

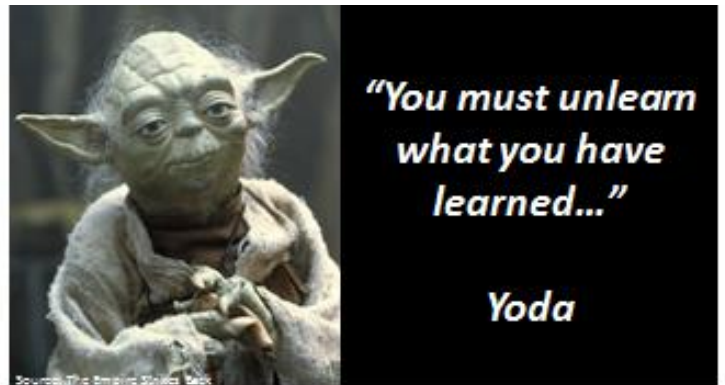
STAR WARS CONVEXITY

A first order movement is a change in position that is probable, standard, and easily conceived.

Higher order movements (second, third, etc.) are non-linear shifts in a position that are rare and not easily conceived.

Success in life and investing is often about sacrificing **first order effects (linear)** for the power of **higher order effects (non-linear)**. Name a single long lasting marriage where sacrifice didn't precede higher order trust and love. Name a single billionaire entrepreneur that didn't sacrifice a safe and linear salary to achieve untold wealth and change the world. Name a single spiritual leader that didn't sacrifice the physical body for spiritual truths. Despite this universal truth, **most of us do the exact opposite. Why?**

You must unlearn what you have learned... from the start of time early humans were hard wired to search for predictable patterns and to identify consistent first order cause and effect to support survival. To our ancestors, losing a day of food, or mistaking a predator for a rock, could spell death. Despite our strong linear perception skills an ability to conceive non-linear patterns was not genetically prioritized. Instead our ancestors rationalized the occasional volcanic eruption or earthquake to the anger of some pagan god. The inability for early homo sapiens to correctly perceive exponential change was arguably less important in a world without computers, nuclear weapons, the internet, cyber warfare, and artificial intelligence.



Fast forward 7 million years and today's world is teetering on the edge of disruptive change driven by complex systems. The potential for extremist outcomes are all around us as the post-Bretton Woods World Order collapses inward. In markets alone, fixed income and equity prices are at all time high valuations, yet our primal instinct remains on maximizing linear yield while ignoring higher order risks.

The riddle of modern investing is to find defensive assets that profit from extreme outcomes with positive yield. For the past 30 years, the primary asset to achieve this end has been high quality fixed income, however with global rates at the lowest levels in the history of human civilization, the defensive properties of fixed income are questionable at best, and dangerous at the worst. Traditional hedges and tail risk funds are difficult to own because the high negative carry offsets any gains accrued during a crisis. If you are up **+100%** in a crisis it doesn't matter if you lost **-50%** holding the asset, you are right back where you started. In essence, they are a costly hedge rather than an offensive weapon. Fortunately, a powerful alternative already exists... but nobody is paying attention.

Long volatility hedge funds have historically generated positive alpha and positive exposure to regime change by selling **first order movements** to finance exposure to **higher order movements**. For example, a 50/50 portfolio using only the **CBOE Long Volatility Hedge Fund Index** (Artemis is a member) and the S&P 500 index registered twice the risk adjusted returns of passive indexation and has beaten the average hedge fund by **+96%** from 2005 to 2016. Based on these results, you would think active long volatility would be a core component of the institutional portfolio, but instead the asset class remains widely under allocated. Why?

Long volatility runs counter to our primitive behavioral biases in that it sacrifices predictably linear gains for unpredictable non-linear exposure in an uneven return pattern. It is very hard to unlearn your biology, but this is going to be a story of why you should try... and that tale begins in a long time ago in a galaxy far far away with a young filmmaker named George Lucas.



In 1976, 33-year old George Lucas, fresh off the success of his successful film “American Graffiti”, was negotiating the fees for directing and writing an ambitious new movie. Lucas did something that seemed irrational at the time. Although the market for his directing and writing services was between \$500k to \$1 million, Lucas accepted a much lower upfront fee of \$150k. In exchange, he would retain all merchandising, licensing, and sequel rights to this new film. Fox Studios was more than happy to relinquish these higher order rights for a lower upfront salary because the executives had painful memories writing down \$200 million in unsold toy inventory on the failed 1967 release of Doctor Dolittle. Dolittle was a bomb with critics and audiences alike, but somehow the film earned 9 Oscar nominations, including best picture, because Fox Studios flat-out bribed the academy in a failed attempt to sell more toys⁽¹⁾. The common knowledge at the time was that merchandising tie-ins for wide release films were a failed concept, and the studio thought Lucas was either too young or brash to know it. Lucas perceived his new film as a franchise from the start and saw massive value in retaining legal and creative control of the property. Despite this fact, during production he became distraught about his vision and told his friend Stephen Spielberg that he had made a “little kids movie”. Lucas made a bet with Spielberg, swapping 2.5% of the box office profits of his new film for the same share of “Close Encounters of the Third Kind” in anticipation his film would fare worse. Higher order movements are never easy to conceive or manage emotionally, even for George Lucas.

In 1977 **Star Wars** was released and took the world by storm, becoming the first and most valuable film franchise in history, and forever changing the art and business of cinema. Star Wars ushered in the modern era of high concept Hollywood blockbusters. The movie quickly became the 2nd highest grossing film of all time adjusted for inflation (\$1.48 billion) and it didn’t stop there. The total box receipts for the original and sequels went on to exceed \$6.4 billion. In the ensuing four decades there have been eight Star Wars sequels, including “Rogue One” released last month (\$829 million to date). Even more impressive are the ancillary revenues including \$17 billion from toy and merchandising, \$5.7 billion in home entertainment sales, \$4.28 billion from video games, \$4 billion in intellectual property sales, and \$3 billion from miscellaneous revenue sources. By some estimates, Star Wars is worth more than James Bond and Harry Potter combined⁽²⁾. The total revenue from the collective Star Wars franchise is estimated at \$42 billion since 1977. Last year, George Lucas sold his company, including rights to all new Star Wars films, to Disney for another \$4 billion⁽³⁾. Not a bad total return on \$850k. The brilliance of George Lucas was that he was willing to forgo a **first order** linear benefit, in exchange for **higher order movements** on the success of Star Wars. In the end, this was one of the greatest business trades ever made.

The business philosophy of Star Wars is conceptually the same as active long volatility trading. In other words, George Lucas was a very good volatility trader.

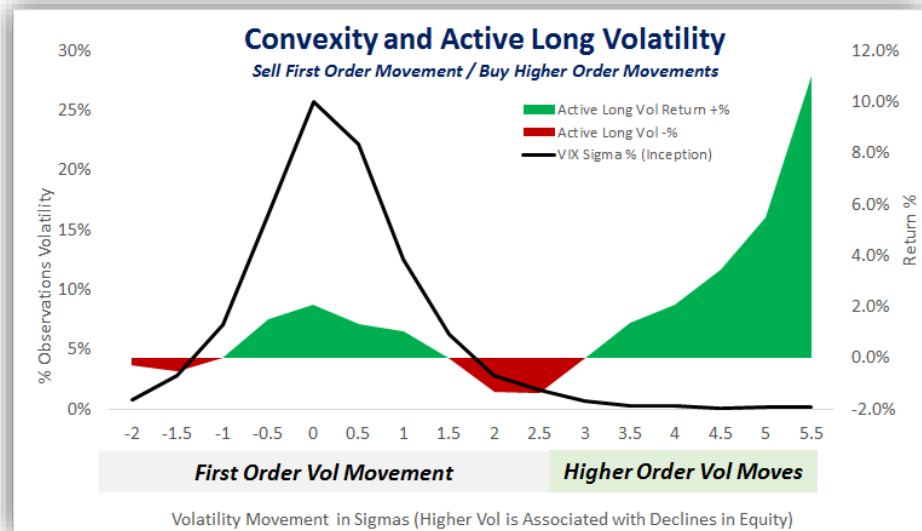
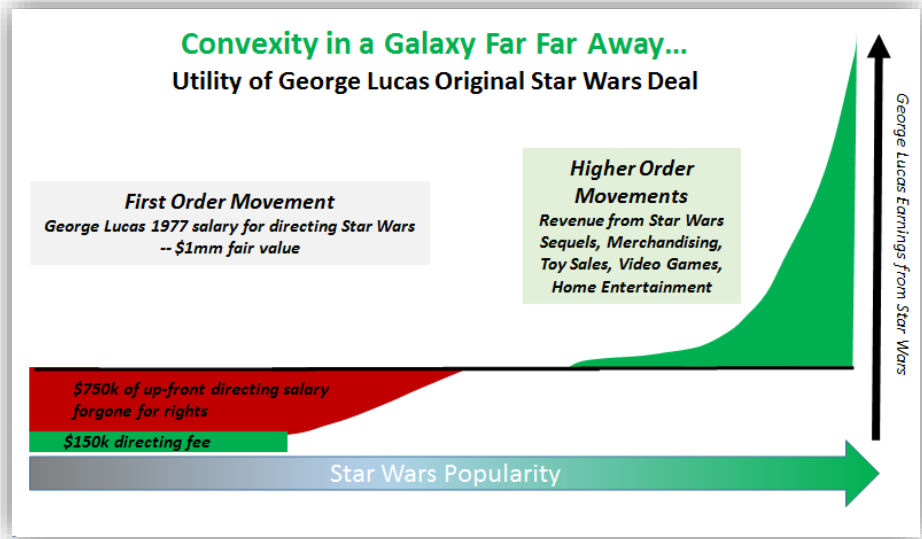


George Lucas the Volatility Trader

Everything you need to know about smart volatility trading you can learn from George Lucas and Star Wars. To start, just understand that George Lucas structured his pay-out to Star Wars as a long option that was financed by taking a lower yielding salary. Lucas structured a position that had slight positive carry with huge non-linear exposure to the success of Star Wars. On the right we graph the “Star War” utility function, which is decidedly non-linear at higher order movements of Star Wars popularity. Lucas sold off linear exposure by reducing his directing fee to purchase second, third, and fourth order movements in the form of Star Wars merchandising, licensing, and sequel rights. As Star Wars gained in popularity these higher order rights became invaluable.

Active long volatility trading (as executed by Artemis and others) is philosophically the same concept as applied to outcomes in markets. Long volatility funds are expected to generate returns that are positively exposed to extreme movements in markets with small positive or neutral carry. The return profile is achieved by selling linear moves in asset prices (minor crashes in the stock market) to finance the cost of owning non-linear payouts in the event of extreme events (1928, 1987, 1998, or 2008). At other times, the market actually pays the volatility trader to own an extreme outcome when there is high expectation of mean reversion (positive carry and convexity). The disciplined execution of this strategy is why funds like Artemis were able to generate positive returns in 2016 with anti-correlation to markets during risk off events like Brexit and the US election.

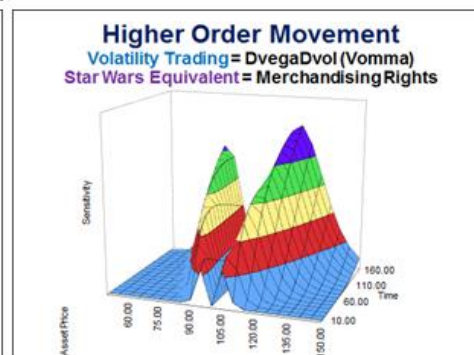
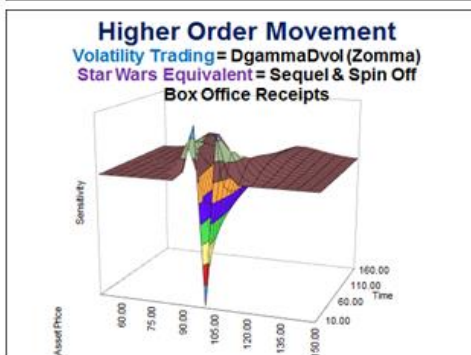
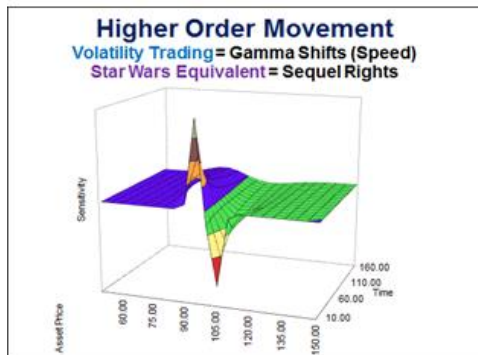
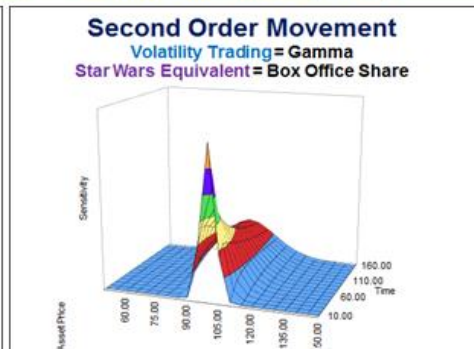
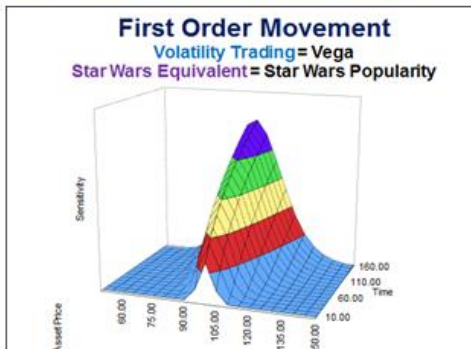
The long volatility return profile is confusing to many investors since it does not have a 1:1 correlation with volatility at lower order movements. In many cases, it means forgoing gains during a **-1% to -5%** decline in markets while providing powerful and non-linear returns during a **-20% to -50%** bear market. Many investors, driven by a linear mindset, become confused as to why long volatility managers don't take profits after a **-5%** drawdown in markets. This is like asking George Lucas why he didn't sell his merchandising and sequel rights the minute Star Wars became a success in 1977. Another source of confusion is that most investors do not differentiate between **tail risk** and **long volatility**. Tail risk has a negative expected return and is negative carry, while long volatility is an alpha vehicle and is expected to generate positive risk adjusted returns when held through a business cycle



A common complaint is that volatility trading is difficult to understand. Again, this is where Star Wars can help by demystifying the jargon through analogy. The table below shows a side-by-side comparison of **first order** and **higher order** sensitivities of the **Star Wars Trade** and their **Volatility trading equivalents** (known as Greeks sensitivities). First order movements include Lucas' directing salary (delta), forgone salary to own sequel and merchandising rights (theta), and positive exposure to the general popularity of Star War (vega), while second order movements include exposure to box office receipts (gamma). The real gains are made from higher order movements including the rights to make Star Wars sequels (derivative of Gamma or Speed), Star Wars sequel box office receipts (DgammaDvol), and merchandising and licensing rights based on the popularity of Star Wars (DvegaDvol). Long volatility funds balance first and second order exposures to own higher order movements.

If you remove the maths, there is nothing conceptually difficult about this philosophy. What is difficult is overcoming natural behavioral biases while making an investment in this strategy. It just *feels* better to leverage first order effects at the expense of the higher order, even when it is to the detriment of long-term returns. All-in-all it takes intense discipline, both for the manager and investor, to systematically pursue an approach that is opposed to our primitive mind. It is not uncommon for investors to redeem from long-volatility investments right before the best gains are to be realized.... Fox Studios made the exact same mistake on merchandising and franchise rights for Star Wars.

| Movement Type | Volatility Trading "Greek" | Star War Equivalent |
|---------------|----------------------------|--|
| First Order | Delta | George Lucas Directing Salary |
| First Order | Theta | % of Directing Salary Paid to own Sequel + Merchandising |
| First Order | Vega | Star War Popularity |
| Second Order | Gamma | Star Wars Box Office Gains |
| Higher Order | Speed | Sequel Rights |
| Higher Order | DgammaDvol | Sequel and Spin Off Box Office Receipts |
| Higher Order | DvegaDvol | Merchandising and Licensing Receipts |
| Higher Order | DdeltaDvol | Higher Future (Directing Fees) from Star Wars Popularity |



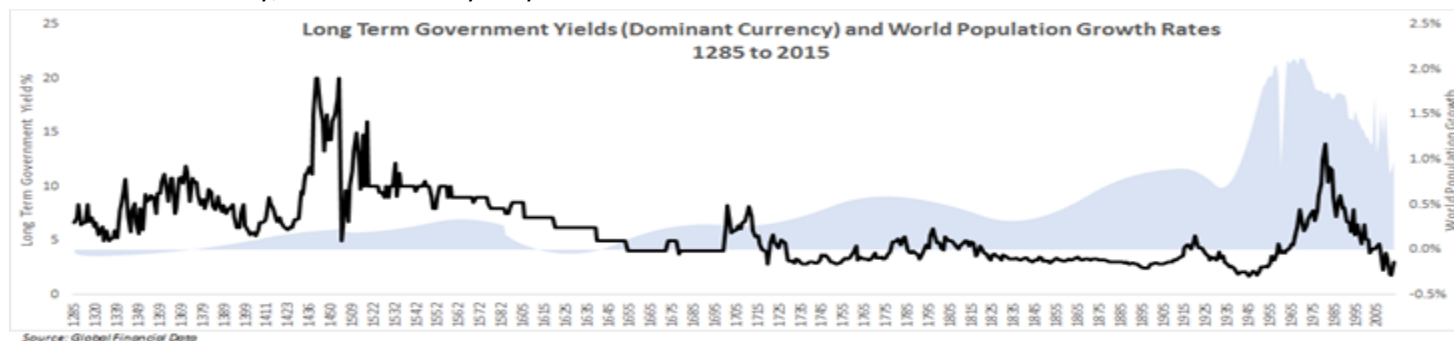
"Many of the truths that we cling to depend on our point of view" Yoda

With 20/20 hindsight Fox Studios is now widely ridiculed for making one of the worst business decisions in history by exchanging \$850k in directing fees for \$43 billion (and counting) in future revenue. Before judging I want you to put yourself in the shoes of the 1976 executive at Fox. Knowing nothing about the future success of Star Wars, *you are presented* a deal to get an 85% discount on a *proven and hot director* in exchange for historically worthless rights on an *unproven* film. Fresh on your mind is the Dr. Dolittle merchandising disaster – \$200mm of unsold toy inventory. Every day you look at that god-damn Dr. Dolittle two headed plush llama toy ("Pushmi-Pullyu") that sits on your desk as a brutal reminder that film-merchandising is a stupid idea⁽⁴⁾. This is not even considering that science fiction is risky genre (keep in mind, it's 1976) compared to westerns and musicals. Why does a brash young director, fresh off his first hit film, suddenly think people will buy toys for a 'space opera' movie? Without 20/20 hindsight, the Fox Studios side of the Star Wars trade seems entirely justifiable in 1976.

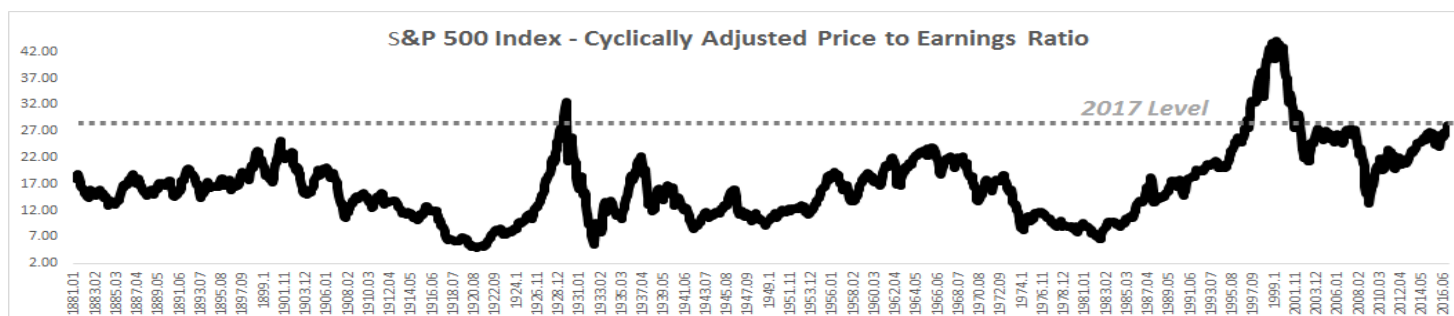


Ask yourself...what investments do you justify by common knowledge today that will look foolish 40 years from now?

The common knowledge trade among institutions today is to **maximize linear yield** from **any source** and **minimize costs** through **indexation** and **factor based-investing**. Institutional investors justify this thirst for yield and cheap, passive, and low volatility investments by optimizing the last six years of returns and conveniently ignoring any broader financial history. The first flaw in this paradigm is that interest rates are at the lowest levels in the history of human civilization. High quality fixed income has performed admirably as a hedge to equities during a three decade decline in yields, but extrapolating that trend into the future defies 1,000 years of common sense. In fact, going back just 100 years we can clearly see that stocks and bonds spend more time correlated with one another than anti-correlated. The last 30 years has been the anomaly, the next 30 may very well be a reversion to the mean.



A second fact is that stocks are at all time high valuations unmatched only by 1928, 1999, and 2007 using EV/EBITDA, CAPE⁽⁵⁾, and Price to Sales. Anyone who says this doesn't matter is selling you something with a short-term payoff. Share-buybacks have surpassed 2007 highs and have outpaced the operating earnings of the entire S&P 500 index. Even more alarming is the valuation of stocks in passive index funds. According to S&P Capital IQ, Russell 2000 index stocks carried a 62% valuation premium over non-index stocks in 2015, rising from just 12% in 2006. Valuations of low beta and high dividend index stocks bear resemblance to the Nifty 50s fad of the 1960s, and DotComs of the 1990s.



A third dangerous truth is that sovereign debt to GDP levels and central bank balance sheets are stretched to historical extremes and are showing waning ability to generate growth. According to a 2015 McKinsey study the world has reached over \$200 trillion of debt (286% of global GDP). In China, debt has grown four times faster than GDP since 2007, and half of that debt is linked to their property market. The expectation that government policy will continue to suppress asset price **volatility** is questionable in a world where populism is rising, the EU is one election away from breaking apart, and China is facing a banking crisis.

When you consider all of these truths... it is puzzling why active long volatility is not a core holding in the institutional portfolio as an alternative hedge to both fixed income and equity. Instead, institutional investors are doing the exact opposite by forgoing actively managed convexity in favor of chasing linear yields, risk harvesting strategies, and low fee index funds. This behavior only makes sense within the context of our primitive and hard-wired need to maximize first order effects to support survival. In that primitive paradigm decisions are made based on **relativism**, **common knowledge**, and **recency bias** rather than **probabilistic assessment of change**. It is the same reason why Fox Studio executives sold off the merchandising and sequel rights to Star Wars in 1976 for nothing, using consensus opinion and the historical failure of Dr. Dolittle to justify a bad probabilistic choice. It will take a crisis whereby stocks and bonds decline together over an extended period of time for investors to reset their world view and see the value of defensive assets like volatility (this has happened many times in 120 years, but not in the past 30).

Ironically modern Hollywood has evolved and is now light years ahead of professional investors in terms of understanding the power of convexity. Disney has outperformed by spending up-front money developing and buying franchises with cross-platform branding convexity like Star Wars, the Marvel Cinematic Universe, and Pixar. Top Hollywood creative talent now structures pay-offs entirely around non-linear revenue streams. For example, in 2015, Harrison Ford received only \$10k in up-front salary to reprise his supporting role as Han Solo in "Star Wars: The Force Awakens" in exchange for a reported \$34 million in back-end receipts when the film surpasses \$1bn in revenue⁽⁶⁾. Today institutional investors do the opposite, chasing and leveraging up-front salary through indexation and throwing away convexity...



"Train yourself to let go of everything you fear to lose." Yoda

Randomness is a gift to those who persistently seek out low rent exposure to change. Next time you go see the new Star Wars movie, buy your kids a Star War toy, or see the Star Wars brand... recognize that the real **FORCE** is **convexity**. If you are so focused on avoiding the next **Dr. Dolittle**, you will fail to see the multi-decade potential of **Star Wars**. **Long volatility is not a hedge... it is a source of ALPHA ... an alternative to fixed income in the new world paradigm**. Some investors may nod their head in agreement with these concepts, but very few put action to words. In the future we will read stories about thoughtful investors that perceived a non-linear world beyond the Post-Bretton Woods order and positioned their fiduciaries for great success during the regime change. You should be one of them, but this takes courage.

May the force be with you.



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Data: Bloomberg, Artemis Capital Management LP

Images

Yoda, Empire Strikes Back 1980

George Lucas on set of Star Wars, <http://www.biography.com/news/george-lucas-star-wars-facts>

Star Wars Original 1977 Poster

Dr. Dolittle Pushmi-Pullyu Toy from Mattel 1967

Obi-Won Kenobi, Star Wars 1977

- (1) "Star Wars' Legacy II: An Architect Of Hollywood's Greatest Deal Recalls How George Lucas Won Sequel Rights" by Mike Fleming / Deadline Hollywood
- (2) "Star Wars Franchise Worth More Than Harry Potter and James Bond, Combined" by Jonathan Chew / Fortune
- (3) "Star Wars \$4bn Price Tag was the Deal of the Century" by Jim McLaughlin / Wired 2015
- (4) <http://arcana.wikidot.com/pushmi-pullyu> Picture of Dr. Dolittle Toy, 1967 ---- Now extinct, the African Pushmi-Pullyu is certainly one of the most unusual creatures of the animal kingdom. It resembles an antelope, but has two heads: one facing forward, and the other facing behind where the tail should be. The legs on each end are oriented the same way as the corresponding head, so the creature in effect has two front ends and no back end. They are terribly difficult to catch because at least one head stays awake at all times. According to the eminent naturalist John Dolittle, who brought one of the last Pushmi-Pullyus to England in the 1830s, they are related to the Abyssinian Gazelles and the Asiatic Chamois —as well as possibly having some Unicorn ancestry. In the 1967 movie Doctor Dolittle, the Pushmi-Pullyu is depicted as resembling a two-headed llama and is said to come from Tibet.
- (5) Robert Shiller / <http://www.econ.yale.edu/~shiller/>
- (6) "Star Wars: The Force Awakens pay deal for Harrison Ford is out of this world" by Peter Vincent / Sydney Morning Herald December 2015

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