility. *Time Magazine* has listed it among the "Top 25 iPad Apps for Kids" (Sharick, 2012), *Wired* recommended it as one of the "top 12 apps" for family iPad use (Donahoo, 2010), and *App Advice* has called the original *Peekaboo Barn* an "iconic kids app" (Dirks, 2014) As of 2015, the game had been a top 25 educational game on the increasingly flooded iTunes App Store for seven years running, and it has been played over 80 million times ("Peekaboo Barn").

While doubtless some of the appeal of *Peekaboo Barn* can be attributed to the game's early entry into what has turned out to be a growing section of the app market, this is not enough to account for the game's longstanding appeal. Like most games

for children, *Peekaboo Barn* is a game purchased by adults who are not the intended player demographic for young players who are only ever indirectly consumers—this is particularly true in the case of games in the toddler market, which generally target 1-3 year olds. The game succeeds in part because it manages to appeal to adult sensibilities and expectations of what an app for children should look like and how children's play time should be spent. That said, while apps for toddlers must get past adult purchasers, they must also provide engaging, satisfying experiences for toddlers. Adults' and children's sensibilities and desires are often at odds; those that most delight young viewers often grate on grown-ups, as evidenced by headlines like "18 Reasons Why Parents Can't Stand Caillou" (Silverman, 2015) and "19 Incredibly Annoying Characters on Kids' TV Shows" (Spohr, 2015). However, *Peekaboo Barn* manages to attract both adults and children.

Peekaboo Barn works, we suggest, not only because it is charming—although it is—but because it carefully works with children's developmental abilities to provide an optimized play experience that seamlessly integrates educational content. In blending play and educational content, it presents the kind of instructional environment that Malone and Lepper (1987) identify as intrinsically motivating; players in such an environment "are motivated to learn in the absence of obvious external rewards or punishments." This article focuses on the combination of ludic pleasures and educational interactions presented in *Peekaboo Barn*. We describe elements of the game's design, emphasizing in particular how the game elicits player engagement and provides players with feedback. We discuss this through the lens of cognitive principles derived from developmental psychology (Miller & Kocurek, 2017). Fundamentally, we argue that *Peekaboo Barn* demonstrates the ways developmental psychology can be successfully leveraged in the design of games for use by young children. Using *Peekaboo*

Barn as an example, we argue that principles from developmental psychology can provide a useful means to not only optimize games for young children for educational and developmental outcomes, but also for player engagement and enjoyment.

GAMEPLAY

Peekaboo Barn incorporates aspects of play readily recognizable from other toys, many of them pre-digital. The folk song "Old MacDonald Had a Farm" is a mainstay on children's albums. Toy pigs, cows, horses, chickens, and other farm animals are readily available from dozens of producers, and some of the earlier talking toys introduced to the market incorporated animal sounds from this group. The Mattel Farmer Says See 'N Say was first introduced in the mid 1960s, and Fisher Price's Little People line introduced its iconic Play Family Farm in 1968; the toy barn's popularity can be attributed in part to the "Moo-ooo door," which made cow noises when opened (Lammie, 2010). Both toys have remained popular and vintage versions are sought after by collectors even though both are still being produced. Thematically, this means that while *Peekaboo Barn* is innovative in bringing this type of play to touchscreen devices, namely smart phones and tablets, it is building on an existing understanding of children's play and learning—one already familiar to parents and educators. *Peekaboo Barn*'s innovation is not in its content, but rather in its mode of delivery and use of interface.

The game's interface is simple. It opens to an initial screen featuring a cow and a cat, the titular barn in the background under a bright yellow sun, the game's title displayed in the sky; a single large button invites "Play" (See Figure 1). The sun is also a button, although a less obvious one, and leads to the game's options. When the player selects the play button and enters the game, a transition screen gives way to a close up of the barn. The barn's doors shake, and if the player touches the barn, it opens,

revealing an animal. The animal moves through a brief animated sequence during which a corresponding sound is played (the mouse squeaks, the horse neighs, etc.) and then the animal is named by a narrator and the word is shown on the screen. The player can then touch the screen to return to the closed barn to repeat the process. If the player waits to touch the barn, the game will begin making animal noises quietly. If the player waits after the barn is open, the game is effectively paused without further player input.

Figure 1. Opening Screen

Depending on the animal to be revealed, the barn opens either at the main doors or at the hayloft (as for the cat and owl) (See Figure 2). Once all animals are revealed, the player is rewarded by the barn opening to show all the animals together, at which point the narrator says, "It's everyone." Touching the game again at this point turns day to night. The barn closes again, the sky turns dark and the stars and moon come out. If the player touches the barn again, the narrator says, "Shh! They're sleeping" and the player is shown a cow, pig, chicken, cat, and sheep snoring

curled up together in the barn. A last touch returns to the game's opening screen with its play button, resetting the game so that the player can begin another round (See Figure 3).

Figure 2. Cat in the Hayloft

Figure 3. Sleeping Barn Animals

LEARNING FROM LLAMAS

The curriculum of *Peekaboo Barn* is straightforward; players can learn the names of various barnyard animals as well as the sounds these animals make. This is a mainstay of children's toys and media, with similar themes and knowledge incorporated into many iconic pieces of children's culture. However, the thematic simplicity and elegant interface of the game mask a nuanced understanding of toddlers' interests and abilities and of appropriate developmental milestones. At a surface level, *Peekaboo Barn* is popular because it builds on familiar cultural themes and understandings of childhood, but it works because of the ways in which it incorporates sophisticated learning strategies and best practices in the development of educational experiences for young children.

The game's emphasis on farm animals fits in with classic children's toys and media like the barn play sets that companies such as Fisher Price and Playmobil have produced for decades. Similarly, animal sounds and names are readily familiar as components of early childhood educational curricula and media (Paul, 1996; Timmerman & Ostertag, Julia, 2011). At the same time, the game appeals to young players; Donahoo noted that "every toddler I see play with it lights up at the images and sounds" (2010), and a reviewer who works as an educator for 3-6 year olds stressed, "All the teachers, parents and students LOVE Peek-A-Boo barn!" ("Peekaboo Barn – Review," 2009). What *Peekaboo Barn* presents builds on the familiar even as it utilizes the relatively new medium of the touchscreen tablet or phone.

Positive psychology is often used to inform or explain serious and educational games for adults (Gee, 2003; Gee, 2007; McGonigal, 2011) and teenagers (iThrive Games). Even more broadly, Mihaly Csikszentmihalyi's (1990/2008) concept of flow states is often used in game studies to discuss deeply engaged experiences. Players, his theories suggest, enjoy games most

when they are just hard enough; if an activity is too easy, the player becomes bored, while if it is too hard, the player grows frustrated. Similarly, education experts have long advocated for scaffolding, a process by which students are provided with just enough support to ensure that they are operating at the edge of their existing abilities and cultivating new ones (Vygotsky, 2005; Hogan & Pressley, 1997). In short, both for effective learning and for effective game design, difficulty needs to be optimized, and this is especially true when thinking of very young players. As we know from decades of research in child development, children's abilities shift rapidly during infancy and early childhood (Fischer, 1980; Flavell 1971; Thelen, 1995). A task that is easy for a child at 24 months may well be impossible at 18 months.

Peekaboo Barn's simple interface is one of many ways it demonstrates a clear understanding of the needs and abilities of its audience of toddlers. The game relies on a single gesture—simply touching the screen—and all touches happen on a large hit box. The player does not have to touch the barn door to open the door, only the barn in general. This is appropriate and accessible for the game's audience, as gestures such as swiping require more advanced fine motor skills (Hourcade, Mascher & Pantoja, 2015). Further, the barn door's shaking is a visual cue for players about what to do, so even if a child does not know intuitively to touch the barn door and is not prompted by a parent, the game itself cues the necessary player response. Similarly, the only screen with any essential instruction or text is the opening screen with its "play" button and options menu; these tools are intended not for child players, but for parents and caregivers. The game incorporates text when naming the individual animals, but there is no implied expectation that children read the text. Instead, the text is shown as part of the act of naming, making an implicit link between the picture of the animal, its spoken name, and its printed name. Print awareness is often cited as an important pre-literacy skill and activities like

this, in which spoken words are tied to visuals and text, can help increase print awareness (Chaney, 1992; Hiebert, 1981; Justice & Ezell, 2002; Pullen & Justice, 2016).

A second important principle from developmental psychology incorporated throughout that game is that of contingent responses. The game's reveal of animals is a contingent response: if the player does not touch the barn, the game does not move forward, effectively waiting for the player's input before progressing. Contingent feedback has been shown to be crucial to children's learning and has been heavily evaluated in studies of children's development and language acquisition (Goldstein & Schwade, 2008; Miller, 2014; Tarabulsy, Tessier, & Kappas, 1996). Here, the response is not contingent upon the child's vocalizations, but rather on their interacting appropriately with the device at the correct moment. This effectively coaches the player in gameplay, rewarding them with new animals throughout the game.

After all animals are revealed and the game loops back to the start screen, the game is replayable in part because of the incorporation of multiple languages and the addition of a Record Your Own Voice function (limited to iOS devices), but this also means that the game can work well in cross cultural and intercultural contexts. Even if played in a single language consistently, the repetition of animals and their attendant sounds and names is pedagogically useful, particularly since the order in which the animals appear is randomized. If a child has a favorite animal, there is no way to determine when exactly that animal will appear, meaning that a player who badly wants to see the barn open to reveal a llama cannot predict when the llama will be revealed. This aids in replayability and adds an element of randomness and surprise that persists even after a player begins to remember all of the included animals.

The importance of play for child development is widely studied

and understood within developmental psychology, and supporting and providing playful experiences is fundamental to producing meaningful learning opportunities. The silly sounds, cheerful voice, bright graphics, and element of surprise in *Peekaboo Barn* ensure that the game provides an experience that is fundamentally playful, and it is this integration of play and learning that is most key to the app's efficacy. Learning apps do not always need to look or feel educational, and in fact those that do not may be among the most effective. Play, after all, contributes to nearly every facet of a child's development, including their cognitive and emotional development (Ginsburg, 2007; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004; Erickson, 1985; McElwain & Volling, 2005; Pellegrini & Smith, 1998; Fisher, 1992). The playful experiences provided by *Peekaboo Barn* are a large part of why the game is so effective; the educational content (animal names and sounds) are embedded in a lightly narrative context that is, at its heart, based on the incredibly simple and incredibly old game of peekaboo. This is not just good game design; it is good educational practice. Play is fundamental to games, but it is equally integral to learning.

In summary, *Peekaboo Barn* rests on a number of key principles that are evident throughout: it presents developmentally appropriate content in a developmentally appropriate form; it relies on contingent feedback to encourage player engagement; it is replayable and incorporates play throughout. This game adheres to a number of best practices for early childhood education drawn from developmental psychology (Miller & Kocurek, 2017, and it demonstrates the degree to which sophisticated developmental and cognitive principles can usefully and seamlessly inform games for young children. *Peekaboo Barn* may not feel like a learning games, but this does not mean that learning is not occurring, rather it means that the educational content is so carefully integrated that it feels like play itself. Further assessment is needed to identify exactly what

children learn from these games. However, games like *Peekaboo Barn* that accomplish this kind of clean fusion of play and learning demonstrate the opportunities available to developers who want to create meaningful learning experiences for the preschool set. After all, play is foundational to children's learning, and games are a medium primed to provide playful educational experiences.

LEARNING FROM SCIENCE

Research on child development can usefully inform games by enabling game makers to ensure that games are developmentally appropriate to the target audience. A game for 2-year-olds that relies on a swipe gesture or that takes more than a few minutes to play might incorporate great content and have a beautiful interface, but it would still be unlikely to resonate with its players who would be more likely to wander off than to finish the game. Games like *Peekaboo Barn* that are educational but that rely on simple mechanics may not always read to adult consumers as educational, but this is reflective of adult expectations rather than child needs. Ultimately, games need to be optimized for child players, not their parents; the gap between children's abilities and adult expectations can be addressed through various communication strategies, including efforts to ensure that a game's curriculum and its underlying educational principles are clearly articulated.

Some of the lessons developers can learn from developmental psychology may seem obvious. Contingent responses and play may seem like common fundamentals for games, but as most designers know all too well, not all games implement them successfully. Contingent responses can and should be implemented in all games (and robust implementation of contingent responses involves more nuanced design than simple 1:1 feedback for players). In *Peekaboo* Barn, the reveal of animals is contingent on player interaction. This type of interaction isn't

uncommon in game design—indeed, we often call games "interactive media," but ensuring that interaction is meaningful and tied to educational goals is key. Interaction is also a means of driving engagement, and research on literacy and language acquisition has shown that children learn words more effectively from didactic rather than passive reading in part because it encourages engagement and reflection (Sénéchal, 1997).

Additionally, games absolutely must be playful to effectively reach young children in particular. To optimize learning games for young children is to optimize playful experiences. The relationship between education and entertainment is fraught, but perhaps less so in the case of games for the pre-school set; children need to play to learn, so playful experiences with some learning woven in are going to be more successful than learning experiences to which play is added as an afterthought. Play as afterthought is a problem in many instances of learning games—that type of approach is part of why the phrase "chocolate-covered broccoli" is invoked. Rather than providing thoughtfully integrated, playful learning experiences, bad games take a learning experience and poorly sugarcoat it, rendering it into something that is appealing to no one, not even those who might have happily eaten the broccoli on its own. Scientific research and design research both can be an antidote to this pervasive problem and ensure that games are offering optimized experiences that provide real, transferable learning and carefully address objectives.

Peekaboo Barn is a thoughtful and well-designed game, but it is far from perfect. That said, the problems it suffers from reflect broader tensions in the industry. At present, the market for smart phone applications is flooded with "educational" content. However, a review of children's literacy apps found that of educational apps featured in the "Top 50" educational apps in popular app stores or critically acclaimed on expert review sites, found a number of problems with apps' integration of learning

(Vaala, Ly & Levine, 2015). Fewer than a third even mentioned any underlying curriculum, and even fewer (24%) mentioned any kind of research testing, and when this kind of assessment was mentioned, it was generally an assessment of appeal or usability, not of learning (Vaala, Ly & Levine, 2015). This state of affairs reflects real limitations on design and development, particularly since robust evaluation takes time and can add significantly to production costs. However, the long-term success of games like *Peekaboo Barn* suggest that thoughtful games with careful attention to educational goals and outcomes can distinguish themselves in the market, making this additional cost a long-term investment in games' success and a means of distinguishing games in an increasingly crowded marketplace.

A focus on the intersection of game development and developmental psychology also suggests many areas in which further research is needed. Work on human-computer interaction for children is still emerging, due in part to the relatively recent relaxing of guidelines that would have advised keeping toddlers and pre-schoolers off touch screens entirely; the work that has been completed is illuminating, but implementation in industry can lag. Now, however, as apps flood the marketplace targeting this audience, poor understanding of what types of fine motor skills designers can expect from their players often leads to poor development. Further research in this area can help provide optimized experiences. Additionally, research has consistently shown that children learn less from a video than from a live person, a phenomenon known as the video deficit (Krcmar, 2010). However, the specifics of how the video deficit does or does not carry over to interactive app-based experiences is not well known even if we can deduce best practices from existing research.

The principles evident in *Peekaboo Barn* are just some of the foundational concepts from developmental psychology that could readily be adapted for and implemented into gameplay.

For example, parent-child interaction is also known to positively correlate to children's learning, and while games can provide parents a brief reprieve, they can also be used to scaffold and encourage interactions. In *Hat Monkey* (Fox & Sheep, 2014), instructions are shown on-screen in text but are not narrated, meaning the game assumes a parent or other older player will read these instructions for young players. The game, then, provides an experience that relates in some key ways to the experience of didactic reading, in which reading, explanation, and demonstration are combined, and which has been shown to be especially effective for teaching language and literacy skills (Sénéchal, 1997; Cornell, Sénéchal & Broda, 1988). Worth noting, however, is the play experience only echoes didactic reading when the game is played as intended with a child and parent or caregiver playing together. If the game is played differently, and surely it is, the experience becomes something else entirely. This open-ness may be part of the appeal of games, but can also add to the challenge of assessing learning efficacy.

The potential for learning games for preschoolers is significant, particularly as this market is continuing to develop. However, research needs to play a clear role in informing design and helping structure effective learning experiences. Designers cannot necessarily wait for academic researchers to produce fresh insights into children's media as new platforms emerge, but they can at least rely on the existing research that delineates best practices in early childhood learning and attends to the developmental needs, abilities, and milestones for young players. Further, parents are likely to remain key gatekeepers and an important secondary audience, which means that parental standards and expectations are also integral to developers' goals. In *Peekaboo Barn*, we see how deeply effective even a light engagement with key pedagogical principles can be for optimizing play experiences for toddlers. As this market expands and as new devices hit the market, researchers would do well to

continue looking beyond the games industry into adjacent fields like developmental psychology and the learning sciences.

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