**“Wow, I did it!”: Unexpected success increases
preschoolers’ exploratory play on a later task**

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Abstract

Exploratory play supports children's learning, but the factors that influence play are not fully identified. Here, we investigate whether experiencing an unexpected success on an initial task influences children's exploration on a subsequent task. In Experiment 1 ($N=72$), we found that when 4-year-olds successfully completed a puzzle that they were told is hard (compared to when they were told that the puzzle is easy or at baseline when no difficulty information was provided), they spent more time exploring and attempted more different interventions with a subsequent novel toy. This suggests that an unexpected success influences children's subsequent exploration. In Experiment 2 ($N=48$) we examined two alternative interpretations of the Experiment 1 findings: that children carried over difficulty assumptions from task 1 to the new toy or that children had unused attentional resources. Children completed the puzzle and then were told that the novel toy itself was either easy or hard. Children did not explore longer or more variably across these conditions, providing evidence against these alternative accounts. Our findings point to an important role for past playful experiences: unexpected success on one task motivates children to explore longer and with more breadth on another task.

Keywords: Exploratory play; Self-efficacy; Cognitive development; Broaden-and-build

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Young children are curious by nature – they ask an incredible number of questions (e.g. Callanan & Oakes, 1992; Chouinard, 2007) and they actively explore their environments (e.g. Piaget, 1930). Exploration plays a key role in children’s learning and development (e.g., Singer, Golinkoff, & Hirsh-Pasek, 2006), and playful exploration in particular provides children with the opportunity to independently discover new information through their own actions (Schulz, 2012). A child who is driven to explore more is a child who independently drives their epistemic advancement. Despite the obvious importance of self-guided play in learning, surprisingly little is known about the moment-to-moment factors that increase a child’s continued exploration of the environment.

Much research has sought to link stable individual traits to exploratory propensity, and investigated the association between these tendencies and early life experiences. Some of the earliest work on exploration and curiosity characterized at least two kinds of more exploratory individuals: those with diversive curiosity (e.g., a desire to reduce the experience of boredom), and those with specific curiosity (e.g., a desire to seek the rewarding experience of increasing understanding; Berlyne, 1960). Later work examined individual differences in exploratory propensity that may have arisen from early home experiences. Children with a secure parental “base” will explore new experiences more broadly (Ford & Thompson, 1985), and other early infant experiences (like maternal responsiveness) correlate with both infants’ persistence in playful tasks (Yarrow et al, 1982) and later intrinsic motivation to explore new academic material (Gottfried, Fleming, & Gottfried, 1998). This past work has demonstrated the importance

of understanding relatively stable factors that might shape individual children's tendency towards increased exploratory play behaviors.

Other literature on children's exploration has focused less on individual traits and experiences and sought to identify the contextual factors that drive playful exploration. One key finding is that children explore more when there is a greater opportunity to learn. This can arise because expectations are violated (e.g. Baldwin, Markman, & Melartin, 1993) or because evidence in the task is confounded (Gweon & Schulz, 2019; Schulz & Bonawitz, 2007). Infants play differently with, and learn more about, objects that violate expectations based on core knowledge (Stahl & Feigenson, 2015; 2017) or violate expectations about determinism (Schulz, Hoopell, & Jenkins, 2008). Young children use categorical and statistical information to draw inferences about objects and explore more when objects violate those inferences (Gweon, Tenenbaum, & Schulz, 2010; Schulz, Standing, & Bonawitz, 2008). Older children explore more when particular objects violate intuitive theories (Bonawitz, van Schijndel, Friel, & Schulz, 2012) and when outcomes violate self-generated explanations (Legare, 2012).

Children's exploratory play is also influenced by the social information in the context. Children explore less following a direct instruction that constrains the expected space of options (Bonawitz, Shafto et al., 2011). For example, when an adult pedagogically demonstrates a single function of a multifaceted toy, children focus heavily on that function in their free exploration, at the expense of exploring other functions. However, when the single function is demonstrated either by accident, when posed as a question, or through other non-pedagogical means, they will explore the toy more broadly and discover more additional functions (Bonawitz, Shafto et al., 2011; Butler & Markman, 2012; Yu, Landrum, Bonawitz, & Shafto, 2018). Children are also sensitive to the reliability of the instructor in similar tasks (Gweon, Pelton, Konopka, & Schulz,

2014). For example, children will explore a toy more broadly if a teacher had previously committed a sin of omission, in which they were under-informative when teaching about the functions of another toy (Gweon et al., 2014). On the whole, this body of literature is shaped by the idea that children are active learners, taking into account opportunities in a given situation that may maximize learning to effort payoffs (Bonawitz, Bass, & Lapidow, 2018; Markant, Ruggeri, Gureckis, & Xu, 2016; Schulz, 2012).

Thus, although work has demonstrated that children use information about an event or object to shape their exploratory play in the moment, relatively less work has focused on how past experiences or mindsets might transfer across tasks to influence exploration. The literature that has focused on longer-term stable environments and traits has pointed to associations (but not causal factors) shaping exploratory play. This leaves open the question of whether and how particular experiences influence later play: What kinds of experiences transfer to, and shape exploratory behavior in new tasks? Day-to-day activities in early childhood are typically marked by rapid and sharp changes from one activity to another (Ruff & Capozzoli, 2003); entire tasks and contexts can rapidly shift. Given this, it becomes important to ask whether preceding tasks affect children's approach to new playful opportunities.

Here we ask whether setting up an unexpected success on an initial task increases children's exploration on a subsequent task. Specifically, we are interested in whether telling children about the difficulty of one task (that in some cases turns out to be easier for them than predicted), will affect the way they explore on a new task. In Experiment 1, 4-year-old children were told that a puzzle they were about to complete is either easy or hard and that most children can/can't solve it, or were given no information about it. Importantly, we chose a puzzle that was quite easily solvable. Then, children were presented with a new task – a large novel toy, with

many parts. They were simply told that it was their job to “figure out” the new toy and were given no information about how difficult that would be. We measured how long and how variably they played with the new toy to examine whether children’s experiences in a previous task (i.e., how their expectations about the difficulty of a task that they successfully completed) would influence their subsequent exploration.

Three possible data patterns could emerge. First, when told that the puzzle is hard, children receive a surprising positive outcome - they succeeded when they might have thought they could not. Given that unexpected reward and uncertainty reduction act as behavioral motivators generally (Inglis, 2000), experiencing an unexpected success may result in increased motivation on a second task, leading children to explore *more* in this condition. This pattern of finding would be consistent with a number of theories of motivation, such as self-efficacy theory (e.g., Bandura, 1977; Schunk, 1987, 1989, 1991), attribution theory (e.g., Weiner, 1979; 1985), and expectancy-value theory (e.g., Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). For example, unexpected success could increase self-efficacy, which has been shown to increase motivation to tackle challenges and which children can self-assess (Bandura, 1977; Schunk, 1987, 1989, 1991). Similarly, expectations for success on a task can be influenced by factors such as past experiences, perceptions of competency, and perceived difficulty of the task. Expectations can then influence performance, effort, and persistence on that task (e.g., Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). The sense of competency that children might feel after successfully completing a puzzle that was expected to be difficult could lead them to expect to also succeed with the novel toy, thus exploring more. Another reason to expect this pattern is that unexpected success could elevate mood, and elevated mood has been linked to greater creativity and exploration (Fredrickson, 2004). Hearing

that the puzzle is easy or receiving no information about the puzzle does not set up this surprising success, so children might not explore more on the subsequent task. This hypothesis is further supported by preliminary results on an independently tested group of participants (Castro & Bonawitz, 2015a, 2015b). They found that children who experienced unexpected success explored longer and more variably than children who did not (see Supplementary Materials for data).

However, children might instead explore less following an unexpected success. Previous research examining persistence on specific tasks (e.g., tracing) suggests that children persist less on a task if they have previously out-performed their peers (e.g., Cimpian, 2010; Cimpian, Arce, Markman, & Dweck, 2007; Magid & Schulz, 2015). Thus, being told that an easily-completed puzzle is hard for other children could lead to *less* exploration on a subsequent task. That is, if a child realizes that they put in very little effort to complete something they were told is hard, they might assume that putting in extra effort is unnecessary more generally.

The final possibility is that the information about the first task will have *no* impact on how children explore on a subsequent task. This would be consistent with some adult research showing that neither a boost nor a reduction in engagement with a new task was observed following success or failure in an unrelated task (Heine et al., 2001). In these studies, North American undergraduates continued to engage in a task when they were told that they outperformed others on that same task, as opposed to when they were told others had done better. However, this pattern did not hold when given the opportunity to engage in a subsequent task that was unrelated to the first task: they engaged in the unrelated task at similar levels regardless of their performance relative to peers on the initial task. The findings from this study suggest that

there may be no relationship, for adults, between past experience and engagement with a new task (Heine et al., 2001).

Experiment 1

Methods

Participants. Seventy-two 4-year-olds were tested individually in a lab. Children were randomly assigned to one of three conditions ($n = 24$ per condition): an “easy” puzzle condition (12 females; Mean age = 52.0 months; $R = 48.8$ -57.8 months), a “hard” puzzle condition, which set up the unexpected success (11 females; Mean age = 52.4 months; $R = 48.3$ -59.4 months), and a no-information puzzle condition (13 females; Mean age = 52.6 months; $R = 48.2$ -59.5 months). Twelve additional children were tested and excluded due to failure to complete the puzzle ($N = 5$), the stimuli breaking during play ($N = 2$), discovering functions at a rate more than 2.5 standard deviations from the mean in their condition ($N = 1$; from the “easy” puzzle condition), and playing with the toy for more than 2.5 standard deviations away from the mean play time of their condition ($N = 4$; 1 from the “easy” puzzle condition, 1 from the “hard” puzzle condition, and 2 from the no-information puzzle condition)¹. Our sample size of 24 children per condition was set a priori and was based on a power analysis on preliminary work (see Supplementary Materials), using these procedures, as well as previous work on children’s exploration using similar methods (e.g., Bonawitz, Shafto et al., 2011; Gweon et al., 2014; Schulz & Bonawitz, 2007; Schulz et al., 2008; Schneidman, Gweon, Schulz, & Woodward, 2016; Yu et al, 2018).

Stimuli. A 6-piece puzzle of a picture of turtles was used. Additionally, a novel toy was built by attaching tubes that were painted with different colors to a board (see Figure. 1). The toy

¹ We also analyzed the data with the outlier children included. Children in the “hard” puzzle condition spent marginally more time playing with the toy than children in the no-information and “easy” puzzle conditions, $t(74) = 1.81, p = .075$. Children in the “hard” puzzle condition performed more different types of interventions than children in the no-information and “easy” puzzle conditions, $t(74) = 2.10, p = .039$.

had four different non-obvious functions: a squeaker toy hidden in one of the tubes, a button covered with black and red tape that played music, a kaleidoscope attached to the top of a tube, and a button that turned on a flashlight to light up the kaleidoscope. The toy also had three spinners and a mirror that were not hidden.

Figure 1. Puzzle and novel toy used in Experiments 1 and 2.

Procedure. All sessions were videotaped. The experimenter introduced the game by saying, “Today I’m going to show you some of my toys. Some of them are going to be hard, and some of them are going to be easy, and it’s going to be your job to figure them out.” The experimenter then presented the puzzle. In the “easy” and “hard” puzzle conditions, the experimenter said, “This is my first toy. This puzzle is [easy/hard] and most kids [can/cannot] solve it. You have to put the pieces together to make it look like this picture. Here, you give it a try.” In the no-information puzzle condition, the experimenter said the same things, but omitted the sentence about the difficulty.

Once children completed the puzzle, the experimenter introduced the novel toy. In all conditions, the experimenter stated, “This is my other cool toy. I don’t know if this toy is easy or hard because you’re the first person to play with it. I’m going to give this to you and you can

give it a try. I'm just going to go over there to do some work. Let me know when you're all done playing with it." Children got a maximum of eight minutes to play with the toy. After five minutes of playing, or 15 consecutive seconds of the child not engaging with the toy, the experimenter asked the child if they wanted to continue playing or if they were done. The play session ended when children said they were done playing, or if the eight minutes were up.

Coding and reliability

Our two measures of interest were how long children spent exploring the novel toy and the breadth of exploration (as measured by types of interventions) on the toy. Amount of time exploring was defined as the time between the child first touching the toy, and when they said they were finished playing or until eight minutes passed. Types of intervention were defined as finding or attempting an action on the toy. For example, children could find any of the functions, press on one of the colored tubes, rotate the toy, lift up the tapes, etc. (for a list of all possible interventions, see Supplementary Materials). The original experimenter coded all data, and a second coder (blind to condition) reliability coded 50% of the data (Experiments 1 and 2). Reliability was high for both amount of time playing with the toy ($r = .951$, $N = 60$, $p < .001$) and variability of functions ($r = .870$, $N = 60$, $p < .001$).

Results and Discussion

Data for both experiments are available at https://osf.io/cx7zu/?view_only=2c45139747a246f0b3e03c4fbecc14c7. Only children who successfully completed the puzzle were included in our analyses. Because we had a priori hypotheses about the patterns of results from preliminary findings (blinded for review), we performed planned linear contrasts. We formalized the prediction that the unexpected surprise in the "hard" puzzle condition would differ from the "easy" and no-information puzzle conditions

with the weights 2, -1, -1 for the three conditions respectively. This test will be significant when the hard puzzle condition differs from the other two and there are no differences among the no-information and easy puzzle conditions.

All linear contrasts were significant two-tailed. Children in the “hard” puzzle condition spent significantly more time playing with the toy ($M = 146$, $SD = 85.98$) than children in the no-information ($M = 96.71$, $SD = 39.03$) and “easy” puzzle ($M = 97.5$, $SD = 61.08$) conditions, $t(69) = 3.01$, $p = .004^2$. Children in the “hard” puzzle condition also performed more different types of interventions ($M = 10.88$, $SD = 2.68$) than children in the no-information ($M = 9.08$, $SD = 2.67$) and “easy” puzzle ($M = 9.17$, $SD = 2.90$) conditions, $t(69) = 2.55$, $p = .013^3$.

Figure 2. Amount of time children spent playing and number of different interventions attempted on the novel toy in Experiment 1. Black bars indicate means and red lines indicate standard deviations.

² These results hold using a one-way ANOVA, $F(2, 69) = 4.54$, $p = .014$, $\eta^2_p = .116$ and follow-up individual t-tests (hard vs. no-information, $p = .028$, $d = 0.738$; hard vs. easy, $p = .031$, $d = .650$; easy vs. no-information, $p = .999$).

³ Results using a one-way ANOVA, $F(2, 69) = 3.25$, $p = .045$, $\eta^2_p = .086$ and follow-up individual t-tests (hard vs. no-information, $p = .069$, $d = 0.673$; hard vs. easy, $p = .087$, $d = .612$; easy vs. no-information, $p = .994$).

These findings show that when children easily complete a first task they were told is hard, they explore longer and more variably on a subsequent task. This suggests that the completion of a first task that they thought was hard motivated them to explore a second task more than when told that the task is easy or when given no difficulty information.

Although we did not set out to identify whether this boost in motivation derives from self-efficacy or improved mood (which are difficult to disentangle) we conducted some post hoc coding and analyses to explore hypotheses about mood and affect. Put simply, children who completed a “hard” puzzle might be happier and thus more open to exploration than children who completed an “easy” puzzle (or when given no difficulty information). We examined the experimental videos for evidence of differences in children’s affect across conditions. Using Likert scales, two coders rated children’s level of engagement, happiness, negative affect, energy, and surprise while they were playing with the puzzle and the novel toy. The analyses revealed no differences across conditions on any of these dimensions (see Supplementary Materials for details), however we cannot draw strong conclusions from this lack of evidence, given the difficulty of drawing inferences about affective responses from facial coding (e.g. Barrett, Adolphs, Marsella, Martinez, & Pollak, 2019; Durán, Reizenzein, & Fernández-Dols, 2017).

One alternative explanation for our findings is that children might have generalized the difficulty expectations of task 1 to task 2. That is, they may have inferred that if a first task is hard, then the second task will also be hard, and further, if a task is hard then perhaps it has many functions to be mastered. Children believe that the more functions a machine has, the more complex its internal mechanism is (Ahl & Keil, 2017), thus it is likely that children believe that a difficult toy should have a lot of functions. If children think in this way, then this could explain

why children in the hard puzzle condition explored longer and found more functions on the new toy than children in the easy and no-information puzzle conditions.

A second alternative explanation is that when children were told that the puzzle they were about to complete is hard, they may have gathered up attentional resources (or “mental energy”) in preparation for completing a difficult task (Young & Stanton, 2002). However, because the puzzle itself was very easy, attentional resources that were not spent on the puzzle may have been carried over to the next task. Under this theory, tasks expected to be easy (or with no information about their difficulty) would not lead to excess, to-be spent mental energy. To examine these two alternative explanations, we conducted a follow-up experiment that controls for both.

Experiment 2

Experiment 2 controls for the “generalized difficulty” and “preparatory resource gathering” explanations by giving children direct information about the novel toy in the second task. The procedure for Experiment 2 was identical to that of Experiment 1, except that children were not given any difficulty information about the puzzle, but were instead directly told that the novel toy is either easy or hard.

If children in the hard puzzle condition of Experiment 1 explored longer and more broadly because they generalized the difficulty of the puzzle to the novel toy, then children in this experiment should play longer and more broadly when told directly that the novel toy is hard. Similarly, if children in the hard puzzle condition of Experiment 1 explored longer and more broadly because they had allocated more mental resources in preparation, which spilled over to a new task, then children should also play longer and more broadly when told that the novel toy is hard. In contrast, if the unexpected success on task 1 was responsible for children’s

increased exploration in Experiment 1, then children who do not experience this should explore the novel toy similarly in both conditions.

Methods

Participants. Forty-eight 4-year-olds were tested individually in a lab. The children were randomly assigned ($n = 24$) to one of two conditions: the “easy” toy condition (12 females; Mean age = 51.8 months; $R = 48.5$ -57.8 months), and the “hard” toy condition (13 females; Mean age = 51.7 months; $R = 48.2$ -58.8 months). Eight additional children were tested and excluded due to failure to complete the puzzle ($N = 3$), unwillingness to complete the experiment ($N = 1$), experimenter error ($N = 1$), and playing with the toy more than 2.5 standard deviations away from the mean play time of their condition ($N = 3$; 2 from the “easy” toy condition, and 1 from the “hard” toy condition)⁴.

Procedure. The procedure for Experiment 2 was identical to Experiment 1, except for the following changes. When given the puzzle to complete, children heard the script from the no-information puzzle condition of Experiment 1. Once children completed the puzzle, the experimenter brought out the novel toy. Children were told, “This toy is [easy/hard] and most kids [can/cannot] figure it out. I’m going to give this to you and you can give it a try. I’m just going to go over there to do some work. Let me know when you’re all done playing with it.”

Results and Discussion

We first examined how long children spent exploring the novel toy in seconds. A one-way ANOVA (i.e., equivalent to a t-test) revealed no main effect of condition, $F(1, 46) = 0.50$, $p = .482$. Children in both the “easy” ($M = 115.38$, $SD = 61.55$) and the “hard” toy condition ($M =$

⁴ We also analyzed the data with the outlier children included. Children in both the “easy” and “hard” toy conditions spent about the same amount of time exploring the novel toy, $F(1,49) = 0.12$, $p = .727$, and attempted about the same number of different interventions, $F(1,49) = 0.01$, $p = .913$.

129.75, $SD = 78.12$) spent about the same amount of time exploring the novel toy. Next, we examined the number of different interventions children attempted. Again, a one-way ANOVA revealed no main effect of condition, $F(1, 46) = 0.05, p = .833$. Children in the “easy” ($M = 9.88, SD = 2.76$) and the “hard” toy condition ($M = 10.04, SD = 2.68$) attempted similar numbers of interventions on the novel toy⁵.

Children showed no significant difference in their exploration across conditions, decreasing the likelihood of the generalized difficulty or preparatory resource gathering accounts. This suggests that the relatively effortless completion of a presumed-to-be hard task is what primarily motivated children in Experiment 1 to explore a novel toy more persistently and broadly.

General Discussion

In Experiment 1, we asked whether children would use their experience on a first task to regulate their behavior on a second task. More specifically, we explored whether easily completing a puzzle that was believed to be difficult would influence preschoolers’ exploratory play in a following task. We found that children explored more given this unexpected success as compared to conditions believed to be easy or with no a priori assumptions. In Experiment 2, we did not find support for two alternative accounts of our results.

The increase in children’s motivation to explore the novel toy in the hard puzzle condition may be caused by a boost in either affect, self-efficacy, or both. Although we did not find differences in children’s affect across conditions using a post hoc coding scheme, a lack of

⁵ Thanks to a suggestion from an outside reader, we also compared the two conditions in Experiment 2 with the no-information condition in Experiment 1 such that the no-information condition could serve as a baseline; ANOVAs revealed no main effect of condition for time, $F(2, 69) = 1.73, p = .185$, and no main effect of condition for interventions, $F(2, 69) = 0.86, p = .427$. This provides some further evidence that the experience of the unexpected success on the initial task in Experiment 1 may be responsible for the boost in exploration.

support from those analyses certainly does not rule out the possibility of a role for improved affect in children's increased exploration. Future research could tease apart each of these possibilities. For instance, researchers could measure self-confidence across conditions following puzzle completion to see whether confidence is elevated in the hard puzzle condition as compared to the others. Likewise, researchers could include measures of affective states in follow-up studies, using self-report scales or physiological measures.

One might raise the possibility that children's differential exploration stemmed from pragmatic reasoning about the difficulty of the novel toy, given the instructions provided by the experimenter. Specifically, because we told children that they would see several toys, and the first toy (the puzzle) was experienced as "easy", perhaps children would believe the next toy was difficult and play longer. However, this argument does not logically hold for several reasons. First, children in both conditions experienced the initial puzzle as easy, so if children went by experience alone, there should be no difference in play with the following novel toy then presumed to be hard. Second, if children instead pragmatically reasoned from the testimony (that the puzzle was said to be "hard" so the next toy would be easy), then if anything, children should play even less in the "hard" condition with the novel "presumed easy" toy. Third, our results from Experiment 2 suggest that direct testimony about the difficulty of the novel toy did not significantly alter play behavior. Taken together, it seems unlikely that such an account could explain the results.

Instead, our findings are consistent with a number of theories of motivation (e.g., Bandura, 1977; Eccles et al., 1983; Eccles & Wigfield, 2002; Schunk, 1987, 1989, 1991; Weiner, 1979; 1985; Wigfield & Eccles, 2000). According to the expectancy-value theory of motivation, our expectations for success on a task can be influenced by a number of factors, such as our past

experiences, our perceptions of our competency, and the perceived difficulty of the task. Our expectations can then influence our performance, effort, and persistence on that task (e.g., Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). It is possible that when children successfully completed a puzzle that they expected to be difficult, they felt a sense of competency and expected to also succeed with the novel toy. This expectancy to succeed could have led them to explore the toy more and find more functions. In contrast, children who completed a puzzle that was expected to be easy would not have experienced this feeling of competency, and thus would not be more motivated when playing with the novel toy. Such an explanation also provides a potential link between how moment-to-moment contextual experiences might build over time and help to set-up longer-term “trait” patterns of exploratory play behavior, which could be pursued in future research.

Our findings are also consistent with classic work showing that uncertainty reduction is a motivator for exploration (Inglis, 2000; Loewenstein, 1994). If experiencing that the puzzle is easier than stated by the experimenter raises general feelings of uncertainty about the current environment, then this might increase exploration on the next task. Our results importantly extend this literature by demonstrating the persistent pull of such uncertainty across tasks, with implications for how children approach novel learning situations. Future work could examine the degree to which such expectations persist across additional novel contexts and perhaps even across delays.

Children’s increased exploration following an unexpected success might be related to persistence. If so, these findings add to a growing body of work on persistence in early childhood. Infants persist in achieving a goal more when an adult has modelled perseverance on a task (Leonard, Lee, & Schulz, 2017), and children’s motivation to persist on a task is

influenced by the type of information they are given about their own or others' ability in relation to that task (e.g., Cimpian, 2010; Cimpian, Arce, Markman, & Dweck, 2007; Magid & Schulz, 2015). Other work has shown that children are *less* persistent when they think they outperformed their peers on a skill (Magid & Schulz, 2015). On the surface, it might appear that our findings conflict with this work. However, in the experiments on persistence, children rationally distributed their energy and efforts, by not practicing a skill they had already proven to be quite good at. Children's behavior in the present experiments provides insight into their persistence and motivation following an apparent success, on an unrelated task. Children easily completed a puzzle after hearing that other children found it hard, and thus they might infer that they have superior abilities to their peers. But, there is no reason for children to think that this should extend to their ability to figure out how a novel toy works. In fact, it might be unwise to assume that they would also be very good at figuring out the novel toy without having any experience with it. However, the boost that they might receive in self-efficacy or to their mood, might provide a more global boost in motivation. Further, children likely understand that just because they are better or worse than their peers at one task does not mean this will extend to another task. For example, preschoolers understand that even adults can have different kinds of expertise depending on the domain of knowledge or skill (Kushnir, Vredenburgh, & Schneider, 2013).

Together, our findings suggest that unexpected *success* on one task increases children's exploration on a second task. A related and interesting idea to consider, is how unexpected *failure* might influence children's exploration. That is, if children were told that an initial task is very easy, and then realized that it is quite difficult, what would they do on the subsequent task? Would failing and performing worse than their peers motivate them to explore more on the next

task, or would it upset them and lead them to explore less? Future research can explore this possibility.

Children are constantly moving from one activity to another, but little is known about how experiences in one activity can influence the next. The present findings provide new insights into children's exploration and the possible influence of unexpected past successes on motivation. Achieving success when children least expect it encourages their future exploration.

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Supplementary Materials

1. List of all possible interventions

- 1)Pressed the squeaky toy
- 2)Pressed the soft ball
- 3)Pressed the flashlight
- 4)Looked in the kaleidoscope
- 5)Pressed/pushed on the kaleidoscope
- 6)Pressed the music button
- 7)Spun pink spinner
- 8)Spun green spinner
- 9)Spun orange spinner
- 10)Rotate toy
- 11)Turn toy upside down
- 12)Press on red tube
- 13)Press on green tube
- 14)Press on blue tube
- 15)Press on yellow tube
- 16)Look into mirror
- 17)Pressed/pushed on mirror
- 18)Asked questions
- 19)Pulled on squeaky toy
- 20)Pulled on soft ball
- 21)Looked into tubes with ball
- 22)Lifted up tape

2. Preliminary results of previous study

Prior to testing the new group of participants for this study, XXXX collected preliminary data from an independent group of preschoolers. 30 children were randomly and evenly assigned to either the hard, no-information, or easy puzzle conditions (Mean age = 55.36 months, no significant differences in age between conditions). Coding for variability of actions on the toy revealed a significant interaction by one-way ANOVA, $F(2, 27) = 4.77, p = .017$. Follow-up

individual t-tests revealed significant differences between hard ($M = 12$, $SD = 2.7$) and no-information ($M = 9$, $SD = 2.4$) puzzle conditions, $t(18) = 2.58$, $p = .019$, as well as between the hard and easy ($M = 8.4$, $SD = 3.13$) puzzle conditions, $t(18) = 2.71$, $p = .014$. There were no differences between no-information and easy puzzle conditions, $t(18) = .48$, $p = .637$. These first results suggested that children in the hard puzzle condition would explore more variably than children in the other conditions if replicated with a larger, independent sample. These participants were tested using slightly modified methodological procedures from the participants collected for the reported primary Experiment 1 results, and thus cannot be collapsed with the primary reported data.

3. Affect Coding

To explore whether there were affect differences between conditions, a research assistant blind to conditions and hypotheses coded children's affect while playing with the puzzle and the toy. We coded children's level of engagement, happiness, negative affect, energy, and surprise in 20 second intervals once children started the puzzle and their first touch on the novel toy. For engagement, happiness, negative affect, and energy, we scored children out of 4, with 0 being not displaying that affect at all, and 4 being intensely displaying that affect. For surprise, we counted the number of times children displayed surprise in the 20 second interval. In order to add surprise to our model, we converted the counts of surprise into a scale from 0-4 to match the other affects. Because some children spent longer with the puzzle and the novel toy than others, we averaged children's scores to get one overall affect score for each of the five affect for when children were completing the puzzle and for when they were playing with the novel toy.

We first ran a multivariate General Linear Model (GLM) for when children were completing the puzzle. For engagement, we found a marginally significant effect of condition, $F(2, 51) = 2.69$, $p = .078$, $\eta^2_p = .095$, however, post hoc comparisons with Bonferroni correction revealed no differences between conditions, $ps \geq .145$. No significant effects were found between conditions for engagement, happiness, negative affect, and energy, $ps \geq .321$. We also ran a multivariate GLM for when children were playing with the novel toy and found no significant differences between conditions for any of the five affects, $ps \geq .474$. These findings suggest that children's longer and more variable exploration on the novel toy in the hard puzzle condition is not due to differences in affect.