Marrow's Compendium of Dragonslaying

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Chapter 1

Preamble

This is a guide on how to play a Fury Warrior in World of Warcraft Classic. It is a work in progress and a living document. All of the information contained within reflects what is best understood as of *today*, and some of is subject to change as more about the game is discovered.

More importantly, this is a guide for players who want to push the envelope of their class, and be the best they can be. That is not the playstyle of every player, nor am I advocating it should be. Ultimately, you should pick your race and spec so that they're both what you *enjoy* the most. To some people that is exactly what they'll find in this guide: doing all you can do to maximize your DPS and compete with your friends, or to clear the content as fast and efficiently as possible. To some other people, it might mean playing a Night Elf and raiding as Arms - and that's completely fine. Ultimately, both groups of players will find a guild and a community that fits them and enjoy this amazing game we love so much together.

Chapter 2

Introduction

2.1 What is the aim of this guide?

This guide aims to help the reader from the ground up: from the foundational mechanics of World of Warcraft (WoW) combat, to an in-depth overview of warrior abilities and their utilization, to cooldown management, raid consumables, and finally how to analyze parses and learn from your own mistakes.

2.2 What is NOT the aim of this guide

DPS simulations will not be covered. There are several reasons for this, but the most important being that there are incredible, well maintained resources currently available for that exact purpose. Notable mentions include Steppenwolf's Classic Warrior Spreadsheet (Steppenwolf, 2019) and Aurana's Classic Warrior Fury DPS Simulator (Aurana, 2019).

In the same vein, questions on how to (specifically) gear will not be covered in this guide. This is because gearing is *highly* contextual - answering questions such as "What is better, Black Dragonscale 3set or Devilsaur Set with Truestrike Shoulders?" is impossible without knowing the rest of your gear and race. Therefore, when this guide makes recommendations, please be aware that exceptions *do exist*, but are rare. By the end, I hope the reader is knowledgeable enough about the base mechanics to critically assess and reason any gearing questions that he or she may have.

Chapter 3

Mechanics

3.1 Introduction

Combat mechanics are at the core of the warrior class, and deeply impact our talent and gearing choices and combat rotation. Therefore, it is important to build a solid foundational understanding of these mechanics in order to make the correct decisions and *understand* the theory behind our choices moving forward.

There are two types of melee attacks: white (auto attacks) and yellow (special attacks). Yellow attacks function exactly like white attacks, except they *cannot* glance. Each white attack made by players against enemy mobs will result in one of the following:

- Miss
- Dodge
- Parry
- Glancing blow
- Block
- Critical Strike
- Hit

A mob being attacked from behind *cannot* block or parry, and thus these two outcomes are removed from the roll table. This means our white attacks can only either miss, be dodged, glance, hit, or critically hit. Therefore, in order to maximize our damage we need to minimize $P(Miss)$, $P(Dodge)$ and $P(Glance)$, and maximize $P(Crit)$. In the subsequent sections, we will take a deeper look into how we can achieve that.

3.2 Miss Chance, Glancing Blows, and Weapon Skill

3.2.1 Miss Chance

Blizzard has confirmed that players have an 8% chance to miss a creature that is 3 levels above them (Blizzard, 2019a). Empirical work from magey and others (magey et al., 2019) further corroborates a formula originally proposed by Beaza during vanilla (Beaza, 2006), which can be summarized as:

If the target is mob and the difference between it's defense rating and the attacker's weapon skill is 11 or more:

$$P\left(Miss\right) \;=\; 0.05 \;+\; ((T_{lvl} \times 5) - Atk_{skill}) \times 0.2 \tag{3.1}$$

If the target is mob and the difference between it's defense rating and the attacker's weapon skill is 10 or less:

Table 3.1: Glancing blow probability and damage penalty per level difference.

Level Difference	Probability	Damage Penalty
0	0.1	0.05
1	0.2	0.05
2	0.3	0.15
3	0.4	0.35

$$P\left(Miss\right) \;=\; 0.05 \;+\; \left(\left(T_{lvl} \times 5\right) - Atk_{skill}\right) \times 0.1 \tag{3.2}$$

Where T_{lvl} is the target's level, and Atk_{skill} is the attacker's weapon skill rating. While simple, this formula carries immense significance - it means that that by having 305 weapon skill, a player only has a 6% chance to miss an enemy mob 3 levels higher, which includes raid bosses. Conversely, a player with only 300 weapon skill will have an 8% chance to miss. This is a huge difference, especially in conjunction with the other benefits that weapon skill brings. It is important to note, however, that this is the behavior exhibited by wielding one one-handed weapon. If dual wielding, probability of missing an attack is calculated as:

$$P\left(DW_{miss}\right) \;=\; \left(P\left(Miss\right) \;\times\; 0.8\right) \;+\; 0.2 \tag{3.3}$$

As a disclaimer, magey notes that further testing is still required to assert the correctness of this formula.

3.2.2 Glancing Blows

Glancing blows are a type of attack that can only occur when fighting an enemy of equal or higher value, and are restricted to white attacks. In accordance with Beaza, magey et al. have determined the glancing blow probability to be as follows:

$$P\left(Glancing\right) \;=\; 0.1 \;+\; \left(T_{lvl} \times 5 \;-\; \min\left(Atk_{lvl} \times 5,\; Atk_{skill}\right)\right) \times 0.2 \tag{3.4}$$

Where Atk_{lvl} is the player's level, and Atk_{skill} is the player's weapon skill value. Knowing that, we can compute the probability that our white attacks will glance, and the damage penalty that that glancing blow carries against enemies of different levels:

This means that against a level 63 enemy mob (all raid bosses) and with 300 weapon skill our white attacks have a 40% chance of being glancing blows, therefore only being capable of dealing 65% of their maximum damage. Needless to say this is an immense DPS loss and should be mitigated as much as possible, and the *only* way that can be done is through increasing the player's weapon skill.

3.2.3 Weapon Skill

magey's work again corroborate the impact of weapon skill on glancing blow probability, damage, and miss probability according to Beaza's formulas ((3.4), (3.1) and (3.2)). The table below summarizes that impact, but it is important to note that not all values have been experimentally confirmed due to the difficulty in acquiring specific weapon skill values that inherently comes from WoW itemization.

As we can see, weapon skill not only reduces the glancing blow damage penalty, it also reduces the hit cap and the $P(Miss)$.

The glancing blow damage penalty reduction is more easily shown graphically:

As we can see, our glancing blows increase in damage linearly with weapon skill until 307 weapon skill. This is incredibly important, as it indicates 308 weapon skill to being the soft cap for glancing blow damage

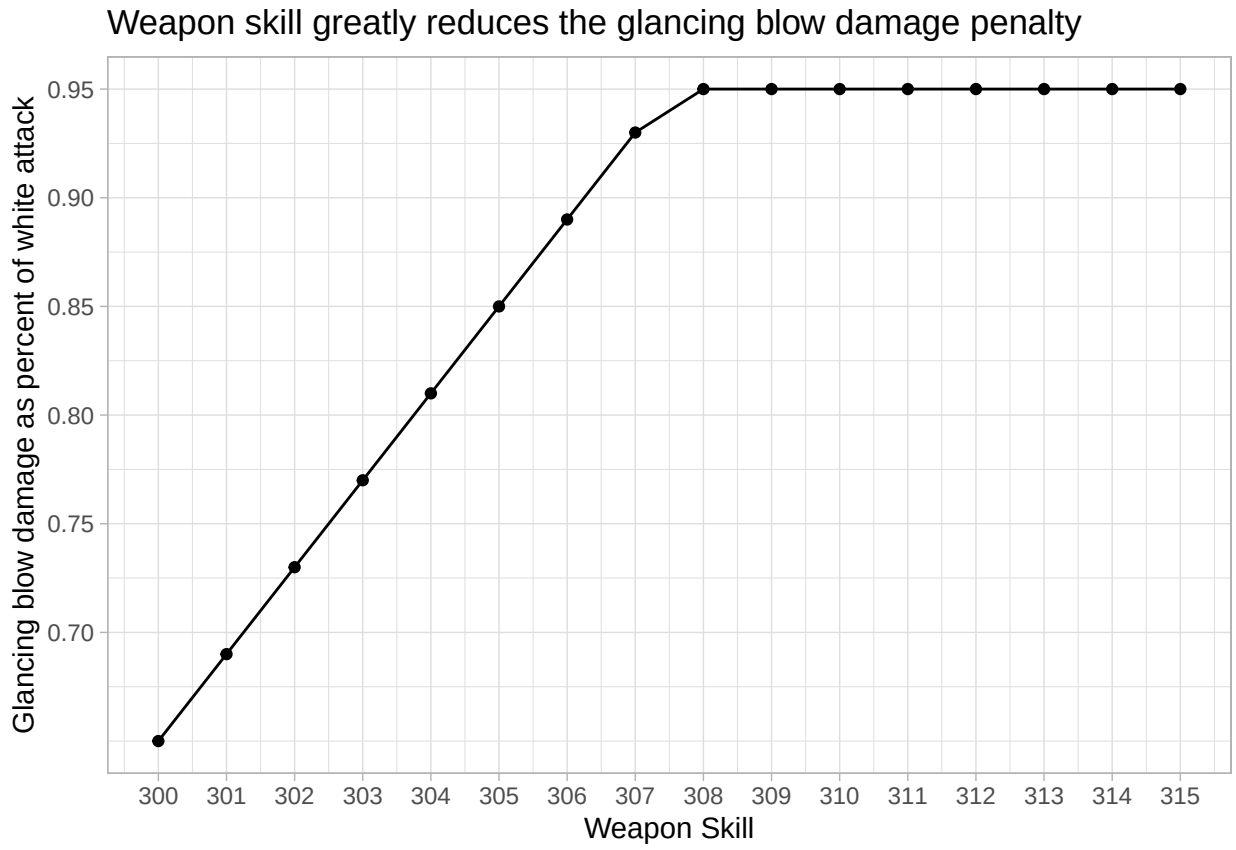

Figure 3.1: Weapon skill greatly reduces the glancing blow damage penalty

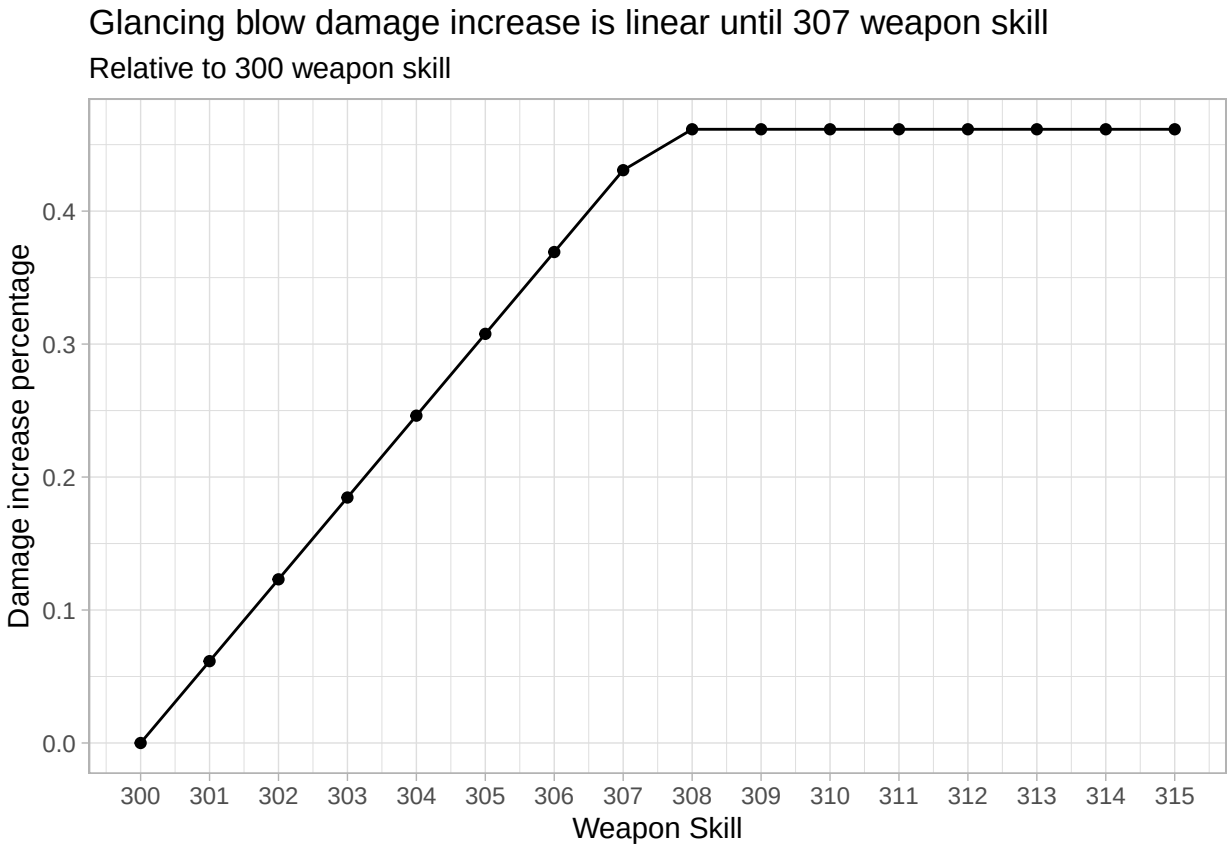

Figure 3.2: Weapon skill increases damage on glancing, relative to 300 weapon skill.

Table 3.2: Weapon skill impact on glancing blow damage reduction, miss chance, and hit cap. Damage increase is relative to 300 weapon skill.

Weapon Skill	Percent of White Attack	Glancing Blow Damage Increase	Miss Probability	Hit Cap
300	0.65	0.0000000	0.080	0.090
301	0.69	0.0615385	0.078	0.088
302	0.73	0.1230769	0.076	0.086
303	0.77	0.1846154	0.074	0.084
304	0.81	0.2461538	0.072	0.082
305	0.85	0.3076923	0.060	0.060
306	0.89	0.3692308	0.059	0.059
307	0.93	0.4307692	0.058	0.058
308	0.95	0.4615385	0.057	0.057
309	0.95	0.4615385	0.056	0.056
310	0.95	0.4615385	0.055	0.055
311	0.95	0.4615385	0.054	0.054
312	0.95	0.4615385	0.053	0.053
313	0.95	0.4615385	0.052	0.052
314	0.95	0.4615385	0.051	0.051
315	0.95	0.4615385	0.050	0.050

penalty reduction - meaning the player gains no benefits in this aspect if their weapon skill is higher than 307 when facing a raid boss.

Similarly, the impact of weapon skill on the $P(Miss)$ and hit cap is clearer when shown graphically:

As we can see, the player's hit cap starts 1% higher than $P(Miss)$ at 300 weapon skill. This is because vanilla WoW code explicitly suppresses the **first 1%** of +hit gained from talents or gear against enemy mobs with more than 10 defense skill above the player's weapon skill (Blizzard, 2019b), in accordance with (3.1). This hit suppression is **not** applied, however, if the difference between the attacker's weapon skill and the enemy mob's defense skill is less than 10 (3.2). Not that values past 305 weapon skill suffer from steep diminishing returns, where an increase of 10 points past that only translates to a hit cap decrease of 1%.

This is why weapon skill is so important: not only does it reduce the glancing blow damage penalty, it removes the inherit 1% hit suppresion, and significantly reduces $P(Miss)$ until 305. This is also why a weapon skill of at least 305 and at most 308 is **highly** recommended. The first 5 points are crucial to overcome the 1% hit deficit, and the 8 points enables us to reach the maximum glancing blow damage. This is a complicated threshold to reach, however, as there are very few items in World of Warcraft that add small amounts of Weapon Skill that would enable you to get to 308. Furthermore, the fact that weapon skill's value in respect to hit chance is *vastly* diminished after 305 clearly indicates that 305 weapon skill is the **most** optimal weapon skill value for Fury Warriors in Classic WoW.

This is why any weapon skill bonus of over 5, whether given by a racial (orcs with axes, humans with maces and swords) or an item is so good - it means that single piece of gear is enough to overcome the hit suppresion versus raid bosses, as well as reducing your $P(Miss)$ by 2%, and glancing blow damage penalty reduction. This is an incredible advantage, especially compared to the alternative which is gearing for weapon skill through items such as Edgemaster's Handguards, since the player with the built in weapon skill essentially has one extra item slot over a non-human, non-orc player. This is also why items that give good stats *in addition* to weapon skill, such as Aged Core Leather Gloves (ACLG), are incredibly good.

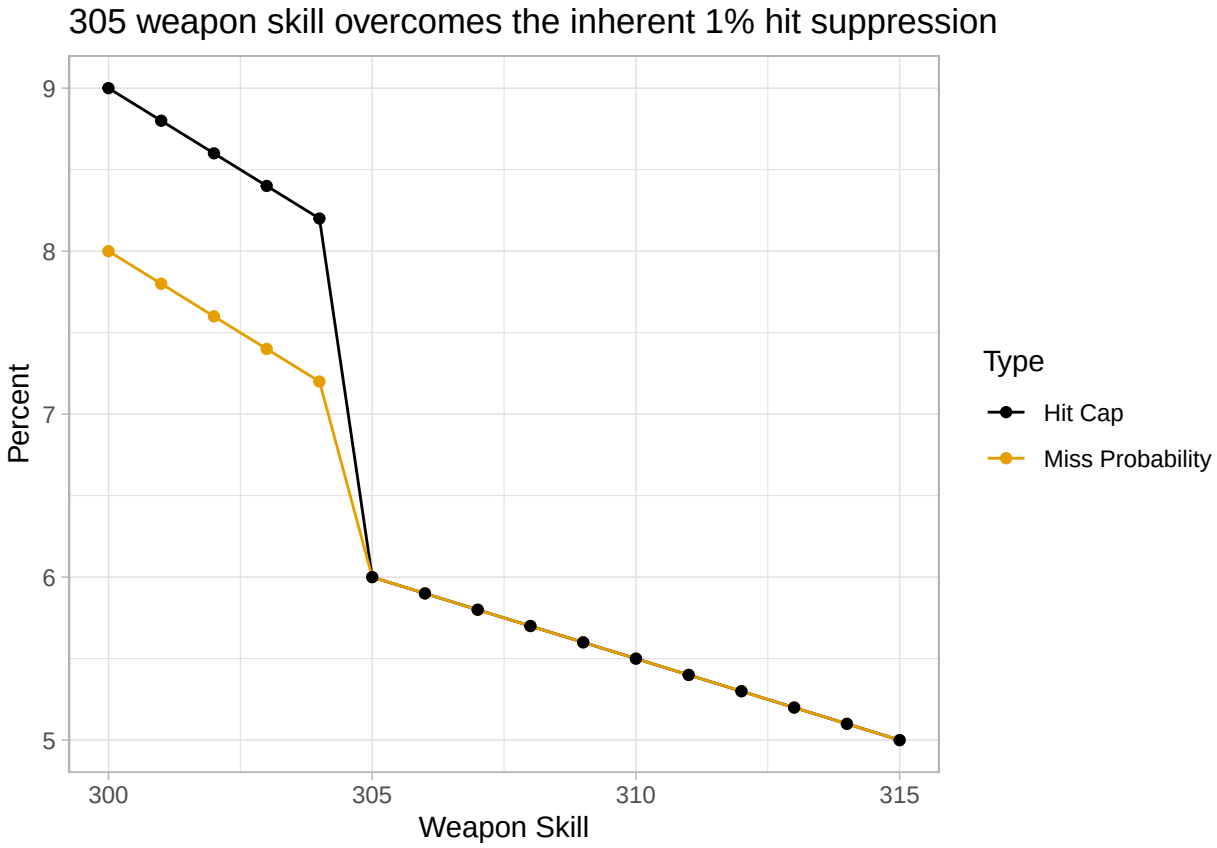

Figure 3.3: Weapon skill contributes to overcome the 1% hit suppression and the miss probability, but suffers steep diminishing returns after 305.

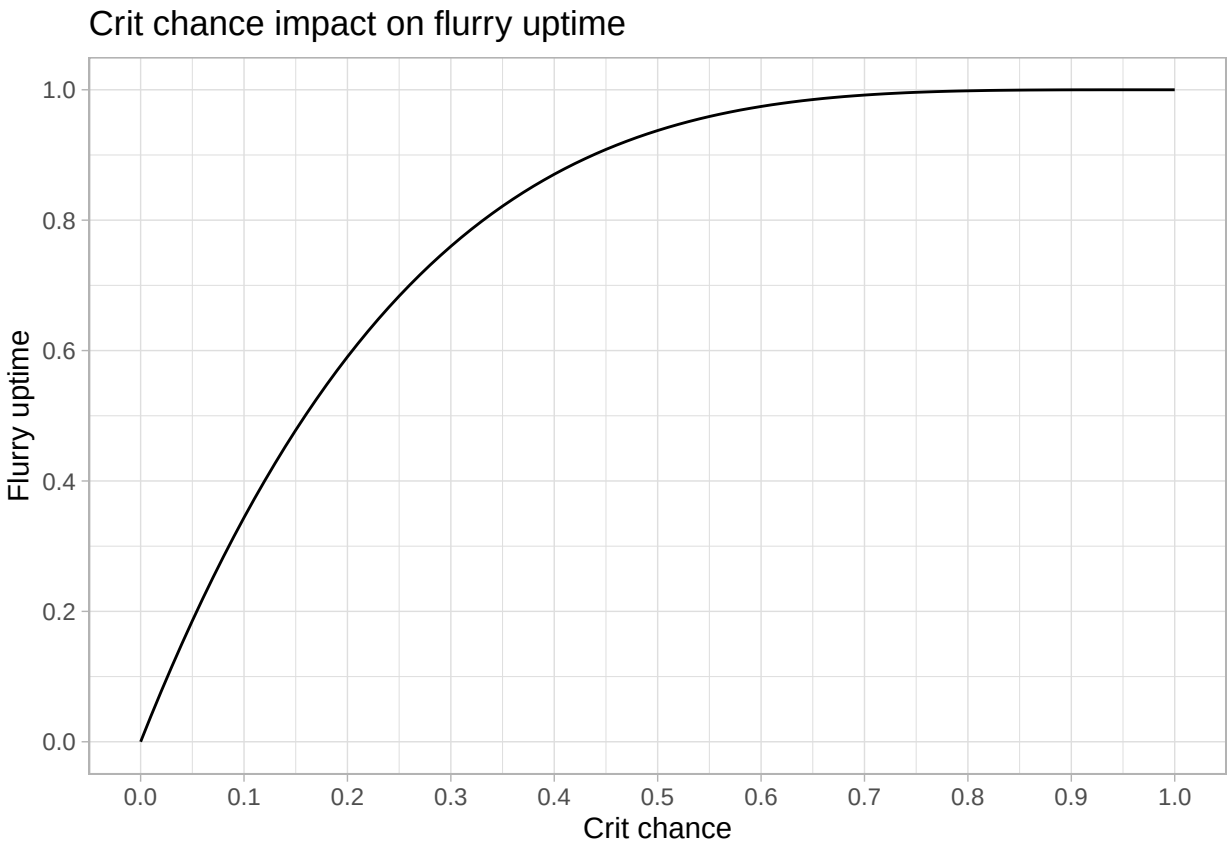

Figure 3.4: (#fig:Crit Chance vs Flurry Uptime Graph)Increase in critical strike chance increases flurry uptime.

3.3 The Crit Cap

3.4 Flurry

Flurry is a 5 point talent that, when maxed, increases the warrior's attack speed by 30% for the next 3 swings after dealing a critical strike. This represents a very significant damage increase, and as such warrior itemization values crit very highly in order to obtain higher and higher flurry uptimes, which can be calculated as follows:

$$F_{up} \;=\; 1 \;-\; \left(\left(1 - P\left(Crit\right)\right)^{A}\right) \tag{3.5}$$

Where F_{up} is the uptime, $P(Crit)$ is the player's crit chance, and A is the number of attacks made in one cycle of Flurry (3 from auto attack swings, and generally one additional from an instant attack; 4 is a reasonable number for a dual wielding player). Flurry is often misunderstood - the main misconception being that 33% crit will translate to 100% flurry uptime. This is incorrect, as shown by the following graph:

We can we now see that a $P(Crit) = .33$ only actually results in roughly 80% Flurry uptime. In fact, any amount of crit under 100% (or the crit cap) will result in less than 100% Flurry uptime, with increasing amounts of crit becoming less valuable the higher your $P(Crit)$ is. This is to say that the amount of Flurry uptime gained going for 1% crit to 11% crit is much greater than going from 40% to 50%, despite both cases representing a 10% overall $P(Crit)$ increase.

Chapter 4

Abilities and Rotation

A warrior's resource is the finite, yet continuously generated, rage. Rage is capped at 100, and the Vanilla WoW Wiki (WoW Wiki, 2019) tells us rage is generated by a successful white attack according to the following formula:

$$Rage \ = \ \left(\frac{15 \ \times \ D}{4 \ \times \ C}\right) \ + \ \left(\frac{(Hf \ \times \ Wep_{speed})}{2}\right) \ \leq \ \frac{15 \ \times \ D}{2} \tag{4.1}$$

Where D is the damage dealt, C is the rage conversion value, Ws is the weapon speed and Hf is the hit factor. The rage conversion value varies by player character level and is dependent on other values such as the mob's hit points and the warrior's expected damage value against that mob. It can be calculated by the following formula:

$$C \ = \ \left(0.0091107836 \ \times \ Lvl^2\right) \ + \ (3.225598133 \ \times \ Lvl) \ + \ 4.2652911 \tag{4.2}$$

What this tells us is that very low damage attacks have an uppber bound on how much they can be averaged up by the hit factor of the Where Lvl is the player's level. Knowing this, we can calculate the conversion value for various level ranges:

Similarly, the hit factor is based on the type of hit you perform against your target:

As we can clearly see, critical hits from either hand have a multiplier twice as big as a normal hit.

In any given fight, we will only generate a finite amount of rage. This means that to deal as much damage as we can, in the most efficient way possible, we need to maximize the ratio between damage dealt and rage spent - the **damage per rage** (DPR). This can easily be calculated:

$$DPR \ = \ \frac{Damage}{Rage} \tag{4.3}$$

Although this is an easy concept to grasp, it'll be an essential part of our discussions throughout this chapter from now on. This is because the DPR of our abilities is **not** constant - Whirlwind's (WW) DPR varies depending on the number of enemies around and the damage and type of our weapon, Execute's varies based on how much rage we consume when activating the ability, and Bloodthirst's depends on our current attack power. Doing as much damage as possible in a fight, thus, is about calculating the DPR of each one of these abilities as the encounter progresses, and utilizing the one with the maximum DPR. We will revisit this concept in more depth in @ref{dpr}

Table 4.1: Rage conversion values.

Player Level	Conversion Value
10	37.4
20	72.4
30	109.3
40	147.9
50	188.3
60	230.6

Table 4.2: Hit factor values.

Weapon	Hit Type	Hit factor
Main Hand	Normal Hit	3.50
Main Hand	Critical Hit	7.00
Off Hand	Normal Hit	1.75
Off Hand	Critical Hit	3.50

4.1 Bloodthirst

Bloodthirst (BT) is an instant ability on a 6 second cooldown that costs 30 rage and hits the enemy target for 45% of our attack power (AP). Mathematically, we can represent it's damage as:

$$BT_{dmg} = AP \times 0.45 \tag{4.4}$$

It might not be immediately apparent, but this is one of the main reasons why fury warrior damage scales so well - no other ability in the game benefits from attack power as much as BT. As we will soon see, at 30 rage it has the highest damage per rage of any of our abilities against a single target, and as such should be prioritized in most cases. The formula shows a linear increase in damage, which can be displayed graphically:

This complete dependence on AP has another important implication: it means BT damage is completely weapon independent. Two warriors utilizing the same gear except for weapons - with one utilizing a 2 handed weapon and the other a dagger - will deal the same damage with Bloodthirst.

4.2 Whirlwind

Whirlwind is an area of effect ability (AoE) that hits four enemy mobs with your currently equipped main hand weapon, on a 10 second cooldown. Its damage can be calculated as:

$$WW_{dmg} = Wep_{swing} + \left(AP \times \left(\frac{Wep_{speed}}{14} \right) \right) \tag{4.5}$$

Where Wep_{swing} is the damage caused by your weapon swing, and the right term is the damage added to that swing by your AP. Instantly, we can notice two differences between the damage scaling of WW when compared to BT: it scales with weapon damage, but much more poorly with AP. Another important distinction between the two is that while BT is a single target ability, WW scales off the number of opponents that are hit with it. Knowing that, we can calculate the DPR of both abilities at varying number of targets when wielding different types of weapons. In order to that, we assume the following:

With this, we can calculate the DPR of one use of Whirlwind when hitting a varying number of targets, and compare it to the DPR of Bloodthirst at the same attack power threshold:

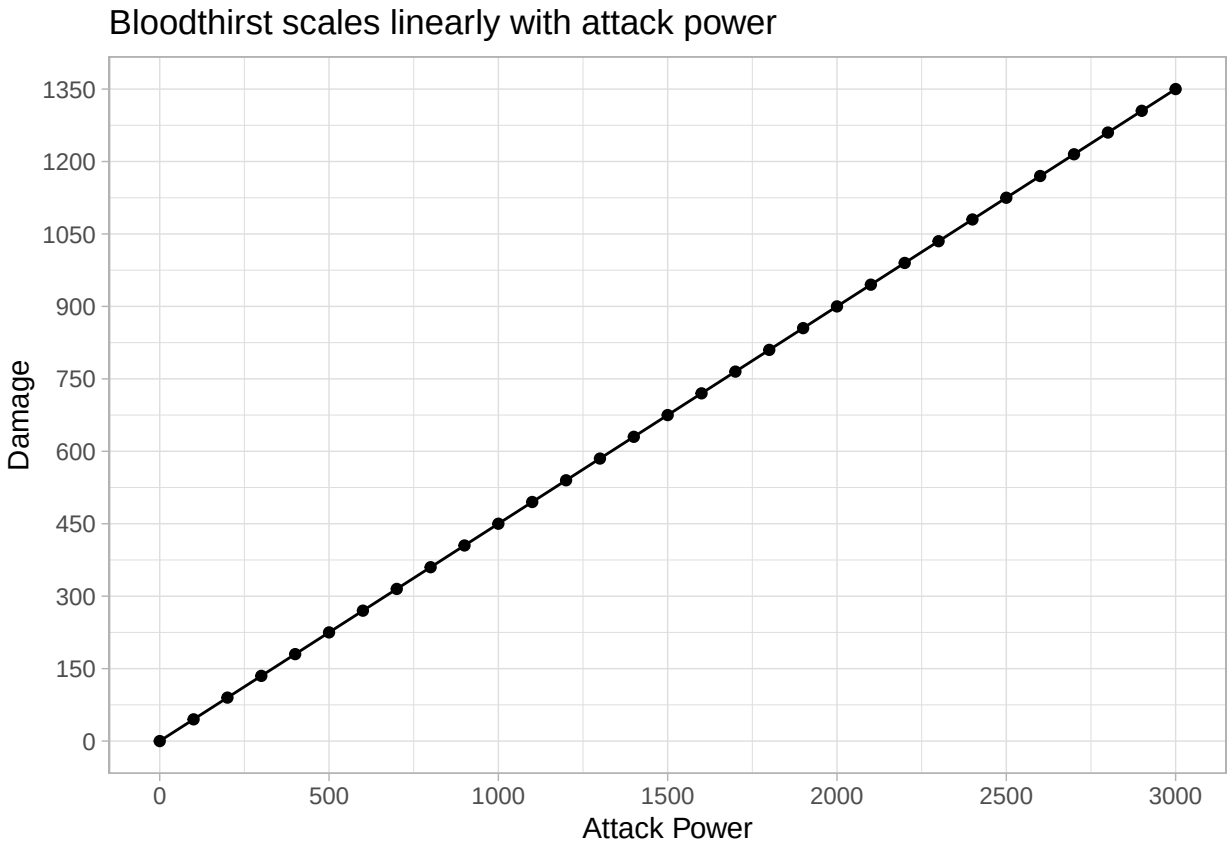

Figure 4.1: Bloodthirst scales linearly with attack power and is completely independent of weapon damage.

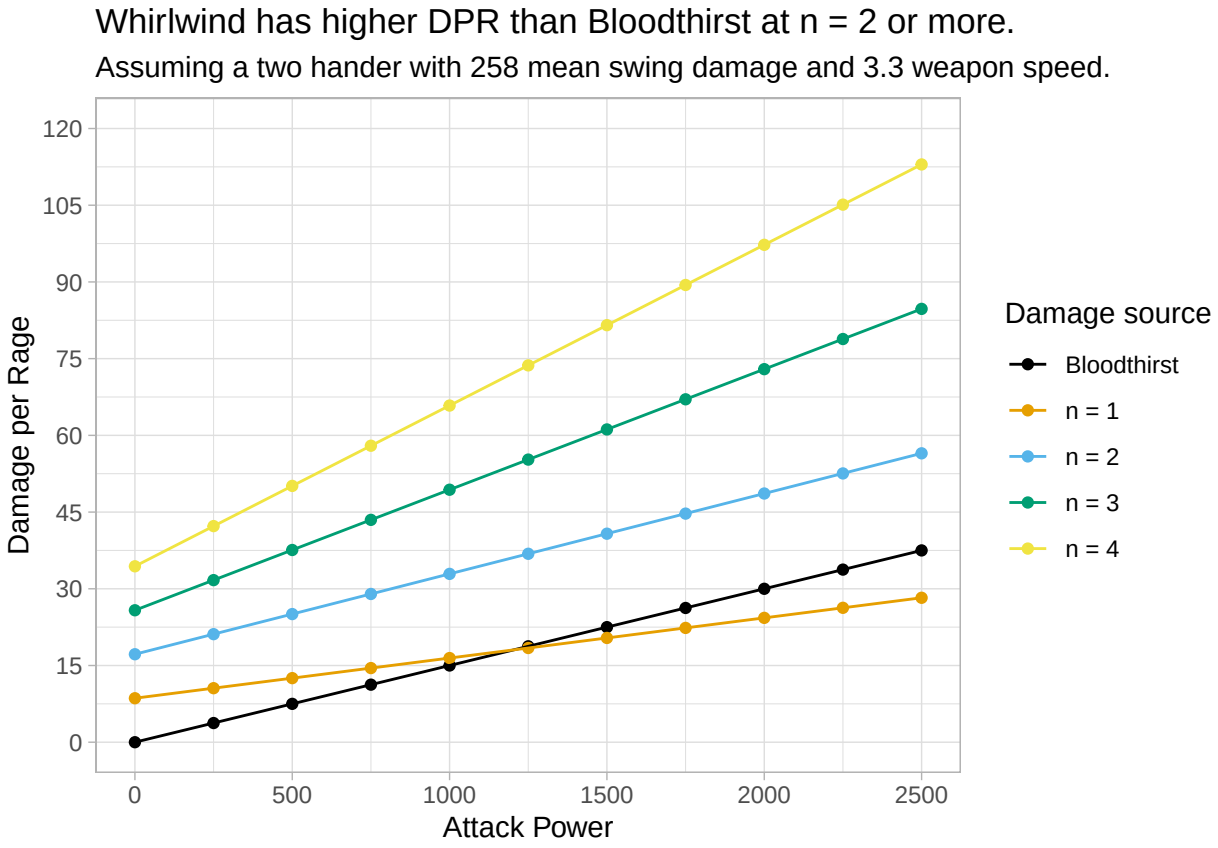

Figure 4.2: Comparison of the damage per rage efficiency between Bloodthirst and Whirlwind with a generic two handed weapon.

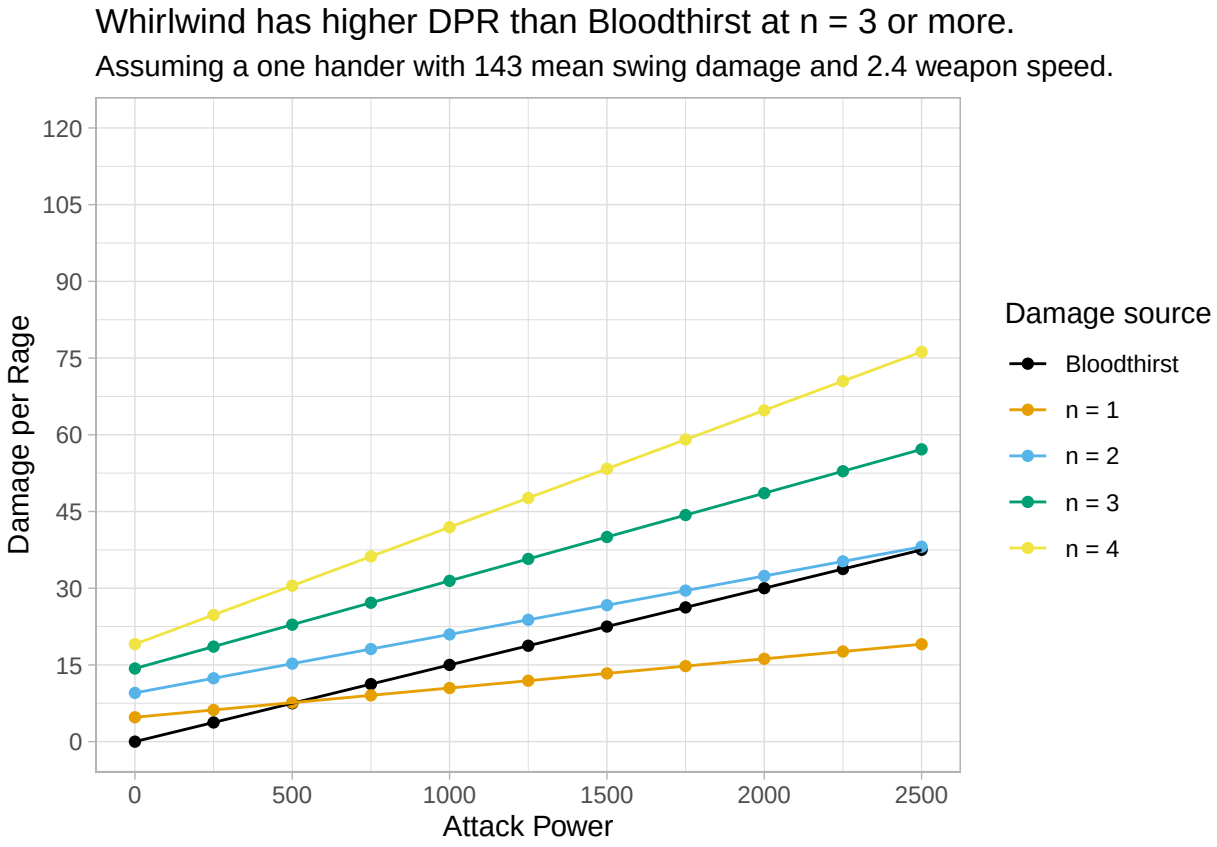

Figure 4.3: Comparison of the damage per rage efficiency between Bloodthirst and Whirlwind with a generic one handed sword.

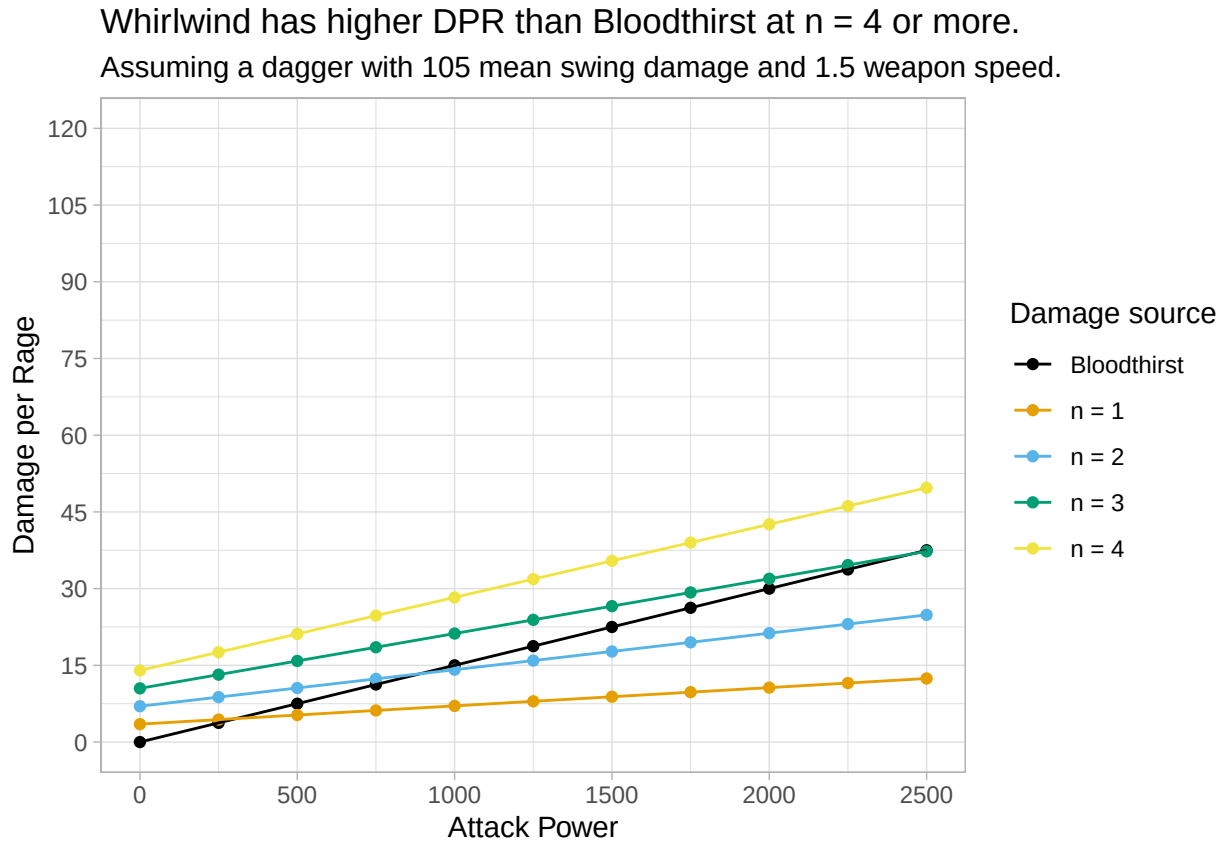

Figure 4.4: Comparison of the damage per rage efficiency between Bloodthirst and Whirlwind with a generic dagger.

Table 4.3: Variables affecting Whirlwind damage calculations.

Weapon	Normalized Speed	Average Damage	Attack Power
Two Handed Weapon	3.3	258	1750
One Handed Weapon	2.4	143	1750
Dagger	1.5	105	1750

The graphs above paint a clear picture: Whirlwind damage per rage increases linearly with number of targets being hit, and that together with the weapon type currently being wielded by the player, should inform *when* the skill should take priority over Bloodthirst at variable attack power thresholds.

4.3 Execute

Different from Whirlwind and Bloodthirst, Execute is an ability with no cooldown, variable rage cost, and that can only be activated when the enemy is at 20% HP or lower. Each additional point of rage used in the activation of the ability past it's activation cost adds 15 damage to the total damage dealt by the ability, and points into the Improved Execute talent decrease the activation cost of the ability at 5 rage per talent point. Therefore, we can calculate its damage as:

```
execute <- function(rage, ac){
        damage = 600 + ((rage-ac)*15)
        return(damage)
}
```

$$Execute_{dmg} = 600 + ((R - Ac) \times 15)\,(\#eq : execute_dmg) \tag{4.6}$$

Where R is the player's current rage, Ac is the activation cost of the ability (dictated by how many points the player has in improved execute) and 15 is the damage multiplier per point of rage. Knowing this, we can quickly visualize the damage per rage of the ability at 0, 1, and 2 points into the Improved Execute talent:

1. Intro to Execute (CD, usage, formula, % of overall damage)
2. Execute batching
3. Execute damage per rage

4.3.1 Execute Switch

1. Why it was effective on private servers
2. Why it's not effective in Classic a. Batching b. Execute phase duration

4.4 Heroic Strike and Cleave

1. Introduction (formula)
2. Opportunity cost - why damage per ratio is deceptive
3. HS doesn't consume flurry

4.4.1 HS Queuing#{hsq}

1. Explanation (include macro)
2. Consequences
3. When should you queue?

4.5 Slam

1. Intro to Slam
2. How spell batching affects Slam
3. Viability of Slam

4.6 Hamstring

1. Intro to Hamstring
2. Why use Hamstring?

4.7 Overpower

1. Intro to Overpower
2. Should you use OP? If so, when?

4.8 Damage per Rage

1. Damage per Rage comparison between main rotational abilities (BT, WW, Exec)
2. Execute DPR decreases the more rage you have
3. The impact of scaling on DPR, and how that affects your rotation

4.9 The Warrior Priority System

1. The Warrior Priority System

Chapter 5

Cooldowns

5.1 Death Wish

1. Intro to DW
2. Utilization

5.2 Recklessness

1. Intro to Reck
2. Utilization

5.3 Trinkets

5.4 Mighty Rage Potion

1. Intro to MRP
2. Utilization

5.5 Bloodrage

1. Intro to Bloodrage
2. Utilization

5.6 Berserker Rage

1. Intro
2. Utilization

5.7 Racials

5.7.1 Blood Fury

1. Intro
2. Formula
3. Scaling (AP/Str)
4. Utilization

5.7.2 Berserking

1. Intro
2. Utilization

Chapter 6

Consumables

6.1 Required

6.1.1 Mongoose

6.1.2 Juju/Giants

6.1.3 Firewater/Juju

6.2 R.O.I.D.S and Scorpok

6.3 Protection Potions

6.4 Assorted

6.4.1 Limited Invulnerability Potions

6.4.2 Restorative Potions

6.4.3 Free Action Potions

Chapter 7

Parsing

1. Intro to parses
2. How parses can be gamed
3. Your parse does not define how good of a player you are
4. Parses can still be very useful

7.1 Factors Affecting Parses

7.1.1 World Buffs

1. List obtainbale world buffs
2. Lay out the value you get from them
3. World buffs are essential if you want to parse highly.

7.1.2 Kill Time & Raid DPS

1. Your guild is the most important factor in whether you'll parse well or not.
2. Your guild DPS severely impact your parses i. High guild DPS is essential ii. Fitting a boss kill within a Reck/DW window.

7.1.3 "What did I do wrong?"

1. Importance of critical self evaluation
2. How to look at your own parses and evaluate your performance a. BT casts per minute and interval between BTs b. Boss uptime and the importance of Charge and Intercept c. Cooldown timings

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