

Optimizing Yone's Item Build: A Weighted Multi-Criteria Decision Analysis Approach to Maximizing Character Strength

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Abstract:



This paper is an attempt at arbitrarily determining the best possible build for Yone at full items. One note is that each stat's innate values will differ depending on game state and team composition. The scenario in which these calculations are made is within the assumption that Yone is max level, and the stats magic resist, armor, and health are valued similarly. The most optimal build is derived from a weighted stat distribution formed from an arbitrary criterion.

Character analysis

When figuring out the most optimal set of items to buy for a character, it's crucial to understand how each item augments the character's overall strength. As a start to determine the most valuable stats, we can investigate Yone's kit. Starting with his passive,

Way of the HunterEdit








INNATE - INTENT: Yone's  **total critical strike chance** is doubled from all other sources, but his  critical strikes deal only $\lceil (157.5\% + \text{36\% AD}) \text{ physical damage} \rceil$. Additionally, $\lceil \text{every 1\% critical strike chance in excess of 100\% is converted into } 0.5 \text{ bonus attack damage} \rceil$.



INNATE - STEEL AND SPIRIT: Yone's basic attacks alternate between his Steel Sword and Azakana Sword on-attack. Yone begins attacking with Steel Sword, and basic attacks with Azakana Sword deal 50% AD physical damage and 50% AD magic damage.

Yone's core passive doubles his critical strike chance while converting excess crit chance into 0.5 ad for every excess percent. His secondary passive converts every other attack into half ad and half ap damage. From the passive alone, we can see that Yone is incentivized to build crit and AD since he receives double value from buying critical strike chance although actual effective value may be lower due to a decreased critical strike damage.


Mortal SteelEdit



CAST TIME: 0.35 – 0.175 (BASED ON BONUS ATTACK SPEED)
STATIC COOLDOWN: 4 – 1.33 (BASED ON BONUS ATTACK SPEED) **RANGE:**  450 / 450 /  1050
COLLISION RADIUS:  100 **WIDTH:**  80 / 160 **SPEED:** 1500






ACTIVE: Yone thrusts his Steel Sword in a line in the target direction that deals physical damage to enemies hit and applies  on-hit and on-attack effects at 100% effectiveness to the first enemy hit. Mortal Steel's damage can  critically strike for $\lceil (60.375\% + \text{37.8\% AD}) \text{ bonus physical damage} \rceil$.

If this hits at least one enemy, Yone generates a stack of Gathering Storm for 6 seconds, stacking up to 2 times and refreshing on subsequent hits. At 2 stacks, the next Mortal Steel consumes them all to become empowered with a new effect.



GATHERING STORM BONUS: Yone  dashes a fixed distance in the target direction and unleashes a whirlwind in the same direction, both dealing the same damage to enemies hit in their path and  knocking them up for 0.75 seconds, but being unable to affect the same target twice.

Mortal Steel's thrust is  interrupted if Yone is affected by  disarming crowd control during the cast time but its  cooldown is reset to 0.1 seconds.

PHYSICAL DAMAGE:
20 / 45 / 70 / 95 / 120 (+ 105% AD)

Yone's Q is a core component of his kit due to its lower cooldown and its third cast acting as a mobility boost for Yone. The ability applies on-hit effects while also being able to crit. This leaves his build path open to an on-hit option, but typically on-hit builds tend to be deprived of crit. An important characteristic to note is that the Q cooldown scales with attack speed which makes the stat itself more valuable to Yone.

Soul Unbound

COOLDOWN: 22 / 19 / 16 / 13 / 10

CAST TIME: NONE / 0.25

RANGE: 300

EFFECT RADIUS: GLOBAL

Edit

SPEED: 1200



ACTIVE: Yone dashes a fixed distance in the target direction, discarding his body and entering *Spirit Form* for 5 seconds. Yone's body is  untargetable and is sent the same distance behind the cast location, though not through terrain, and is reclaimed when *Soul Unbound* ends.



SPIRIT FORM: Yone becomes  ghosted and gains  10% – 30% (based on seconds active) **bonus movement speed**. Enemy champions damaged by his basic attacks or abilities are *marked*. Each *mark* stores a portion of the *post-mitigation* damage that Yone deals to the target with his basic attacks and abilities.

DAMAGE STORED:
25 / 27.5 / 30 / 32.5 / 35% of damage dealt

Activation resets  *Way of the Hunter's* current sword state. *Soul Unbound* can be recast after 0.5 seconds, and automatically does so after the duration.



RECAST: Yone dashes back to his body with  displacement immunity, ending *Spirit Form* and detonating the *marks* on each champion to deal  **true damage** equal to the amount stored against each of them. After the cast time, he will  cleanse himself from all  immobilizing effects and  polymorphs* that were applied to him during it as well as all  blinds,  cripples and  drowsy effects.


The automatic recast is delayed if Yone is winding up a basic attack or is unable to recast *Soul Unbound* under any circumstances, which includes if he cannot move or cast abilities. *Soul Unbound* will also immediately recast upon  death or entering  resurrection.


Yone's E is highly regarded as one of the most bullshit abilities in league of legends due to the true damage amp, mobility, and cleanse that is provided to Yone while also acting as a fail-safe. The only stats which affect this ability is ability haste which changes the cooldown of the ability. One important thing to note is that the true damage amps are still gated by resistances as it is based on cumulative damage in which Yone is applying ad and ap damage.

Fate Sealed


COOLDOWN: 120 / 100 / 80





CAST TIME: 0.75



RANGE:  1000


WIDTH:  225


Edit



ACTIVE: Yone prepares a strike over the cast time, then *marks* all enemies within an area in the target direction,  knocking them down and  stunning them for 1 second. He  blinks 200 units beyond the center of the last enemy  champion struck, or else to *maximum range* instead.

After 0.3 seconds, a gust rushes along the same area that deals equal parts **physical** and **magic** damage to *marked* enemies within and  pulls them towards the location Yone blinked to, then  knocks them up for 0.75 seconds.

TOTAL MIXED DAMAGE:  200 / 400 / 600 (+ 80% **bonus AD**)

The  *stun* ends prematurely upon the knock up.

Yone's ultimate is an effective tool in breaking up enemy formations or securing kills due to its role as a near instant long range gap closing crowd control. This ability is affected by ability haste and bonus ad.

Stat weight determination

From the character kit analysis, we can see that Yone values attack speed, attack damage, and critical strike chance. Although This wouldn't be entirely accurate since it does not account for health, magic resist, and armor effectiveness. We will create a Yone strength value determined as a product of his dps, relative health, and healing percentage.

$$CPV = \frac{DPS_C}{DPS_{Base}} \times \left(\frac{Effective\ health}{Effective\ health\ 18} + \frac{E((DPS \times LifeSteal, AR, MR)) + E(HR, AR, MR)}{Effective\ health\ 18} \right)$$

Where function E is the raw health to effective health conversion. Since armor and magic resist have different effective conditions, weights will be assigned as ratios of physical and magic champions.

$$DPS_A(AD, AS, CC, CD) = AS(AD + AD(2 \times Crit\ chance \times (Crit\ damage - 1)))$$

$$E(HP, AR, MR) = HP \times \left(1 + \frac{AR \cdot \omega_{ar}}{100} + \frac{MR \cdot \omega_{mr}}{100} \right)$$

$$\omega_{ar} = \frac{N_{physical}}{N_{physical} + N_{Magical}}$$

$$\omega_{mr} = \frac{N_{Magical}}{N_{physical} + N_{Magical}}$$

Considering Yone's passive, we get,

$$CC_{effective} = \begin{cases} CC & \text{if } CC \leq 0.5 \\ 0.5 & \text{if } CC > 0.5 \end{cases}$$

$$AD_{bonus} = \begin{cases} 0 & \text{if } CC \leq 0.5 \\ 100 \cdot (CC - 0.5) & \text{if } CC > 0.5 \end{cases}$$

$$AD = AD + AD_{bonus}$$

We will now calculate ability induced DPS and combine it with DPS from auto attacking,

$$DPS_p = \left(\frac{Q_d}{Q_{cd}} + \frac{W_d}{W_{cd}} \right) + \frac{0.35 \times \left(\frac{Q_d}{Q_{cd}} + \frac{W_d}{W_{cd}} \right)}{E_{cd}}$$

$$DPS_C(L, RA_p, ARP) = (DPS_p + DPS_A) \left(\frac{100}{100 + ((1 - ARP)(1 - RA_p)(AR_{Yone\ 18})) - L} \right)$$

Flat armor reduction is not considered since there is no item that provides it. Our reference armor will be Yone's base stats.

$$Q_d = (120 + (1.05 \times AD))(2 \times CC \times (0.6037 + Ex\ Crit\ damage) \times (120 + (1.05 \times AD)))$$

$$W_d = 50 + 0.14(2586) = 412$$

The Q damage is reflected as an average damage per Q when continuously attacking.

The cooldowns of W and Q respectively can be expressed as arrays at different break points,

$$W_{cd} = [14, 13.2, 12.4, 11.6, 10.8, 10, 9.2, 8.4, 7.6, 6.8, 6]$$

$$Q_{cd} = [4, 3.64, 3.28, 2.92, 2.56, 2.2, 1.84, 1.48, 1.33]$$

$$W_{thresh} = [0, 9.46, 18.91, 28.37, 37.82, 47.28, 56.73, 66.19, 75.64, 85.1, 94.55]$$

$$Q_{thresh} = [0.0, 0.15, 0.30, 0.45, 0.60, 0.75, 0.90, 1.05, 1.1111]$$

$$E_{cd} = 10 \times \frac{100}{100 + Haste}$$

Where W_{cd} and Q_{cd} are the respective ability cooldowns at different bonus AS percent break points. When using break points an issue arises where bonus attack speed is undervalued if it doesn't contribute to the Q and W cooldown directly so we will be using this formula for cooldown instead.

$$Q_{cd} = \begin{cases} 4 \times (1 - (0.01 \times \frac{AS_{bonus\ percent}}{1.67})) & \text{if } AS_{bonus\ percent} \leq 120 \\ 1.33 & \text{if } AS_{bonus\ percent} > 120 \end{cases}$$

$$W_{cd} = \begin{cases} 14 \times (1 - (0.01 \times \frac{AS_{bonus\ percent}}{1.51})) & \text{if } AS_{bonus\ percent} \leq 94.6 \\ 5.25 & \text{if } AS_{bonus\ percent} > 94.6 \end{cases}$$

Initially the plan was to compute the partial derivatives of each stat to see which one provides the highest CPV stat gradient at different stat checkpoints, but this seems too mathematically demanding so instead we are writing a program that computes the CPV and creates a heatmap of the most important variable using randomly generated samples.



This is the heatmap we get when generating 50000 random samples for each variable within their respective ranges. We already figured out that attack speed would have been a high priority stat from the character kit analysis, but now we get a comprehensive understanding of how each stat is weighted.

Stat	Correlation	Normalized Weight
HP	0.4550	0.8815
AS	0.5162	1.0000
AD	0.2937	0.5687
AR	0.3032	0.5873
MR	0.3026	0.5862
CC	0.3241	0.6279
CD	0.0935	0.1811
HR	0.0100	0.0194
Haste	0.0080	0.0155
Life Steal	0.0314	0.0608
Lethality	0.0298	0.0577
Armor pen	0.0083	0.0161
A-Reduce	0.0004	0.0008

Further analysis of weight determination

An issue that arises with the use of correlation matrix is that certain attributes are calculated as being negatively impactful towards the character power value when in theory all stats should improve the character power value even by a small margin. To address this, we will be using multiple correlation methods (Pearson, Spearman, Kendall) to see if any results differ.

Additionally, we will be producing confidence intervals by bootstrapping each correlation value.



Above We can see the spearman correlation method which tends to denote a similar trend with attack speed being the most valued stat. One thing to note across all heatmaps is that lethality's value seems to be inflated compared to the other means of armor penetrations which could be explained by our assumption that the target has only its base armor which may inflate the worth of lethality. Although not entirely inaccurate since Yone's primary targets tend to be low durability characters.

Item induced character strength change

We will define a new expression for character strength as a summation of their stats multiplied by their importance towards Yone. The following expression combines all stats and their respective weights to produce a single score for evaluation.

$$CS = \sum_{i=1}^{13} \sqrt{stat_i} \times W_i$$

$$CS + CS_o = (\sqrt{HP} \times W_{HP}) + (\sqrt{AS} \times W_{AS}) + (\sqrt{AD} \times W_{AD}) + (\sqrt{AR} \times W_{AR}) + (\sqrt{MR} \times W_{MR}) \\ + (\sqrt{CC} \times W_{CC}) + (\sqrt{CD} \times W_{CD}) + (\sqrt{HR} \times W_{HR}) + (\sqrt{H} \times W_H) + (\sqrt{LS} \times W_{LS}) \\ + (\sqrt{L} \times W_L) + (\sqrt{ARP} \times W_{ARP}) + (\sqrt{A} \times W_A)$$

With each iteration of character strength calculation, the previous character strength values are summed as an initial character strength input. The stats and weights are normalized to prevent large values from skewing the character strength value.

$$stat\ max = (initial\ stat + \sum_{i=T(s)}^5 v(s, i) \ \forall s \in S)$$

Where T(s) is defined as the 5 items with the highest stat s and v (s, i) is the stat s provided by item i. S is the set of stats

$$stat_i = \frac{stat}{stat\ max}$$

$$w_i = [\frac{\partial CS}{\partial stat_1}, \frac{\partial CS}{\partial stat_2}, \dots, \frac{\partial CS}{\partial stat_3}]$$

$$W_i = W_o + learning\ rate \cdot \frac{N - R(w_i) + 1}{N}$$

For weight updates we use a rank-based normalization and then modify the previous iteration's weights by a percentage of the new weights dictated by the learning rate.

Passive induced character strength change

Legendary items in league of legends typically come with a special item passive that can augment a character's overall strength whether that be damage output, durability, healing, or mobility steroids. This study will not be considering the impact of dashes and blinks since these effects have varying degrees of effectiveness depending on player skill. Instead, we will look at the dps additions or survivability added through passives. For example, Hextech rocket belt will only have its dash damage considered. Similarly, items that scale off enemy health will instead use Yone's base HP in its added damage calculation. All passives will be simplified to stat sticks and added on to the item base stats. Although this does introduce multiple limitations since the effects of some item stats will vary depending on game state as such leaving the model open to inaccuracies caused by varying game conditions.

Results

We will be comparing the results of the two models alongside the 1v9 Yone items from WayOfTheTempest as a reference for assessing how reliable some of these builds may be. For all builds it is assumed the berserkers greaves were bought first. The effectiveness of each build can only be truly understood from practical application which will also have varying performance due to player skill level or game conditions. Ultimately there isn't an objective best build. Additionally, these models do not consider build path and gold efficiency so it's up to the player's choosing which item to buy although I will attempt to provide a reasonable build path for each model.

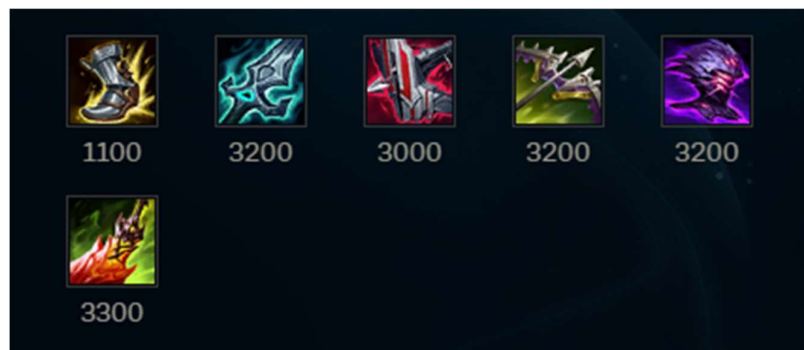


Where lord Dominik's regards and mortal reminder are interchangeable depending on what you need. In theory this doesn't look completely horrible considering that it has all the stats Yone needs except any form of durability increase. A potential reason for this is that the model doesn't know what anti-heal is and replaces all forms of durability as life steal. Additionally, Navori's presence here may be a slight inaccuracy since its passive is converted into a rough estimate of raw ability haste value. If we exclude all item passive simplification, phantom dancer will take Navori's place due to higher base stats. When looking at the build path starting Navori's is probably the right choice since capping Q cooldown is especially important in laning and skirmishing. The only issue that arises from this is lack of AD which is why collector is built second due to its high base AD. The third item should be either blood thirster or ravenous to address lack of sustain in the build. The rest is dependent on whether you need anti-tank items.







The second model provided a more believable build with the presence of blade of the ruin king which every Yone builds. We also see here that there is a tank item which suggests that the model was able to capture the importance of defensive stats as opposed to relying on life steal purely.









In this build, our two potential first item would be blade of the ruin king and kraken slayer since they are our only source of attack speed. Depending on the match up, you'd either take bork or kraken first. Third item should be Jak'Sho to provide balance between offensive and defensive stats. The last two items are dependent on what is needed although I think it's preferable to go Infinity edge last or else you can't utilize the full effect of its crit damage amp.



The reference build is the one I got from WayOfTempest and if we compare it to the two builds we have generated, it seems that the second model is more in line with the norm since we see a balance of offensive and defensive items. One important note is that Tempest's build has more defensive utility than the builds generated which could be explained by our models assuming that one shot and anti-heal do not exist. A potential way to implement this is to create a probability value that is a ratio of current effective health and current dps which represents the chance of being blown up. As another reference point, we will be using Coachless to compare the highest win probability items at different slots.

First Item	Second Item
 ↑ 0.26 % ↻ 49.77 % # 565	 ↑ 0.67 % ↻ 52.20 % # 173,113
 ↑ 0.17 % ↻ 48.53 % # 315,847	 ↑ 0.42 % ↻ 48.22 % # 458
 ↑ 0.10 % ↻ 45.59 % # 1,646	 ↑ 0.03 % ↻ 60.59 % # 603

When looking at the highest probability items in Coachless, we can see that our first model isn't entirely off. Navori's and Collector can be seen in the top 3 although collector's win probability isn't exactly meaningful since shield bow has a significantly higher win probability added.

Third Item	Fourth+ Item
 ↑ 2.06 % ↻ 49.88 % # 419	 ↑ 2.66 % ↻ 55.43 % # 559
 ↑ 1.17 % ↻ 59.88 % # 720	 ↑ 1.26 % ↻ 58.11 % # 822
 ↑ 0.43 % ↻ 60.23 % # 86,430	 ↑ 1.07 % ↻ 61.51 % # 5,241

As for the third and fourth item, we can see that defensive items are highly valued which further solidifies our reasoning previously that the model is unable to understand that one shotting and anti-heal exists.

Conclusion

This study explored the optimization of Yone's item build using a weighted multi-criteria decision analysis (MCDA) framework. Through the examination of Yone's kit and the mathematical modeling of character power values (CPV), the analysis identified attack speed, attack damage, and critical strike chance as the most impactful statistics for maximizing his effectiveness. While the models demonstrated a reasonable ability to propose viable builds, they also highlighted notable limitations and areas for improvement.

Key findings revealed that attack speed consistently emerged as the most significant contributor to Yone's overall power, aligning with his passive and kit mechanics. However, the models struggled to fully account for in-game nuances such as the value of defensive utility, the necessity of anti-heal, and the dynamics of one-shot potential in various matchups. Simplifications, such as treating item passives as static stat sticks, introduced further inaccuracies, underscoring the challenge of modeling complex game mechanics in a static framework.

The generated builds provided insight into potential paths for maximizing Yone's effectiveness. The first model emphasized raw offensive potential, while the second model produced a more balanced approach, integrating defensive items like Jak'Sho and core items such as Blade of the Ruined King. These builds compared favorably with community reference builds, such as those from WayOfTheTempest and Coachless, though the lack of nuanced considerations limited their practicality in real-game scenarios.

Future iterations of this analysis could benefit from incorporating additional variables, such as the probability of one-shot scenarios and the effectiveness of anti-heal, to enhance the model's accuracy. Additionally, factoring in build path efficiency and gold cost could provide more actionable recommendations for players at various stages of the game.

Ultimately, while this study highlights a robust framework for systematically evaluating item builds, it also affirms that the dynamic nature of League of Legends, coupled with factors such as player skill and game state, precludes the existence of a universally optimal build. Instead, the insights derived from this analysis serve as a foundation for informed decision-making, enabling players to adapt their builds to the ever-changing demands of the game.