Diminutive Subjects, Design Strategy, and Driving Sales: Preschoolers and the Nintendo DS

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Video games have become a common part of children's everyday play, and are even reaching the lives of preschoolers. Rideout and Hamel (2006) report that as many as 29% of children in the U.S. under 6 have played console video games, and 18% have played hand-held ones. Although the first video games were developed for and enjoyed by adults, such play is no longer exclusively reserved for the grown ups in the home (Funk, 2009). While the number of American preschoolers who regularly play video games may appear low at first (11%), the percentages of those who have console and handheld video game players in the home are actually quite high, at 50% and 28% respectively (Rideout & Hamel, 2006). Given young children's insatiable eagerness to learn (Dorr, 1986) coupled with the fact that they are clearly surrounded by these media, we predict that preschoolers will both continue and increasingly begin to adopt video games for personal enjoyment. Although the majority of gaming equipment is still designed for a much older target audience, once a game system enters the household, it is fair game for all family members, including the youngest. Portable systems, and the Nintendo handheld systems in particular (the DS and the previous GameBoy iteration) have done a particularly good job of penetrating the younger market. According to NPD, the Nintendo handhelds make up almost half of the entire video game system market in the U.S. for children under 12 (NPD, 2008). In 2007, 18% of 2-5 year olds in the U.S. played with the Nintendo GameBoy and 8% played with a DS (NPD, 2007).

In the video game market research on games is typically done in two places: 1) sometime close to the end of the product cycle in order to get feedback from consumers so that marketing can develop a strategy; and 2) at the very end of the product cycle to "fix bugs" in the game. While both of those types of research are important, and may be

sufficient for some titles when dealing with adult consumers, neither aids in designing better games – especially when it comes to designing for an audience that may have particular needs when it comes to design, such as preschoolers or senior citizens. Instead, exploratory and formative research has to be undertaken in order to truly understand those audiences, their abilities, their perspective, and their needs.

In the spring of 2007, our game producers had a hunch that the Nintendo DS – with its new features, such as the microphone; small size and portability; and its relatively low price point – was a ripe gaming platform for preschoolers. There were a few games on the market at the time which had characters that appealed to the younger set; but our game producers did not think that the game mechanics or design were appropriate for preschoolers or beginning gamers. What exactly preschoolers *could* do with the system, however, was a bit of a mystery.

This paper builds on our experiences over the past two years to answer this query. The specific developmental needs of preschoolers when it comes to handheld gaming are highlighted; and we chronicle the research and design process that our preschool games group has developed, discussing the roles of both exploratory and formative research in creating new titles for this youngest set. Moreover, in addition to a set of best practices from a process perspective, we discuss our "top ten" key findings and design tips for the DS when it comes to preschoolers and their cognitive abilities, motor skills, and design preferences.

In order to design the best possible DS product for a preschool audience we fully embody the ideals of a "user-centered approach" which "assumes that users will be at least considered but ideally consulted during the development process" (Markopolous,

Read, MacFarlance, & Höysniemi, 2008, p. 45). After all, when it comes to introducing a new interactive product to the child market, and particularly such a young age group within it, we believe it is crucial to assess the range of physical and cognitive abilities associated with their specific developmental stage (Bryant, Akerman, & Drell, 2008). What could we expect preschoolers to be capable of in the context of hand-held game play and how might the developmental literature inform us as we proceeded with the creation of a new outlet for this age group? What immediately follows is a brief overview of preschoolers' developing motor skills and cognitive abilities with respect to how their inherent limitations in these domains might affect handheld video game play, and, ultimately, design preferences therein.

Literature review

Motor skills have typically been grouped by developmental scholars as pertaining to one of the following groups: gross and fine. While gross motor skills (or movement skills), require the usage of larger muscles, fine motor skills (also known as manipulative skills) involve smaller ones (Wang, 2004). Examples of activities which entail mastery of the former include: static and dynamic balance, strength and agility, as well as general body coordination. In the world of preschoolers this allows for movements like crawling, walking and sometimes even running, however slowly or awkwardly. In contrast, finger dexterity, wrist flexibility, arm and hand steadiness, and finger speed all involve the use of fine motor skills (Wang 2004). Mastery of these manipulative skills typically lags behind movement skills; preschoolers may demonstrate rapid gains in gross motor skills while fine motor control progresses more slowly (Gallahue & Ozmun, 1995). As such, handling and controlling basic household objects often presents unique challenges for

preschoolers. Common examples include dressing and feeding oneself, in addition to using tools like scissors or writing instruments. Each involves grasping and visual motor integration, two dimensions which are typically assessed to determine children's level of fine motor development (e.g. Fine Motor Scale of the Peabody Developmental Motor Scales–second edition (PDMS-FM-2), as discussed in Hartingsveldt, Cup, & Oostendorp, 2006). With age and experience, as well as a supportive environment and practice (Benelli & Yongue, 1995), the fine motor skills required for successful completion of such seemingly simply tasks steadily improves.

When we consider the interplay between common household media devices and the motor skills required for their play, we find interesting differences. The small size of the Nintendo DS, and other handheld devices, suggests that their usage and manipulation would require the recruitment of fine motor skills. This becomes especially clear in contrast with a system like the Nintendo Wii, which relies on broader movements involving primarily gross motor skills. This paper will focus on preschoolers' interactions with the former. Although, the motor activities of preschoolers become increasingly deliberate as they learn to exert greater control over their large and small muscles (Needlman, 1996), they are still developing and, as such, highly constrained.

Although children's motor development is often described, most prominently by Arnold Gesell (1880-1961), as proceeding in a series of predictable and seemingly fixed developmentally determined sequences (Ames, Gillespie, Haines, & Ilg, 1979), modern accounts have put a greater emphasis on the crucial role of the physical and social environment, with particular attention to the tasks presented therein (Thelen, 1995). According to this view, movement is thought to be heavily influenced by the

opportunities (or lack thereof) presented by the environment of the developing child (e.g. Benelli & Yongue, 1995). As we've argued before, new media technologies are steadily entering children's homes and have the potential to fundamentally alter their developmental experiences by providing new tasks and challenges (Bryant, Akerman, & Drell, 2008). Many of the devices surrounding youth were not intended for their use. The interaction between these latest electronic devices and the youngest household members is still a new field with limited empirical research (Wartella, Vandewater, & Rideout, 2005). We therefore focus here on the Nintendo DS, with the greater goal of trying to meet Wartella et al.'s (2005) plea to better understand how young children use (and are subsequently affected by) new media.

Early motor development and implications for video game play

As Gallahue and Ozmun (1995) describe, the first voluntary movements, which begin in infancy and dominate until approximately 2 years of age, are referred to as the rudimentary movement phase. By preschool, physical energy peaks and children are typically in what is commonly referred to as the fundamental movement phase of motor development (Benelli & Yongue, 1995; Needlman, 1996). Active exploration and play dominates much of the day. A significant milestone of the fundamental movement phase is increased motor control and movement competence (Gallahue & Ozmun, 1995), determined by, as described earlier, not only age, but ecological factors too. Scholars have described the importance of participating in success-oriented developmentally appropriate motor activities which can assist with the development of a healthy self-concept (Benelli & Yongue, 1995).

During the preschool years, children become increasingly efficient in: gross motor locomotion, posture and balance control, and object manipulation (Wang, 2004). Successful gains in these three motor domains are highly important given that all observable movement is dependent upon some combination of each (Gallahue & Ozmun, 1995). Thus, the ability to change location, maintain equilibrium, and direct control over the environment becomes increasingly pronounced. This is evidenced by greater proficiency with activities like: crawling, walking, and running; standing, twisting, and sitting; as well as feeding oneself and drawing. This last group of object manipulation activities involves directing control over objects in one's immediate environment. As Wang (2004) explains, this entails not only locating something visually and/or aurally, but making contact with it and identifying it tactilely too. The idea that the fine motor skills associated with grasping and holding objects in the environment develop more slowly and after gross motor abilities associated with the torso is known as the proximodistal pattern of motor development, encapsulating the idea that physical and motor development develops in an outward fashion – from the torso to the hands, and feet (Adolph & Berger, 2005). In the realm of object manipulation this is demonstrated with grasping, which progresses from the arms to the hands and finally the fingers (Cook and Cook, 2005).

One relevant example of the fine motor development that takes place involves early grip attempts. According to Braswell, Rosengren, & Peirroutsakos (2007), children first grasp at writing instruments using a palmar or power grasp, which involves using the palms and fingers. From there they go to using a tripod grasp, where the implement is held, more firmly, between the thumb and first two fingers. Between 4 and 6, children

learn to use the more sophisticated dynamic tripod. This achievement, which involves much smaller movements in the fingers and thumbs, is what allows them to draw finer details and is considered a major milestone of this age (Braswell, Rosengren, & Peirroutsakos, 2007). Thus, although the fine motor skills required for object manipulation develop more slowly than those associated with gross motor abilities (which undergo dramatic progression during these early childhood years), improvements are made in the fine motor category as well (Gallahue & Ozmun, 1995), as the grip example demonstrates.

Early cognitive development and implications for video game play

According to Jean Piaget (1896-1980), commonly referred to as the most influential developmental theorist (e.g. Ginsburg & Opper, 1988), preschool mental activity is best characterized by preoperational thought, which dominates between the ages of two and seven (Gruber and Vonèche, 1977). A major hallmark of this stage is that children become increasingly able to think in representational terms, which allows them to understand, albeit in a non-sophisticated fashion, that pictures can stand for real-life objects. Regardless, the ability to perform mental manipulations as well as think symbolically and abstractly remains quite difficult for children in this age group. Indeed, Siegler (1991) attests that children experiencing the preoperational stage are typically characterized by their limitations, namely in their ability to perspective-take or entertain multiple concepts simultaneously. This is evidenced, for instance, via their attention to the perceptual space. Preschoolers frequently delegate their attention to a single feature – that which is most salient – to the exception of others, demonstrating a pattern referred to as centration (Ginsburg & Opper, 1988; Gruber and Vonèche, 1977). Not surprisingly,

these cognitive constraints have implications for what children choose to play with and how that play is enacted – be it physical or mediated.

Revelle and Medoff (2002) review some of the basic reasons why home entertainment systems, computers, and other electronic gaming devices, are often difficult for preschoolers to use. In addition to their still developing motor skills (which make manipulating a controller with small buttons difficult), many of the major stumbling blocks are cognitive. Though preschoolers are learning to think symbolically, the vast majority are still unable to read and write. Thus, using text-based menu selections is not viable. Mapping is yet another obstacle since preschoolers may be unable to understand that there is a direct link between how the controller is used and the activities that appear before them on screen (Revelle & Medoff, 2002).Though this may be changing, in traditional mapping systems real life movements do not usually translate into game-based activity. Given preschoolers only recent and, as a result, somewhat shallow ability to think symbolically, screen-based representations can often pose difficulties as well.

Clearly, this raises certain important considerations when it comes to game design and play. Most video game systems are created for adult players in mind and, as a result, can be extremely challenging for young children. After all, preschoolers typically lack fine motor control, cognitive understanding of the mapping between controller use and on screen activities, and, the kinds of abstract thinking skills required to understand the representational nature of concepts, in this case those taking place on screen (Revelle & Medoff, 2002). And yet, young children, in particular, are curious about the world around them and increasingly surrounded by media devices -- be they intended for their use or

not. Our game producers suspected that features of the Nintendo DS might render it appropriate for preschoolers. Taking the user-centered approach described earlier, we sought to examine how, if at all, preschoolers might engage with this new handheld technology in the interest of creating a DS game for the 3-6 year old market.

Given that most of preschoolers' waking hours are spent playing and that much of their learning about the world originates with exploration in recreation, it seems crucial to examine the newest playthings available and, ultimately involve children in the creation of new products for their specific use. We know that traditional forms of physical play can provide learning opportunities about the body and its capacity for movement as well as aid the development of fine and gross motor skills (Gallahue & Ozmun, 1995); play also correlates with development in other areas such as cognition, social development (Eisert & Lamorey, 1996). As mediated play via electronic devices increasingly becomes the chosen leisure option, it becomes essential to examine this new recreational context. Benelli and Yongue (1995) emphasize the importance of providing preschoolers with opportunities to practice and refine their motor skills. Could the Nintendo DS provide such an opportunity in the realm of fine motor skills? According to von Salisch, Oppl, & Kristen (2006), children select their chosen leisure activity because it addresses a developmental task which they are motivated to resolve. Indeed, they speculate that school-age children may spend hours playing video games due to a desire to hone their fine motor skills, and ultimately be an expert in the game. Might such a model apply to preschoolers? Von Salisch et al.'s (2006) approach is an interesting one that provides a broader landscape with which to consider electronic games and children's growing fascination with them. Below we outline how this understanding of young children's

abilities and challenges in the realm of cognitive and motor skills as it relates to gaming has become a centerpiece of our research and design process at the Nickelodeon Kids & Family Group.

Methods: Exploratory, Formative, & Best Practices

Instead of focusing on one particular research project targeted to this question of how to design games (in this case for the DS) that are both user-friendly and fun for preschoolers, we will discuss the various types of research we have undertaken over the past two years, as well as outline the "Best Practice" research-design system that we have incorporated into our game creation process. Our first step toward a research strategy for "user-centered" design was to delve into the world of preschoolers with a large-scale exploratory research project.

Exploratory Research

After consulting with our producers who were interested in designing for the DS, we decided on three key objectives for our initial exploratory project: understand the range of physical and cognitive abilities of preschoolers in the context of handheld system game play; understand how preschoolers interact with the DS, specifically how they handle the various forms of play and game mechanics offered by the games currently on the market for this platform; and understand the expectations of the parents of preschoolers with regard to handheld systems and the purchase and play contexts within which game play occurs. The research team decided that in-home ethnographies with preschoolers and their families would yield us the richest data with which to arm our producers, so we began by conducting 26 in-home ethnographies in 3 markets across the

U.S. (a West coast urban/suburban area, a Midwest suburban/rural area, and an East coast urban/suburban area).

The preschoolers in this study included 11 boys and 15 girls ranging in age from 3 years & 3 months to 5 years & 11 months. In addition, because previous research had shown the effects of older siblings on game play, such as more advanced motor coordination when using a computer mouse, households were recruited to have a combination of preschoolers with older siblings and without. In order to understand both "new" and "experienced" preschool users of the platform, we split the sample so that 13 families had at least one Nintendo DS and the others did not. For those households that did not own a DS, one was brought to the interview for the child to play. This allowed us to see both the instinctive and intuitive movements of the new players (and of the more experienced players when playing new games), as well as those aspects of game play that had been learned through experiences with the more experienced players. Each of these interviews lasted between one and two hours and included the preschooler, at least one parent, and often siblings and another parent or caregiver.

During each interview three types of information were gathered. From the parents and any older siblings that were around, we collected information about: the purchase decisions surrounding game systems in the household, the family's typical game play patterns, levels of parental moderation with regard to gaming, and favorite games played by various family members. Because these interviews were in-home, we were also able to understand the ecology of gaming in their home: what types of spaces (communal or private) were used for game play, how were the systems set up, where did handheld play occur in the house (and we asked about play on-the-go), and the number

and type of games and game systems owned. Finally, and most importantly, we gathered the game play data for each child.

With regard to the format, the interviews were mostly unscripted and the moderator began by observing the preschoolers in their usual gaming activities, talking with both the child and their parent about their typical usage habits, abilities, likes and dislikes. Prior to the interviews, the research team had worked with the game producers to create a list of game mechanics and issues tied to preschoolers' motor and cognitive abilities that were critical for them to understand before developing the games. These ranged from more general dexterity issues related to game controllers, to the effectiveness of in-game instructions, to specific mechanics in current games that the producers were interested in implementing in future preschool titles. During the interviews, therefore, the moderator guided the preschooler though a series of games, so that he/she could observe the interaction and probe both the preschooler and his/her parent on feelings, attitudes, and frustrations that arose in the various circumstances observed.

If the child had previous experience with the DS, he/she was first asked to play his/her favorite game on that system. Across the 26 preschoolers, the Nintendo DS selections were very broad, including *Nintendogs, Super Mario Bros., Tony Hawk*, and *Sonic Rush*. The interviewer watched the child play, noting their preference for game mechanics, their motor interactions with the device, and how easy or hard each game mechanic was for the child. All of the preschoolers were asked to play with a specific games chosen by our research team in consultation with our producers (*The Little Mermaid: Ariel's Undersea Adventure*). That game was chosen for several reasons.

First, it was one of the few games on the market with characters that appeal to this young age group. Second, it incorporated a large variety of mechanics that highlighted the uniqueness of the DS platform, including using the microphone for blowing or singing. Based on our previous work with preschoolers, we did expect that there might be issues for preschoolers in playing the game because of the large amount text involved in the game; but we used that issue to draw out information about the ways that other family members aided the young children in game play. That said, parents and older siblings were instructed to interact with the preschooler during their game play only if that interaction was a normal part of their game play.

The findings from this initial exploratory study were extensive (and will be highlighted in the Key Findings section below). After reviewing the results and discussing the implications for the game design with our internal game production team, we then traveled with them to our external game design firm (Black Lantern) to present the findings to them. We then worked intensely with them to base the game design for the two preschool-targeted DS games under development (one for the *Dora the Explorer* property and one for *Go, Diego! Go!*) on what we had learned. We then began the formative research process.

Formative Research

As the two DS games went into development, we began a formative research course of action. Whenever we developed new game mechanics, we brought preschoolers into our in-house usability lab to test the mechanics and make sure that they were not only simple enough, but also engaging. We tested either alpha or beta versions of different elements of the game, as well as looked at overarching game structure. Once

a full version of the DS game was ready, we went back into the field and tested it in a research facility with a dozen preschoolers (along with their parents) to make sure that each of the game elements worked for the children, and that the overall game was understandable and enjoyable for them. We also got parent feedback on what they thought about the game with regard to appropriateness, engagement, and purchase-intent.

One of the key learnings from this process was *when* to test various features of the game. Although it makes sense to test early versions of game mechanics, those initial renderings can be so stark that they are difficult to test with preschoolers, who have trouble imagining the larger game context in which they are meant to be playing. In the same way, from a research perspective, in order to test different elements of the game, you have to have a prototype that is functional; but from a production perspective, you do not want to have spent a lot of resources designing something that then has to be either redesigned or left out of the game entirely. This balance has become a constant, but critical, negotiation point between our research team and the production team.

Our Process

After going through the entire "life cycle" process for these first two DS games, and learning about when research was most effective and necessary, we created an integrated research and design process for subsequent games. It should be noted here that while we were going through the above experience with the DS, we were also undergoing the same research process across a number of platforms, including the Wii, PlayStation 2, and computer. Our method, therefore, has been created to be implemented across all systems, and has become a fundamental part of game design for the Nickelodeon Kids & Family Games Group.

The first step in this process is doing exploratory research if there is a new platform involved. Just as we did with the in-home ethnography research on the DS and other platforms, whenever our production team is interested in designing games for a new system, we undertake exploratory research to figure out both the possibilities and challenges that the new platform holds for a particular audience (or audiences). For example, the current adoption rate of the Apple iPhone and iPod has our production team curious about possibilities for creating games for all ages, so we will soon be in the field conducting research on those mobile devices. Methodologically, we chose research techniques appropriate for the context in which the games are played. For the DS research, which was done in conjunction with research on the Wii and PlayStation 2, we conducted in-home ethnographies. In the case of the mobile-oriented iPhone and iPod, we very well might decide to take a different approach. In any case, we strive to make sure that our research is conducted in an environment that will yield us the greatest amount of information regarding the context of the devices use, along with specific about mechanics and design.

The second step in the process is to sit down with the game producers to discuss the overall game design. Based on the exploratory research and previous formative research, we brainstorm ways to be innovative with our game play, while remaining appropriate for our audience. Being part of this creative process is incredibly useful (and satisfying) for our research team, because it allows us to understand and appreciate the creative applications of our work. In turn, we are not afraid to push the limits of the game design – we just make sure that we test any new mechanics or design

implementations that we come up with, which is the third phase of the research-design process.

Just as we did in our initial DS game design process, we test new game mechanics before implementing them into the game. Sometimes this is done by testing similar mechanics corollaries from other games, and other times our designers create stripped-down, preliminary versions for us to take into the field. These game elements are then tested with the audience in our New York or LA in-house usability labs, with the participants recruited from a national panel that we maintain for the Kids & Family Group.

The fourth stage in the research and design process is the script review. At least one member of the research team sits down with the production team to go over all voiceover scripts and instructional text that will be part of the game. Our role in these meetings is to gauge the appropriateness of the vocabulary for the target audience and to make sure that the game instructions are clear.

The next phase of the process is the initial alpha/beta testing. Similar to the earlier mechanics tests, we bring participants into our in-house facilities to test early versions of both the overall game and the various elements. Since these are rough versions of the games, and voiceovers have usually not been recorded, we often have to read the dialogue or instructions out loud to simulate the game play. However, we are often curious as to whether the game mechanics are intuitive in and of themselves as well, so we will wait to see if the participant can play the game without the instructions. (This is also important because based on all of our past research with children and video gaming we know that most of them skip any and all instructions for the game.)

The final phase of our research and design process is to test the end product. Once the game is very close to being complete, we do one-on-one user experience interviews with about a dozen of our target audience in an outside facility (and often using an outside research vendor). In the case of doing research with children, we always include their parents, so that we can better understand their reactions to the game and purchase intent. At those research sessions, we make sure to invite not only the game production team, but also the marketing and public relations teams, so that they can see the product in action and hear how the consumers respond to it.

By creating this 6-phase integrated research and design process, we have greatly improved the both our products and our knowledge about our consumers. In order to capture this knowledge, and to avoid "reinventing the wheel" every time we partner with a game studio to create a new title, we have also created an online Game Developer's Handbook. Designed as a constantly-updatable wiki, this interactive information platform allows our design and creative partners to search for information that will aid them in designing games for our audience. For example, a designer working on a new preschool-targeted game on the DS simply logs onto the Handbook, clicks the link for the Nintendo DS and the corresponding target ages, and all the information that they need to know in order to develop age-appropriate, engaging games for that audience is provided. In addition, the Handbook also contains our "Design Philosophy" documents, which outline our approach to creating games. Some of our key findings that are in the Handbook when it comes to preschoolers and the DS are highlighted below.

Key Findings: Our Top Ten List

Over the past two years, our research has uncovered vast amounts of information and insights into how preschoolers interact with various platforms, including the DS. Here are the top ten insights we have garnered about this handheld platform.

1. The DS is about the coolest hand-me-down you can get.

   Although this first insight is not specifically about game design, it is a critical component to our understanding the importance of research on the preschool segment. As we have interviewed kids and families in their homes and on-the-go, it has been clear that handheld gaming systems, and particularly the Nintendo DS, are coveted entertainment devices. As older children in the household "graduate" to newer versions, the younger members of the household inherit their old systems. This opens up the opportunity to create games for the younger audiences, particularly preschoolers.

2. Preschoolers can't read, which means that all instructions need to be in voiceover and include visual representations.

   Although this finding may seem like a no-brainer to those who work with young children on a consistent basis, this has been one of the most difficult areas for us to negotiate on with game design on the DS. Because the game cartridges have very limited memory capacity, particularly in comparison to console or computer games, the ability to capture large amounts of voice over data via sound files or visual representations of instructions becomes limited. Text instructions take up minimal memory, so there are preferable from a technological perspective. Figuring out ways to maximize the sound and graphics files we have, while

retaining the clear visual and verbal cues that we know are critical for our youngest players, is a constant give and take.

3. Preschoolers may use the DS stylus or may use their fingers, or both! (Although they're not very accurate with either.)

   One of the very interesting aspects of the DS is that the interface, which is designed to respond to stylus interactions, can also effectively be used with the tip of the finger. This is a particularly interesting find in the context of preschoolers for two reasons: 1) although they are relatively adept at using the stylus, they still have trouble with fine motor skills and their hand-eye coordination is still in development, so they are less exact with their stylus movements; and 2) their fingers are so small that they mimic the stylus very effectively, and therefore by using their fingers they can often be more accurate in their game interactions.

4. Although preschoolers do not have trouble holding the small stylus, they do have difficulty making small movements that require fine motor skills. This means that the "hotspots" for interaction within the game must be forgiving for them (i.e., larger).

   Along the same lines as the finding above, the small scale of the DS and the stylus are a plus for the tiny hands of the preschooler audience; *but* they still have trouble making precise contact with objects on the screen. For example, when they are told to wipe away a sand dune on the beach in one of our games, they scrawl with their stylus (or finger) over the entire screen, instead of just the one area where the sand dune is. When programming the "hotspots" for the game

interactions with this age group, there has to be a much larger area that gives them a positive response.

5. While rhythm games seem ideal for the DS, and are very successful with older demographics, preschoolers find it difficult and frustrating to tap in a rhythm or on a beat.

   Initially, we were very excited about the possibility of incorporating games that used rhythmic tapping with a stylus or finger into the preschool games. Over the past two years, we have tested a variety of variations on this type of game, and have consistently found that it is very difficult for preschoolers to remain on beat when using either the stylus or their finger on screen. Because they get frustrated very easily, we initially tried to make the game response to their taps very forgiving. Unfortunately, by the time the game mechanic was "forgiving enough," it no longer required them to actually match the rhythm displayed by the game – they could just tap the screen in rapid succession and it would record it as a positive response.s

6. The microphone is a big hit with preschoolers! They love to yell or blow into it and see the game respond.

   The microphone was one of the key features of the DS that had initially intrigued our game design team. The idea that we could overcome motor skills issues and rely on kids' love of talking, singing, and making noise seemed a perfect fit for the preschool audience. For the most part, that is indeed the case. The exception to this rule is for games that require the child to match a tone or pitch through singing. This is much too difficult for young children. In addition, the success of

microphone integration into a game comes with a critical caveat – most preschoolers do not know where the microphone on the DS is. Therefore, the instructions on where to speak or blow have to be very clear and include graphics showing them what to do and where. If those are included, children have no problem engaging in those games, and truly enjoy them.

7. Combining directional pad mechanics with stylus movements is a problem for young children.

   When preschoolers play with the DS, they usually hold it in their lap or place it on something, like a table, because their small hands make it difficult to hold and play the system at the same time. As they play, they do one thing at a time – either use the directional pad or pick up the stylus and use it. There is a significant transition period, and mental effort involved, for them to transition from one of these play-types to another. Therefore, trying to incorporate both into a single mechanic creates a complex mechanic that they cannot handle, both physically and cognitively.

8. Two-step processes (i.e., drag the item over here and then tap on it) are not as successful with preschoolers.

   Similar to Finding #7, the cognitive requirements needed to interact with multi-step mechanics are beyond the abilities of most preschoolers. When instructions are given at the beginning, they often forget the second part of the objective and then need to have the instructions repeated. If two steps are required to complete a task, they should be presented separately and sequentially.

9. Preschoolers love immediate (and positive) responses to their actions.

Young children have raw, emotional responses to media; and they want to see the results of their actions in a game immediately. We have designed games with a variety of positive response feedbacks – from responding to every interaction the child makes to those that require the child to accomplish several tasks before the game responds (e.g., tapping a drum to fill an entire "power meter"). The most popular games are ones where their actions have positive immediate consequences.

10. Replayablity is key with both parents and preschoolers.

    Although, clearly, simplicity and intuitiveness of game play must be the hallmark of a good preschool-targeted game for the DS; the game also needs to be fun the fifteenth time it is played, not just the first. Ideally, replayability is fostered through multiple levels, re-skinned games, or increased difficulty of the tasks. The memory capacity issues of the DS cartridges, however, mean that the integration of these replay-oriented features must be smartly incorporated into the design. Being able to re-use graphics or sound for new variations on a game are a good way to make the game feel "new" to the child. In addition, we often include both a "Story Mode," which plays through the entire game, and a "Mini-Game Mode," which allows kids to play their favorite mini-games over and over again. We usually set up the game so that the child has to first play through the game in Story Mode in order to "unlock" the entire game and then be able to go back and choose their favorite parts to play over and over again. This issue of replayability is one that we continue to struggle with in developing games for this age group.

Conclusion

Over the past two years, we have not only learned a lot about the game design process; but also about how the research process can be improved, so that we are a more strategic, integrated part of creating games for our audiences. For our preschool audience, in particular, we have seen tremendous results from the fruits of our labor. Those first two DS games, *Go, Diego, Go! Safari Rescue* and *Dora Saves the Mermaids,* were awarded the Editor's Choice Award for December 2007 by the Children's Technology Review, and were chosen to be part of their Top Five Favorites for 2007. In addition, *Dora Saves the Mermaids* DS remained in the Top 3 position in the children's DS software category for at least 6 months after its launch. In response to this success, we are developing 3 new DS games this year. In addition, as outlined above, our experiences with these first two titles have deeply shaped the research and design process that we have created for games across all platforms.

Our experiences (and success) with integrating research into the creative and design process for games and other digital products spans across all ages, but the results are most dramatic for our youngest audience. By keeping their needs and desires front-and-center with every game we design, we create the self-fulfilling prophecy of a successful game.

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