A Conceptualization and Analysis for the Aesthetic Design of the Zero Reel

by

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A CAPSTONE PROJECT

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Abstract

This paper explores and explains my concept for the aesthetic design of the Zero Reel. I worked with my father, a mechanical engineer who invented a fishing reel that solves the problem of backlash. I moved through concepts in several different mediums and eventually came up with something beautiful and plausible. My final concept is expressed in a few refined sketches and a to-scale model machined out of plastic. This paper walks through my design philosophy as it developed through research, a description of the physical concept and its functions, and a few extra benefits of its unorthodox construction.

Introduction

My favorite fast-food place is In-N-Out Burger. They serve great food and have excellent service. Their prices are competitive. They are not so different from any other medium-tier hamburger joint, except for their menu, which has roundabout five items on it—usually a hamburger, a cheeseburger, and three flavors of milkshake. This is why they are my favorite restaurant. I basically don't have to choose. I don't have to spend any time wondering whether one item will be worth the cost, or if the one I've chosen will taste better than an alternative. All I have to say is whether I want cheese or not, and how many burgers I would like. Because they only serve a handful of items, their service is remarkably fast, and their quality is consistent and delicious. They stand out because they have made the choice already. In a sense, my order was placed before I walked in, and I am just arriving to enjoy the undoubtedly satisfying food.

In contrast, I hate shopping for toothpaste. It takes too long, presumably because I am not a dentist. When the day comes that I squeeze the last bit of life out of the tube I've been

using, I am forced to go to the store, where I am overwhelmed by an entire aisle, jam-packed with hundreds of kinds of toothpaste. Most are packages in boxes about the same size. Some are more expensive than the average by a few dollars. All of them claim to have some feature that sets them apart from the rest—usually something like "supreme whitening power" or, "with cavity protection." I am paralyzed by the number of options available. I expect any one of them would clean my teeth, but I am skeptical of buying the cheapest kind. In fact, I'm somewhat skeptical of all of them. I am not a dentist—I don't know what features or ingredients I want my toothpaste to have. *I merely want to brush my teeth.* In this situation, being unable to effectively analyze all given options, I must "satisfice." This term, used in Herbert Simon's *The Sciences of the Artificial*, refers to the phenomenon where optimization is too costly to be worth it, so the first adequate solution is selected. My project doesn't have much to do with toothpaste or In-N-Out Burger, but it has everything to do with the principles behind these anecdotes.

I intend to become an industrial designer. I find that most people are unfamiliar with this, so I'll briefly explain it. Industrial designers are responsible for the aesthetic of everything from cell phones to sports cars, and they help engineers design the functions of things. They design furniture, toys, appliances, packaging, tools, automobiles, and more. Their job is innovation, invention, and aesthetic design. They assure that things are easy and intuitive to use. They are often invisible when successful, because good design doesn't call attention to itself as loudly as bad design does. One may recognize, however, some famous industrial designers, such as Jony Ives, who designed the iPhone, or Adam Savage, a host for the show, Mythbusters.

Because I mean to pursue this field, I wanted to choose a capstone project that would help slingshot me into it. I decided to help my father, a mechanical engineer, design the outside of a fishing reel he has invented. That said, most thesis projects for industrial design students

look a little different from the one I have come up with, but I have done my best to work with what I have in the way of academic and material resources.

When I decided to design a fishing reel, I shopped for one first. I scoured the internet, looking for anything that stood out. I found that there are thousands of reels on the market. I narrowed my search to "baitcast reels"—the type which I had originally set out to design. There were still hundreds with various colors and price points. Without an advanced knowledge of both engineering and fishing, I began to realize that no one could be qualified to say which reel was the very best. I'm sure there is a "best" reel out there, but I'm convinced that it is quietly hidden away in all the noise, with an overcomplicated design that looks like every other baitcast reel on the market. They are admittedly "different," but the margins of variation are small. Each baitcast reel is essentially another flavor of the same design. The marketing, too, is unhelpful—most reels claim to be the finest one there is, usually because of some added gimmicks. Some reels may genuinely have nicer bearings or materials, but the differences in performance for a given price range is undetectable by an average consumer. An average fisherman is forced to satisfice, since no reel sufficiently stands out in its capabilities or aesthetic. This means it largely comes down to the aesthetic of the product to catch the buyer's attention.

The Zero Reel

Several years ago, my father came up with a concept for a baitcast fishing reel that would never backlash. After constructing a working prototype, he garnered a group of investors and formed a company called Zero Reels Inc. The Zero Reel, due to its new capabilities, is not aesthetically limited by the current convention. It has opened the door for a design that is truly new, eye catching, and simple. Between the engineering and a striking, intuitive, self-advertising design, the Zero Reel has the potential to satisfy everyone from professional anglers to people like myself who buy a reel because they merely want to catch fish.

Traditionally, baitcast reels, which are a type of freshwater reel for all levels of fishermen, are selected over other types because of their ability to cast far, their strength when reeling in, and their relative ease of use. The thumb is placed directly onto the spool of line as a cast is going out, and the user brakes by applying pressure. If something goes wrong, however—a breeze catches the lure, a user fails to brake the spool after the lure lands in the water, or the lure collides with an obstacle—the line will backlash, creating a knot, sometimes the size of a fist, around the reel. This happens because the weighted spool is seated on a bearing, and will continue to spin after the lure has reached it's target, and the line is no longer being drawn out. Loops form rapidly and evolve within an instant into what some call a "bird's nest." Even expert fishermen are plagued by this problem. The response time and attention needed to consistently prevent a backlash would be superhuman. Thus, the Zero Reel.

Put simply, the Zero Reel is outfitted with an internal camera that watches the line spool out. Using line-detection software, a tiny onboard computer is able to see a backlash before it happens, apply a brake, and save the cast. The first prototype works. Another prototype is on the way. My job is to present aesthetic design concepts and work with my father as he continues

to design the internal workings of the reel. The long-term goal is to reach a consensus where the engineering and aesthetic work in harmony.

Eliminating backlash, the Zero Reel is naturally accompanied by several delightful side-effects and simplifications. First, the reel is theoretically optimized for maximum casting distance. The autonomous brake leaves no room for human error, and does not actuate until the instant it is needed. Fishermen may prevent a backlash on a normal baitcast reel, but they do so at the cost of casting distance. There is also no need for the spool to be exposed in the Zero Reel. Every traditional reel design, save spincast reels, must leave the spooled line exposed. The Zero Reel, having eliminated the reasons for this, is exempt. Furthermore, because the spool does not need to be exposed, it can be oriented on any axis and on any part of the reel. These factors lend themselves to incredible aesthetic possibilities in a market where the existing limits have been thoroughly explored.

My Design Philosophy

Not all things so nicely fall into the category of ideal design objects, but a fishing reel does. Their size, timeless functionality, mechanical (vs. electrical) quality, and broad market make this design job relatively quintessential. On the other hand, the new technology and capabilities of the reel raise questions about how closely the modern model of the average fishing reel should be followed. In searching for this answer, I immersed myself in books on design and fishing, along with journals documenting behavior related to design. I have been left with a design philosophy, which has guided my choices and thinking throughout this job.

Simplicity is the first and most commanding idea in my design. In reading *The Laws of Simplicity* by John Maeda, I found that simplicity in design might be better described as humility. Some designers assume that their product is itself so extraordinary, that they include

an enormous amount of unwanted features. Suddenlink's universal remote control, for instance, has sixty-one buttons and a battery cover. It's absurd. No one in my house can interpret the remote, much less the user interface. The mute button, which is handy for thriving in our advertisement-driven world, is amazingly camouflaged in the mess of controls. The remote is so "capable" that it is unusable. In fact, there are really only a handful of controls anyone regularly uses—volume, power, channel, and input. Anything else should be accessible through the joint use of the software interface and some arrow keys. This attitude is the key to my designs on this project. If anything can be eliminated, I have tried to eliminate it. I mean to construct a very humble fishing reel that doesn't interrupt. If a fisherman were to spend an entire day fishing and never notice the reel he was using, I would consider my design an absolute success. As Don Norman, an authority on design, said, "Good design is actually a lot harder to notice than poor design, in part because good designs fit our needs so well that the design is invisible, serving us without drawing attention to itself."

With this view of simplicity, I have made a few decisions concerning the materials, abilities, and general shapes of my reel concept. First, my design incorporates three main materials, each one being distinctly different and complementary to the others. As far as abilities, I have designed a single button to release the line that will double as a manual brake, and triple as an activator to expose the chassis. There will be a small wheel to adjust the drag, and, of course, a handle with two tabs to reel up the line. It will have a foot at the bottom of the reel to connect it to any conventional rod, of course. The body design is sleek. There are no logos or words printed on it, and no groves or complex contour lines. I believe that empty space and a beautiful, plain shape speak loudly enough on their own. Everything that can be simplified, has been simplified.

There are, then, three major controls for my concept a red button, a drag adjustment, and the handle. Because the reel is impossible to backlash, I imagine that anyone could learn to use it very quickly. This brings me to my second driving factor—signifiers. Signifiers, a term coined by Don Norman, are those things that indicate to a user what action must be taken to elicit a response. Signifiers tell the user what to do. For me, the best possible signifier is a big red button. Red buttons need to be pushed. They are self-explaining, elegant, and timeless, and thus make the perfect signifiers. In the same way, it is obvious that the drag control is separate from the reel handle, and turns like a wheel. A user would not expect to be able to interact with it in any other way. I have taken care to avoid accidental signifiers—making things that appear to do something that they do not. No one should need an instruction manual to operate the reel, because the signifiers should give it away flawlessly. My emphasis on clarity in signifiers leads me into my next point: user experience.

User experience is related to function, but is not the same. Function is the primary concern of the engineer, but a branch of that function—the user experience—is a shared concern between us. How does the button feel when it clicks down under one's thumb? Does the reel give clear and warranted feedback? How does a user know when the battery is charged? The communication and interaction between the user and the product is the concern with this point. Though my concept is only presentable with descriptions, sketches, and models, I have done my best to design a theoretical user experience that is achievable, intuitive, and enjoyable. User experience is inseparably connected to the physical design itself. I mean to win the user's trust and interest first with the appearance, then with the feel of the materials and controls, followed by a new and unexpected user experience. Scientist Noam Tratinsky observed that things that had been more beautifully designed tended to "work better." In his study, people tended to be

more willing to cooperate with beautiful objects, but had trouble manipulating the less beautiful ones, despite the fact that everything functioned in the same ways. One can see, then, how the user experience springboards off of a beautiful design, and, in some ways, depends on it.

Similarly, function is also a concern of mine. Again, while this is primarily the domain of the engineer, the job of the industrial designer is to suggest functions based on his design, working toward a more optimal user experience. A light that lets the user know when the battery is charged is part of the user experience, but the way that the battery gets charged or replaced is the domain of function. The engineer may have a way to charge it already, but the industrial designer's job is to challenge those ideas with something presumably more elegant. At some point, a consensus can be reached between the engineer's prototypes and the designer's concepts.

These four overarching areas of focus—simplicity, clear signifiers, a pleasing user experience, and seamless functionality—have guided my decisions. There are also a handful of minor, more specific principles that have guided me, such as the golden ratio, contour bias, the "MAYA" principle, the Von Restorff effect, horror vacui, mapping, and the red effect, to name a few. I will not expound on these principles here, but several of them helped me more boldly make the littler choices that led me to my final product.

The Concept

My first sketches for this project were, looking back, a bit unrealistic. I sketched out dozens of forms until I found a handful I really liked. I began exploring these specifically, and moved on to working with clay. Because most of my designs were so contoured, I found clay to be the easiest medium to experiment with. As I progressed, the differences in the models became slowly more subtle until I had come up with a general form. I also worked with a

modeling and rendering software called SpaceClaim to achieve more precise renderings of parts of the reel. Finally, I began machining blocks of high-density modeling foam to achieve a lightweight, durable prototype, which I could attach other features to. My design process was not perfectly linear, however, and I occasionally found myself switching between all of these mediums in the same hour.

As I already touched on, the market is saturated with designs that all look the same, but these designs are all equally complex. On average, I find that they use four to six different colors and textures, are spattered with logos and the like, and above all, share a nearly identical shape. The shape is not unappealing on its own, but it is usually obscured by overcomplicated groves, screw-heads, and markings. Though many variations of the shape exist, its general form is apparent in all baitcast reels, due to the functional demands of the internal construction. My first instinct was to break the mold, so I did.

My concept is first distinguished by its unorthodox shape. From the foot of the reel to its highest point, it measures exactly four centimeters, which is thinner than the average baitcast reel by about a centimeter and a half. This is possible because the reel accommodates a spool that lays flat against the rod with a vertical axis. I should note here that simple tests showed that the anti-backlash mechanism would also work with such a construction. I was initially attracted to this shape because of the dynamic sense of motion it conveys, especially when seen from the side. It is mildly anthropomorphic, subtly resembling part of a human foot. Curiously, the initial inspiration for this form was a classic newsboy's cap. My earliest models reflect this. When looked at from the side, one can see the peak height of the reel set just toward the back, sloping down again toward the front. The lowest point on the underside, when seen from the same angle, divides the reel by the golden ratio. It is subtle, but some of the worlds most beautiful things

share the same ratio—the human body, violins, an iPod, etc. These same peaks create a space for the inner components, such as the tiny camera, onboard computer, and battery.

I decided that sandblasted aluminum would be an ideal finish for the reel for a handful of reasons. First, I don't feel that plastics, even the finest plastics, tend to convey a sense of high quality. Metal does. Aluminum, specifically, is having excellent success on the market, thanks to Apple's unibody computers and a few other products. It is lightweight for a metal and relatively resistant to corrosion. I envision the Zero Reel being used primarily in freshwater fishing, but I want to be sure that ocean fishermen can also enjoy the reel. To that end, I have decided that anodizing the aluminum would be a necessary step to ensure quality and durability. This will allow it to stand up even when exposed to saltwater. The sandblasting will give the aluminum a matte finish and prevent an otherwise shiny surface from collecting fingerprints and reflecting the sun into an angler's eyes.

Carefully integrated with the back of the body, a red tab extends for the thumb to rest on. This is the line release. It is made of a heavy plastic, but is covered with a layer of soft, matte silicone, rendering its otherwise crisp shape gentle to the touch. It functions a little like the button on a spincast reel, so that when it is depressed and released, the spool is released to spin freely. However, if pressure is again applied to the tab, a manual brake will gently come in, scaling with the amount of force applied to the button, much like the brakes in an automobile. I particularly like the idea of a red button. I have yet to find any where the line release seems very proud to be a button. They are too often lost in the noisy, overcomplicated design. With the Zero Reel, I want the line release to draw a person in. A red button begs to be pressed, and I think it will naturally advertise the reel. My aim is to elicit a visceral response from the user, so that merely pushing the button is a pleasure.

The button also has a more unexpected function. The body, though appearing to be one solid piece, is actually a shell that can be swung open, hinged at the front, by pulling the red button upward with the shell. Once opened, a lower shell, or chassis, is revealed. Attached to this are the major components of the reel—namely the gearbox, handle, and spool. This function essentially provides for easy changing of the line.

The housing for the gears is simple, having radial symmetry and an orthodox construction. It is attached to the chassis on the right side of the body. Beside it, on the same axis, is a meager drag control. The drag, for those who are unfamiliar, adjusts how easily a fish can strip off line from the reel during a fight. It prevents the line from having too much tension on it at any given time to avoid breaking. Most drag controls are massive wheels with long, elaborate, asymmetrical spokes. I never liked those, and I have never thought that so much leverage should be needed to adjust the drag. Thus, the drag wheel I have designed is small and textured with seven rivet-like knobs that run the circumference. Turning it has a gliding feel, and it clicks lightly between ones fingers as it is rolled to the right position. It is intuitive to use and invisible when not needed. Despite the drag wheel's meek form, it gives sufficient texture for even slippery fingers to manipulate. The subtle clicks can be felt and heard, providing feedback for a user.

The size of the drag is in part made possible by the sleek, unobtrusive design of the handle. I decided early on that a flat, plain piece of aluminum would be sufficient. I contoured it to be thinner at the ends, being thickest in the middle. Three screws—one larger, in the center, and two smaller, on the sides—elegantly secure it. The crank is attached to the two knobs.

The knobs are the bits that a user pinches between his or her fingers to wind the line up. In searching for the right form for the reel knobs, I have decided on a few criteria and points of

focus. They, like with other reels, will be replaceable in case a buyer prefers another style, but I mean to prevent such a preference from developing. Continuing with my theme of simplicity, I designed the knobs to have symmetry along all three of their axes. Almost all existing reels have knobs that are symmetrical in one of two ways: The majority of baitcast reels have knobs that are symmetrical in the sense that the top and the bottom are mirrored. While many of these "flip symmetric" knobs are extremely ergonomic and attractively textured, I feel that for about half of the reels I've seen, these knobs appear overdone and clunky, and detract from otherwise chic body designs. Other reels, constructed for reeling in much heavier fish, often have handles that are radially symmetric around their spinning axis. These reels have a great initial tactile attraction, but they denote a reel for a different kind of fishing than the Zero Reel aims to cover.

I have constructed my knobs with three way symmetry, which is a nice balance between flip and radial symmetry. This gives the shape a sort of quietness that does not distract from the body. Though I seek elegance in my design, I did not neglect the function of the knobs. Force, occasionally immense, must regularly be applied to these handles without causing the user discomfort. Creating an ergonomic design for the knobs was made easier because they are free-spinning, and automatically orient to the user's plane of interaction. The depression for the thumb and index finger are comfortable and sturdy, and they are covered with a durable, matte rubber for grip. I have also avoided any large detailing on the knobs, such as ridges and the like. Although these may add some initial interest, I find that smooth, ergonomic surfaces are entirely adequate to interface human fingers. A shape like the one I've chosen is difficult to describe, but it is essentially very simple, mildly ergonomic, and highly symmetrical.

Density is another factor to consider with the knobs. Good rods and reels tend to embody a sense of quality via density and balance. In a part of the reel that is so small and simple to

manufacture, I certainly do not mean to cut corners. The weight of knobs at first may seem to be trivial, but because they are free-spinning, their inertia is often and inadvertently indexed by the fingers of an angler. This inertia is jointly determined by the weight and construction of the knob and the coefficient of friction provided by the bearing. I can remember playing with the knobs on various fishing reels when I was a kid, and the ones I liked best were not chosen because of their shape. Instead, the ones I liked the best were the ones I could get to spin the longest. The illusion of an object being frictionless still maintains its visceral appeal, much like the red button.

Overall, I think my physical concept has promise. It's unique internal structure allows it to be thinner and sleeker than other reels. Its contours are appealing at the visceral level, and they add a tasteful degree of complexity. The red line release is a perfect accent to the body, giving the eye a place to start and rendering the object instantly as inviting, signifying how a person ought to interact with the reel and tempting a viewer to try. Users are rewarded with a satisfying, soft "punch" when the button is pressed. The gearbox is simple, and does not detract or clash with the shape of the body. The drag is elegant. The crank is sufficiently strong, but also elegant in its simplicity. The knobs, likewise, are simple yet comfortable to use, and have a sturdiness and weight to them. The bearings within are smooth, and let the knobs spin freely.

A Note on User Interface

The physical concept is the bulk of my focus, but I have also considered furthering the user experience. The relatively large amount of clear space on the aluminum body could be used as a sort of screen, with simple lights hidden just under the surface to provide extra feedback. The drag, for instance, in my opinion, has always needed more feedback than conventional reels

provide—I never know what the drag is set to until I manually tug on the line. Instead, imagine that you turn the drag, and a tiny, bright row of lights begins to glow from under the seamless aluminum. As you continue to adjust it, the dots begin to decrease or increase, indicating the amount of drag. The mystery is eliminated within seconds, and, when the drag stops moving, the tiny lights fade and vanish back into the smooth, sandblasted aluminum. This concept may seem impossible, but it has been done before on older Macbook computers. I believe it is perfectly feasible for a device like this. These lights, as well as more complex, screen-like displays could potentially be added. One can imagine placing their thumb on the surface of the circle on the top of the body, pushing slightly, and feeling a subtle click beneath what appeared to be a continuous piece of aluminum. The entire face of the reel would illuminate, giving data about cast distance, number of casts, temperature, battery life, etc. This is a true conceptualization, but I believe it is worth noting here as something to aim for and explore further.

More on Spool Orientation

I finally want to touch on the reasons driving my decision to turn the spool sideways. The vertical-axis spool sets my design apart from other fishing reels in a number of ways. I initially decided to orient the spool vertically because it would better accommodate the extreme forms in my early drawings and allow a much lower profile for the reel. It does this, lowering the profile by more than a centimeter below a given baitcast reel. While exploring this spool orientation, however, a handful of other benefits became apparent to my father and I. These helped cement my decision.

On a baitcast reel, the spool is broad, and a "level winder" guides the line back and forth across it while reeling in. This takes up a considerable amount of space, and adds a lot of

complexity to the mechanics. With a flat spool, however, no level winder is necessary. (Remember that baitcast reels do not use vertical-axis spools because a fisherman would not have a good way to physically slow the spool.) Instead, a simple eyelet is integrated just under the lip of the body that sufficiently, statically winds the line evenly onto the slim spool. This reduces the complexity and size of the reel, thus reducing the cost of manufacturing.

A second benefit is more theoretical, but worth noting. Because the spool has a larger radius than normal, the line is technically easier to initially draw off the spool. Imagine the radius like a post with a string attached to the top. A very short post will remain planted in the ground when pulled on from the top, but if one applied the same amount of force to a rope tied to the top of a telephone pole, one might just be able to pull it down. In this way, we believe that lures could be potentially cast further, as they would have more leverage to get the spool moving. The trade off, of course, would be that the spool's initial rotation would be slightly slower. We believe that any of this would be extremely minor factors, and likely would be totally invisible when everything was said and done, but I think it is worth discussing anyway.

Conclusion

Overall, I think this project was an excellent simulation of an industrial designer's job. Working with an engineer from a designer's standpoint was entertaining and challenging, and I am much more confident about my decision to go into industrial design than I was before. If I could do it over again, I would do it very differently. I count this project as a successful failure in that my final product is sufficient, but that my actual process of getting there was, put lightly, a learning process. I am excited about pursuing other projects, and already have a few in mind. This time, my planning and execution will look very different, knowing what I know now.

During this project, it dawned on me that truly good design is always done in service to the public. Good designers seek to sacrifice a lot of their time to save a little of everyone else's. They go through worlds of tedious examination, facing every possible problem with a product and come out with an innovation that saves every user thereafter from a few minutes of frustration. I think it is somehow noble, and I am inspired to keep looking for little ways to take the "backlash" out of things.

My hope is that, within a few years, shopping for a reel will be nothing like shopping for toothpaste. I hope this product becomes a clear choice for anglers of all levels. I believe this technology could revolutionize the fishing industry, and my father and I believe that an aesthetic like the one I have come up with could be a key to deliver this product to the top of the market. I hope we can provide the public with a top-of-the-line product at a reasonable price.

Fishing is fun. Messing with fishing reels and untying gigantic knots is not. "Zero Reels" is either a poetic name or an ironic one, but the product truly is centered around eliminating itself as much as possible. Zero reels. Only fishing.

Final Remarks

I was privileged to work with Professor Chris Stewart, who helped guide me through this project, as well as Professor Philana Pace, Professor Ryan Button, and Professor T. J. McLemore, all of whom encouraged and assisted me with different aspects of this undertaking. I am honored that this project was selected as a finalist at the Undergraduate Research Conference at Stephen F. Austin University, and am incredibly grateful for my professors being involved enough to get me there. Most of all, I am indebted to my dad, Jim Beckham, who let his kid

have a hand in his grand scheme. I am extremely proud of him, and incredibly fortunate to be his son.