

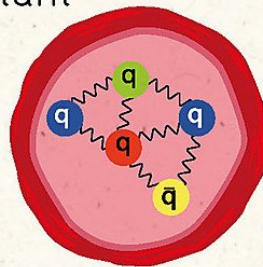
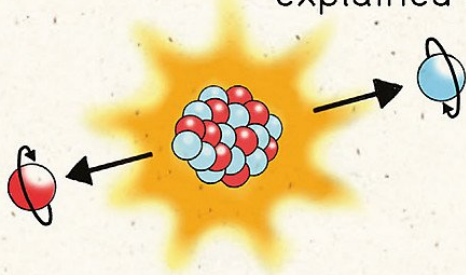
*Tools for converting invention to innovation and how they can be applied to commercialize quantum innovation*

Debasish Chakraborty, DTU Physics



# QUANTUM PHYSICS IN MINUTES

The inner workings of our universe  
explained in an instant



Gemma Lavender

*Anyone who is not  
shocked by quantum  
theory has not understood  
it.*

-Attributed to Niels Bohr



# STORY TELLING AND PITCHING

Picture: <https://blog.hubspot.com/marketing/visual-storytelling-examples>

Imagination is more important  
than knowledge

- Albert Einstein









hoc est enim corpus  
meum





DTU Physics  
Department of Physics

DTU



HPN<sup>o</sup>w

Debasish  
Chakraborty

- Ph.D. in Chemical Engineering
- Business Education from Harvard Business School
- Scientist and Business Developer
- Co -founder of two companies
- Co-inventor of four patents
- Author of scientific papers in high impact journals

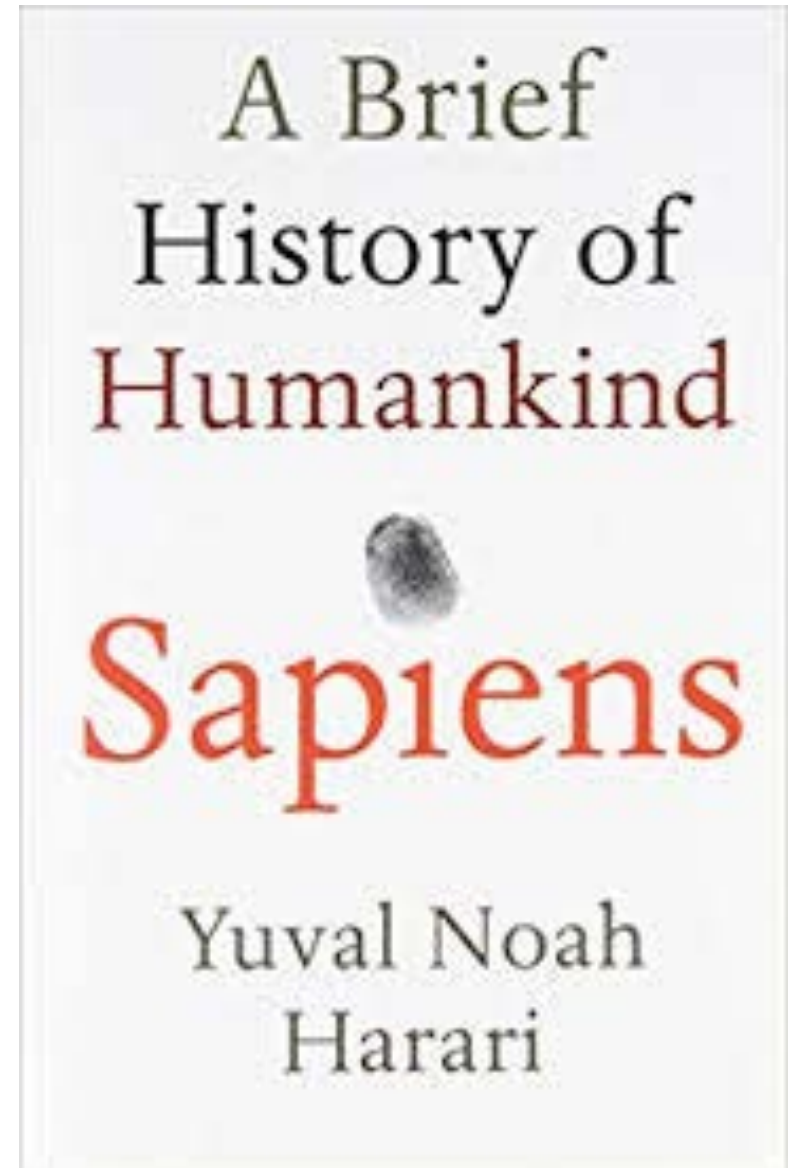


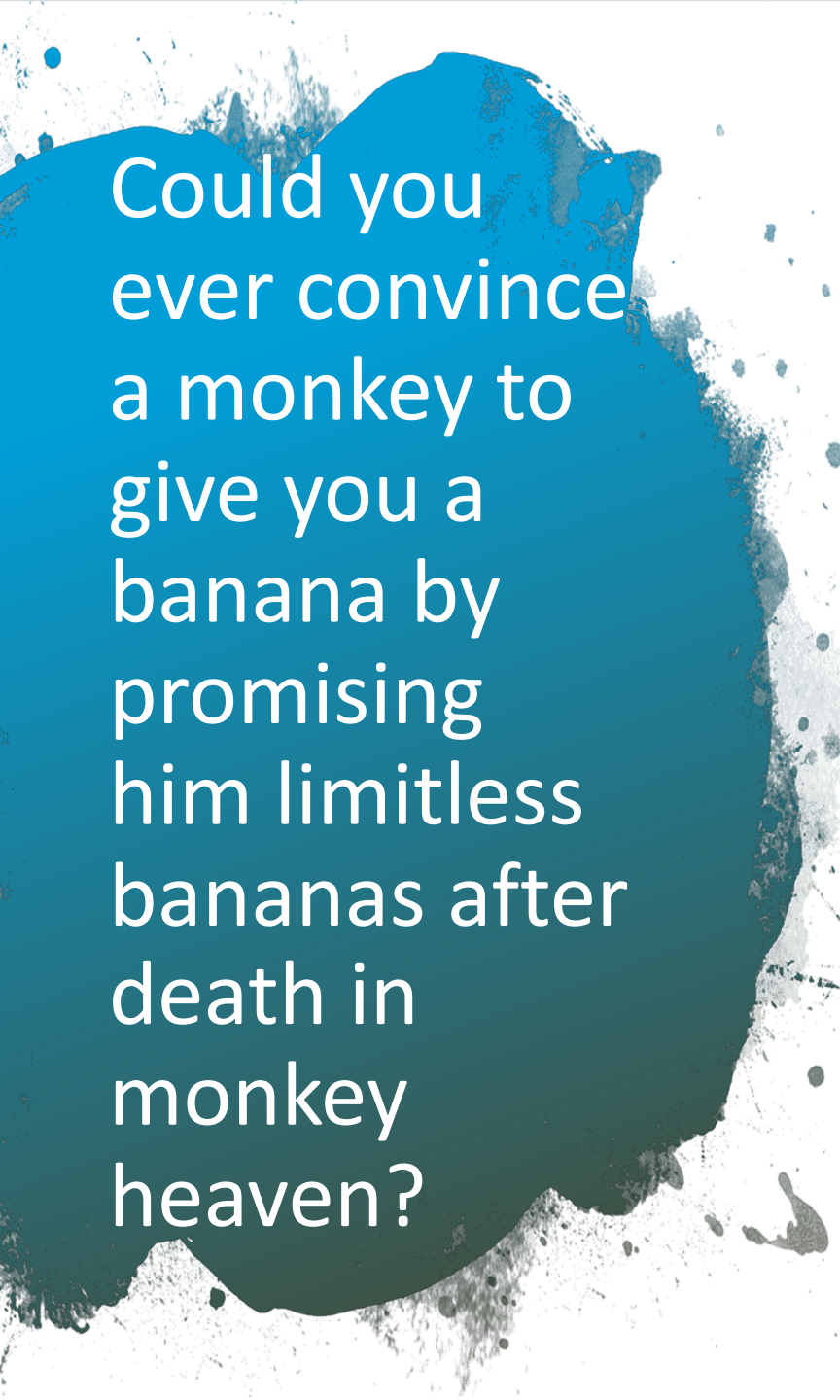
# What Turns Bread and Wine into God's Flesh and Blood



What Turns  
Bread and Wine  
into God's Flesh  
and Blood

---





Could you  
ever convince  
a monkey to  
give you a  
banana by  
promising  
him limitless  
bananas after  
death in  
monkey  
heaven?

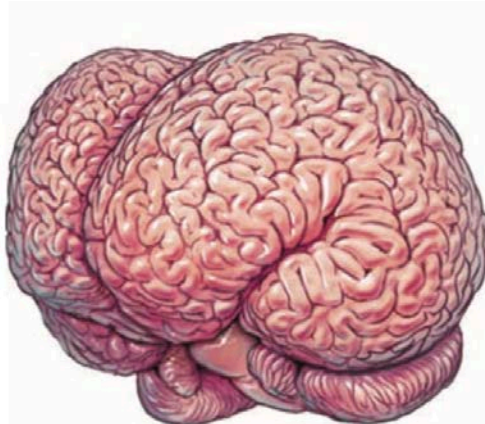
Could you ever  
convince a human  
to give you a  
banana by  
promising him  
limitless bananas  
after death in  
human heaven?

What differentiates  
humans from other  
animals





# Size of the brain?



Killer whale brain  
5,620 grams



~5000 kg

1g/kg



Human brain  
1,350 grams



~80 kg

16g/kg



~ 2 g

50 g/kg

→  
Etruscan shrew brain  
0.1 gram

Origin of the mind,  
Scientific American



Language?

Origin of the mind,  
Scientific American



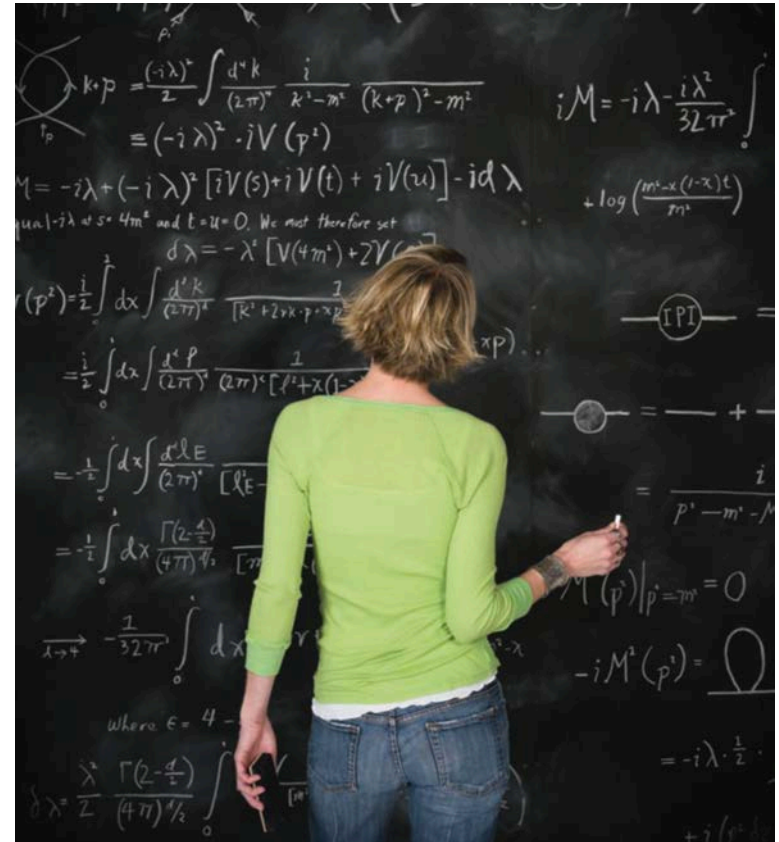
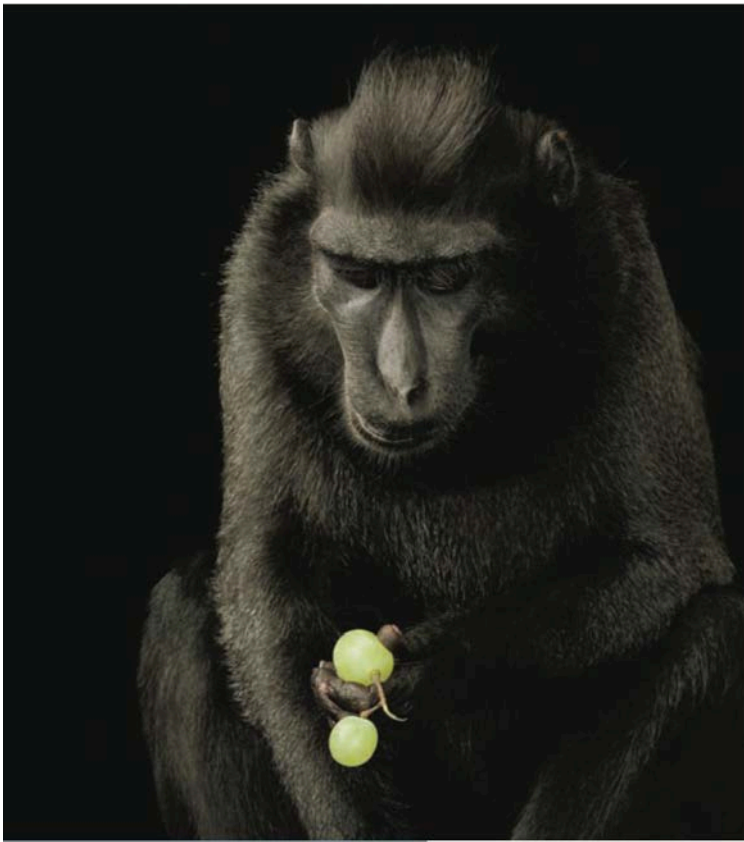




# Innovation?

---

Origin of the mind,  
Scientific American



Counting vs solving **abstract** problem



# Grooming, Gossip and Evolution



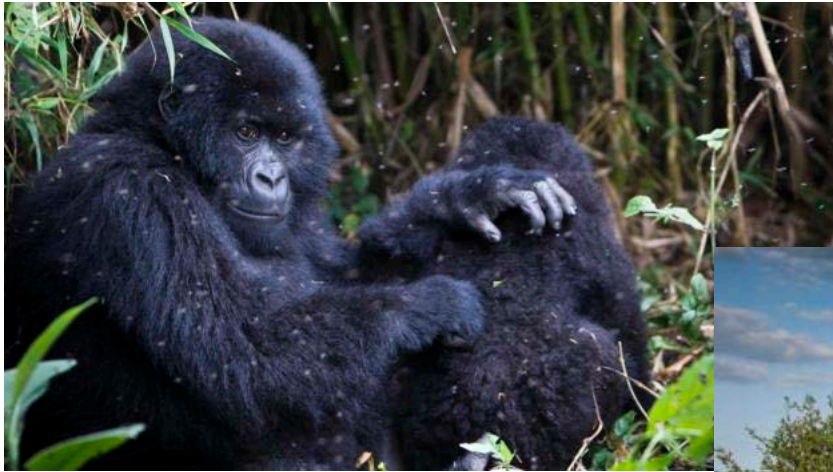
Grooming

Gossip



<http://www.bbc.com/earth/story/20150227-where-did-gossip-come-from>

# Grooming, Gossip and Evolution



Gossip is "to groom several people simultaneously" Robin Dunbar



All human societies are built on chatter and gossip (Credit: Christophe Courteau / NPL)



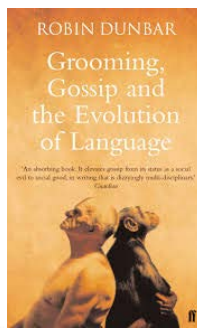
Gossip and  
Imagination: The  
ability to make up  
things beyond  
obvious reality





78% is gossip

Grooming, Gossip and the Evolution of Language, Robin Dunbar, 2011





Fiction: the ability to transmit  
information about things that do not  
exist at all

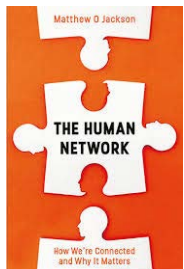


Lion-man or Lion-Woman (32000 years ago): Cave in Stadel,  
Germany



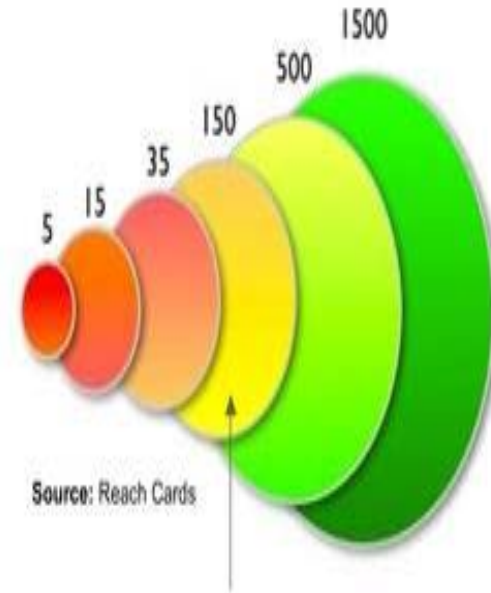
# Cognitive Revolution: allows humans to create myth

Our ability to grasp abstract concepts combined with our ability to communicate them with others sets us apart



How many  
friends can  
we have?

---



Robin Dunbar's threshold of maximum number of individuals

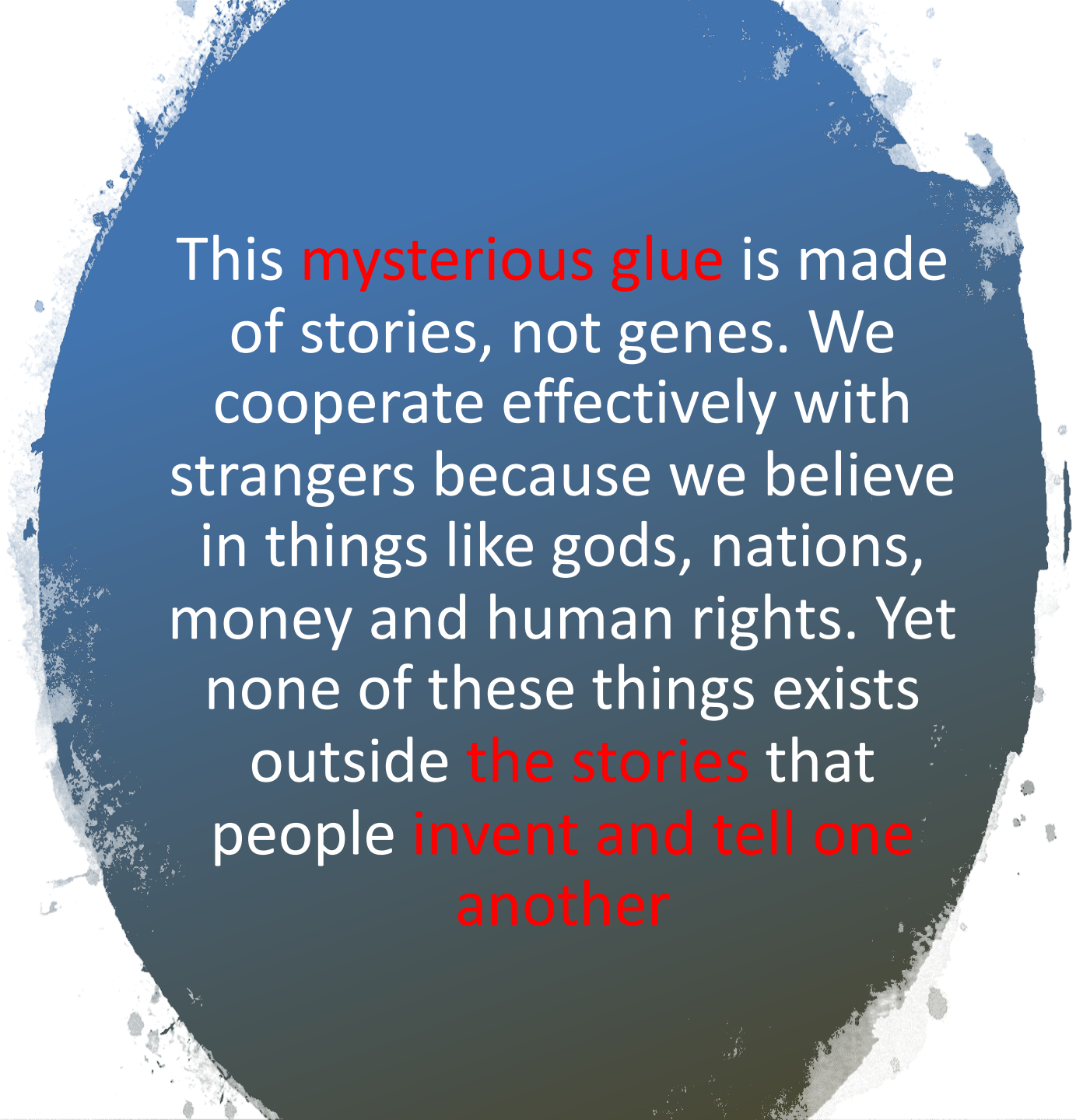
But in order to  
establish your idea,  
you need to convince  
many many more than  
150





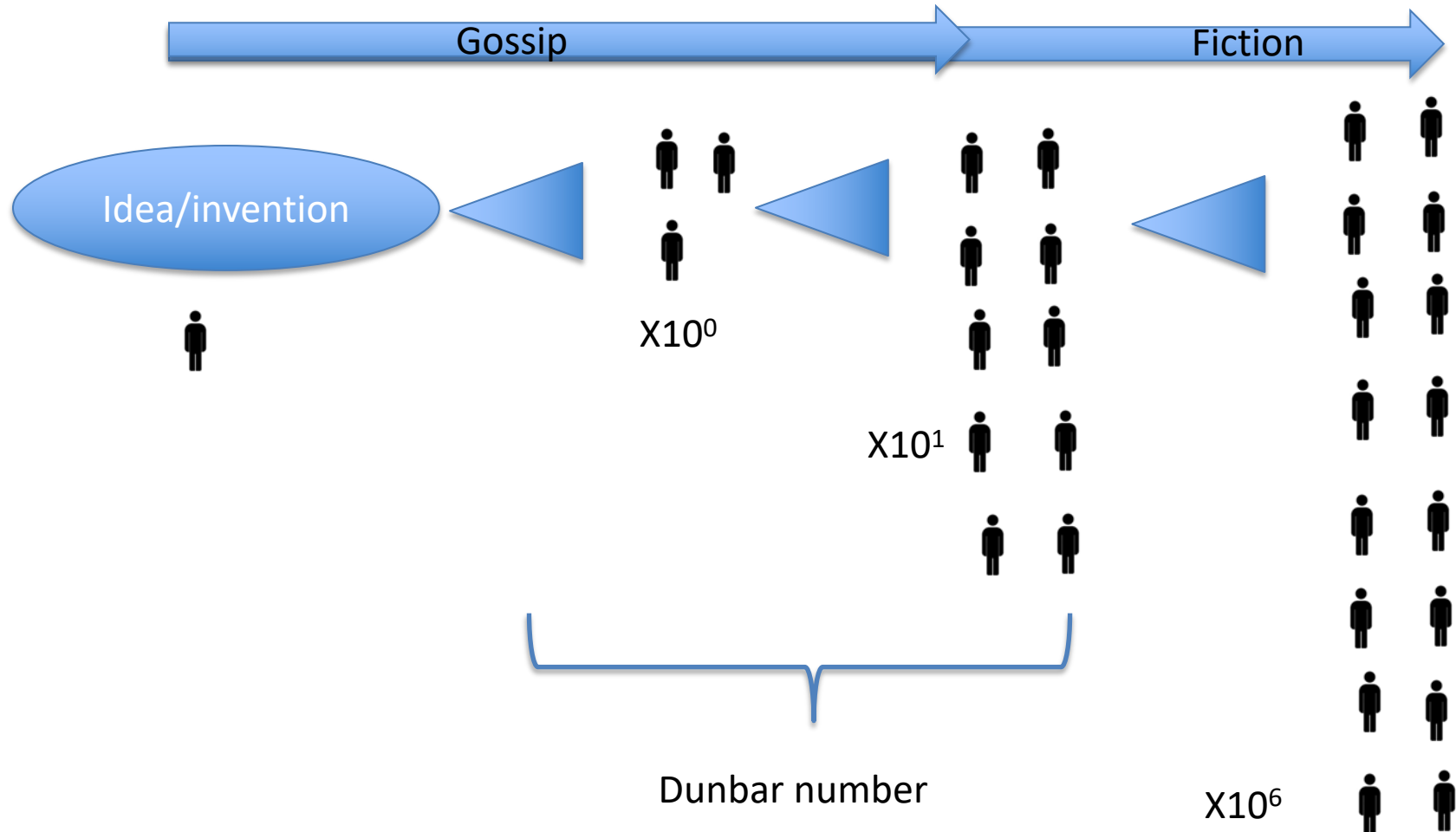
Gossip vs Myth



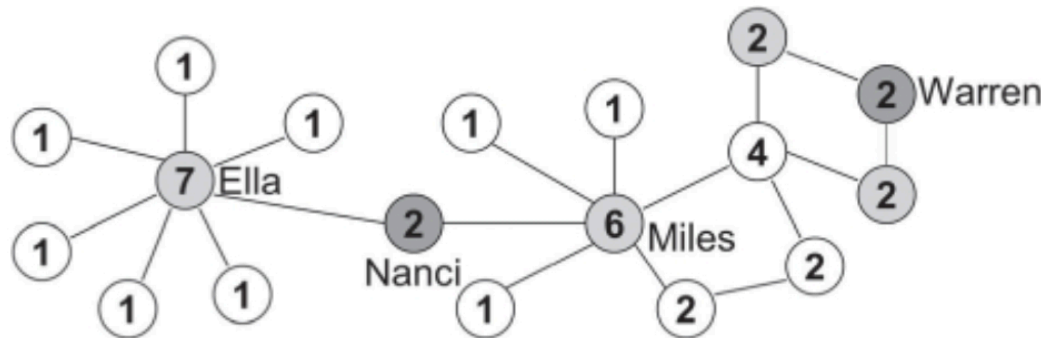


This **mysterious glue** is made  
of stories, not genes. We  
cooperate effectively with  
strangers because we believe  
in things like gods, nations,  
money and human rights. Yet  
none of these things exists  
outside **the stories** that  
people **invent and tell one  
another**

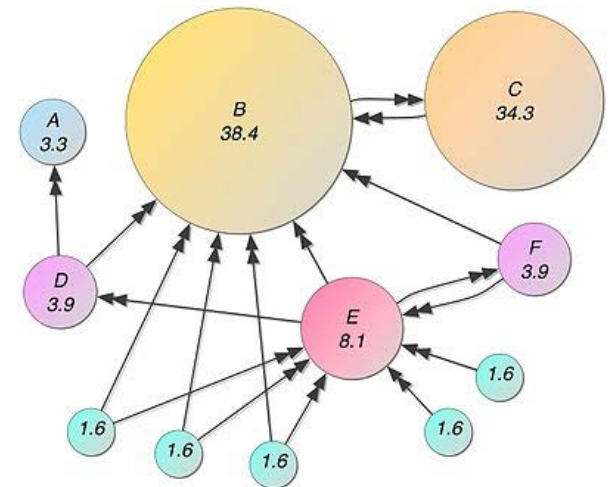
# Propagation of Idea



# Networking: have well connected friends



**Figure 2.5: Two people, Nanci and Warren, both have degree 2. However, they differ in how connected their friends are and in their overall positions in the network.**



**PageRanks**

Crux of Google's search algorithm developed by Brian and Page: If other important Web pages point to a page, then that suggest that it is an important page. One does not judge a page simply by how many pages link to it, but by whether it is linked to by well connected pages.





# The story of Peugeot

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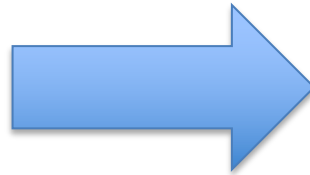


Limited Liability Company  
-The greatest 'legal fiction'  
of human history

# Telling the story and convincing people



Armand Peugeot



Société des Automobiles Peugeot

- The crucial story was the French Legal Code
- Lawyer performed the right rituals and pronounced all the necessary spells and oaths ( 1896)
- Millions of French started believing that Peugeot really existed

You could kill every employee and stakeholder in Peugeot, but the corporate entity would still exist. The building isn't Peugeot — it can move offices. Peugeot could make planes rather than cars, so it isn't what they do that defines them. The only thing that makes Peugeot Peugeot is **everyone's agreement** that Peugeot exists, duly noted in the papers of some lawyer.

# Modern Myths

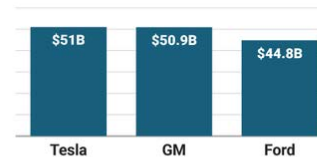
- A million car a year by 2020 (actual: 350,000 in 2018)
- A valuation of \$700 Billion by 2025 (current value \$41 Billion)



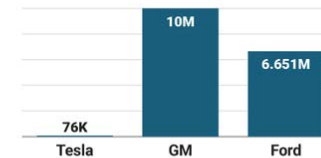
TECH CHART OF THE DAY

## THE NUMBERS BEHIND THE 'NEW BIG THREE'

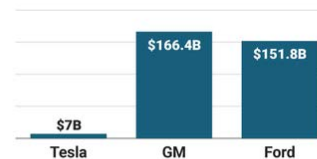
Market cap (as of April 10, 2017)



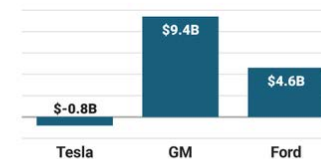
Vehicle deliveries in 2016



Revenue in 2016



Net income/loss in 2016



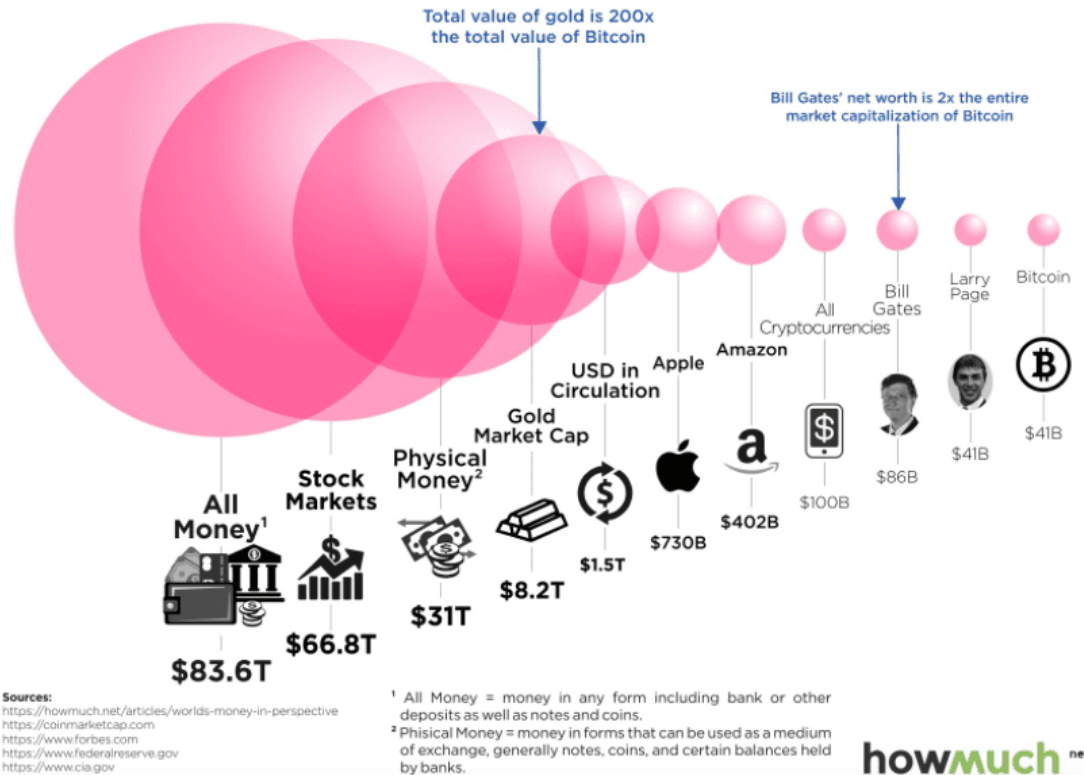
SOURCES: Ycharts, Company reports

statista BUSINESS INSIDER





## Putting the World's Money into Perspective



Modern Myth

# The Right Wing Myth

HOME SEARCH

The New York Times

China Bolsters Its Economy as Debt and Trade Pressures Mount



Fed Monitoring Tariffs but Suggests Rate Increases Are on Track



THE NEW NEW WORLD  
China's Consumption Downgrade: Skip Avocados, Cocktails and...



8 Ways the Next Round of China Tariffs Could Pinch Consumers

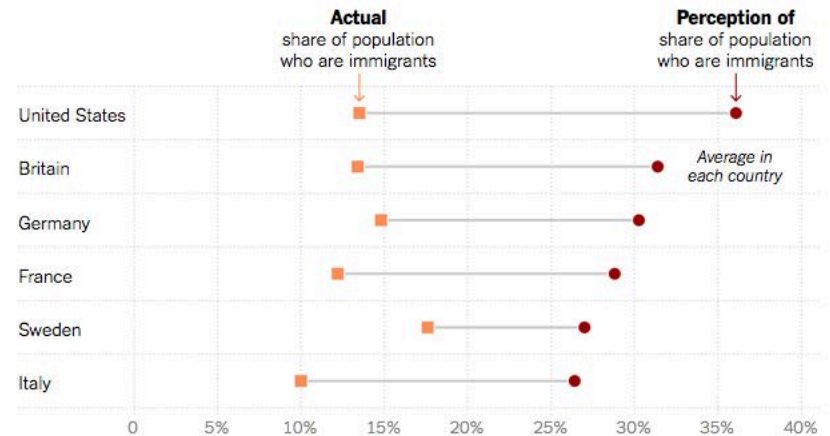
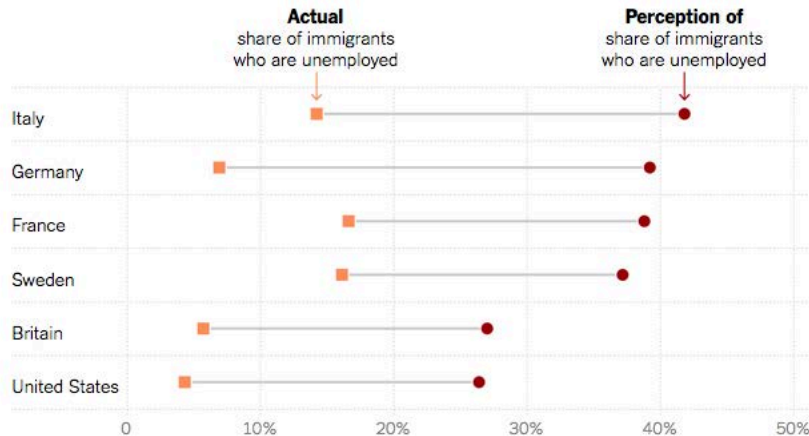


Greece's Bailout Is Ending. The Pain Is Far From Over.

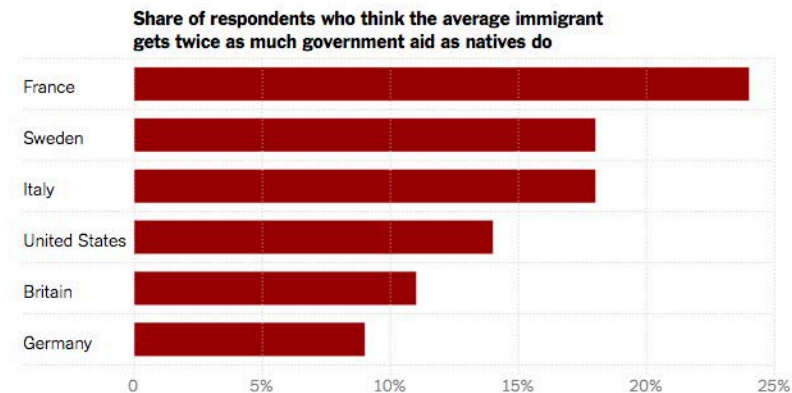
ECONOMY


## Migrants Are on the Rise Around the World, and Myths About Them Are Shaping Attitudes

By EDUARDO PORTER and KARL RUSSELL JUNE 20, 2018



Note: For the United States, the number of actual immigrants includes estimates of the illegal immigrant population | Source: "Immigration and Redistribution," 2018. Alberto Alesina, Armando Miano and Stefanie Stantcheva (Harvard University)





# How do you form a successful venture?

- What you offer is important but what people **BELIEVE** you offer is the most important
- Build credibility
  - Bound by law, supported by trustworthy lawyer
  - Patents, articles
  - Validated e.g. at MIT, DTU
  - Eminent people in team
- Create **myth** around your offer
- Make people talk/gossip about you
- Tell **stories** that people believe



Fiction is not  
necessarily lie: It turns  
bread into God's Flesh





DTU Physics  
Department of Physics

DTU



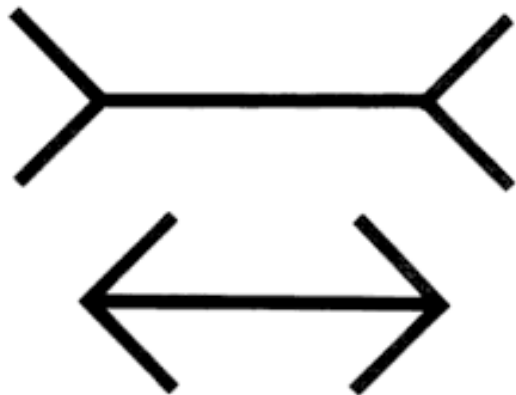
HPN<sup>o</sup>w

Debasish  
Chakraborty

- Ph.D. in Chemical Engineering
- Business Education from Harvard Business School
- Scientist and Business Developer
- Co -founder of two companies
- Co-inventor of four patents
- Author of scientific papers in high impact journals

Remember this slide?

# Developing your business case and Pitching Your Idea



Which line  
is shorter?

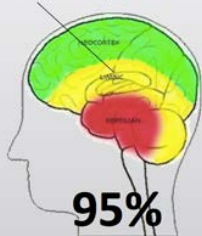
# Thinking, Fast and Slow

- System 1:  
automatic ( so  
spontaneous)
- System 2:  
effortful ( so  
lazy)

## SYSTEM 1 AND SYSTEM 2 PROCESSING

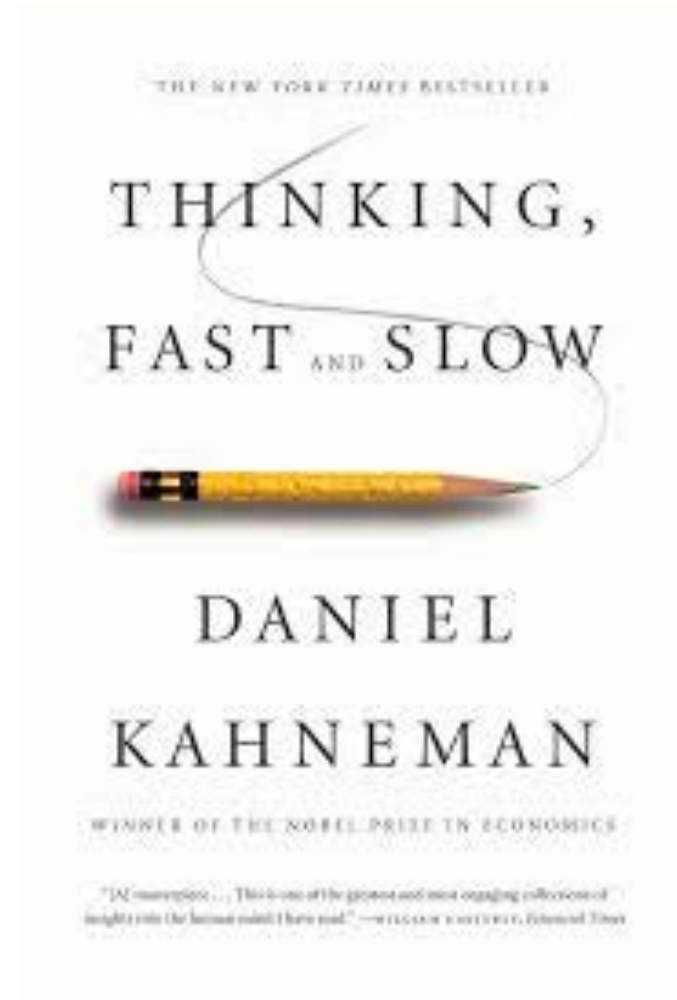
### "FIRST REACTIONS"

**System 1** = fast, automatic, impulsive, associative, **emotional**, and unconscious processing = limbic.



### "THINKING"

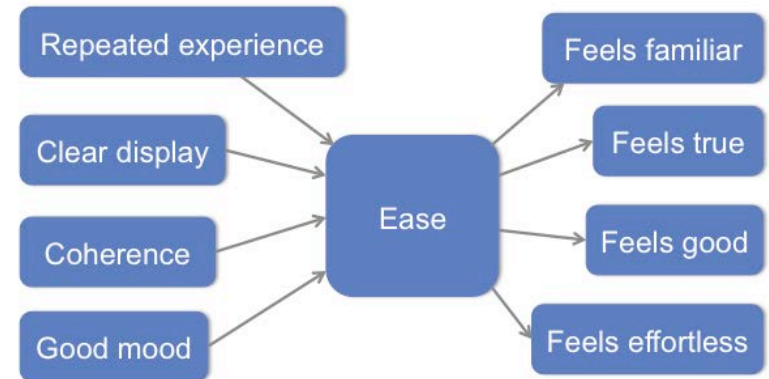
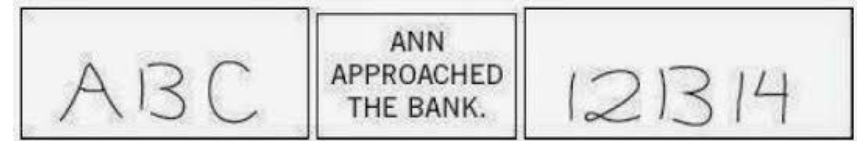
**System 2** = slower, conscious, reflective, deliberative, analytical, rational, logical processing = neocortex.





# How most people make conclusion

---



*Thinking, Fast and Slow*, Daniel Kahneman (2011), p. 60

Sonya Song: Psychology of Sharing on Social Media

On most occasions, the lazy system 2 adopts the suggestions of system 1 and march on

- Reduce cognitive strain or Increase cognitive ease
  - Maximize legibility :  
Maximize contrast between characters and background
  - Use simple language where possible to thought of as credible and intelligent
  - Make the message simple and memorable
    - Woes unite foes vs Woes unite enemies
    - Uber for Cycles



Vision

**Make America Great  
Again**

# Value proposition

- Articulate Compelling Value Proposition
- Critical for building a company from Idea



# What is Value proposition

- A Positioning statement that explains what benefit you provide for who and how you do it uniquely well



# The Severity of the problem

- Unworkable
- Unavoidable
- Urgent
- Underserved



4 U

# Measure

## Gain/Pain ratio

- Revenue
- Cost savings
- Time
- People
- Competitive advantage
- Reputation
- Etc..
- Inertia
- Switching costs?
- Default = do nothing
- Alternatives?
- Good enough = good enough!
- RISK on a startup
- Find (See)
- Try
- Buy
- Implement
- Deploy
- Own – eg TCO



# Statement(Elevator Pitch)

- For ( target customer) who are dissatisfied with ( current solution) our product (new product) that provides ( key problem solving capability) unlike ( the alternative)



# Minimum Viable Product(MVP)

- A prototype
  - Captures the most important value proposition
  - Fabricated most inexpensive way
  - In quickest possible time



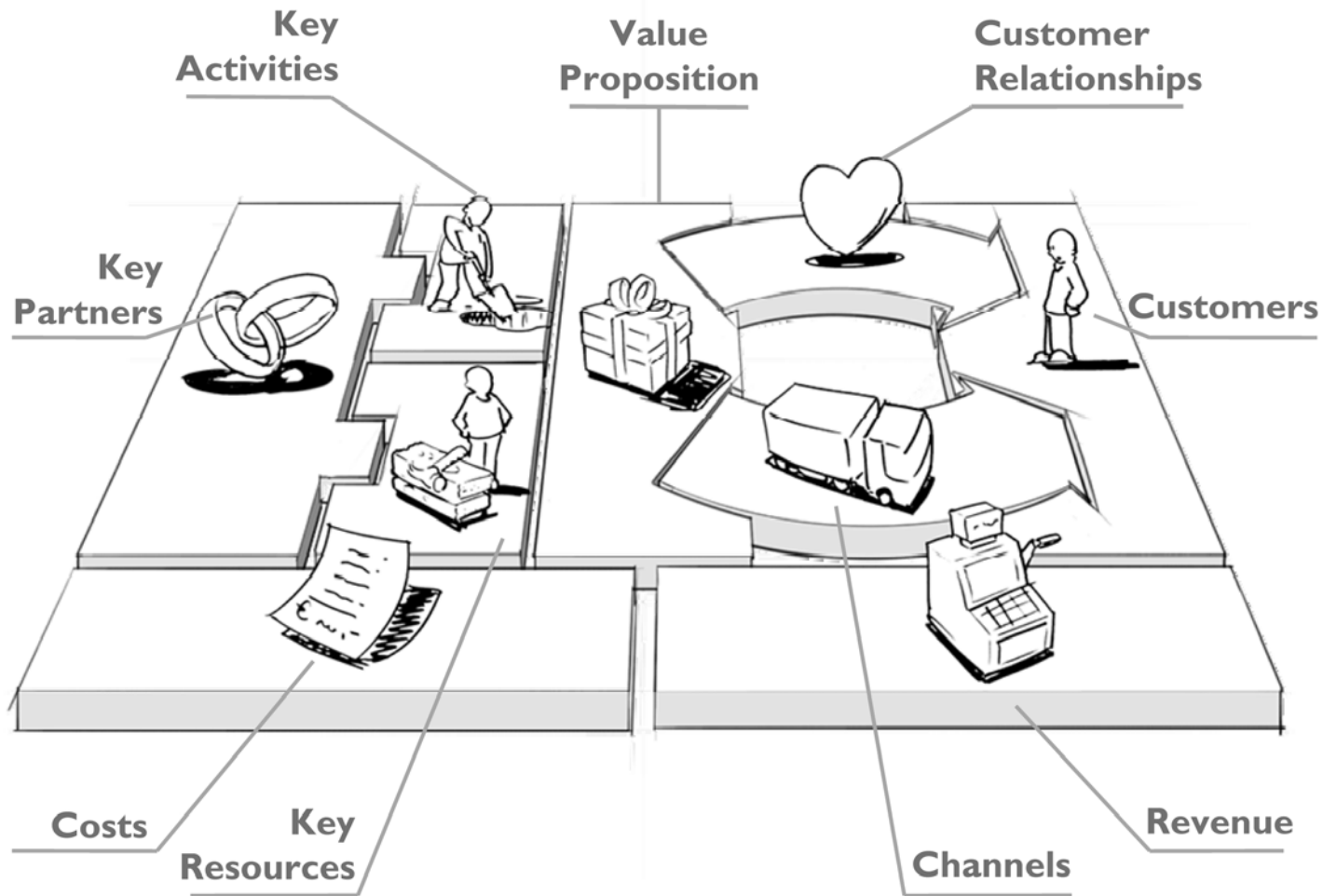
(minimum viable product)



(product)

Presented by BrainTree

# Business Model Canvas



drawings by JAM

# Pitch

- Know your audience and show respect
- 10/20/30 rule(Guy Kawasaki)
  - 10 slides
  - 20 minutes
  - 30 minimum font size
- No technical jargon
- Iterate, Iterate, Iterate



# Pitch content

**DocSend**  
OBSERVED ORDER



**SEQUOIA**  
RECOMMENDED ORDER





# Picture, Image, Graph

- A woman
  - Has three eyes, one on the forehead
  - Has ten hands with different weapons in each hand
  - Standing on a lion
  - Fighting a demon
  - Bla Bla
  - Bla Bla

# Picture, Image, Graph



# Body language

## Don'ts



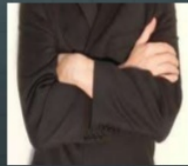
Hands in Pockets



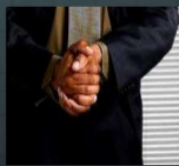
Hands Behind Back



Fig Leaf



Crossed Arms

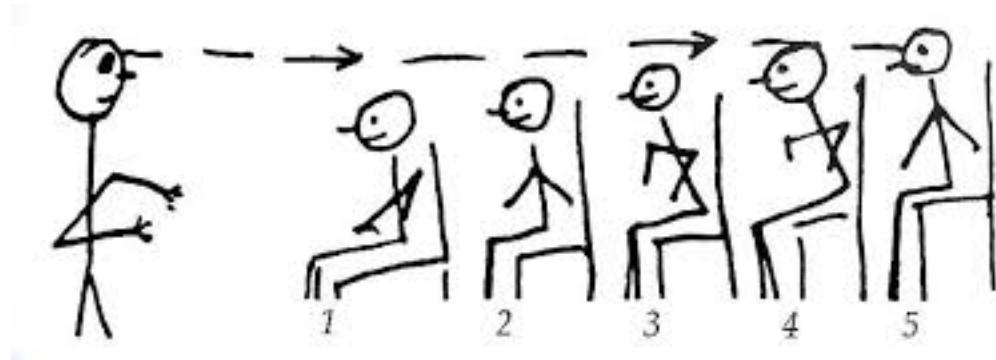


Wringing Hands



Open and upright

## High-Power Poses



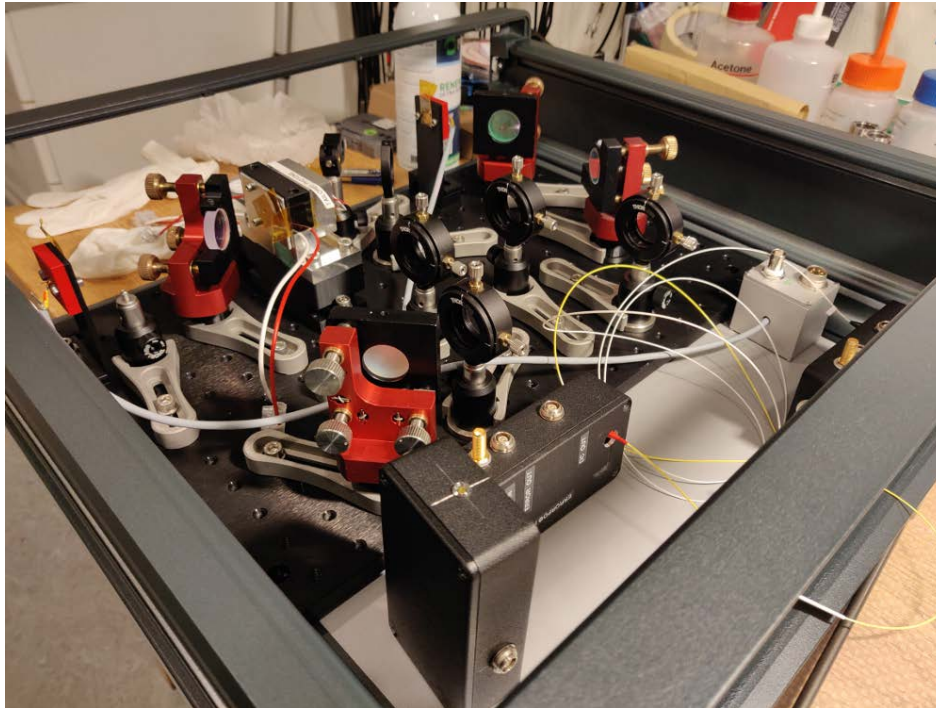


# Innovation: Half creativity half discipline

---



# Developing a business case for Squeeze Light Source





# The commercial potential of quantum technology in general

- The potential is huge but it is not possible to quantify the potential in numbers as yet
- Many major countries are investing heavily (public investment) to 'be ready' and 'take advantage' of the second Quantum revolution
  - £270 million in UK
  - \$100 million public matched by \$50 million private in Canada
  - €100M by ERC
  - €85 M invested by China to build QKD network
  - €150M by the Dutch government +€50 M by Intel in QuTech
  - €11M by Innovation Fund Denmark
  - €1B Quantum Flagship by EC

# Private Capital

- Many big companies are investing in quantum R&D but the plan and ambition remain modest
- Only one dedicated venture funds for quantum technology could be found showing either the lack of technological advancement or the lack of demand or may be both
  - Quantum Valley Investment <http://quantumvalleyinvestments.com/the-fund/>



<https://sifted.eu/articles/europea-n-vcs-quantum-computing/>

9 July 2019

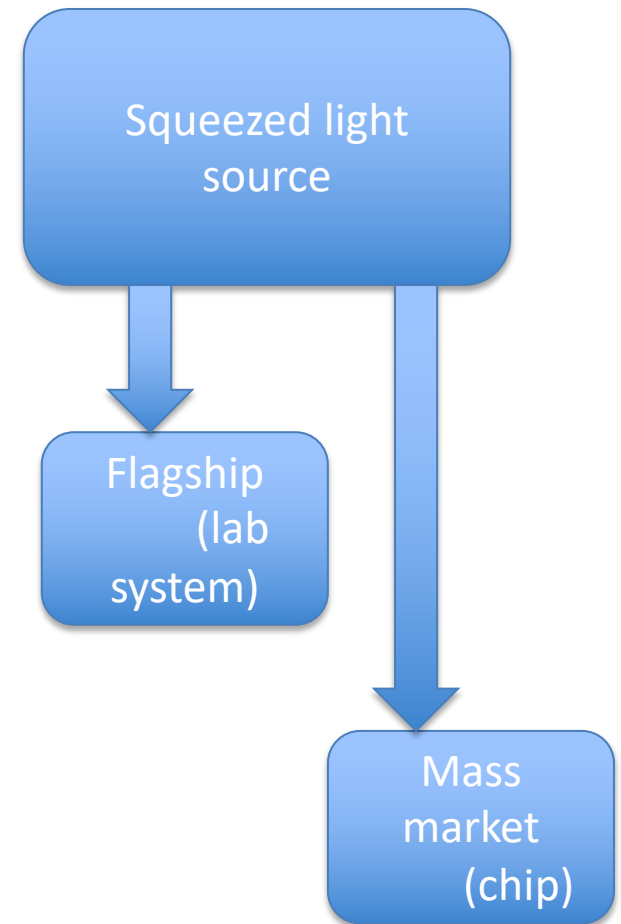
# Squeezed light: Potential Applications

- Device for quantum research labs
- Optical sensors (Interferometer based)
- Optical readouts of magnetometers
- Optical gyros
- Biological/chemical sensing
- Spectroscopy
- Quantum key distribution
- Quantum Simulation: Boson Sampling
- Quantum computing

However, no commercial application yet

# Commercialization strategy

- The near term commercialization strategy should be to exploit the huge scientific interest in quantum technology generated in recent times helped by the massive public funding in this field: 19" rack mounted device
- For mass market in commercial application-observe the development and become ready once the demand is generated: chip based squeezed light source



# Immediate plan: sell to quantum labs all over the world

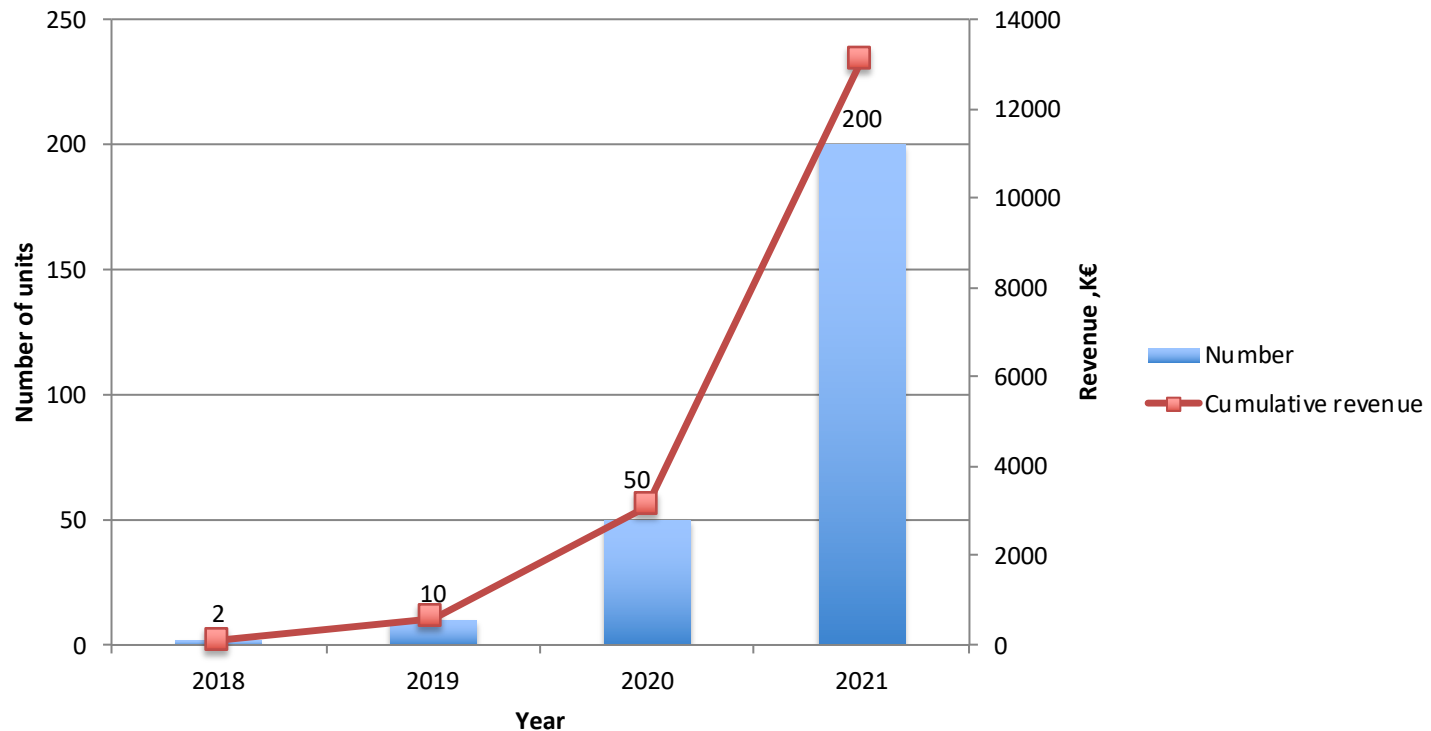
- Pain points: noise reduction sources are still only available on optical tables in laboratories, require a lot of man power to build, are bulky and time consuming to operate
- QPIT solution: Self standing, Plug and Play, 19" rack mounted squeezed light source immediately ready to be used
  - Save man hour, saves cost of building from scratch, gives better reliability
- QPIT differentiation: Only group with the expertise of developing a self standing plug n play squeezed light generator using in house expertise and pending patents



# Immediate plan: sell to quantum labs

- There are about 1400 quantum labs all over the world. Number expected to increase as public funding is surging. So, can be considered a growing market
- Considering that each lab has the desire to obtain at least one squeezed light source at a cost of €50000, the overall present market size is €70 M
- If a 20% of market penetration happens in the next 4 years(280 squeezed light sources), the average revenue potential will be ca. €3 M/year

# Short term revenue potential



A surge in demand is expected once the European flag ship program starts in 2018

# Revenue potential

- The target should be to accept orders and deliver self-standing 19" rack mounted squeezed light sources when the flag-ship starts i.e. already in 2018
- The flagship will result in many research groups wanting to buy the light source using the grant from the flagship program
- It is expected that the demand will surge in 2019-2020 period

# To Do

- Aggressively seek IPR protection
- Built a self-standing squeezed light source and bring it out of the lab
- Build a strong patent portfolio by identifying the differentiators
- Carry out strong business development activity

# Prototype to product

- The researchers will be enthusiastic early adopters
- They will be more forgiving to the flaws of a new technology and feedback from them will help in technology maturation
- It is important that the shipment of 1 or 2 devices starts already in 2018 so that the possible surge in 2019-2020 could be exploited



# Prototype to product


- The 19" demo unit should be made available as soon as possible and demonstrated in trade fairs and conferences to gauge/ create interest among the researchers all over the world
- Exploring the end users
  - Create a list of all the 1400 quantum labs in the world and send them product spec and subsequently follow up
  - Create a list of important stake holders in industries and establish communication with them to understand the possible demand and the required product specification
- The input can be used during the implementation of next version of the rack mounted device and subsequently the chip device
- This will give the QPIT squeezed light source the first mover advantage

# Possibility of Startup

- The squeezed light generator commercialization can happen through a startup
- As the only company to commercialize Squeezed light generator commercially, the startup will be the first company to be explored whenever there is a demand
- However, the private investment to the startup is very unlikely at this stage specially for 19" rack mounted light source as the market size is too small. Also only a handful start ups based on quantum technology are in operation today showing the lack of demand of the technology in mass scale
- The startup has to be closely tied with the University group specially for the first 2-3 years
- Good news is that if some early revenue can be demonstrated based on the lab equipment business case, it is very likely to attract soft money from programs like InnoBooster, SME.
- A startup selling squeezed light source to quantum labs can still be self sustaining without venture investment

# Some questions to be answered for assessing the mass market disruption

- Performance- does the introduction of of squeezed light source give incremental improvement or radical change?
  - In case of incremental improvement in performance, it is unlikely that a new technology will beat the existing in mass market
  - In case the improvement is radical, one needs to look at new markets/customers in the early adaptor group( less focus on perfection because the new technology will not be perfect to start with)
- Economics –cost reduction
  - What is the price now and what will be the price in mass scale
  - How the price reduction resulting from economy of scale is going to happen- reduction in manufacturing cost, reduction in labor cost etc
- Dependence on ecosystem
  - Considering that the perfect squeezed light source on chip has been developed, what else need to be developed to use it in the potential application
  - What is the current state of development of the ecosystem? Is the ecosystem ready and just waiting for the perfect squeezed light source roll the device out?
- Identify the possible value chain for the possible applications



Thanks!  
Questions?