Distinguished Primordial Mark:

I've designed dice myself, and studied the subject quite a bit. Like most, I used to think that the only way to make a really geometrically "fair" die was to use one of the Platonic solids, a Catalan solid, a dipyramid, or a trapezohedron (an anti-dipyramid, dual of an antiprism.) This makes sense: these are the only shapes which are properly face-transitive, where all the faces are exactly alike in shape and size and also in relation to one another, so there's no way there can be any preference for one face over another. Well, those and the dual of the Johnson Solid J37, the elongated square gyrobicupola, which is almost a Catalan solid. But I realized that was wrong when I saw a die on Shapeways made in the shape of a gyrobifastigium, Johnson Solid J26. The gyrobifastigium has 8 sides, of different shapes (some are squares and some are triangles); how could it possibly be fair? Ah, but it can only land on four of them! Four (the triangles) aren't stable, and it rolls off those onto a square. So, yes, the die is unfair, but in the sense that four of its faces have a 0% chance and the other four have a 25% chance each—which winds up being fair!

In retrospect, of course, it's already obvious. Barrel dice are long thin prisms with effectively 0% chance of landing on their ends, and coins are flat cylinders with effectively 0% chance of landing on their edges (there are documented cases of it happening, but still.) That's how those triangular d5s work: somewhere between the long triangular prism that can only land on its sides and the short flat triangle that can only land on its ends there has to be (by the Intermediate Value Theorem) a "sweet spot" where the odds of landing on an end are 20% and thus the same for each of the sides.

And that's what it looks like the hexacube folks have done as well. They're still only varying one parameter (the amount of chamfer), so it's straightforward to understand: chamfer very little or not at all, you get a cube or near-cube, with chamfered edges too small to land on. Chamfer all the way or almost all the way, you get something close to an octahedron that can't land on the square faces. Somewhere in-between there's a chamfer for any distribution of odds between the square and hex faces that you like, and they can tune that so they can assign the faces to numbers such that it winds up fair.

Something like this requires more "trust," in a sense, than geometric fairness. Anyone can see that a geometrically-fair die *should* be fair (whether or not it is), but something like this is

not obvious to the observer. You have to trust that the designer really did work things out and design dice so the unfairnesses cancel out and it winds up a fair die (or you can test it, of course.) Not necessarily a bad thing; just observing. This probably makes it harder for some people to overcome the knee-jerk reaction of "that can't possibly be fair."

There are also probably other ways to make a fair die. https://mathartfun.com/DiceShop.html has some "skewed" dice they claim are just as fair as normal ones, though tbh some of them have failed my chi-square testing. And I've designed a d12 that looks really weird but *does* have all the faces identical and I'm pretty sure it's fair as well, even though it is not Catalan or dipyramid or anti-dipyramid.

Oh yeah, I forgot: I also rolled a Hexacube d12 144 time (12× number of faces, data available on request), ending with a final score of 23.26%, which is nothing to be ashamed of, though it was in the 40s and 50s almost the whole time and only started dipping near the end. Probably needs a larger data set.

HexaCube Dice Company

Thank you for your comments on the theory side of the dice. Going into this, I thought that since HexaCubes were not Platonic solids they might be affected by things like bounce and surface friction. My experiments indicated that this was not true, at least to detectable degree. I think my misunderstanding was that these factors affect the entire roll. After my experiments, I believe changing chaotic motion to a different chaotic motion does not affect the odds. As long as the motion is chaotic, then the frequency of the results are determined by the shape of the die (again, to a detectable extent.)

I must confess I am disappointed in your appraisal of HexaCube accuracy. As I said above, I did almost everything in this project from 3d design to package design. One thing I did not do was statistics. I don't know the math. However, I did personally run the trials, and got good statistics people to look at them. I am told HexaCubes wildly outperform the competition in accuracy.

I'm aggrieved that the d4 performed 'pretty bad' in your trials. That should be the second best performer (perhaps third, behind d6). While I have thousands of rolls on various prototypes and flawed manufactured samples, I have a two sets of 200 rolls for the HexaCubes I am making now. Through the development process it became clear to me that the theory was sound, so I just rolled those two samples sets to make sure that nothing was awry.

One suggestion on your methodology, there are two geometries of dice in the basic set. all the 20mm are the same, and all the 18mm are the same. (Oddlings will not have that correspondence.) If you consider the four 18mm dice as a set, I think you will find the square/hexagon ratio to be very good. Also with the three 20mm dice, as a set.
Comparing the d4 to the d8 would indicate the fidelity between the mold cavities and the uniformity of the final dice. Obviously, I want to be very successful in this regard. However the bone people will have to pick is with the design itself.

I hope that your results for the d4, and even the d8 are an anomaly. Here is a link to a 200 roll data set, if you are interested. There is more where that came from, including 200 more rolls each on two sets of d20 pairs. I also left a link to my guy's analysis of the trials right below the sample. Also, at least two other Primordials have done some runs, and have given my work their stamp of approval.

I am curious whether the different assessments are just a product of random variance, or if you think my current assessment of the fairness of the dice is misguided.
Walter and I made additional claims that our d20 pairing blew away the online stats for Chessex and Game Science d20s. do you think that is true?

I realize that you don't work here. So feel free to ignore all of this. But if the subject interests you, I would value your input. I don't really know what the Chi test is, (I've learned it and forgotten) but I don't like that the d4 did not impress. Thank you very much for the effort you already put in.

Whoops, forgot to add the link to the data I was discussing...
https://rollhexacubes.com/dice-resources/

Distinguished Primordial Mark:

Please don't mistake my reports on my results as an indictment against the fairness of Hexacube dice. I tried to make it clear that I did *not* think my experiments really proved hexacube dice to be any worse than others.

To be sure, the d4 had some awful performance, but like I said, I've seen really awful performances from other dice as well, even ones that otherwise seemed fair. In fact, I've even had times where I had an abysmal score with a die, then decided to do a whole new series of rolls with it and saw no signs at all of bias. (which therefore would tend to cast doubt on the reliability of the test, I guess.)

You clearly put a lot of *informed* thought into this design, not just "gee, it should be..." And more than that, you put in a lot of experiments, which in this kind of situation are worth a whole lot more than theoretical design. A really fantastic design with subtle flaws in the production is still a rotten die, and only experiments will find that out—and you did those, too. There is certainly room to find fault with my results. I didn't roll from a cup, I didn't roll on a perfectly level surface... I said at the outset that I made no claims as to the validity of my rolling methods. OTOH, normal people don't roll in perfect ways either. And it sounds like you've done a lot more experimenting with different rolling situations than I did anyway.
If you had "good statistics people" look at your results, it's very likely that they are better statistics people than I am.

I certainly hope the d8 results were NOT an anomaly: that die came through with flying colors. 84% is much higher than I ordinarily see, and even if it had been at its low point of 15% at the end of the experiment, that STILL counts as "no evidence to consider the die biased." The d4's results might have been an anomaly, as you say, and I said above as well. Maybe it needed some more rolling, maybe the data set was small. Maybe it was having a weird day. As for the d12, 23% is NOT a bad score. It's important to remember that it isn't about getting a high score, and a high score is better than a low one. So long as the score is above the pre-determined threshold (and it's important that it be pre-determined), the die passes and we

don't have a reason to suspect bias. Your d12 *passed*, and did not do "poorly" or "not so great." It did Just Fine.

> I am curious whether the different assessments are just a product of random variance, or if you think my current assessment of the fairness of the dice is misguided.
I'm sorry if I left the impression that it was in doubt. You're obviously doing something right: your data shows that and even my test of the d8 agrees. The d4 was wonky, maybe that means something, maybe it doesn't. It has the same geometry as the d8, as you note, so why should it have different results? Dunno. The fact that the observed skew aligns with the way the faces were numbered does seem significant to me, and maybe it is, but maybe it's because of how I roll (so to speak.)

The chi-squared test is described at https://en.wikipedia.org/wiki/Chi-squared_test, and tbh I'm not even such an expert at it; I just know it's the right test for dice and how to apply it. You have to understand what the result means: for a series of rolls X, it's the odds that you'd see a distribution of rolls that's as skewed as X is (or worse), IF the die really were fair. So if the result is 25%, that means that a *perfectly* fair die will roll a series of rolls that's as skewed as what you're seeing 25% of the time. That's no reason to reject a die; it might well be completely fair and you're seeing one of those one-in-four cases. So you set a threshold, usually 5%, and say that's the point where you begin to suspect. A fair die only has a 1 in 20 chance of giving results like that, so maybe I should start to think something is wrong. And even then, maybe I just happened to hit that 5%. It happens once every 20 times, after all (https://www.explainxkcd.com/wiki/index.php/882:_Significant). For that matter, I'd be mighty suspicious of a die that always showed a score of something close to 100%. A normal die shouldn't be THAT perfectly even in its distribution over a finite number of rolls. Maybe something is up with it.

I have no real reason to doubt that the fairness of your dice is as good as normal polyhedral dice, and in fact I can believe that you'd do better (as you claim to), since the chamfered cube is probably a much simpler shape to get *right* and within good tolerances than some weird shape with strange angles like an icosahedron or dodecahedron. And I've heard bad things about an awful lot of commercial icosahedra (I wouldn't be surprised if an ordinary d10 paired with a cube labeled as a d2, or a coin, outperformed an ordinary d20).

I'm probably going to roll some more of your dice anyway, depending on the level of boredom in my day... It sounds like I've only done different version of a single shape so far, and the d10 really needs trying out. I'll post results here if you like, or we can take this to email/DM.
I wasn't trying to cast aspersions on your dice. On the contrary, I was trying to show that they really DO seem to be fair, despite their unalike faces. I had to report the failure with the d4, true, but most of the results were quite good.

HexaCube Dice Company

I think you did a good job giving context to your trials. My question/concern was whether your trial of the d4 conflicted with my data. It seems like you are saying both could be true. Regardless of your actual findings, I welcome the input. I would prefer that we continue to discuss this here, if you choose to continue. As you say, there are likely a lot of people that find my dice suspect, but are not interested enough to comment. I have been looking forward to having an in depth conversation in a public forum that I can direct skeptics to.

I perhaps made a mistake by writing I was a 'little disappointed' by the results. When some say that, they mean they are so upset they are going to bring it up. I just mean I am a little disappointed. Also, I used the word aggrieved. I just like that word.
I think you are selling yourself short on your qualifications. You have very clearly considered a lot of the issues that I studied creating HexaCubes and selecting a near Johnston Solid for my dice. The fact that you understand that HexaCubes are only a matter of finding the correct chamfer, which must exist, means that I can discuss things with you that I can't with others. I wrote dozens of emails trying in vain to explain to dice makers those concepts. This is not an exaggeration.

There is no reason for me to doubt the theory behind HexaCubes or the experimental process used to arrive at the correct numbers. The experiment regime was designed by a person with a Master's in computer modeling, and the actual math was done by an archeologist that uses this sort of math in his work. That said, I will always have an unreasonable fear that someone will walk up to me and say "HexaCubes obviously can't be fair, and here is why." And they will be obviously correct. That won't happen, but I will continue to worry about it.

More worrisome still, is the notion that I am making 'x' bad dice that are so misbegotten, that even redundancy cannot save the results. Since I have made many thousands of HexaCubes, 'x' cannot be zero. But that is pretty much all I know right now. I would be disappointed to discover that your d4 was so off, that it skewed the results. But, obviously that die will exist somewhere. I am hoping that such a die will be visibly deformed.

Rolling technique should not matter. During the invention process, I anticipated that I would have to specify the sort of rolling that would be needed to make HexaCubes fair. I ultimately found no bias, under gaming conditions. For awhile, my results in long rolls (longer than 2ft) were wonky, but they eventually evened up. I welcome you to find the breaking point of the dice. I still suspect that such situations exist and HexaCubes are not fair if rolled in a pan of water or something. It is my hope, and my premise, that HexaCubes should work in any gaming type situation such as cup rolls, hard rolls or rolls on slightly off level surfaces. Again, if you want to do those investigations, you are welcome to report them here, good news or bad.

For those that are following along, Mark performed a statistical test, and one of my die did not do well. Mark has clarified that is possible for a fair die to not do well in that particular test.

For my part, I stand by the accuracy of the dice. However, I concede that manufacturing defects are inevitable, and somewhere there is are HexaCubes that are not fair. The question is 'how many'?

I cannot stress enough that I am thankful and humbled by your interest in HexaCubes.

Distinguished Primordial Mark:

I should probably re-roll that d4 and see if that reassures you. Like I said, I've had dice that did *awful* and then restarted and they did fine. I don't know what that says about the meaningfulness of my tests. (Maybe I was just hitting that 1-in-20 case.) For that matter, when I rolled your d10 today, after the first one or two dozen rolls I think I still hadn't seen a single 6, and I gave it a do-over and started again. After 200 rolls it ended with a final score of 24.93%, which again isn't "bad" or "just passing," it's a *pass* and it means there is no evidence of

bias. It looks like in the end we were short seven 6s (i.e. out of 200 rolls, instead of the expected value of 20 6s, there were only 13), and an extra seven 4s. There were eight extra 9s. But again, this is *within expected results* for a completely fair die.

(Could I have misread some 6s as 9s and vice-versa? I don't think so, I tried to be pretty careful. I'm also a font-designer, or at least a font-geek, and I can appreciate the distinction you make with the straight tail for the 9 and the curved one for the 6 (which is the way I would do it) instead of using dots or underbars. It might take some getting used to for some people.)

The running score of the d10 was all over the map, all the way down at around 7% at roll #10, then back up and hanging out in the 80s and 90s for a long time, and wobbling back down and up into the 50s and down into the teens, etc.. Again, expected behavior, and roll-sequence available on request. Rolled from a cup this time, on a stabler and more level surface. I think you're right about rolling technique in general, but there are some possible issues. Your dice tend to roll a lot along one axis, the axis that's perpendicular to the direction in which they were cast. If that isn't properly randomized, that could be trouble, etc. Most of these cases involve presuming a dice-roller acting in bad faith, though, and there's not much you can do about that. And "obviously" geometrically-fair dice aren't all free of them either. You're definitely going to have to put up with some "there's no way that's fair" reactions. There are many people who distrust the triangular-prism d5s and pentagonal-prism d7s for the same reason. And again, it comes down to trusting the designer. The difference between a fair hexacube, with its probabilities properly worked out and given the right chamfer, and one with wildly wrong probabilities is not something that's visible, even with careful measurement (because you still have to work out how those measurements affect probability, which is beyond most people, including me.) You *say* that you have things worked out so they're fair, but how do I know I can believe you? Well, you have evidence, you've rolled it a zillion times, etc etc... and that's about the best you can do, and about the best that can be expected. But there will be a lot of people who simply can't accept that such an "obviously" unfair die (different-sized faces, without even having each number on the same number of the same kinds of faces) can be fair. And I can't really suggest anything that would change their minds, and I guess it's just something you have to shrug and deal with.

I had fun playing around with the math a little, of how you were doing the dice I have, and the oddlings, and oddlings you might not have done yet. I see how you only need two shapes for the ordinary seven dice: one with x=2y and one with x=3y (I use x for the probability of landing on a square face and y for the probability of landing on a hex face.) The d2, d3, and d6, of course, can have any values of x and y. I found ways of doing all the numbers from 2 through 18, except for a d11, d16, and d17. The last two are pretty obviously impossible, and I'm pretty sure the d11 is as well. I found five different d7s; at least some of them can be turned into d14s. I didn't really look much for alternates of other dice. Some of my results had some really wacky values for x and y, like a d7 with x = 5y and another with x = 12y! And a d13 with y = 6x, etc. You've probably already considered these and chosen the ones easiest to make work by chamfering. (I don't know how the probabilities vary with the chamfer; I imagine it isn't a linear relationship. I guess you'd want to pick values where the derivative is comparatively low, so small deviations wouldn't cause outsized changes in the probabilities.)

A proof by the Intermediate Value Theorem and solving for x and y should be pretty definitive in terms of demonstrating to someone that hexacube dice *could* be fair. There obviously is *some* chamfer that would make it work (oof, but obviously I was wrong about a "completely" chamfered cube becoming an octahedron. Would you get a rhombic dodecahedron?).

Proving that you found that chamfer and that the manufacturing tolerances are fine enough that it works out is another matter, and people will give your grief about it no matter what you say. (And I can easily see people who can be faced with indisputable mathematical and physical and experimental proof that they're fair, and still just not be able to accept a die that doesn't have the symmetries they're expecting.)

HexaCube Dice Company

Oh, hi Mark,

(I'm sure you are sick of that bit. I will probably never get tired of it.)

"I should probably re-roll that d4 and see if that reassures you. "

It isn't necessary for you to do extra stuff, like reroll the d4, to make me feel better. That is kind of you, though. As I said before, and as you explain below, that little nagging doubt is irrational. The only thing that can really go wrong here is a widespread problem with the manufacturing process. There's no real point in worrying about that until there is evidence of an issue.

I suspect that a higher sample number that 200 is required for 10 outcomes. That is the number I was assigned by the math geeks to test 2 outcomes (square and hex).

"...I can appreciate the distinction you make with the straight tail for the 9 and the curved one for the 6 (which is the way I would do it)..."

The six and nine convention I am using has gotten mostly positive reviews. A few people mentioned not liking it. Also it has been suggested that it might not be a friendly solution for certain neurodivergent people. Overall I think that detail is a success. I am open to changing it in the fairly far future, when I have to retool.

"I think you're right about rolling technique in general, but there are some possible issues. Your dice tend to roll a lot along one axis, the axis that's perpendicular to the direction in which they were cast."

I worried about the rolling on one axis behavior you are talking about. I determined that in, nearly all cases, either the die makes a few chaotic moves before this happens, or the die's axial roll decays into a chaotic bounce at the end. As you say, this is also an issue with regular cube dice, though it is less likely to 'naturally' occur. Allegedly Vegas sharps practice doing this with regular cubes to increase their odds a bit. They can teach you for $999, or whatever. Sounds like a great way to bounced by casino staff. Whether this is easier or harder with HexaCubes, I can't say. Keep in mind that the 18 sides make it much harder to find an advantageous axis because I have much more control over 'hotspots' where the values are high or low. I think it is conceivable that someone could finesse HexaCubes without making it obvious. But that is only because people can do anything with enough practice. Again, even when Hexacubes roll like a wheel, there is almost always a chaotic move before, after or both. That move serves as a randomizer. Even then, each axis has eight outcomes, not four.

"You're definitely going to have to put up with some "there's no way that's fair" reactions."

Oh, I deal with that plenty. This conversation will help me with that a great deal in the future. I agree that some people are just not going to buy HexaCubes being fair, no matter what. I consider it my mission to be as convincing as possible to as many people as possible. I don't mind nonbelievers. But I will need to engage people that erroneously think the have proof that HexaCubes are not fair and are in a position to convince other people to not buy in. I also have to be careful not to seem petty or aggressive while doing so. I don't want to be one of those creators that has online beefs with people that do not like my dice.

"I had fun playing around with the math a little, of how you were doing the dice I have, and the oddlings, and oddlings you might not have done yet."

"A proof by the Intermediate Value Theorem and solving for x and y should be pretty definitive in terms of demonstrating to someone that hexacube dice *could* be fair. There obviously is *some* chamfer that would make it work …"

Your reasoning that leads to there necessarily being a correct solution is sound. On your speculation on how the math works... I prefer not to comment. There are some pitfalls that can cause people to come up with the wrong answers. Frankly, I hope they do, then make bad dice that I can publicize. This will make me the 'trusted brand'. If you do end up doing the work, please don't post it here. I would prefer that you not tell anyone, but I am not in charge of that. Other people will certainly be able to work out the geometries behind HexaCubes. But they won't get help from me :-)

Eleven outcomes on a chamfered cube is, in fact, impossible. It will work on a truncated octahedron. Early versions of HexaCubes were split between chamfered cubes and truncated octahedrons. I think chamfered cubes are the better solution. One reason is I felt like truncated octahedrons would be easier to finesse, as discussed above. The higher numbers of outcomes, do not have enough redundancy for me to consider them implementations of my method. D18 is trivial in the context of my method. I think you will find that you are mistaken that there are solutions between d12 and d18.

"(oof, but obviously I was wrong about a "completely" chamfered cube becoming an octahedron. Would you get a rhombic dodecahedron?)"

Chamfered cubes are an imperfect Johnston Solid. So on one end of the scale you have a perfect cube, and on the other you have something that wants to be a regular dodecahedron but has only irregular hexagons to work with. By extension, there is no chamfered cube with regular hexagons. The angles are slightly wrong for that solution. Chamfered cubes are closely related to rhombic dodecahedrons and are easily transformed into them. I would have to look up the details to remember exactly how.

"Proving that you found that chamfer and that the manufacturing tolerances are fine enough that it works out is another matter, and people will give your grief about it no matter what you say. "

This is my assessment as well. For the reasons you lay out, I know I am right about this. Essentially I just have to wait for someone interested enough to formally replicate my results. In the meantime, I will have to contend with a lot of naysayers that have flawed proofs that I am wrong, even though I definitely am not.

Once again, thank you for this. This conversation encapsulates the thought process a lot of the more mathy people go through when thinking about HexaCube dice. It is nice to be able to address the most common concerns in one place, as opposed to comment by comment. After we are done here, I would like to edit this down and use it in the future. I also may add it to my 'Are HexaCubes Fair' page on my site. Pending your permission, of course.

Distinguished Primordial Mark:

"It isn't necessary for you to do extra stuff, like reroll the d4, to make me feel better."

No, but a bad result like that bothers me, too, and needs to be confirmed (or disconfirmed).

"The six and nine convention I am using has gotten mostly positive reviews. A few people mentioned not liking it. Also it has been suggested that it might not be a friendly solution for certain neurodivergent people."

It's mostly a style-choice thing, and you're always going to have disagreements. I suppose someday I should work out a really, really clear and hard-to-misread font for just the ten digits, that avoids things people forget to look for, like "8" and "6" looking alike (that curly top on the six can seem like it's closing down...) Or look for one someone's already made. The neurodivergent are, by definition, divergent, and what's good for some will be bad for others. It's balancing act.

"Your reasoning that leads to there necessarily being a correct solution is sound. On your speculation on how the math works... I prefer not to comment."

Well, I certainly didn't work on math involving what chamfer gives what probabilities. I just assumed you have 6 faces with equal probability x and 12 faces with equal probability y, and you could set x and y to anything you wanted so long as 6x+12y=1. Now, my assumptions may be wrong, maybe there are constraints I don't know about.
"I think you will find that you are mistaken that there are solutions between d12 and d18."
I don't see what's wrong with my reasoning, assuming that x and y are free to vary:

(OOPS, typed in my solutions for 13, 14, and 15, as well as the five d7s I found, then saw your request not to post it here! Maybe I'll DM you. I'm curious what's wrong with my reasoning regarding 13, 14, 15. But I don't know that my math is really what you're worried about leaking out. My math isn't all that complex, and it *definitely* doesn't involve the physics

or anything about the actual engineering. It's purely a numbers game, of how to split up 6 x's and 12 y's into N groups such that each group is worth the same, assuming I'm allowed to make Ax = By for whatever A and B I want.)

As I said before, I figure chamfered cubes are a good choice for you also for practical purposes. I imagine (and only imagine: I have no experiential basis for this) that it's easier to make a chamfered cube to precise specs than some weird dodecahedron. Chamfered cubes seem like much better-behaved shapes. Chamfered octahedra? Lacks the solid orthogonal cubeness, maybe not as easy. On the one hand, 18 faces seems at first glance like a really bizarre number to make work as you make it work, but on the other hand, hey, it *does* work.

"By extension, there is no chamfered cube with regular hexagons. The angles are slightly wrong for that solution."

Interesting. I would have thought there would have to be, again by intermediate value.... no, it doesn't work like that. The two extremes don't necessarily contain the "mean" we're looking for, it isn't like it's short fat hexagons at one end and long skinny ones at the other. Truncating is easier to picture, for me, than chamfering, and also when it comes to thinking visually vs non-visually, I'm definitely nearer the non-visual end of the scale. I *think*, and maybe this is what you mean by "related", that if you chamfer the cube "all the way", i.e. until the square faces are completely gone, two of the edges of each hex will have shrunk to zero and you'll have rhombs, and thus a rhombic dodecahedron (which, btw, is quite a handsome and distinctive d12). Rhombic dodecahedra are interesting shapes (dual of cuboctahedra, for people reading my other boring posts). Five of the six regular polytopes in four dimensions have some correspondence to the five regular polyhedra in three, but the sixth is unique and in some ways corresponds to the rhombic dodecahedron... which for some reason is

accidentally not a regular polyhedron in 3-space. Oops. (Beyond four dimensions, every dimension from five on up has only three regular polytopes.)
Invoking the Intermediate Value Theorem should be enough to convince someone that it's POSSIBLE for it to be fair. They might fight about differences in rolling making a difference or something, but it ought to be a firm case that it COULD be done, even for the naysayers with "proofs."

It would be great if you could use this conversation and my observations to help make your point on your website. And I would say that even IF I didn't like or trust hexacubes myself, by the way. Clear thinking and clear debate are things that people should be exposed to more, on any topic, and it's good to help out someone trying to do things a different way. When they give you lined paper, write the other way, I always say.

Distinguished Primordial Mark, later:

All right, let's set minds at ease. I re-rolled the d4, 240 times (twice as many as the last time), and it ended with a completely acceptable 36.66%, having spent most of the time even higher up, in the 60s and upward. The skew was eleven too many 1s, balanced by a shortfall of eight 4s, two 2s, and one 3. Again, this is what's *supposed* to happen. It isn't supposed to be perfectly even, that's what being random is all about.

You know, when I first saw hexacubes, I, too, reacted with "that can't be fair." The thought process started with "that can't possibly be fair, both because the number of faces isn't a multiple of the index number of the die, and also because the faces aren't all alike!" And then "wait, if the faces aren't all alike, maybe they can use that along with numbering to cancel out the two sources of bias." But it still seemed pretty far-fetched, even at that point. They can

really balance those so well? Oh, but the chamfering gives them control over the probabilities and they can tune to exactly what they need. The hard part is being convinced that you actually DID it, and your tweaked chamferings really do give you the probabilities you want. (it helps a little to find out that it isn't even really complicated and you're looking at things like x=2y and stuff.)

HexaCube Dice Company

Hello Mark,

Thank you for extending the test for the d4.

When you say the math is not complicated, you are totally correct. My talent lies with telling ghost stories. To say that I am not an engineer would be and understatement. I would be surprised if I 'math' at a 12th grade level. Very surprised.

If the math was complex, we would not be having this conversation right now. I am simply not capable in that discipline. In my opinion, HexaCubes are a clever answer to the stupid question "How can Platonic Solid dice be improved?" I do have a knack for asking the right stupid question.

The thought process you describe above is the typical one for people that see my dice and are a hard "nope". I confess that I had many of the same concerns when I started. It is really gratifying to know that you have done the trials yourself, and are satisfied with the results.