

# The use of power ups in arcade games

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## Abstract:

This paper covers the definition of the power-up and its integrations into the genre modifier described as arcade, it attempts to break down the usefulness of power-ups inside this game type and how they influence player decisions.

## Introduction:

The purpose of this paper is to assess the definition of a *power-up*, their use within an *arcade* game and how players prioritise them. In the context of this review *arcade* refers to the arcade genre as opposed to the coin operated arcade model.

## Research:

In order to investigate the involvement of the power-up in the arcade genre the two must first be defined. To begin with the power-up, the power-up in technical terms is a child object of a game's *pick-up class*, Staffan Bjork describes the pick-up as "Game items that exist in game worlds and can be collected, usually by moving avatars or units so that they are in contact with the game items." (Bjork), further extending the definition of the power-up to "A special type of Pick-Up is a Power-Up, which gives players a time-limited advantage often consisting of increased efficiency at an action or by providing a Privileged Ability." (Bjork). This defines the power-up as a temporary increase in the player character's usual abilities.

Filip Lange-Nielsen takes the idea of what a power-up can be and divides it into 4 distinct types with distinct effects on the player character and how they interact with the game mode. He collates his findings into table 1

<b>Type:</b>	<b>Expendable, stored</b> as inventory. Triggered by choice after acquisition.	<b>Expendable, instant</b> power-up (might resurface). Triggered on touch.	<b>Constant</b> (The "upgrade")	<b>Re-chargeable</b> (like constant, but needs other (inventory type) items to be refilled).
<b>Example:</b>	Potions (restores health) or Speed Drink (casts Haste) in <i>Final Fantasy VII</i> (Square, 1997)	Star Power in <i>Super Mario Bros.</i>	Space Jump Boots in <i>Metroid Prime</i>	Missile Launcher in <i>Metroid Prime</i> .
<b>Modifiers:</b>	<p>"<i>Acquired through</i>": E.g.: Charge, purchase, level up, pick-up (visible or secret) vs. automatic (dominant system). In the latter case, see "<i>Necessity</i>".</p> <p>"<i>Supply</i>": limited in numbers, or limited to time frames, vs. resurfacing at intervals. Applies to all but the "constant" (with exceptions in special cases, like in <i>Metroid Prime</i> where constant upgrades are removed once, to later be won back).</p> <p>"<i>Duration</i>": lasts a set or variable amount of time.</p> <p>"<i>Necessity</i>": necessary for completion, vs. optional, or permanently changing from necessary to optional at some point.</p>			

**Table 1:** A model for analyzing power-ups

fig 1

This improves upon Bjork's binary distinction between the pick-up and the time based power-up allowing for a model that includes any augmentation to the player (time limited or otherwise) to be included under the umbrella definition of the power-up, provided that the augmentation was acquired in game and not through tertiary means, such as a shop or level up system, the power up must be acquired as opposed to being learned or purchased.

The arcade game itself is more elusive and hard to define, the aforementioned distinction between

arcade as a genre and a format seems to be somewhat contested, Jeremiah Freyholtz of mobygames defines the arcade genre "Arcade : Denotes an arcade or "arcade-like" game, whose gameplay mimics or was inspired by a traditional coin-op arcade game. Arcade games usually have very little puzzle-solving, complex thinking, or strategy skills needed; the focus is on reflexes and "twitch". The Arcade genre is usually used as an additional modifier to Action games." (Freyholtz), Key to not here is the use of the term "arcade-like" to introduce the genre shows that it is being viewed as an adjective to a more established and defined given genre or as Freyholtz refers to it as a "modifier". In their paper Multi-Faceted Evolution Of Simple Arcade Games Michael Cook and Simon Colton create a framework for the generation of complete arcade games, however the definition of an what an arcade game actually is never formally gets stated, when discussing map-generation the phrase "range of arcade-style archetype maps"( Cook, Colton) further attributing the idea of arcade as Freyholtz's modifier.

To properly assess the interaction and use of the power-up in any arcade game (which will now be being used as a generic catch all term for a game that has an arcade modifier attached to its other genre/s) we must examine the context of the power-up, in his case study of *Metroid Prime* Lange-Nielsen describes power ups as "enablers of reaching goals" jump boots allowing you to clear a ledge etc. or as a goal in itself, however this adds a depth of strategy that is not accepted by our definition of the arcade modifier "very little puzzle-solving, complex thinking, or strategy skills needed" the need to complete a level in *Metroid* with its platforming gameplay, enemies and the sometimes complex interaction between the two takes it out of our arcade design space. A better contextual example would be that of the Mario Star power, simply giving the player a brief moment of invulnerability does not equate to the same strategic depth of giving the player a double jump or an otherwise new way to interact with the game space.

Power-ups can function to break the players flow of play or at least vary it enough to break up more monotonous or repetitious parts of a game experience. Bjork tells us that "Power-Ups give players Ephemeral Goals of Collecting when they appear;" due to the apparent importance of the power-up to the player, they will divert their attention away from the main game objective in order to collect the power up and gain whatever advantage it is that it affords them. Classic *bullet hell* games such as *Ikaruga* and *Metal Slug*, will break up the waves of enemies with a strategically placed power-up, the player will have to make a different set of choices when approaching the next wave, do they relinquish whatever positional advantage or combo they have built up in order to attain the power-up and effectively try and make the next wave easier for themselves.

These power ups also typically use Bjork's time limited definitions and can be used to force the player to think more about how they will deal with a situation they have created whilst the power-up was active as Bjork states "Since the effect has a Time Limit, picking up a Power-Up can actually increase Tension if the usefulness of the Power-Up depends on the success of other goals" when the player feels under pressure to make use of a power-up they may use it inefficiently, through repeated play the player can assess how useful a power-up will be in their current situation and whether or not it is a effective use of their time to divert from the main game objective to go and collect it.

The supporting project will attempt to prove the hypothesis that in an arcade shooter environment with twitch reaction focuses, the player will prioritise power-ups that allow for higher survivability, as opposed to those that provide combat stats. Thus allowing them to more effectively complete the ultimate objective as opposed to making the moment by moment defeating of enemies easier. This supports the idea of power-ups in arcade games being a means to end as opposed to an objective in themselves.

## Method

For ease of testing the expendable instant model of power-ups has been implemented. The upgrades afforded by the rate of fire power-up full fill progression for the player whereas the survivability simply helps them achieve the ultimate goal of the game.

To support the above hypothesis the level of power afforded by each item has been balanced in first in favour of the survivability health power-up and then the offensive rate of fire power-up, the speed power-up will remain the same in order to provide a control. Play tests are carried out with each enemy killed guaranteed to spawn a power-up. Players will then be observed and the amount of each power-up collected will be recorded and compared, the values will then be changed to see if a player can be convinced to change which type of power-up they gravitate towards.

The pass fail criteria for this testing will be if during the majority of play throughs, including those with balance skewed towards the offensive power-up, the player continues to prioritise the survivability pickup.

## Testing:

Below are the in game print strings for the five playthrough tests with balance as even as could be designed



Fig 2

Initial tests show a large majority in the gravitation toward the survivability pick up as opposed to the neutral or offensive.

The second battery of test were conducted with the rate of fire afforded by the offensive power-up being increased from a five times increase to a seven times increase in rate.



Fig 3

After the initial increase in fire rate there has been no change in the preference, excluding the outlier of zero pickups which is believed to be caused by player bias during testing.

The third and final battery of tests the fire rate increase was ten times the original rate of fire for the weapon.



Fig 4

As is apparent from this data set the rate of fire needs to be increased to a completely unbalanced amount before the player has any reason to prioritise it over the survivability pick up.

## Evaluation:

The above testing has shown that a player will prioritise the need to complete the games main objective over the ability to increase their capability to defeat enemies. Only when the values for the fire rate pickup were increased to a point where the player could instantly destroy all enemies on screen was it a viable alternative, and at that point the player is using it effectively as both an offensive and survivability power-up, mitigating any incoming damage with a best offense is a good defence play style. The above statements of power-ups as ephemeral goals is shown to be subjective here, the abundance of all power-ups was the same throughout all the testing and the player was not informed of the balance changes to them however once they had encountered a particular power-up that they didn't value highly, in this case the speed power-up throughout and the health power-up in the final battery of tests, they are ignored almost entirely thereafter. Despite giving the player a noticeable advantage in game, the ability to continue playing at the normal rate was prioritised over the possible risks presented by picking up any other power-up.

## Conclusion:

The hypothesis that in an arcade shooter environment that with twitch reaction focuses, the player will prioritise power-ups that allow for higher survivability, has been supported by all of the evidence provided by the project testing outlined above. However the variables and controls employed in this testing were very limited. The entire ecosystem in which the power-up is employed must be quantified and controlled in order to assess it's nature as a means to an end or as an ephemeral objective. The collection and use system for example has not been modified at all during these tests, the player may be more inclined to go for offensive power-ups if they do not need to choose when to use them.

The enemies and the amount of those enemies was not altered or recorded during these tests, the players ability to reach the final objective may be heavily influenced by their ability to kill enemies quickly if the amount of enemies was vastly increased or if the amount of damage each enemy could take before they die and drop the next power-up was also increased. Future testing would need to account for both of these metrics.

The reward system will also play a large role in which objectives the player prioritises, in this example the player is awarded a set amount of points for killing an enemy. Presenting the player with some sort of multiplier or incentive for avoiding damage, losing score when being hit, would definitely have an impact on the players choice of power-up, the generally overlooked speed power-up could be made extremely useful if the player was incentivised to mitigate or otherwise avoid incoming damage. Overall this paper has shown that the topic of power-ups is effected so highly by the context and mechanics of the game environment in which they are placed, that one must first wither create a complete control project where all aspects are finely controlled with a single objective, before any aspect of their importance can be tested and quantified.

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