

# Promoting Unruly Programming with Random Blocks and Physical Play

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**Abstract**— This paper presents the Unruly Splats platform designed to promote active STEM play. We summarize design considerations that shaped its current prototype. Unruly Splats are a set of foot-sized floor buttons that light up, sense pressure, and make sounds, according to programs that learners age 6 and up create using a blocks-based programming environment on their tablets or computers. We discuss how the system works using a game in the whack-a-mole genre. The paper illustrates the ways in which programs and Splats connect, to allow for a low-barrier to entry into coding experiences while supporting a myriad of programming possibilities. We discuss the role that the “pick random number” block plays in creating challenging and collaborative experiences and conclude with observations from interactions with early users.

**Keywords**—physical play, blocks-based programming, Scratch, Blockly, random, active STEM play

## I. INTRODUCTION AND RELATED WORK

An increasing number of toys are becoming available that introduce blocks-based programming to youth. Examples are: Wonder’s Dash robot [1], Cubelets [2], and the physical blocks of Osmo [3]. At Unruly Studios, a startup which incubated in the Olin College of Engineering’s Extending Access to STEM Empowerment (EASE) Lab, we are creating a platform for the related market of active STEM play, that has yet to see products with wide reach. Our Unruly Splats product is designed to facilitate kids empowering themselves to develop critical STEM skills (such as programming and collaboration) while encouraging physical play and social engagement. An experience described below will illustrate how one or more creators can program and play games inspired by the whack-a-mole arcade genre to get them moving around a room - while coding and collaborating at the same time.

Innovators and researchers in the blocks-based programming space are discussing key components of what we are integrating at Unruly Studios. For example, Mikala Streeter introduced a position paper at the inaugural Blocks and Beyond Workshop to encourage blocks-based language creators to think critically about non-coding components of early experiences that contribute to positive learning outcomes, such as collaboration [4]. Work in progress on the Scratch Nodes project [5] show that other researchers are looking to explore active STEM play. In the Scratch Nodes project, handhelds are the focus, as opposed to wearables, or objects placed in the environment, such as our Splats.

## II. THE UNRULY SPLATS PLATFORM

We have built prototypes of a system called Unruly Splats to facilitate kids moving themselves around as a result of coding (whereas there are multiple platforms that do the opposite: focus on kids coding to make objects move around). We designed the system with playground interactions in mind, such as: hopscotch, dance routines, obstacle courses, relay races, and the like. These are a few examples that we leverage to take advantage of a set of social rules around each game or experience that young people have. Many children readily modify the rules of these games when playing on the playground. We’re looking to support rewriting the rules in a programming environment as well.

The current Splat prototypes, shown in Fig. 1, are each 23cm in length and width and stand 2cm in height off of the ground. It is a blue enclosure that features an internal pushbutton sensor, to detect hand or foot presses of a child or adult weighing up to 115kg. A central translucent splat shaped cover shows the lights of any or all of the array of 14 RGB LEDs underneath it. Each Splat connects to a tablet (or PC) via a USB cable for power and communication (as a placeholder for a forthcoming internal 3-AA battery slot and bluetooth low-energy modules). The tablet plays the audio files and recorded sounds in the program (as a placeholder for built-in speakers in forthcoming Splat prototypes).



Fig. 1. A set of Unruly Splats and a tablet running a blocks-based app

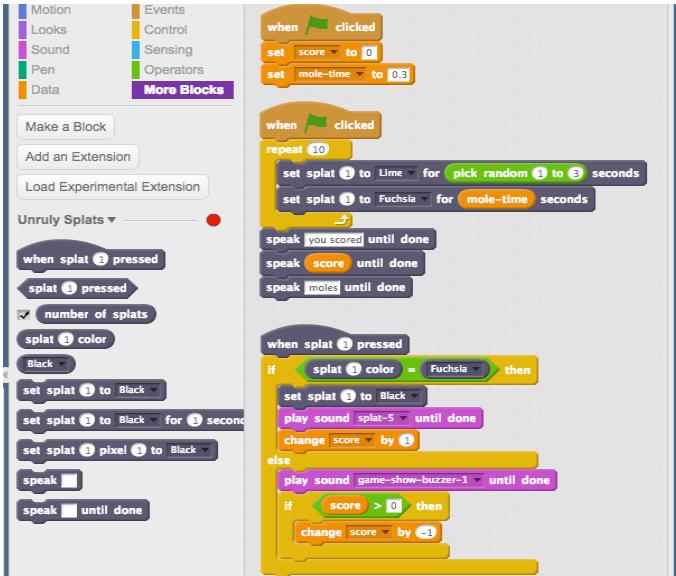


Fig. 2. Unruly Splats Scratch Extension Blocks Whack-A-Mole example

Each Splat connected to a tablet or PC via USB or bluetooth responds to blocks-based programs authored in the Scratch Extension for Unruly Splats environment (see Fig. 2) or our alpha-level Blockly app (see Fig. 1). Users see a pre-loaded game, such as whack-a-mole, explained in the next section, then think of ways to change its rules or come up with an entirely new experience to make (based on popular playground games or invented ones). The blocks featured in Fig. 2 are placeholders used for playtesting with kids. We learn from each experience and then adjust the block vocabulary accordingly. We expose new concepts, such as loops carefully so that novices can experience them by repeating N times or forever. We support repeating over the content of a list, but that looping mechanism is placed with blocks a submenu labeled “lists” for when a user is ready to explore those features.

### III. AN EXAMPLE: WHACK-A-MOLE

For many who have enjoyed a trip to an arcade or fun center, the simple rules for the whack-a-mole genre of games are committed to memory. The rules governing games in this genre are typically: a game starts with one or more “enemies” popping out of a hole for a matter of seconds (usually one mole per hole), then a player “whacks” or hits the enemy with a hand, mallet, or similar object, the game awards points for successful hits, time runs out and it is time to play again or give someone else a turn. Fig. 3 shows a whack-a-mole variant.



Fig 3. A Whack-a-Mole variant in an arcade



Fig. 4. Whack -A-Mole player jumping on a Splat

Fig. 4 shows a young player jumping on a Splat that is running the blocks script in Figure 2. Lime green lights on the Splat represent grass. When a Splat turns fuchsia for a few seconds, the player must jump on the color before it goes away to score. The time between fuchsia “moles” is determined randomly, according to the parameters set in the program. The player in Fig. 4 is playing both Splats at once. He and the player waiting behind him for a turn could modify the program to quickly remix the experience to a number of variations that would be fun for them. For example, they could make separate scores for each Splat, make moles of different colors, change the sound made upon a hit, and much more. The “pick random number” block can be used to adjust timing, colors, or the number of points awarded per hit to make the play dynamic for each player. Randomizing helps early games stay surprising, unpredictable and fun, as learners begin developing more ability to program each Splat to behave differently (without random).

We use the whack-a-mole example, and others like it, to get feedback at workshops and maker faires. Young users give us ideas for new types of interactions that they would like our platform to support, such as dodgeball and air hockey-inspired experiences. We do not expect to come up with all of the games that young people will imagine, that is up to them once we release refined Unruly Splats as a product.

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