Splatoon 2 Abilities

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Abstract — **This report provides an overview of abilities and their mathematical background in Splatoon 2.**

I. INTRODUCTION

One of the most important aspects in Splatoon 2 is Gear and their corresponding abilities. Planing ahead and using abilities that are beneficial for yourself is important as they might give you the edge you need to win a match. In this report an overview about abilities in Splatoon 2 and the way they are calculated is given

II. MAIN PART

Abilities are one of the most important parts in the game. They are split in two categories: main and sub abilities. Every piece of gear has one main ability and can have up to three sub abilities. The main ability on a piece of gear is fixed, while sub abilities can be changed at any time. But what exactly are they?

A. Abilities

Abilities are used to handle stats like the speed while running, swimming, how fast you recover your ink, and so on. Most abilities can appear as main and as sub ability in game, but some are limited as main ability only. A list of abilities can be seen in Table I.

B. Abilities and Gear

Abilities are tied to your gear. Every piece of gear can initially have one, two, or three slots that can hold abilities. These slots need to be leveled to unlock the corresponding ability hidden on the slot. To level them online matches must be played. After a match the amount of experience is displayed and added to the equipped gear. The amount of experience needed to unlock a slot depends on the amount of initial sealed abilities, which is called rarity. This is also represented by the amount of stars the gear has. Table III shows how many experience points are needed to level one slot. To unlock more hidden slots Super Sea Snails[1] need to be used. The ability that is unlocked is predetermined when adding the gear to your inventory. The brand of the gear is used to decide affinities, see Table II for more info. These slots can be rerolled, scrubbed, filled with chunks or manipulated with drinks.

1) Rerolling: Gear can be rerolled by talking to Murch and offering him one Super Sea Snail. Rerolling will convert the current slots to chunks and add them to your inventory. Further, three new slots will be randomly generated.

[1]cf. https://splatoonwiki.org/wiki/Super_Sea_Snail

Fig. 1. Example loadout.

2) Scrubbing: Scrubbing is another way to remove the current abilities from the gear. It converts all unlocked abilities to chunks and then randomly generates these slots a new. Scrubbing costs 30.000 for normal gear and only 2.000 for the Splatfest-Tee.

3) Chunks: The previously mentioned methods to replace abilities are purely random. Chunks can be collected and be used to replace specific slots with specific abilities. To add a specific ability the first time on a piece of gear, 10 chunks with the corresponding ability are needed. To add the ability a second time to a piece of gear, 20 are needed and 30 for the third time. Chunks can be used on unlocked and locked slots.

4) Drinks: Drinks are able to change the predetermined ability after a level up. While a drink is active there is a 30% probability that the ability is the same as the drinks ability and a 70% chance that the ability is different. The brand of the gear is ignored for this process.

C. Effect of Abilities

The most asked question when working with abilities is if your current loadout is beneficial. To answer this one needs to calculate the exact effect. There are three steps to calculate the result. We will do this along the loadout in Figure 1.:

1) **Point Calculation**: Each main ability contributes 10 AP (Ability Points) to the ability effect. Each sub abilitiy contributes 3 AP. It does not matter if the abilities are spread in your loadout or all relevant slots are on one piece of gear, they are all treated the same. This leads to a minimum amount of 0 AP and a maximum amount of 57 AP for a single ability. In our example we have 19 AP of Quick Respawn, 10 AP of Swim Speed Up, 9 AP of Ink Recovery Up, and 19 AP of Ink Saver Main.

2) **Calculate Value**: In this step the ability effect will be calculated. Every effect that is calculated here has a minimum effect, maximum effect and mid effect. First, we need to calculate p, the percentage value:

Icon	Name	Description
	Stackable Abilities	
	Quick Respawn	Reduces respawn time after getting splatted repeatedly without splatting any opponents.
	Quick Super Jump	Increases Super Jump speed.
	Ink Recovery Up	Increases ink-tank refill rate.
	Special Power Up	Improves the effectiveness of your special weapon.
	Sub Power Up	Increases sub-weapon proficiency.
	Ink Saver (Sub)	Decreases amount of ink consumed by your sub weapon.
	Swim Speed Up	Increases movement speed in squid form.
	Special Saver	Reduces special-gauge decrease after getting splatted.
	Run Speed Up	Increases movement speed in Inkling form.
	Bomb Defense Up	Reduces damage taken by blasts from sub weapons or special weapons.
	Special Charge Up	Increases special-gauge fill rate.
	Ink Saver (Main)	Decreases amount of ink consumed by your main weapon.
	Cold-Blooded	Decreases effectiveness of opponent Point Sensors and other items that reveal location.
	Ink Resistance Up	Reduces damage taken and improves mobility when walking through enemy ink.
	Headgear-Only Abilities	
	Opening Gambit	Boosts your speed while moving for the first 30 seconds of battle.
	Last-Ditch Effort	Boosts ink recovery rate and weapon ink efficiency for the last 30 seconds of battle.
	Tenacity	Fills special gauge automatically if your team has fewer active players than the enemy.
	Comeback	Boosts some of your abilities for a short time after respawning.
	Clothes-Only Abilities	
	Ability Doubler	Doubles the effect of other gear abilities attached to this gear.
	Respawn Punisher	Increases respawn time and special-gauge spawn penalty for you and any player you splat.
	Ninja Squid	Leaves no trace when swimming in inked ground, but slightly reduces swim speed.
	Haunt	Once you've respawned, reveals the position of the player who splatted you.
	Thermal Ink	Allows you to track distant players hit with shots from your main weapon.
	Shoes-Only Abilities	
	Stealth Jump	Hides your Super Jump landing point from distant players.
	Object Shredder	Increases damage dealt to all non-player targets.
	Drop Roller	Tilting the L Stick during a Super Jump allows you to perform a roll in that direction when landing.

TABLE I

LIST OF ALL ABILITIES IN SPLATOON 2.

Brand	Favored	Unfavored
SquidForce		
Zink		
Krak-On		
Rockenberg		
Zekko		
Forge		
Firefin		
Skalop		
Splash Mob		
Inkline		
Tentatek		
Takoroka		
Annaki		
Enperry		
Toni Kensa		
Grizzco	Neutral	
Cuttlegear	Neutral	
amiibo	Neutral	

TABLE II

BRAND AFFINITY TABLE. FAVORED ABILITIES APPEAR WITH A PROBABILITY OF $\frac{10}{35}$, WHILE UNFAVORED APPEAR WITH A PROBABILITY OF $\frac{1}{35}$. EVERY OTHER ABILITY APPEARS WITH A PROBABILITY OF $\frac{2}{35}$ FOR GEAR WITH FAVORED/UNFAVORED ABILITIES, AND $\frac{1}{14}$ FOR NEUTRAL GEAR.

$$p = \min(3.3AP - 0.027AP^2, 100)$$

p describes how much of the effect is applied. A graph showing the ability curve is provided in figure 2. The end result is calculated with

$$res = \min + (\max - \min) \cdot lerpN\left(\frac{p}{100}, s\right)$$

where $s = \frac{mid - min}{max - min}$ and $lerpn$ is an interpolation function, defined as

$$lerpN(p, s) = \begin{cases} p & s = 0.5 \\ p & p = 0.0 \\ p & p = 1.0 \\ e^{\left(-\frac{\ln(p)\ln(s)}{\ln(2)}\right)} & s \neq 0.5 \end{cases}$$

Level	Experience
One Star	
1	2000
2	6000
3	10000
Two Star	
1	3000
2	7000
3	11000
Three Star	
1	4000
2	8000
3	12000
Splatfest-Tee	
1	7500
2	7500
3	7500

TABLE III

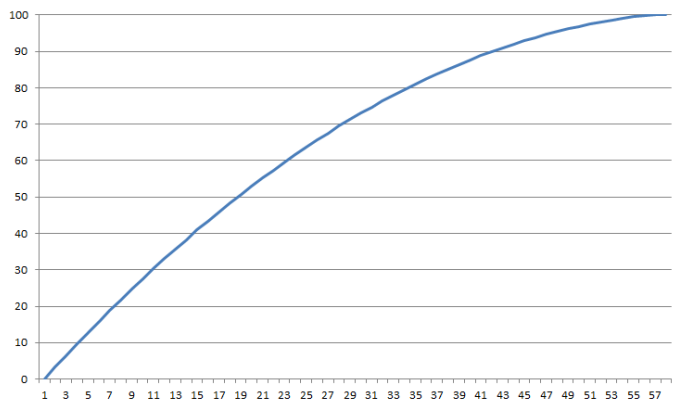LIST OF EXPERIENCE POINT NEEDED TO UNLOCK NEW SLOTS ON GEAR.

Fig. 2. Percentage curve $p(AP) = \min(3.3AP - 0.027AP^2, 100)$.

D. Examples

We will cacluate a few examples to make things clear. In the appendix document[2] we can see tables with the current low, mid, and high values for each ability. For these examples we will use Swim Speed Up and Special Saver.

1) Example: 1 Swim Speed Up: We will use the medium class here. so $min = 1.92, mid = 2.16, max = 2.4$.

2) Example 1.1: 1 Main 1 Sub: For 1 Main and 1 Sub we have $10 \cdot 1 + 3 \cdot 1 = 13AP$. We insert this into our formula for p and get $p = \min(3.3AP - 0.027AP^2, 100) = \min(3.3 \cdot 13 - 0.027 \cdot 13^2, 100) = \min(38.337, 100) = 38.337$. Next, we cacluate s. For this we need the three earlier mentioned values and we get $s = \frac{mid - min}{max - min} = \frac{2.16 - 1.92}{2.4 - 1.92} = 0.5$. And last, but not least, we calculate res with $res = \min + (\max - \min) \cdot lerpN\left(\frac{p}{100}, s\right) = 1.92 + (2.4 - 1.92) \cdot lerpN(0.38337, 0.5) = 1.92 + 0.48 \cdot 0.38337 = 2.1040176$. This means that with 1 Main and 1 Sub we travel 2.104 distance units/frame.

[2] https://leanny.github.io/paper/abilities_appendix.pdf

3) Example 1.2: 3 Main 9 Sub: For 1 Main and 1 Sub we have $10 \cdot 3 + 3 \cdot 9 = 57AP$. We insert this into our formula for p and get $p = \min(3.3AP - 0.027AP^2, 100) = \min(3.3 \cdot 57 - 0.027 \cdot 57^2, 100) = \min(100.377, 100) = 100.0$. Next, we calcuate s. For this we need the three earlier mentioned values and we get $s = \frac{mid-min}{max-min} = \frac{2.16-1.92}{2.4-1.92} = 0.5$. And last, but not least, we calculate res with $res = min + (max - min) \cdot lerpN \left(\frac{p}{100}, s\right) = 1.92 + (2.16 - 1.92) \cdot lerpN(1.0, 0.5) = 1.92 + 0.48 \cdot 1.0 = 2.4$. This means that with 1 Main and 1 Sub we travel 2.012 distance units/frame.

4) Example 2: Special Saver: For Special Saver we have $min = 0.5, mid = 0.8, max = 1.0$.

5) Example 2.1: 1 Main 0 Sub: For 1 Main only we have $10 \cdot 1 + 3 \cdot 0 = 10AP$. We insert this into our formula for p and get $p = \min(3.3AP - 0.027AP^2, 100) = \min(3.3 \cdot 10 - 0.027 \cdot 10^2, 100) = \min(30.3, 100) = 30.3$. Next, we calcuate s. For this we need the three earlier mentioned values and we get $s = \frac{mid-min}{max-min} = \frac{0.8-0.5}{1.0-0.5} = 0.6$. This time we have $s \neq 0$, so we need to calculate $lerpN \left(\frac{p}{100}, s\right)$ in more detail. For $s > 0.5$ the result is $lerpN(0.303, 0.6) = e^{\left(- \frac{\ln(0.303) \ln(0.6)}{\ln(2)}\right)} = 0.4148....$ And last, but not least, we calculate res with $res = min + (max - min) \cdot lerpN \left(\frac{p}{100}, s\right) = 0.5 + (1.0 - 0.5) \cdot lerpN(0.303, 0.6) = 0.5 + 0.5 \cdot 0.4148 = 0.707$. This means that with 1 Main you keep 70.7% of your special bar after dying.

E. Usefulness

Now the question remains about how useful it is to stack more abilities. By looking at the derivation p' of p this question can be answered rather easy:

$$p'(AP) = 3.3 - 0.054AP$$

It is obvious that the more is stacked the less the effect is. As long as $p'(AP) \geq 2$ holds the effect can be seen quite well. This is true as long as $AP \leq 24$.

3) **Apply Post-Calculation Effects**: This step is only applied for Respawn Punisher and Ninja Squid. Respawn Punisher reduced the AP of the opponents Quick Respawn to 15%. Additionally 45 frames are added to the opponents time, while 68 frames are added to your time. Further, Respawn Punisher multiplies the AP for Special Saver by 0.7 and then removes 15% of the end result for the opponent and 22.5% of your own. This means that when $20AP$ are used, only $3AP$ are used for the calculation. Ninja Squid works a bit different: First, after calculating p, p gets multiplied with 0.8. Then, after calculating the effect, this value is multiplied by 0.9.

FURTHER DATA

An implementation can be found on github (https://github.com/Leanny/Splatoon2Parameter) and data mined parameter can be found there as well (https://github.com/Leanny/Splatoon2Parameter/blob/master/parameter.json).