

Using a Choice-Based Assessment to Measure the Effects of a Summer Camp Program on Persistence

Abstract

Assessing the impact of informal learning programs can be difficult, especially when examining non-cognitive outcomes. We present research using choice-based assessment (CBA), in the form of an online game, to measure the impact of a summer camp on children's persistence in response to failure. The study was replicated across two years at a camp focused on innovation, involving children (8-10 year olds) playing the game either at camp or at home ($N_{\text{total}}=881$). Results indicate the camp had a positive effect on persistence, as represented by the number of tries at the hardest level of the game. This is a promising demonstration of using *behaviors*, rather than survey measures, to examine non-academic outcomes.

Introduction and Theoretical Framework

Many parents and educators look to informal learning experiences as an important complement to school-based learning. Often, the goals of these experiences reflect skills and dispositions that cannot be measured by traditional tests of knowledge (e.g., Duerden et al., 2012; Authors, 2013; Gutwill, et al., 2015). Here, we use a game-based assessment to examine whether a summer camp program focused on innovation, making, and design influences children's responses to failure. In particular, do children transfer behaviors beyond the camp activities themselves?

It is well known that the mindsets children bring to a learning situation can influence their learning behaviors (e.g., Dweck, 2000). Making and design-thinking have been lauded by educators as encouraging productive mindsets and approaches to problem solving (Martin, 2015; Carroll et al, 2010). For example, the autonomy youth have over their learning can support persistence and resourcefulness. Experimentation, failure, and revision in a low stakes environment can promote adaptability (Martin, 2015). Here we

examine the outcomes of a summer camp that focuses on making and design, in terms of how it influences camper's response to failure during problem solving.

A key question is how to measure the effects of a summer camp experience. Several studies have used self-report surveys to identify benefits of summer camp experience on non-cognitive outcomes such as independence, resilience, and problem solving (e.g., Thuber et al., 2006; Allen et al, 2006; Garst et al., 2016). The American Camp Association developed a survey index to evaluate camps on several dimensions (American Camp Association, 2011; Henderson et al., 2006). However, researchers and practitioners from have called for additional measurement tools that go beyond surveys (e.g., Authors, 2016; West et al., 2016; NRC, 2009). Behavioral evidence of whether students engage in the desired skills in a new situation would help make the case for the lasting value of summer camps. One of the first studies of summer camps used behavioral observations of boys at camp to look at skill growth (Dimock and Hendry, 1929). While powerful, observational work is difficult to scale, and it does not easily provide evidence of whether the behaviors transfer beyond camp.

Here, we use the construct of a choice-based assessment (CBA) to measure the impact of a summer camp experience on children's learning behaviors in response to failure. CBAs are short (10-15 minute), game-like, computer-based technologies, that present learners with a challenge and learning resources, and then track how learners solve the challenge (Authors, 2013, 2015, 2016). In this case, we developed a CBA called, *Farmlet*, in which children plant virtual farms to feed various animals.

We tested the CBA with children who attended a summer camp program that explicitly encourages design-thinking mindsets, such as not being afraid of failure and

seeing failure as an opportunity to learn. To our knowledge, this is one of few investigations of the transfer of summer camp outcomes that primarily uses behavioral, rather than self-survey, outcome measures.

Farmlet: Assessing Response to Failure

Farmlet is a CBA in which players are trying to grow crops. Figure 1 shows the version of the game used in 2015. A few modifications were made prior to the 2016 implementation, though the general gameplay remained the same. In the game, there are three primary choice points relevant to the response to failure. 1) Do learners persist after failure, or do they abandon the level and try something different? 2) Do they choose to share failures with their community members? 3) Do they look in the community book to try to learn after failure? This paper focuses on choice point (1) persistence after failure.

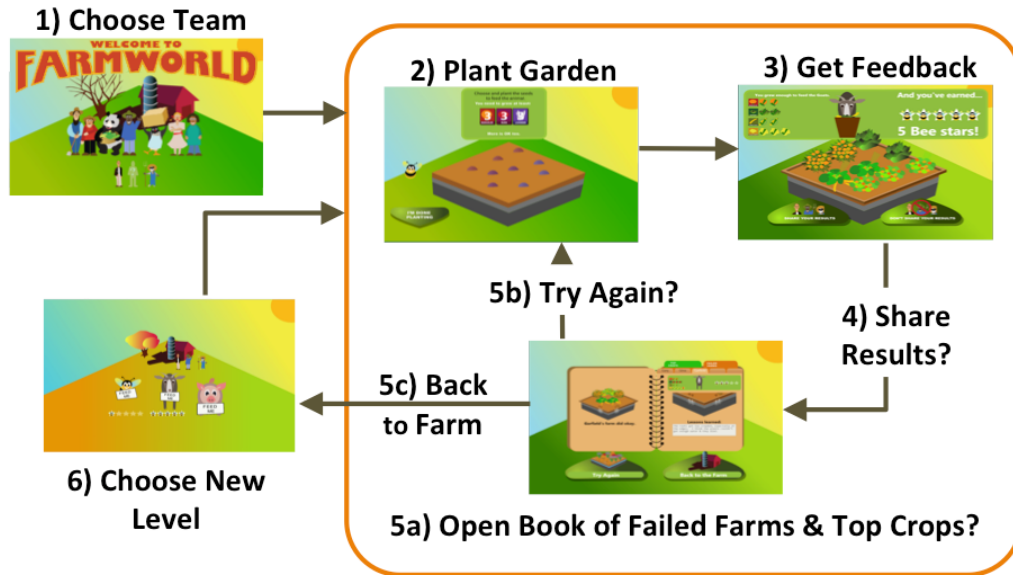


Figure 1: Farmlet Game. Players grow crops to feed animals in a series of increasingly challenging levels. When learners enter the game, they (1) choose the characters in their growing community. At each level, learners (2) plant seeds by dragging them into the plot and then watch their gardens grow. A feedback screen (3) shows how well the garden grew and if it met the needs of the animals. (4) Learners then choose whether or not to share their results with their growing community. After, learners have the optional choice to look in the community book (5a), which displays successes and failures that have been shared, along with some notes. The learner's farms appear in this book if they chose to share, and they have the option to add their own notes. The other book entries are canned. Learners can try again (5b) to replant their farm, or they can go back to the home screen (5c) to choose a different animal to feed (choose a different level).

Summer Camp Program

We worked with rising 3rd-5th graders at a camp program whose mission is to teach children to “embrace challenges, learn from mistakes, and create without fear”. Over the course of a week, campers engage in themed art, science, and outdoor activities, in which designing and building play prominent roles. For example, in a medieval-themed week, campers design a catapult that can launch different kinds of projectiles. Some campers attend different themed sessions over multiple weeks. As campers engage in activities, they are encouraged to take on innovation mindsets, such as being courageous, collaborative, and determined. We worked with the program administration

to identify *response to failure* as the specific construct they were most interested in measuring.

Study Design

Over two summers, we measured whether children's amount of camp experience impacted their choices within the CBA. Camp experience was tabulated on prior years of attendance (0-3 years), as well as whether they had already attended a full session that summer or not. Children were measured either at camp or at home.

At Camp. Researchers brought iPads on-site, and groups of children (~15 at a time) were pulled during the after-camp, extended-care time to play Farmlet, individually, for approximately 15 minutes. Most children played on their first (2016) or second (2015) day of the given camp week. The onsite administration provided a tight control over the conditions of assessment. However, it also may have cued children into using the strategies and mindsets encouraged by the camp, because they were still in the same physical location as camp.

At Home. Other campers played the game online from an email link sent at the beginning of July to parents of all children registered for camp anytime that summer. Some children had already been to camp when their parents received the link, while others were scheduled to attend in later weeks. We had less control over the conditions of play for the online implementation, but it was removed from the camp environment and presents a farther test of transfer. Response rate from the number of emails sent to the number of campers who played was approximately 5% in both 2015 and 2016. A total of 881 children played Farmlet on-site or at home over the two years (Table 1).

Table 1: Number of participants in each assessment administration

Year	Location	N	%Female	Mean Age (SD)
2015	At camp on-site	145	42.1	8.8 (.8)
	At home	207	47.3	9.0 (.8)
2016	At camp on-site	206	44.2	9.2 (1.1)
	At home	323	45.2	9.4 (2.3)

In examining camp effects, a selection bias may exist for those who attended multiple years of camp – children who attend multiple years may have some underlying factor in common, unrelated to camp experience. Thus, an important sub-sample are children with no prior years of camp experience. In this sub-sample, all the campers had registered for the first time that year; some happened to attend camp before playing the game, and some after. Comparing patterns of behavior among this group enables a stronger causal claim about the effect of camp attendance on response to failure.

Results

The game involved three increasingly challenging levels. In level one, most children succeed in feeding all the animals on their first try. In the most challenging level, level three, only a small subset of children (9% in 2015, 16% 2016) ever succeeded in growing a farm that fed all the animals. Children did not need to succeed at one level to go on to the next, and they could go back and forth between levels of the game.

We analyzed multiple measures of persistence in the initial, exploratory 2015 study. One measure of persistence is the number of tries at the most challenging level of the game. Analysis of the 2015 data showed significant differences or trends towards

differences on this measure based on different metrics of camp experience. Therefore we used this as our *a-priori* measure of persistence in 2016.

Our primary analysis is of the 2016 data, focusing on the tightest comparison – those who attended camp for the first time in 2016. For the at-home online assessment, we compare campers who have not yet been to camp at all (registered for later weeks) to those who have already completed at least one week of camp. For the at camp on-site administration, we compare those who are in their first or (less frequently) second day of camp to those who have already completed at least one full week of camp. We conducted an ANCOVA with ‘tries at hardest level’ as the dependent variable, age as a covariate, and ‘assessment location’ and ‘completed 1+ weeks of camp’ as factors. We found a main effect of completing 1+ weeks of camp ($F_{(1,263)}=9.07, p<.01$). There was a marginally significant interaction between having completed 1+ weeks and the assessment location ($F_{(1,263)}=3.53, p=.06$) -- the effect of camp is greater on-site than at-home. The right panel of Figure 2 shows the 2016 data. The left panel presents data from 2015, which shows similar patterns, though with a smaller sample size.

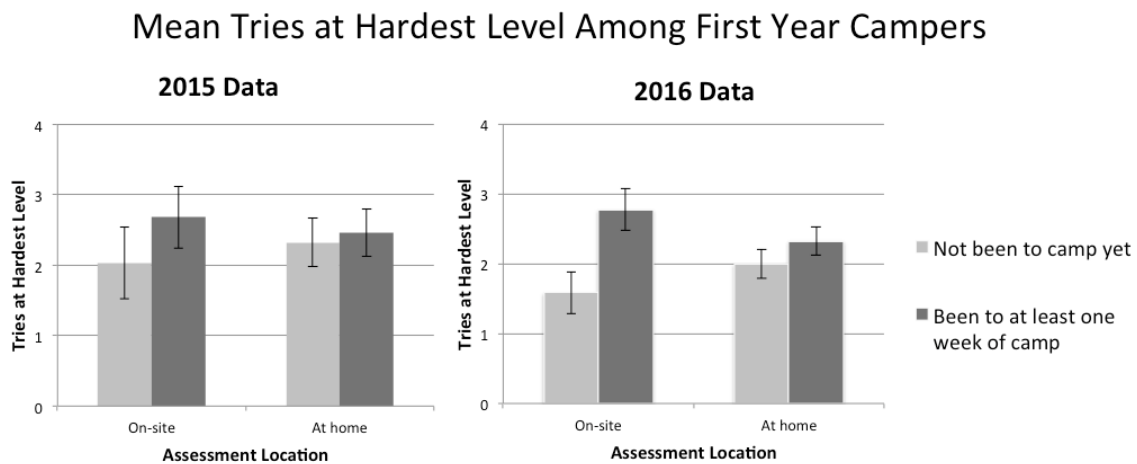


Figure 2: Graphs of number of tries at hardest level by camp experience, among campers registered for their first year. Means corrected for age

A second question is whether number of prior years of camp experience influences the level of persistence in response to failure (dosing effect). This analysis involves a 4x2x2 interaction ('number of prior years' (0,1,2,3) by 'been this year or not' by 'at-home or on-site' administration.) Because sample sizes attenuate when parsing by year, we include both years 2015 and 2016 into a single analysis.

Analysis of the combined data showed the age covariate was marginally significant ($F_{(1,861)}=2.88, p=.09$). Age was positively related to number of tries at the hardest level. There was a significant effect of having been this year ($F_{(1,861)}=13.65, p<.01$), as well as a significant effect of number of prior camp years ($F_{(3,861)}=5.01, p<.01$). More camp experience was related to more tries at the hardest level. There was no main effect of location, but there was a significant three-way interaction between assessment location, number of prior camp years, and whether a camper has been yet this year ($F_{(3,861)}=3.76, p<.05$).

Mean Tries at Hardest Level Among Veteran Campers by Location

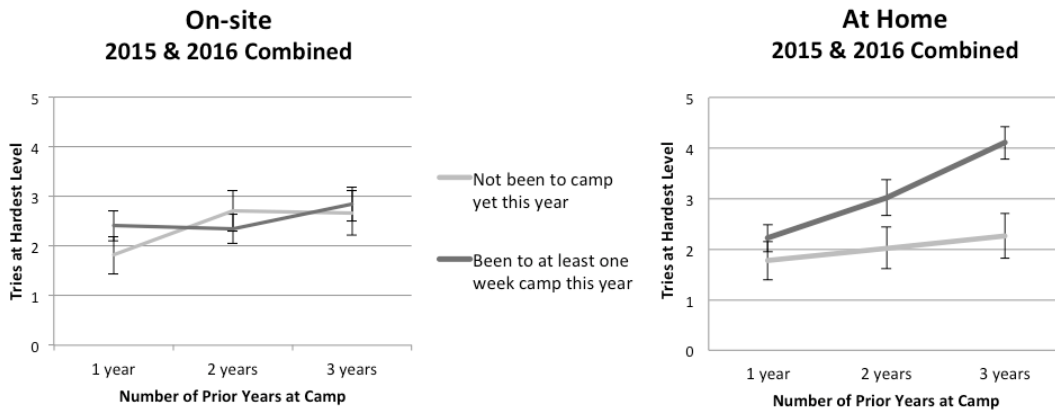


Figure 3: Graphs of number of tries at hardest level by camp experience, among campers who have been to camp prior years. Combining 2015 and 2016 data. Means corrected for age

Figures 2 and 3 help illuminate this interaction. It appears that if children take the assessment on-site at camp and they have prior years of camp experience, then getting a “refresher” in the current summer does not further improve persistence. For children taking the assessment at home, having been to camp the current summer may be necessary to see the beneficial effects of multiple years of camp experience. While at camp, the cues to apply camp-related mindsets are strong, and learners show benefits of camp-related experience (compared to those without prior camp experience). Playing the game at home, in contrast, is a much farther transfer of mindsets and dispositions. The same environmental cues to apply what was learned at camp are not present. Here, multiple years of camp drives an increase in persistence, but only if the children had received the ‘booster’ of having attended camp prior to the assessment. Persistence from a camp experience transfers to out-of-camp settings, but only if children had been to camp recently. An important question is whether there are other ways to sustain the transfer of camp messages that do not require re-attending camp,

We also conducted the same analysis with just the 2016 sample, in which tries at the hardest level was our prospective measure of persistence, though sample sizes in some cells are small. We found similar patterns to the combined data. The age covariate was significant ($F_{(1,511)}=4.86, p<.05$). There was marginally significant effect of having been this year ($F_{(1,511)}=3.45, p=.06$), as well as a significant effect of number of prior years of camp ($F_{(3,511)}=2.86, p<.05$). The three-way interaction between assessment location, number of prior camp years, and whether a camper has been yet this year was marginally significant ($F_{(3,511)}=2.19, p=.09$).

Conclusions

The study used a CBA to measure the impact of an innovation-focused summer camp program on children's responses to failure. Specifically, we looked at persistence behaviors after failure, as measured by number of tries at the hardest level of the game. Comparing children who had already attended camp to those who were registered for later weeks, but had not yet been this summer, we found differences in behaviors based on camp experience when children played the CBA at camp and when they played at home. This game-based assessment provides one possible model for assessing changes in learning behaviors as a result of informal experiences, such as summer camp. It leverages the informal nature of games and the interactive data-logging capabilities of computer technologies. Because they are easy to implement and not tied to one learning context, CBAs have the potential to be used across settings and to evaluate different informal learning experiences (Authors 2015, 2016).

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