

The overall damage done while bashing is a function of the player's crit rate, strength/int (depending on the attack), the base damage of the attack, and the hit rate. The attack's damage and the stats are invariant with respect to level, and the hit rate can be assumed to be 1 (If not, go spend lessons on your skills first! Or, more specifically, I don't want to calculate damage done as a function of hit rate, itself a function of lessons/credits spent: a function which is unknown to me) and so can be divided out of the damage formula to leave something of the following form:

$$Damage = f(g(level))$$

The function  $g$  is established by my research (Off the old forums) to be:

$$g(level) = crit = (level * .01 - .25)^3 \equiv x \text{ if } level > 25$$

$$g(level) = 0 \text{ if } level \leq 25$$

Furthermore, the method for calculating chances for crushing, obliterating... crits has also been established. Specifically, a check is made to see if a crit occurs (at the crit rate above). If that check passes, another check is made using the same crit rate to upgrade the crit to a crushing crit, and so on down the line. Taking the chance of any crit occurring and multiplying it by its relative amount of damage leads to the simple geometric progression for calculating total expected damage relative to a single hit:

$$\sum_{i=0}^5 (2x)^i (1-x)$$

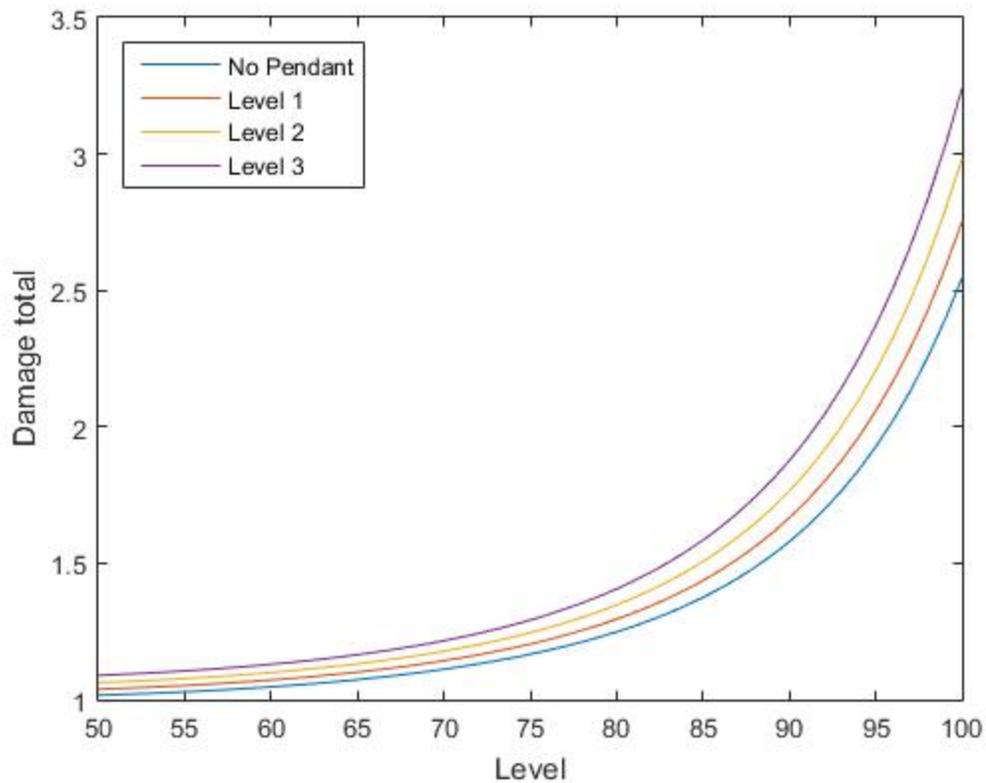
Where  $0 \leq x \leq 1$ , the player's base critical hit chance. The index goes from 0 to 5 to scale from a hit ( $i=0$ ) to a world shattering crit ( $i=5$ ). Expanded out (Because nobody likes series notation), this looks like:

$$f(x) = (1-x) + 2x(1-x) + 4x^2(1-x) + 8x^3(1-x) + 16x^4(1-x) + 32x^5(1-x)$$

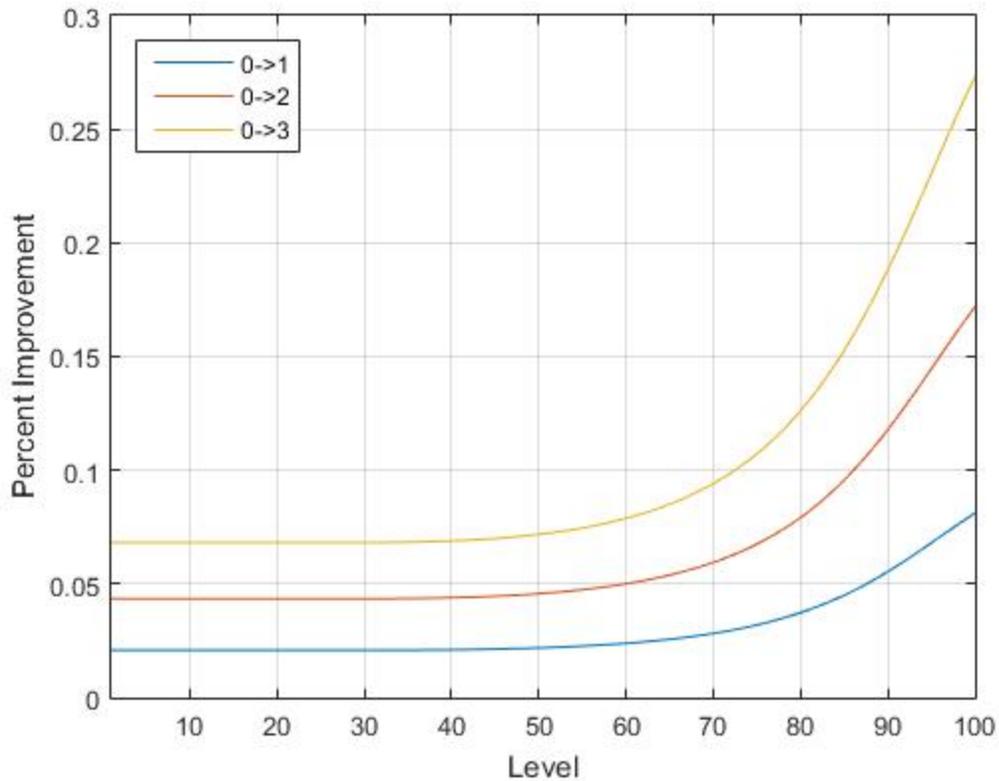
Okay, great, now we have the formula for damage done. How does that help us calculate how much the pendants help? Well, this is where we start venturing dangerously close to calculus (Pre-calculus, actually, but hold on to your pants, anyway). The pendants give a flat increase to the crit rate, which we can call  $\Delta x$ . This means we can replace every occurrence of  $x$  in the damage formula with  $x + \Delta x$  to get the damage at a given crit rate plus the pendant. And more importantly, we can use the following ratio to find the relative percentage increase in damage:

$$\%change = \frac{f(x + \Delta x) - f(x)}{f(x)}$$

I made a MATLAB script to do exactly this for each of the pendants. The following plot shows the total damage done relative to a regular hit for each pendant level:

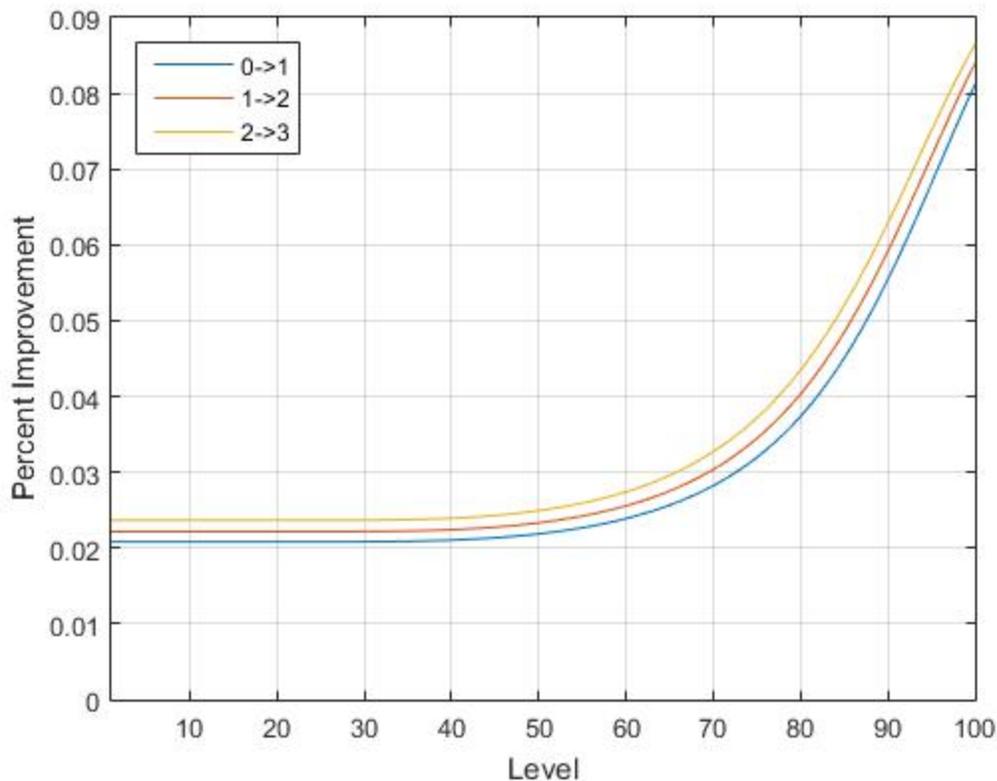


Neat! The blue line shows that even with no artefacts of any kind, the overall damage done by a player increases steadily to about 255% of a non-critting player. Levels below 50 have been excluded because they're boring. You could also do some fun things with this plot, like tracing rightwards from a line to a level on the blue line, to see how many "levels" a player effectively gains (in damage) from any of the pendants. A level 70 player with a level 3 pendant, for example, does the same damage as about a level 80 player without. But that's not really useful knowledge. Better is when you normalize to get a percentage increase at a particular level:



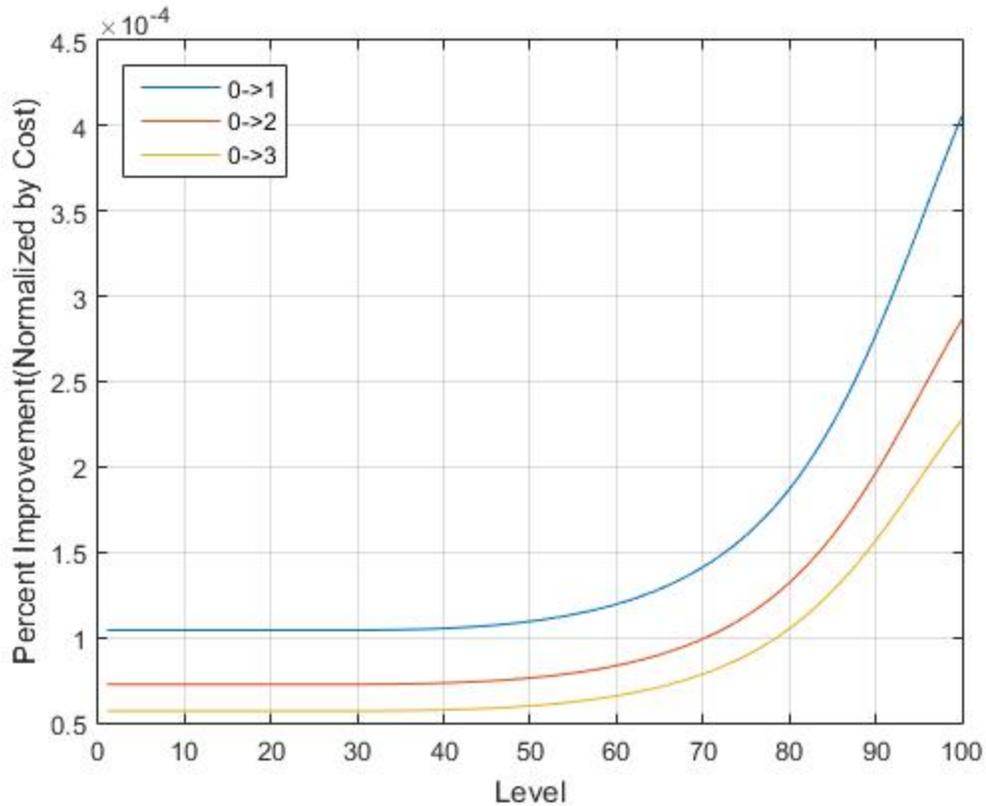
It's hard to tell by the plot alone, but the damage improvement at low levels (<25) is slightly higher than the nominal value of the pendants (2.08%, 4.35%, and 6.82%, respectively). This is good; it means our calculations are taking into account 4x, 8x, 16x and 32x crits. Another thing to notice is the *sharp* increase in benefit for all three pendants around level 70. This will turn out to be an interesting data point later on, but for now it shall sit as a novelty.

Perhaps a better plot to look at is the plot comparing each pendant to the level below it; i.e., the increase of going from no pendant to level 1, level 1 pendant to level 2, and level 2 pendant to level 3. Here it is:



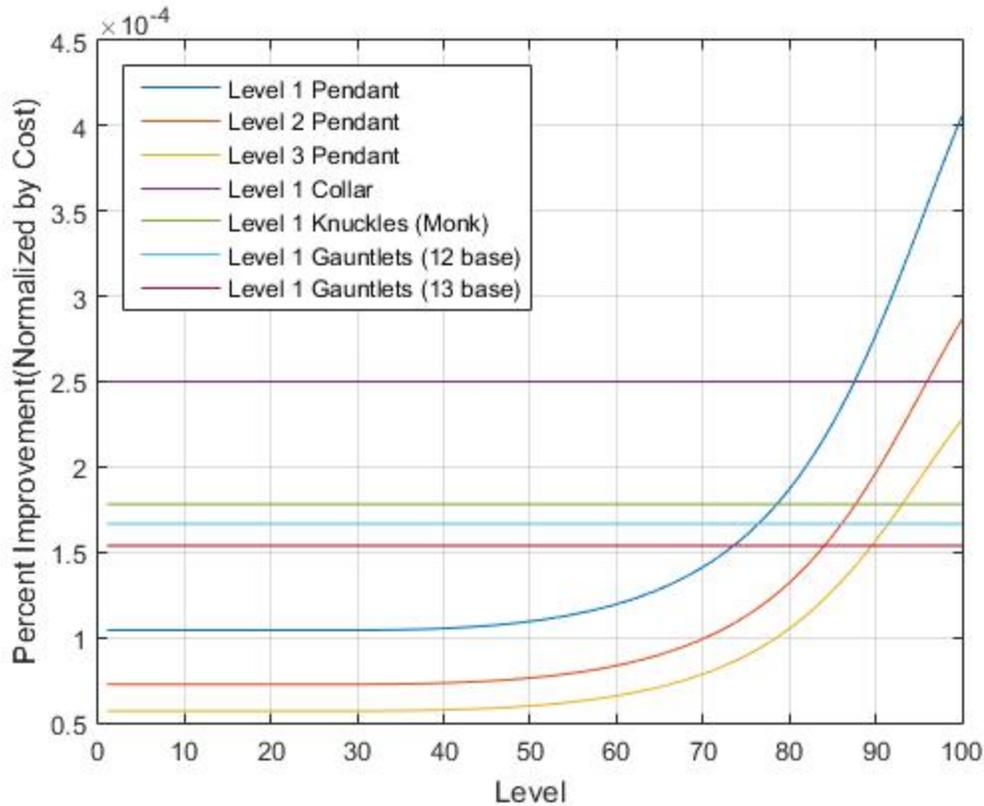
You can see that upgrading from 2 to 3 gives a better performance boost than upgrading from 1 to 2, and that one is better than 0 to 1. This isn't that surprising, given the always-increasing slope of the first plot, but it's nice to see it laid out without having to think about calculus. Again, notice the sharp increase around level 70. If levels were unlocked up to level 125, to give a crit rate of 100% at 125 (this is not the case, crit rate is constant after 100), you'd see an interesting feature; there would be a maximum around level 112 (Or  $\frac{2}{3}$  crit rate) after which the benefit begins to decrease. This is because of our limitation on maximum crit level; and this is the crit level at which you begin to see more world-shattering crits than any other type. That is, the crits sort of "pile up" at the end because they can't roll even further.

You might notice that the increased benefit from upgrading to a higher level pendant is not that much, and we know that each successive pendant is much more expensive than the last. Indeed, if you normalize the benefit to the cost of the pendants in credits, you get the following plot:



Now we see that the level 1 pendant reigns absolutely supreme in value. I don't think this is that surprising to most Achaeans; it's known by most that level 1 artefacts give you the most bang for your buck. Still, you can see that at low levels the level 1 pendant is 5-6 times more value than the level 3, and even at dragon it's about twice.

I went to the trouble to do all these plots of the crit pendants, I decided I might as well compare them to the other damage-increasing artefacts. Fortunately, all of the other damage artefacts have constant values (i.e., 10% for collar, 15% for fangs (but they're 150% the cost of the collar, so same benefit per credit)), so I plotted several of them against the pendants:



This is a good reference if you're wondering what you should buy next. All of these have been normalized by their cost; so this is a plot of extra-damage-per-credit you'll get. If your bank is limited, it may be worthwhile to get the cheaper but less valuable artefacts first, but that's a discussion for another time. Level 2+ artefacts have not been plotted, as they will be worse per-credit than the level 1 versions.

Also, the level 1 collar line also holds for silver fangs, knuckles for metamorphs, and anything else in the 10% for 400 credit family I may have missed. Notice that these artefacts are the *only* artefacts worth buying before upgrading to level 3 knuckles after level 90 (Although the previous bank considerations may factor in to your personal decision). Tekura knuckles are crap for damage value, and are beaten by a level 1 pendant as low as level 78. Strength gauntlets (Or +int arties for mages etc) are given at two different base values; the trend should be relatively clear – higher base strength leads to lower value.