Exploratory Data Analysis and Sentiment Analysis of TED Talks

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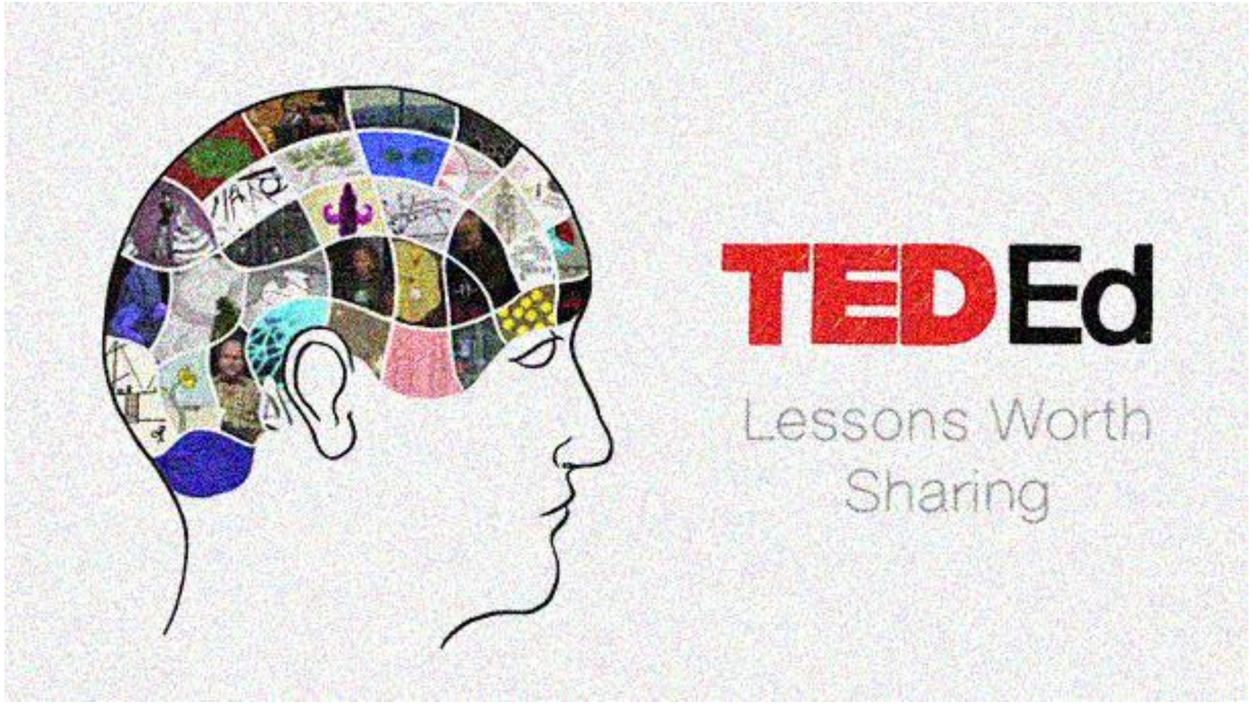


Abstract

This is an exploratory data analysis for TED Talks using TED Talks dataset on Kaggle.

This project seeks to find the most popular ideas and topics, the top speakers in TED Talks and the sentiment of comments for the most viewed talks.

The data is processed using pandas ,visualized using matplotlib and seaborn, and Naive Bayes classifier is used for sentiment analysis.

The findings of this project are presented in following individual slides .

Motivation

Watching TED Talks is a fascinating way to gain a deeper understanding of the world. However, there are so many conferences held over the past 30 years with broad and diverse topics. The goal of this project is to find the most popular Talks and topics.

The hope is that this project’s findings will be a valuable resource for people who seek to find TED Talks which contain their topic of interests and also present to them the most inspiring and informative TED Talks.

Dataset

- The dataset is downloaded from Kaggle. It contains information about all TED Talks(2550 events) uploaded to the official TED.com website until September 21st, 2017.

- The TED main dataset contains information about all talks such as comments, description, duration, event, film date, number of languages the talk is translated to, speakers, ratings, title and url.

Data Preparation & Cleaning

- Data is checked for missing values .For speakers occupation, 6 entries are missing, but since it does not affect our analysis we keep it.

- Column “ratings” contains information about the rating given to TED Talks. It is in string format which has dictionary of id of the reviewer, the word used for review and count. The abstract Syntax Trees (ast) module and further text cleaning methods are used to extract information of words and their frequencies. Then, a bag of words is built for sentiment analysis of words used in ratings/comments.

- Column “tags” also was processed using nltk.

Text cleaning the two above-mentioned steps, was a bit challenging since different methods and libraries had to be used to prepare the text for data analysis.

Research Questions

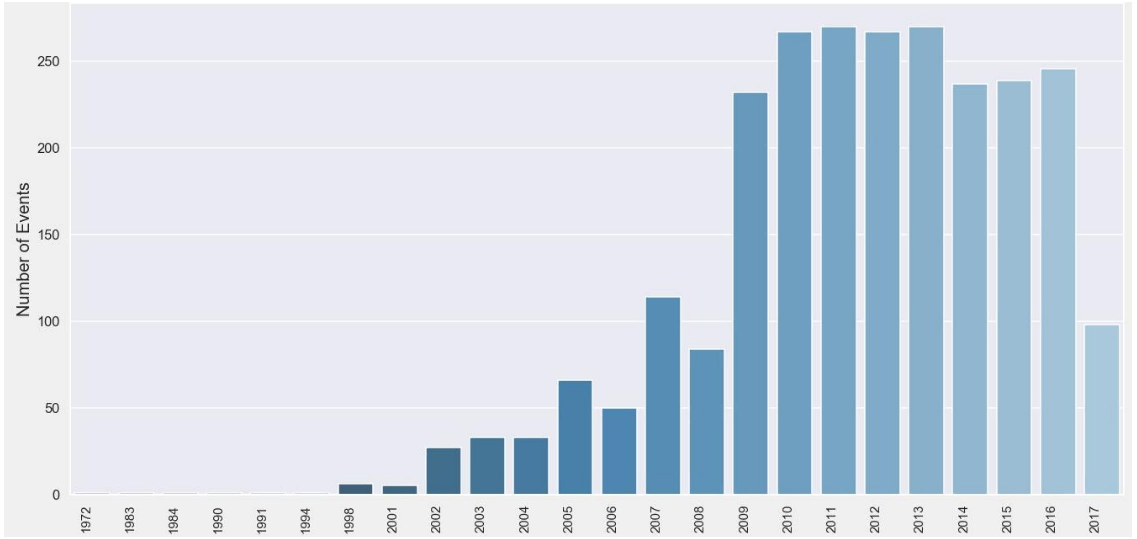
- How is the trend of number of TED events held over the years?
- What are the most popular TED Talks?
- Who are the top TED speakers? What profession do they have?
- What are the most popular topics of TED Talks?
- What is the distribution of positive and negative ratings of TED Talks? What words did audiences use to describe the TED Talks?

Methods

- Pandas library is used for loading the data in Jupyter Notebook since it contains easy-to-use data structures and data analysis tools.
- Matplotlib and Seaborn are used for visualization of data.
- For sentiment analysis, Naïve Bayes Classifier from nltk library is used which is a simple, yet effective and commonly-used, machine learning classifier.

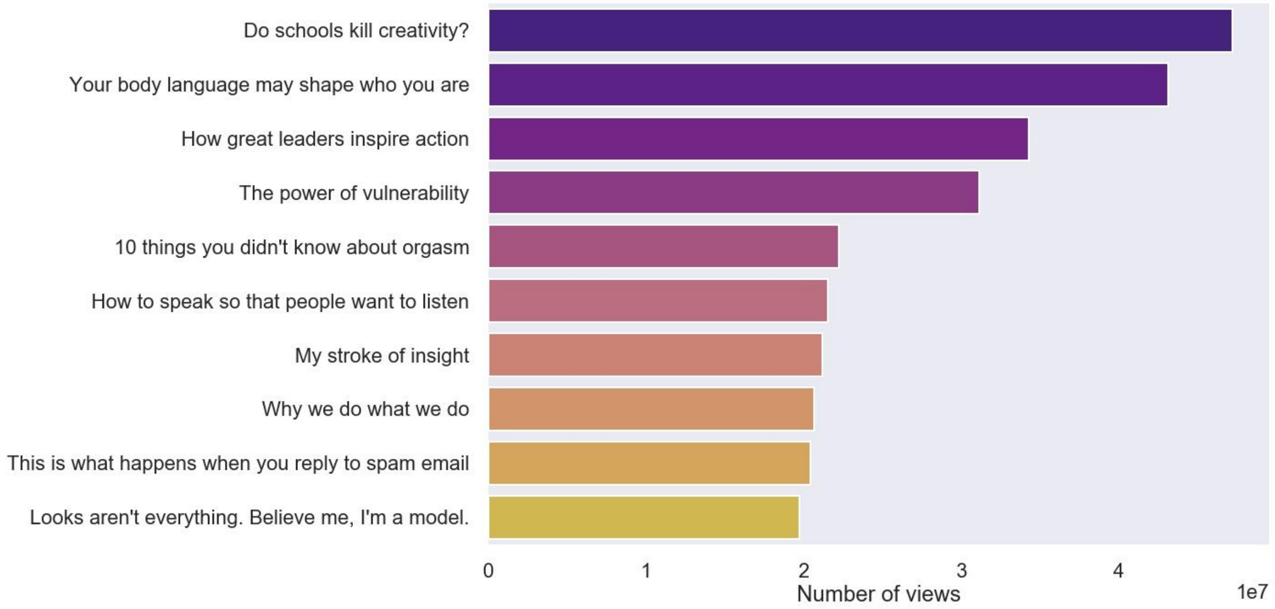
TED Talks : A Short History

TED was born in 1984 with focus on convergence of technology , entertainment and design. In 1990 , it became an annual event in Monterey California. As time went on, the topics broadened to include scientists, philosophers, musicians, business and religious leaders, philanthropists and many others. In 2009, the TED Fellows program was launched to bring up-and-coming innovators from around the globe to the conference for free. As we can see, the number of events has increased dramatically after that. (Note: data for number of events is not complete for 2017,hence the drop.)



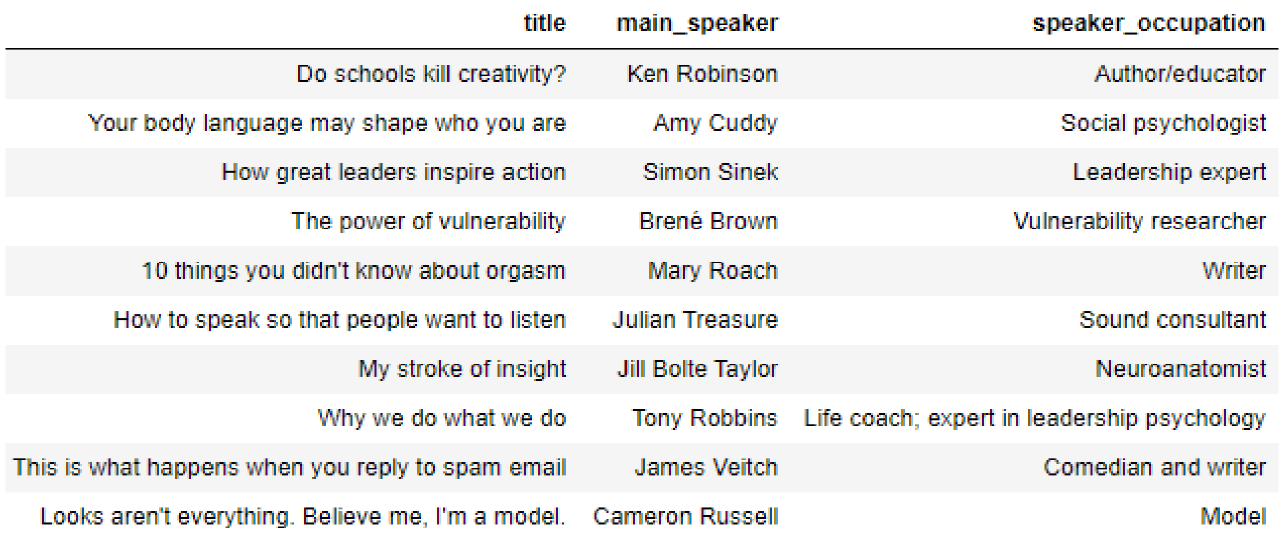
The Most Popular TED Talks

The visualization below shows the 10 most viewed TED Talk of all times. The titles of these Talks all seem innovative, insightful and touching. The most popular Talk with topic of “Do school kill creativity?” is among the first five TED Talks posted online in June, 2006. By September, the first five TED Talks had reached more than one million views.



The Top TED Speakers

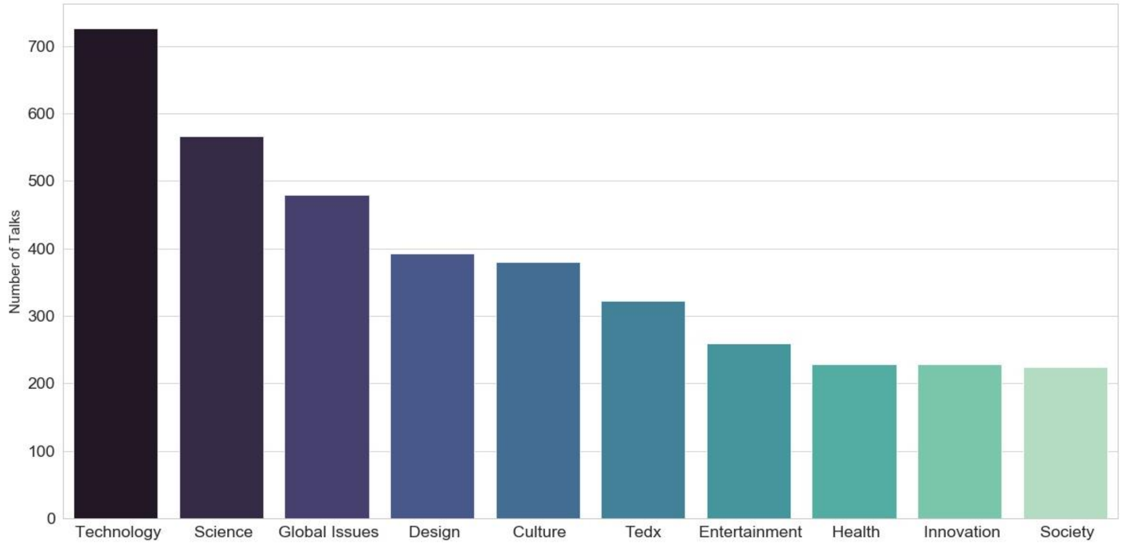
It is very fascinating to see the diversity of speakers occupations and the subject of their Talk.



title	main_speaker	speaker_occupation
Do schools kill creativity?	Ken Robinson	Author/educator
Your body language may shape who you are	Amy Cuddy	Social psychologist
How great leaders inspire action	Simon Sinek	Leadership expert
The power of vulnerability	Brené Brown	Vulnerability researcher
10 things you didn't know about orgasm	Mary Roach	Writer
How to speak so that people want to listen	Julian Treasure	Sound consultant
My stroke of insight	Jill Bolte Taylor	Neuroanatomist
Why we do what we do	Tony Robbins	Life coach; expert in leadership psychology
This is what happens when you reply to spam email	James Veitch	Comedian and writer
Looks aren't everything. Believe me, I'm a model.	Cameron Russell	Model

The Most Popular Topics of TED Talks

Technology, science and global issues are the most popular topics in TED Talks followed by design and culture.
There are many fields and topics touched by technology and science. The number of topics on global issues are also high since the world is connected more than ever and many issues affect the whole world. The digital era we live in, creates many conversation and ideas in these fields.

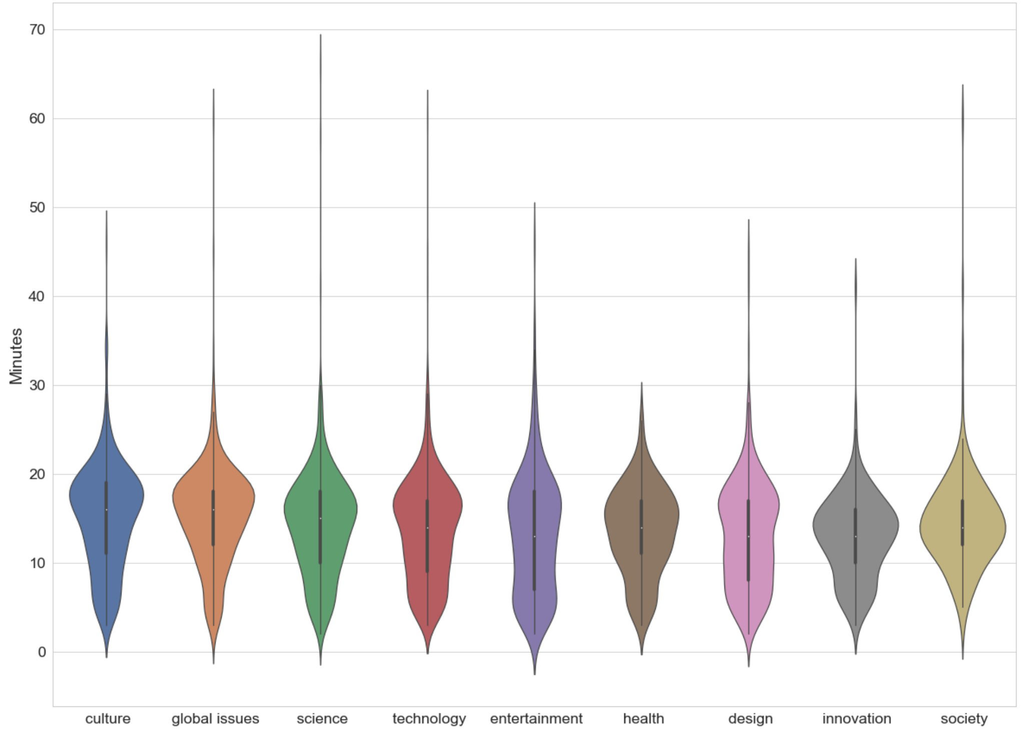


Duration of the Talks for Popular Topics

A TED talk is usually 18 minutes long. It was chosen based on neuroscience and strategy. It is long enough for a speaker to flesh out an idea, but short enough that a listener could take in, digest and understand all of the important information.

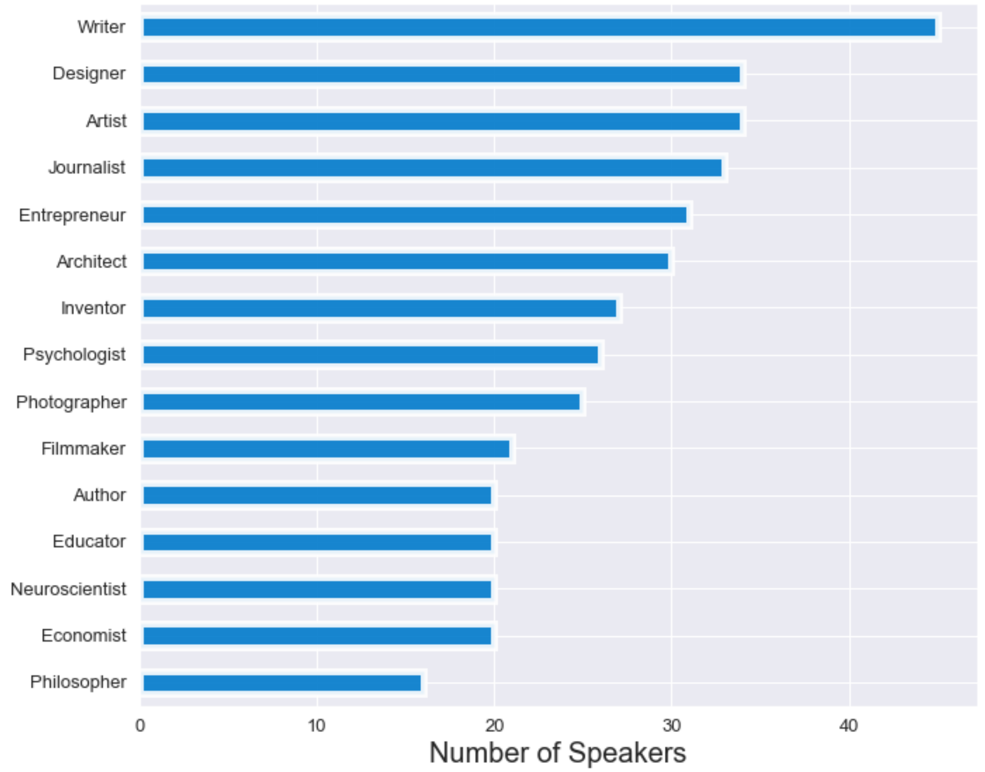
Delving into the data, visualization of some of popular topics and their length of talks confirms it.

As we can see the average duration of these Talks are all around 18 minutes.



What Do Popular Speakers Do?

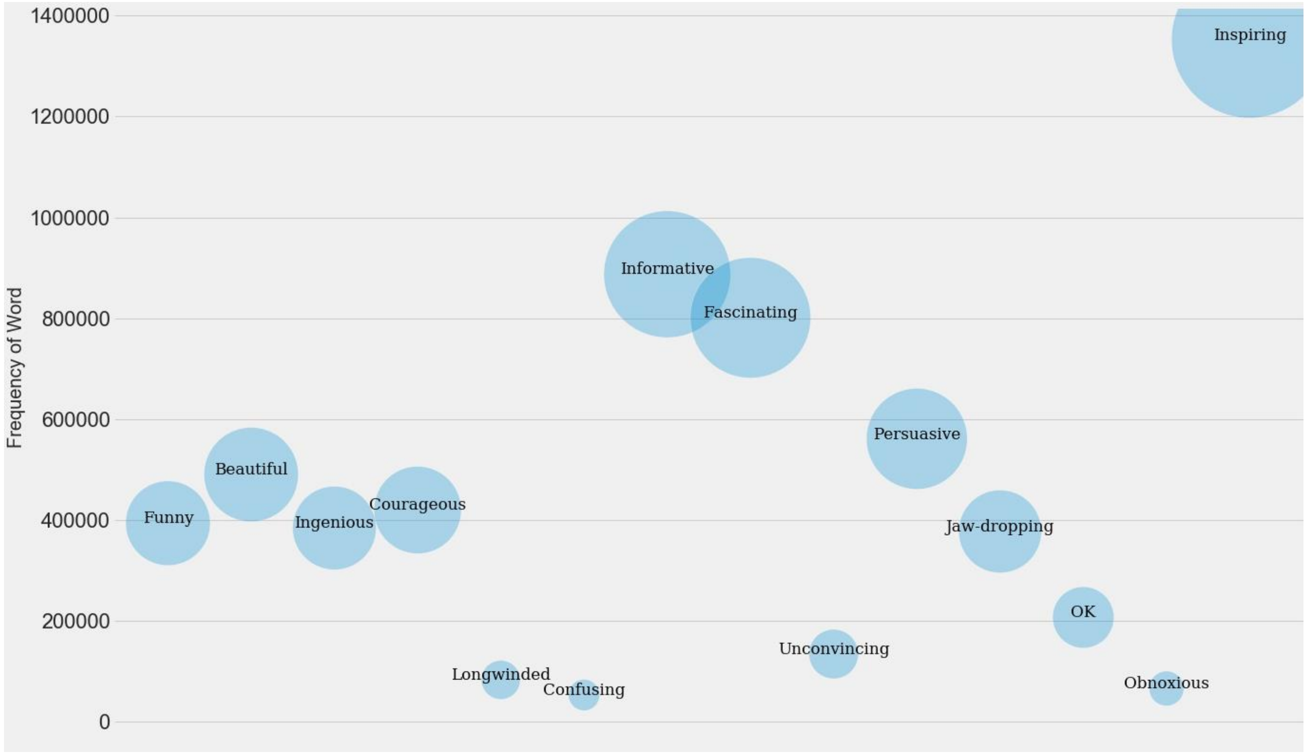
Based on this visualization extracted from data, writer is the most common occupation of TED speakers, followed by designer and artist.
Creativity and innovative design and research, and new ideas are what all these profession have in common. This remarkable variety is the spice of TED Talks.



Designer
Writer
Journalist
Artist
Architect
Inventor
Entrepreneur
Neuroscientist
Educator
Author
Biologist
Economist
Computer scientist
Psychologist
Photographer
Technologist
Singer/songwriter
Historian
Marine biologist
Philanthropist
Oceanographer
Filmmaker
Legal activist
Philosopher
Behavioral economist
Roboticist
Musician
Climate advocate
Evolutionary biologist
Mathematician
Techno-illusionist
Physicist
Astronomer
Reporter
Comedian
Social psychologist
Activist
Astrophysicist
Photojournalist
Writer, activist
Graphic designer
Social entrepreneur
Singer-songwriter
Novelist
Engineer
Poet
Futurist
Global health expert; data visionary

The Most Frequent Words Used in Comments

As a fan of TED Talks, I must agree that they are indeed inspiring, informative, fascinating and beautiful.



Sentiment Analysis Of Comments with Naïve Bayes Classifier

- Two Naïve Bayes Classifiers have been built using two data sets, movie reviews and twitter samples data sets available in nltk with model accuracy of 70% and 98% respectively.

- The sentiment of each topic's comments has been evaluated .Since the available comments are very limited, the sentiment analysis is also very general based on the small number of words of comments.

- Both models have classified almost all TED Talks comments as positive. Although, model number two has classified 8 TED Talks comments as negative, looking closer at data reveals that the weight of positive words is heavier than the negative words.

```
data['sentiment_of_comments_1'].value_counts()

pos     2550
```

```
data['sentiment_of_comments_2'].value_counts()

pos     2542
neg        8
```

Output of two models: Number of positive and negative comments

```
{'Beautiful': 41, 'Courageous': 43, 'Inspiring': 35, 'Informative': 15, 'Jaw-dropping': 3, 'Unconvincing': 5, 'Ingenious':
7, 'Fascinating': 14, 'Persuasive': 2, 'Funny': 6, 'Obnoxious': 5, 'Confusing': 1, 'OK': 1, 'Longwinded': 3}
```

Exploring one of the comments tagged as negative with model 2

Limitations

- The sentiment analysis of the comments is not a thorough and complete analysis since the complete data of comments was not available.

Conclusion

TED Talks are powerful short talks with the goal of spreading profound ideas of experts.

Today, it covers almost all topics from science to business and global issues.

It is no surprise that people call the inspiring, fascinating, innovative and beautiful.

Acknowledgements

- The dataset has been downloaded from Kaggle.
- TED Talk website has been studied to gain domain knowledge for analyzing the data for this project.
- The descriptions in this project has been written with help of ted.com.
- No feedback has been received since there was no one to show this project to.

References

- TED, Ideas worth spreading: www.ted.com
- Kaggle : www.kaggle.com
- Seaborn Library: https://seaborn.pydata.org/
- Stack overflow: https://stackoverflow.com/

Importing Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import matplotlib.ticker as ticker
from collections import Counter
import nltk
import string
import pickle
import re
import ast

from wordcloud import WordCloud
from nltk.classify import NaiveBayesClassifier
```

In [2]:
```
#can we predict number of view or popularity based on tags/or based on speaker
occupation
```

Loading Data

In [3]:
```
data=pd.read_csv('ted_main.csv')
```

In [4]:
```
data.head()
```

Out[4]:

	comments	description	duration	event	film_date	languages	main_speaker	name
0	4553	Sir Ken Robinson makes an entertaining and pro...	1164	TED2006	1140825600	60	Ken Robinson	Ken Robinson: Do schools kill creativity?
1	265	With the same humor and humanity he exuded in ...	977	TED2006	1140825600	43	Al Gore	Al Gore: Averting the climate crisis
2	124	New York Times columnist David Pogue takes aim...	1286	TED2006	1140739200	26	David Pogue	David Pogue: Simplicity sells
3	200	In an emotionally charged talk, MacArthur-winn...	1116	TED2006	1140912000	35	Majora Carter	Majora Carter: Greening the ghetto
4	593	You've never seen data presented like this. Wi...	1190	TED2006	1140566400	48	Hans Rosling	Hans Rosling: The best stats you've ever seen

In [ ]:

Data Cleaning

```
In [5]: data.isnull().any()

Out[5]: comments              False
        description           False
        duration              False
        event                 False
        film_date             False
        languages             False
        main_speaker          False
        name                  False
        num_speaker           False
        published_date        False
        ratings               False
        related_talks         False
        speaker_occupation     True
        tags                  False
        title                 False
        url                   False
        views                 False
        dtype: bool
```

```
In [6]: data.isnull().sum()

Out[6]: comments              0
        description           0
        duration              0
        event                 0
        film_date             0
        languages             0
        main_speaker          0
        name                  0
        num_speaker           0
        published_date        0
        ratings               0
        related_talks         0
        speaker_occupation    6
        tags                  0
        title                 0
        url                   0
        views                 0
        dtype: int64
```

```
In [7]: data.shape

Out[7]: (2550, 17)
```

```
In [8]: #not droping null values,keeping the null speakers
        # data=data.dropna()
        # data.shape
```

Data Exploration

In [9]:
```
data.columns
```

Out[9]:
```
Index(['comments', 'description', 'duration', 'event', 'film_date',
       'languages', 'main_speaker', 'name', 'num_speaker', 'published_date',
       'ratings', 'related_talks', 'speaker_occupation', 'tags', 'title',
       'url', 'views'],
      dtype='object')
```

In [10]:
```
#checking the most viewed TED Talks
#data.sort_values('views',ascending=False).head()
```

In [11]:
```
#exploring the ratins
data.ratings[0]
```

Out[11]:
```
"[{'id': 7, 'name': 'Funny', 'count': 19645}, {'id': 1, 'name': 'Beautiful',
'count': 4573}, {'id': 9, 'name': 'Ingenious', 'count': 6073}, {'id': 3, 'nam
e': 'Courageous', 'count': 3253}, {'id': 11, 'name': 'Longwinded', 'count': 3
87}, {'id': 2, 'name': 'Confusing', 'count': 242}, {'id': 8, 'name': 'Informa
tive', 'count': 7346}, {'id': 22, 'name': 'Fascinating', 'count': 10581}, {'i
d': 21, 'name': 'Unconvincing', 'count': 300}, {'id': 24, 'name': 'Persuasiv
e', 'count': 10704}, {'id': 23, 'name': 'Jaw-dropping', 'count': 4439}, {'i
d': 25, 'name': 'OK', 'count': 1174}, {'id': 26, 'name': 'Obnoxious', 'coun
t': 209}, {'id': 10, 'name': 'Inspiring', 'count': 24924}]"
```

In [12]:
```
data.ratings.shape[0]
```

Out[12]:
```
2550
```

Data PreProccesing

Extracting words of comments and their frequency

In [13]:
```
#a function to extract dict
def get_literal(data):
    '''
    returns the extracted dic from string
    '''
    x = ast.literal_eval(re.search('({.+})', data).group(0))
    return x
```

In [14]:
```
#a function to extract name and its count
def ratings_dict(x):
    '''
    return a dictionary with words & counts in ratings
    '''
    ratings_dict=dict()
    for d in x:
        key=d['name']
        value=d['count']

        ratings_dict[key]=value
    return ratings_dict
```

In [15]:
```
#adding a column to save extracted words and count
data['words_of_comments']='word'
```

In [22]:
```
data.tail(2)
```

Out[22]:

	comments	description	duration	event	film_date	languages	main_speaker	
2548	32	In an unmissable talk about race and politics ...	1100	TEDxMileHigh	1499472000	1	Theo E.J. Wilson	T V bl unc
2549	8	With more than half of the world population li...	519	TED2017	1492992000	1	Karoliina Korppoo	I K

In [25]:
```
#creating a list of words and frequency for each TED Talk and to use later for
sentiment analysis
list_of_dict=[]
for rating in data.ratings:
    list_of_dict.append(ratings_dict(get_literal(rating)))

len(list_of_dict)
```

Out[25]:
```
2550
```

In [ ]:

```
In [26]: #testing to see if comments words are correctly extracted
         list_of_dict[:1]
```

```
Out[26]: [{'Funny': 19645,
           'Beautiful': 4573,
           'Ingenious': 6073,
           'Courageous': 3253,
           'Longwinded': 387,
           'Confusing': 242,
           'Informative': 7346,
           'Fascinating': 10581,
           'Unconvincing': 300,
           'Persuasive': 10704,
           'Jaw-dropping': 4439,
           'OK': 1174,
           'Obnoxious': 209,
           'Inspiring': 24924}]
```

```
In [27]: #building data.words column with comment and frequency
         for i in range(len(list_of_dict)):
             data['words_of_comments'][i]=list_of_dict[i]
```

```
C:\Users\fayal\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
  This is separate from the ipykernel package so we can avoid doing imports u
ntil
```

```
In [28]: data.words_of_comments[:1]
```

```
Out[28]: 0    {'Funny': 19645, 'Beautiful': 4573, 'Ingenious...
         Name: words_of_comments, dtype: object
```

```
In [29]: print('There are:',len(data.main_speaker.unique().tolist()), 'main speakers.')
```

```
There are: 2156 main speakers.
```

```
In [30]: print('There are:',len(data.speaker_occupation.unique().tolist()), 'speaker oc
         cupations.')
```

```
There are: 1459 speaker occupations.
```

There are 2544 rows in data and 2150 speakers. So, that means some speakers have held TED Talk more than once.

```
In [31]: #we don't need the url
         del data['url']
```

Parsing date

In [32]:
```
#let's parse the film date and publish date
data['film_date']=pd.to_datetime(data['film_date'],unit='s')
data['film_date'][:10]
```

Out[32]:
```
0   2006-02-25
1   2006-02-25
2   2006-02-24
3   2006-02-26
4   2006-02-22
5   2006-02-02
6   2006-02-24
7   2006-02-23
8   2006-02-02
9   2006-02-25
Name: film_date, dtype: datetime64[ns]
```

In [33]:
```
#since we are interested to explor film date only, we will delete published da
te from dataframe
del data['published_date']
```

In [34]:
```
data['film_date'].describe()
```

Out[34]:
```
count                    2550
unique                    735
top       2017-04-24 00:00:00
freq                       64
first     1972-05-14 00:00:00
last      2017-08-27 00:00:00
Name: film_date, dtype: object
```

In [35]:
```
#exploring range of years
range_years=sorted(data['film_date'].dt.year.unique().tolist())
print(range_years)
```

```
[1972, 1983, 1984, 1990, 1991, 1994, 1998, 2001, 2002, 2003, 2004, 2005, 200
6, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017]
```

In [36]:
```
#extracting year from film date
data['year']=data['film_date'].dt.year
data.head(2)
```

Out[36]:

	comments	description	duration	event	film_date	languages	main_speaker	name	nı
0	4553	Sir Ken Robinson makes an entertaining and pro...	1164	TED2006	2006-02-25	60	Ken Robinson	Ken Robinson: Do schools kill creativity?	
1	265	With the same humor and humanity he exuded in ...	977	TED2006	2006-02-25	43	Al Gore	Al Gore: Averting the climate crisis	

In [37]:
```
#changing duration from second to minute
data['length_minute']=(data['duration']/60).round()

data.head(2)
```

Out[37]:

	comments	description	duration	event	film_date	languages	main_speaker	name	nı
0	4553	Sir Ken Robinson makes an entertaining and pro...	1164	TED2006	2006-02-25	60	Ken Robinson	Ken Robinson: Do schools kill creativity?	
1	265	With the same humor and humanity he exuded in ...	977	TED2006	2006-02-25	43	Al Gore	Al Gore: Averting the climate crisis	

Data Visualization

https://seaborn.pydata.org/generated/seaborn.cubehelix_palette.html (https://seaborn.pydata.org/generated/seaborn.cubehelix_palette.html)

In [38]:
```
data['length_minute'].describe()
```

Out[38]:
```
count    2550.000000
mean       13.777255
std         6.249848
min         2.000000
25%        10.000000
50%        14.000000
75%        17.000000
max        88.000000
Name: length_minute, dtype: float64
```

In [39]:
```
#which TEDtalk has maximum views
data[data['views']==data.views.max()]
```

Out[39]:

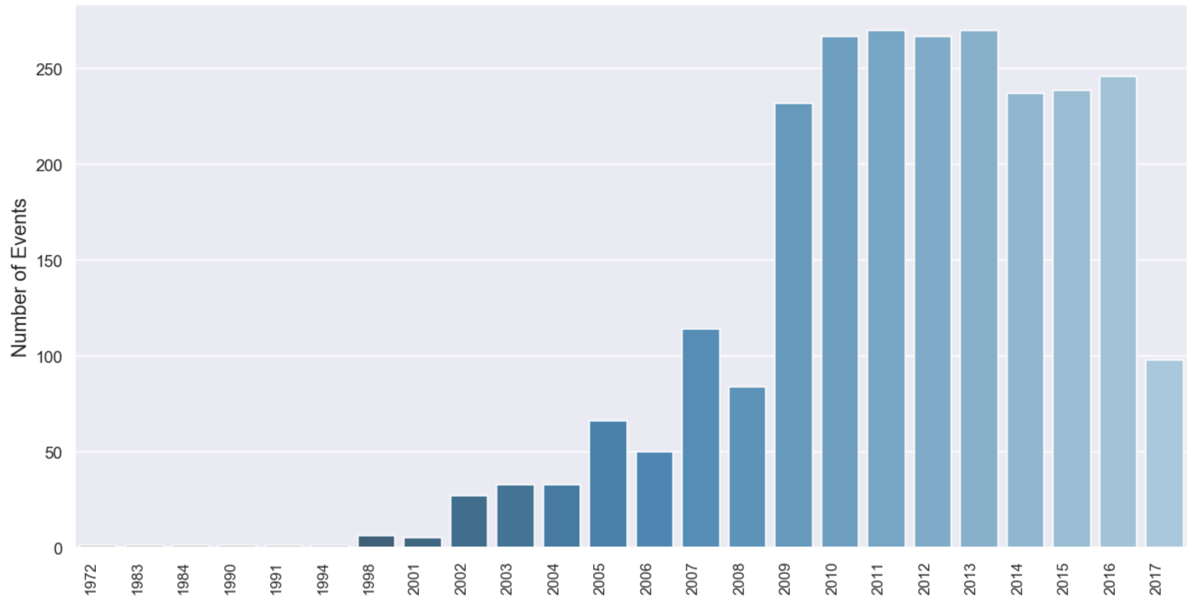
	comments	description	duration	event	film_date	languages	main_speaker	name	nu
0	4553	Sir Ken Robinson makes an entertaining and pro...	1164	TED2006	2006-02-25	60	Ken Robinson	Ken Robinson: Do schools kill creativity?	

In [40]:
```
type(data.views[0])
```

Out[40]:
```
numpy.int64
```

History: Events per year

In [41]:
```
#plotting number of events per year

sns.set(style="darkgrid",context='talk')


fig, ax = plt.subplots(figsize=(20,10))


sns.countplot(x='year',data=data[['event','year']],palette='Blues_d')

ax.set_xticklabels(ax.get_xticklabels(),fontsize=15,rotation=90, ha="right")

ax.set_xlabel('')
ax.set_ylabel('Number of Events',fontsize=20)

plt.savefig('history of TED Talks.jpeg')
plt.show()
```

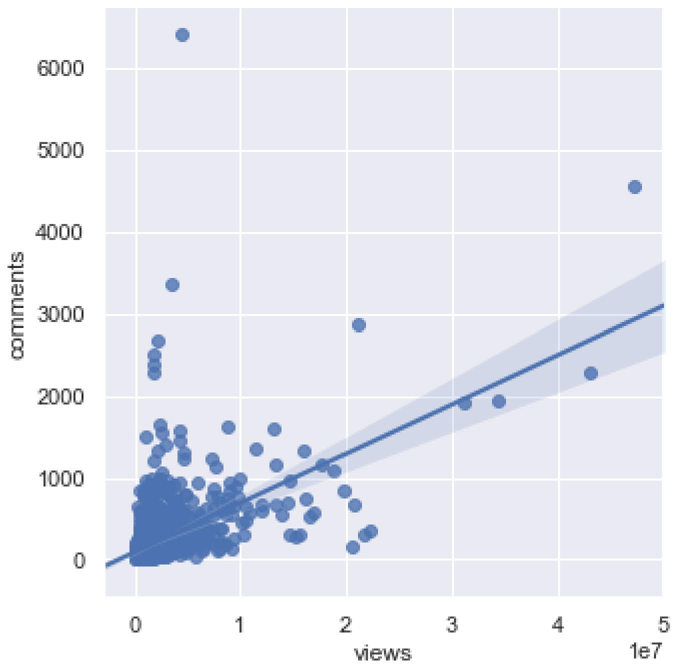


It is possible that the data does not have all the TED events in 2017.

In [ ]:

Correlation of comments and views

In [42]:
```
sns.set(style="darkgrid")


sns.lmplot(x='views', y='comments', data=data,x_jitter=.05)

plt.show()
```



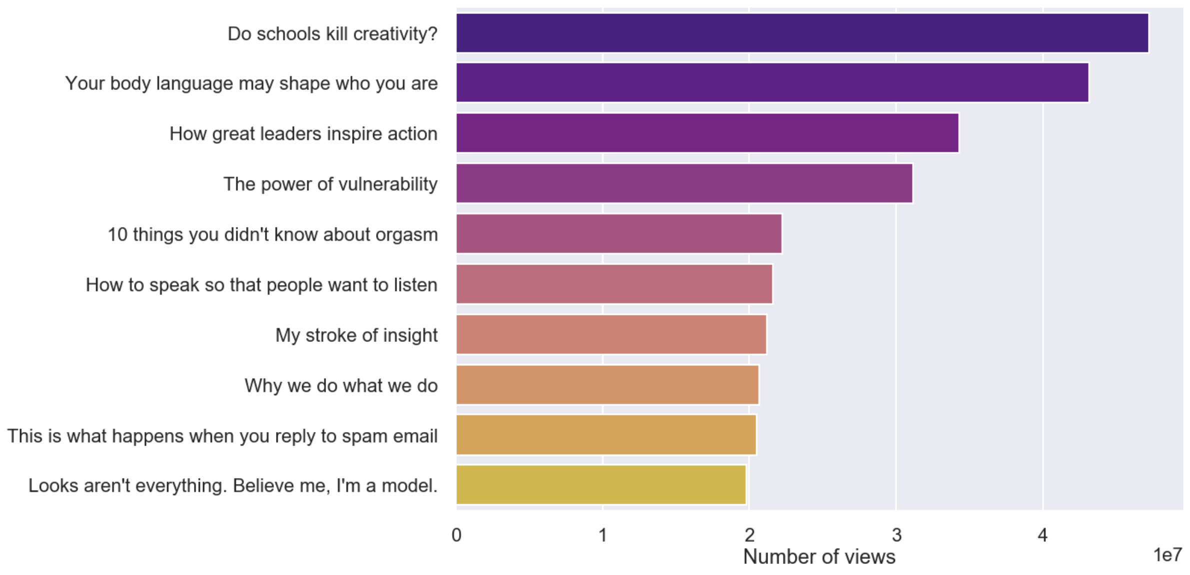
Most Viewed Talks

In [43]:
```
most_viewed=data.sort_values('views',ascending=False).head(10)
most_viewed.head(2)
```

Out[43]:

	comments	description	duration	event	film_date	languages	main_speaker	nam
0	4553	Sir Ken Robinson makes an entertaining and pro...	1164	TED2006	2006-02-25	60	Ken Robinson	Ke Robinsor D school ki creativity
1346	2290	Body language affects how others see us, but i...	1262	TEDGlobal 2012	2012-06-26	51	Amy Cuddy	Am Cuddy Your bod languag ma shap who yo.

In [44]:
```
#plotting the most viewed
#most_viewed=data[['title','views','main_speaker','year']].sort_values('view
s',ascending=False).head(10)

sns.set(style="darkgrid",context='poster')


plt.figure(figsize=(20,10))
sns.barplot(x=most_viewed.views,y=most_viewed.title,palette='plasma',saturatio
n=0.6)

#plt.title('The most popular TED Talks')
plt.xlabel('Number of views')
plt.ylabel('')

sns.despine(offset=5,trim=True)
plt.tight_layout()

plt.savefig('most_popular_TT.jpeg')
plt.show()
```



In [ ]:

Most Popular Speakers, Occupation of speakers

In [45]:
```
speaker=most_viewed[['title','main_speaker','speaker_occupation']]
speaker
```

Out[45]:

	title	main_speaker	speaker_occupation
0	Do schools kill creativity?	Ken Robinson	Author/educator
1346	Your body language may shape who you are	Amy Cuddy	Social psychologist
677	How great leaders inspire action	Simon Sinek	Leadership expert
837	The power of vulnerability	Brené Brown	Vulnerability researcher
452	10 things you didn't know about orgasm	Mary Roach	Writer
1776	How to speak so that people want to listen	Julian Treasure	Sound consultant
201	My stroke of insight	Jill Bolte Taylor	Neuroanatomist
5	Why we do what we do	Tony Robbins	Life coach; expert in leadership psychology
2114	This is what happens when you reply to spam email	James Veitch	Comedian and writer
1416	Looks aren't everything. Believe me, I'm a model.	Cameron Russell	Model

Topics/ Tags,using nltk tokenizer

In [46]:
```
#exploring
data.tags.value_counts()[:15]
```

Out[46]:
```
['live music', 'music', 'performance']                                    3
['entertainment', 'live music', 'music', 'performance']                   3
['art', 'creativity']                                                     3
['cities', 'culture', 'design', 'transportation']                         2
['demo', 'design', 'interface design', 'technology']                      2
['TEDx', 'inequality', 'race', 'social change', 'society']                2
['creativity', 'entertainment', 'live music', 'music', 'performance']     2
['business', 'technology']                                                2
['architecture', 'cities', 'design', 'infrastructure']                    2
['mission blue', 'oceans', 'science', 'technology']                       2
['culture', 'technology']                                                 2
['charter for compassion', 'compassion', 'global issues', 'religion']     2
['TED Fellows', 'photography', 'war']                                     2
['culture', 'love', 'relationships', 'sex']                               2
['design', 'entertainment', 'live music', 'music', 'technology']          2
Name: tags, dtype: int64
```

In [47]:
```
data.tags[0]
```

Out[47]:
```
"['children', 'creativity', 'culture', 'dance', 'education', 'parenting', 'te
aching']"
```

In [48]:
```
data.tags[0].split(',')
```

Out[48]:
```
["['children'",
 " 'creativity'",
 " 'culture'",
 " 'dance'",
 " 'education'",
 " 'parenting'",
 " 'teaching']"]
```

In [49]:
```
#testing the function:
l=[]
w=''
for x in data.tags[0].split(','):
    for char in x:
        if not char in string.punctuation:
            w+=char
    l.append(w)
    w=''
print(l,len(l))
```

```
['children', ' creativity', ' culture', ' dance', ' education', ' parenting',
' teaching'] 7
```

In [50]:
```
data['tags'].shape[0]
```

Out[50]:
```
2550
```

In [51]:
```
data['theme']='theme'
```

In [52]:
```
for i in range(data['tags'].shape[0]):

    l=[]
    w=''

    for x in data.tags[i].split(','):
        for char in x:
            if not char in string.punctuation:
                w+=char
        l.append(w)
        w=''
    data['theme'][i]=l
```

```
C:\Users\fayal\Anaconda3\lib\site-packages\ipykernel_launcher.py:13: SettingW
ithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
  del sys.path[0]
```

In [53]:
```
data['theme'].head()
```

Out[53]:
```
0    [children,  creativity,  culture,  dance,  edu...
1    [alternative energy,  cars,  climate change,  ...
2    [computers,  entertainment,  interface design,...
3    [MacArthur grant,  activism,  business,  citie...
4    [Africa,  Asia,  Google,  demo,  economics,  g...
Name: theme, dtype: object
```

In [61]:
```
#combining all tags in one list to feed the Counter object
list_tags=[]
for i in range(data.theme.shape[0]):
    list_tags.extend(data.theme[i])
```

In [62]:
```
len(list_tags)
```

Out[62]:
```
19154
```

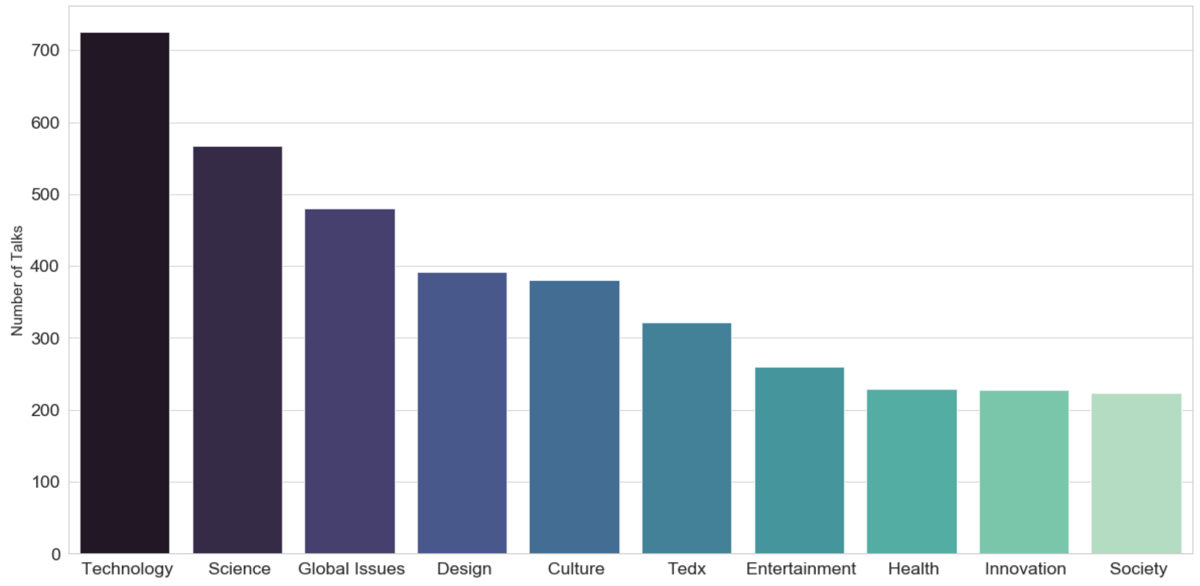
In [63]:
```
count_tags=Counter(list_tags)
most_common_tags=count_tags.most_common()[:10]
```

In [64]:
```
type(most_common_tags)
```

Out[64]:
```
list
```

In [65]:
```
#combining all words in tags column and making a text blob
# all_words_of_tags=''
# for tag in data.tags:
#     all_words_of_tags+=tag
# all_words_of_tags[:30]#testing if geting a blob of text from tag col works
```

In [66]:
```
sns.set(style='whitegrid',font_scale = 2,context='paper')
plt.figure(figsize=(20,10))
x=[]
y=[]

for i in range(len(most_common_tags)):
    x.append(most_common_tags[i][0].title())
    y.append(most_common_tags[i][1])

#plt.stem(x,y)
sns.barplot(x,y,palette='mako')

#plt.title('Most Popular Topics')
plt.xlabel('')
plt.ylabel('Number of Talks',fontsize=15)

plt.savefig('most popular topics.jpeg')
plt.show()
```



In [67]:
```
print(x)
print(y)
```

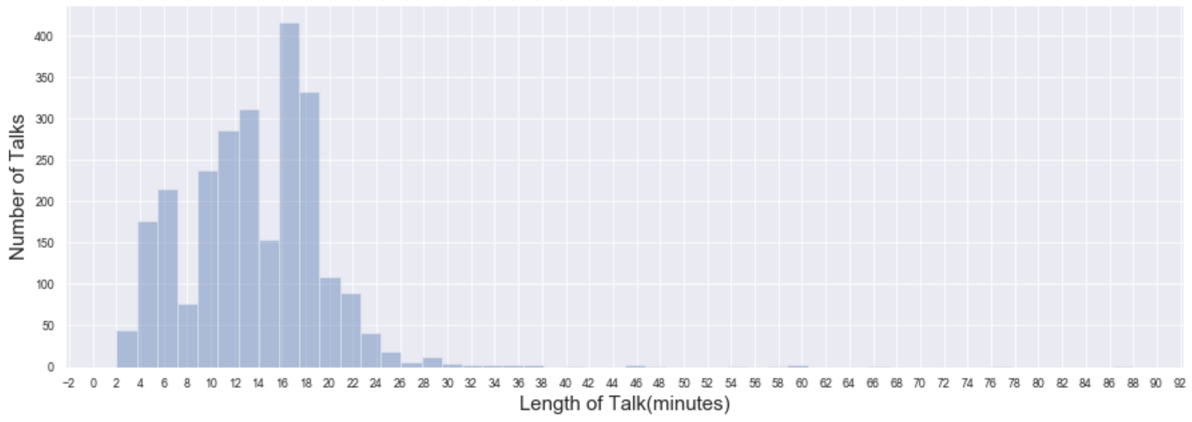
```
[' Technology', ' Science', ' Global Issues', ' Design', ' Culture', 'Tedx',
' Entertainment', ' Health', ' Innovation', ' Society']
[726, 567, 480, 392, 380, 322, 260, 229, 228, 224]
```

In [68]:
```
data.theme[:2]
```

Out[68]:
```
0    [children,  creativity,  culture,  dance,  edu...
1    [alternative energy,  cars,  climate change,  ...
Name: theme, dtype: object
```

Duration of Talks, based on topic

In [69]:
```
#plotting the distribution of length of Talk
sns.set(style="darkgrid",context='paper')
fig, ax = plt.subplots(figsize=(15,5))
ax.xaxis.set_major_locator(ticker.MultipleLocator(2))

sns.distplot(data['length_minute'],norm_hist=False,kde=False,bins=50)


ax.set_xlabel('Length of Talk(minutes)',fontsize=15)
ax.set_ylabel('Number of Talks',fontsize=15)
plt.show()
```



As TED Talk must be around 18 minutes, histogram shows the distribution confirm it. There are some outliers though.

In [70]:
```
topics=[]
for topic in x:
    topics.append(topic.lower())
topics
```

Out[70]:
```
[' technology',
 ' science',
 ' global issues',
 ' design',
 ' culture',
 'tedx',
 ' entertainment',
 ' health',
 ' innovation',
 ' society']
```

In [71]:
```
length_of_topics=pd.DataFrame({'length':np.repeat(data.length_minute.values,da
ta.theme.str.len()),
                              'topic': np.concatenate(data.theme.values)})
```

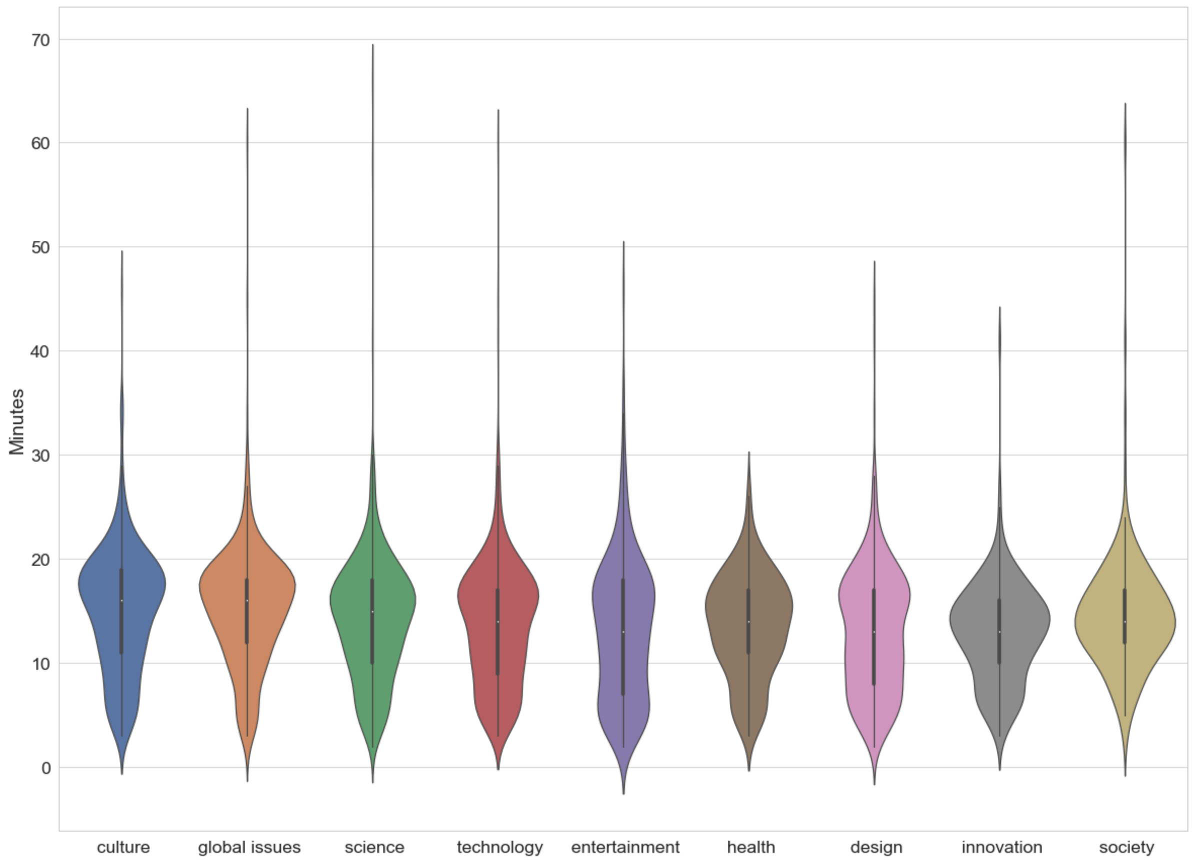
In [72]:
```
filtered_topics=length_of_topics[length_of_topics.topic.isin(topics)]
filtered_topics.shape
```

Out[72]:
```
(3486, 2)
```

In [73]:
```
filtered_topics.length.describe()
```

Out[73]:
```
count    3486.000000
mean       14.025531
std         5.939647
min         2.000000
25%        10.000000
50%        14.000000
75%        18.000000
max        66.000000
Name: length, dtype: float64
```

In [74]:
```
sns.set(style='whitegrid',font_scale = 2,context='paper')

plt.figure(figsize=(20,15))
sns.violinplot(x='topic',y='length',data=filtered_topics,kind='violin')

plt.xlabel("")
plt.ylabel('Minutes')

plt.savefig('Duration of Talk')
plt.show()
```



Speaker Occupation

In [75]:
```
print('There are:',len(data.speaker_occupation.unique().tolist()),'occupation
 among speakers.')
```

```
There are: 1459 occupation among speakers.
```

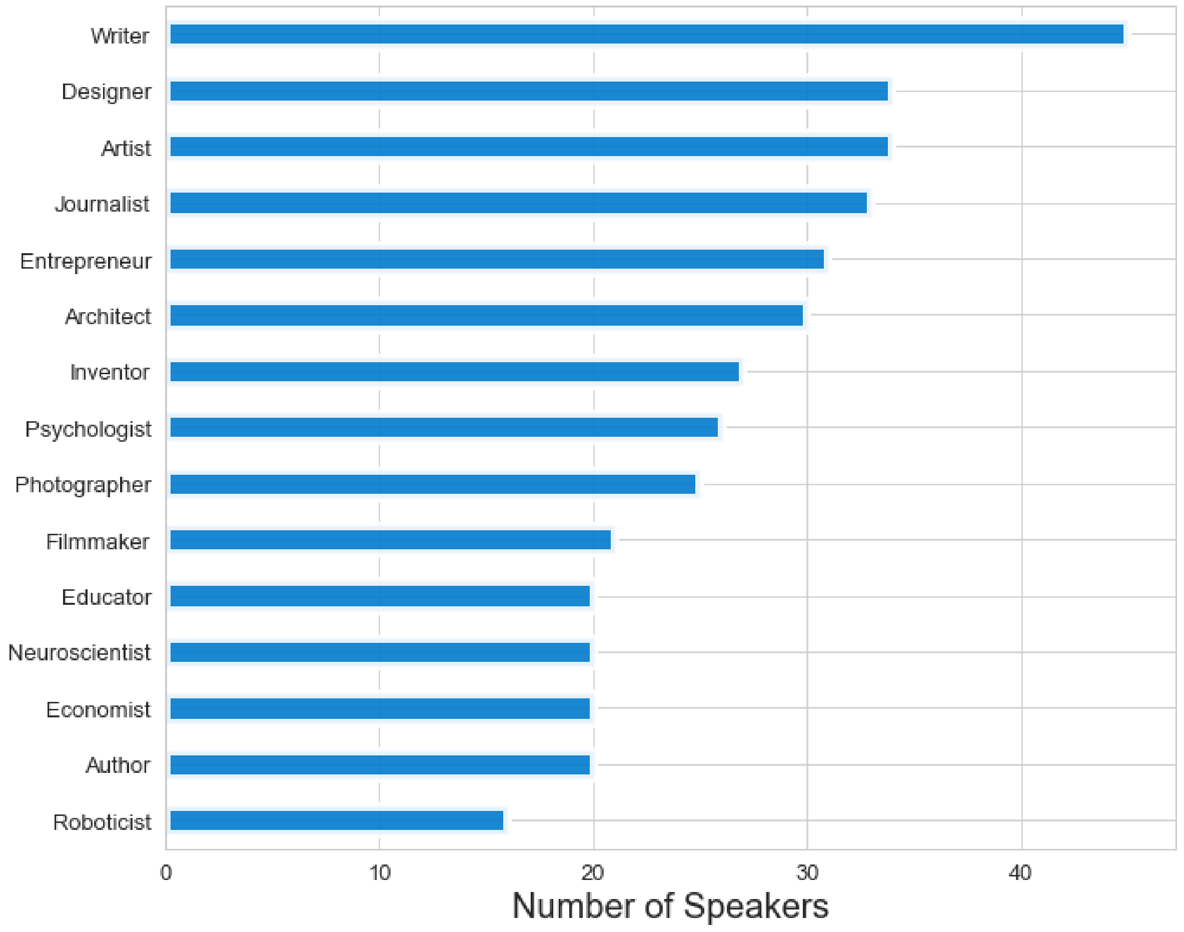
In [76]:
```
print('There are :', len(data.main_speaker.unique().tolist()),'speakers and ',
data.shape[0], 'TED Talks.')
```

```
There are : 2156 speakers and  2550 TED Talks.
```

Some speakers have had more than one TED Talk.

In [77]:
```
occu=data.speaker_occupation.value_counts()[:15]
```

```
In [78]: #data.speaker_occupation.value_counts()[:15].plot(kind='barh')

         fig, ax = plt.subplots(figsize=(25,15))




         occu.plot(kind='barh', figsize=(10,8),color='#007acc', alpha=0.9, linewidth=5,
         fontsize=13)
         plt.gca().invert_yaxis()
         plt.xlabel('Number of Speakers',fontsize=20)
         plt.tight_layout()
         plt.savefig('most_popular_occupation.png')

         plt.show()
```



```
In [79]: #the most common occupation
         speakers_occupations=dict(data.speaker_occupation.value_counts())
         sum(speakers_occupations.values())

Out[79]: 2544
```

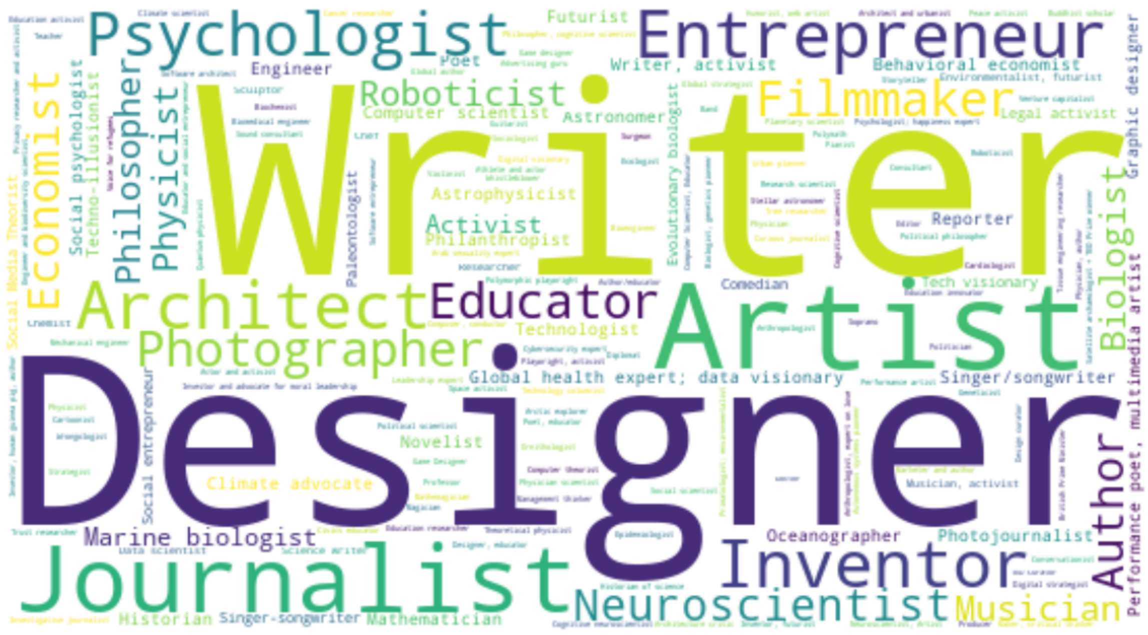
```
In [80]: len(speakers_occupations.keys())

Out[80]: 1458
```

In [ ]:

```

```

In [81]:

```
f, ax = plt.subplots(figsize=(20, 20))
wordcloud = WordCloud(width=550,height=300, background_color='white',
                      max_words=5000,relative_scaling=0.1,
                      normalize_plurals=False)
wordcloud.generate_from_frequencies(speakers_occupations)
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis('off')

plt.tight_layout
plt.savefig('wordcloud.png')

plt.show()
```



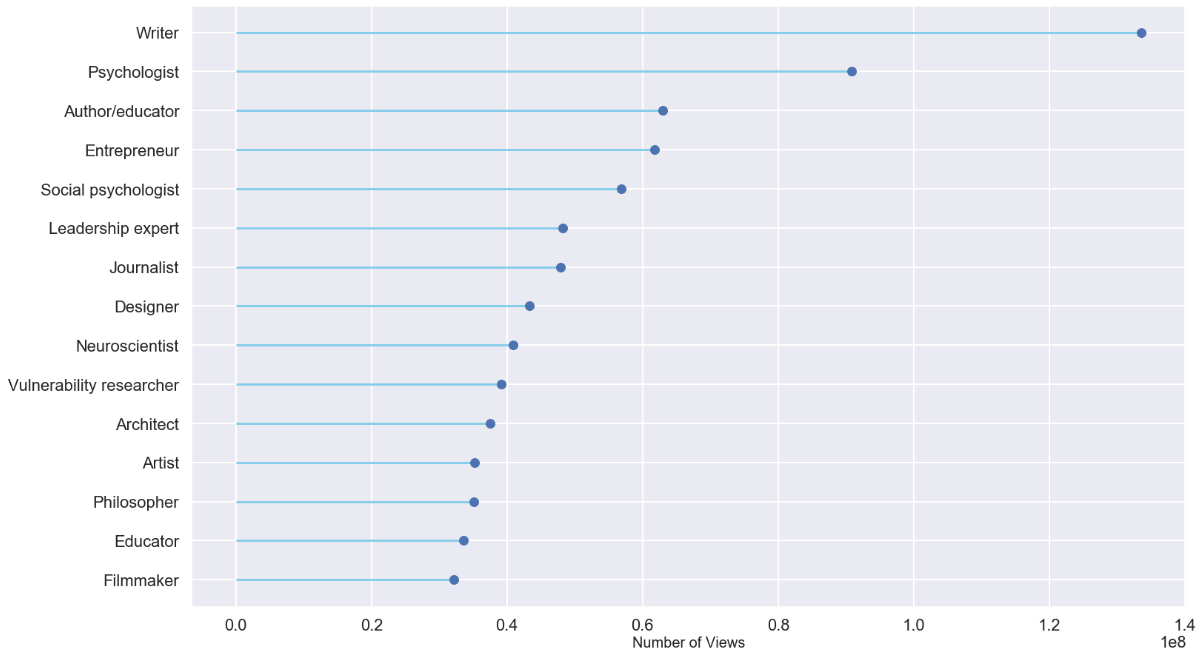
occupation of speakers who have attracted the most viewers?

In [82]:
```
occ_with_most_views=data.groupby('speaker_occupation',as_index=False)['views']
.sum()
top_occu=occ_with_most_views.sort_values('views',ascending=False)[:15]
top_occu
```

Out[82]:

	speaker_occupation	views
1426	Writer	133549303
1131	Psychologist	90851398
142	Author/educator	63006281
515	Entrepreneur	61764022
1257	Social psychologist	56813602
781	Leadership expert	48203767
753	Journalist	47860783
413	Designer	43294187
924	Neuroscientist	40889730
1408	Vulnerability researcher	39157044
71	Architect	37549155
83	Artist	35248703
1003	Philosopher	35100406
491	Educator	33538513
567	Filmmaker	32112289

In [83]:
```
sns.set(style='darkgrid',context='poster')

plt.figure(figsize=(23,13))

plt.hlines(y=top_occu.speaker_occupation,xmin=0,xmax=top_occu.views,color='sky
blue')
plt.plot(top_occu.views,top_occu.speaker_occupation,"o")



plt.xlabel('Number of Views',fontsize=20)

plt.gca().invert_yaxis()
plt.tight_layout()

plt.savefig('occu_w_most_views.jpeg')
plt.show()
```



Who is this Vulnerability researcher poping up here?

In [84]:
```
data[data['speaker_occupation']=='Vulnerability researcher'][['main_speaker',
'title','views']]
```

Out[84]:

	main_speaker	title	views
837	Brené Brown	The power of vulnerability	31168150
1177	Brené Brown	Listening to shame	7988894

In [85]:
```
len(data[data['speaker_occupation']=='Neuroscientist']['main_speaker'].unique
().tolist())
```

Out[85]:
```
18
```

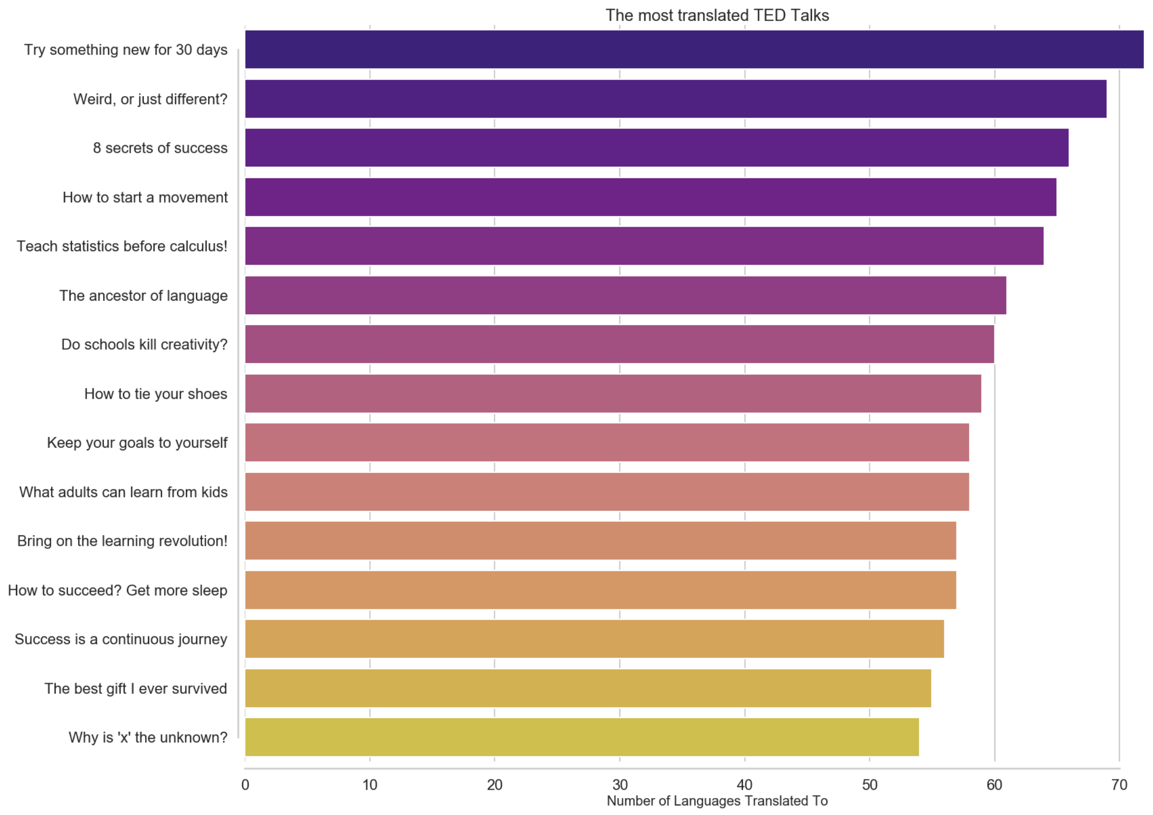
Languages Translated To

In [86]:
```
most_translated=data.sort_values('languages',ascending=False)[:15]
most_translated.head()
```

Out[86]:

	comments	description	duration	event	film_date	languages	main_speaker	name
973	736	Is there something you've always meant to do, ...	207	TED2011	2011-03-03	72	Matt Cutts	Matt Cutts: Try something new for 30 days
606	238	"There's a flip side to everything," the sayin...	162	TEDIndia 2009	2009-11-06	69	Derek Sivers	Derek Sivers: Weird, or just different?
47	578	Why do people succeed? Is it because they're s...	210	TED2005	2005-02-23	66	Richard St. John	Richard St. John: 8 secrets of success
653	422	With help from some surprising footage, Derek ...	189	TED2010	2010-02-11	65	Derek Sivers	Derek Sivers: How to start a movement
479	398	Someone always asks the math teacher, "Am I go...	178	TED2009	2009-02-05	64	Arthur Benjamin	Arthur Benjamin: Teach statistics before calcu...

In [87]:
```
sns.set(style='whitegrid',context='poster')

plt.figure(figsize=(25,20))
sns.barplot(x=most_translated.languages,y=most_translated.title,saturation=0.6
,palette='plasma')

plt.title('The most translated TED Talks')
plt.xlabel('Number of Languages Translated To',fontsize=20)
plt.ylabel('')
sns.despine(offset=10,trim=True)
plt.show()
```



In [ ]:

What are the most used words in TED Talks

In [88]:
```
transcripts=pd.read_csv('transcripts.csv')
transcripts.head()
```

Out[88]:

	transcript	url
0	Good morning. How are you?(Laughter)It's been ...	https://www.ted.com/talks/ken_robinson_says_sc...
1	Thank you so much, Chris. And it's truly a gre...	https://www.ted.com/talks/al_gore_on_averting_...
2	(Music: "The Sound of Silence," Simon & Garfun...	https://www.ted.com/talks/david_pogue_says_sim...
3	If you're here today — and I'm very happy that...	https://www.ted.com/talks/majora_carter_s_tale...
4	About 10 years ago, I took on the task to teac...	https://www.ted.com/talks/hans_rosling_shows_t...

In [89]:
```
type(transcripts.transcript[0])
```

Out[89]:
```
str
```

In [90]:
```
#a function to add all transcript into one text blob, making lower case to inc
lude all words
#transcripts_text=transcripts['transcript'].str.cat(sep=' ').lower()
```

In [91]:
```
transcripts_text=transcripts['transcript'].str.cat(sep=' ').lower()
```

In [92]:
```
transcripts_text[:100]
```

Out[92]:
```
"good morning. how are you?(laughter)it's been great, hasn't it? i've been bl
own away by the whole th"
```

In [93]:
```
for char in string.punctuation:
    transcripts_text=transcripts_text.replace(char,' ')
```

In [94]:
```
'_' in transcripts_text
```

Out[94]:
```
False
```

In [95]:
```
#tokenizing all words
nltk.download("punkt")
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\fayal\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
```

Out[95]:
```
True
```

In [96]:
```
nltk.download("stopwords")
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\fayal\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

Out[96]:
```
True
```

In [97]:
```
transcripts_words=nltk.word_tokenize(transcripts_text)
```

In [98]:
```
useless_words=nltk.corpus.stopwords.words("english")+list(string.punctuation)
type(useless_words)
```

Out[98]:
```
list
```

In [99]:
```
list(string.punctuation)[-7:]
```

Out[99]:
```
['^', '_', '`', '{', '|', '}', '~']
```

In [100]:
```
def build_bag_of_words(words):
    filtered_words=[word for word in words if not word in useless_words]
    return filtered_words
```

In [101]:
```
filtered=build_bag_of_words(transcripts_words)
```

In [102]:
```
filtered=[word for word in filtered if word!='—']
```

In [103]:
```
word_counter=Counter(filtered)
word_counter.most_common()[:30]
```

Out[103]:
```
[('one', 20208),
 ('people', 19733),
 ('like', 19203),
 ('know', 13017),
 ('going', 12880),
 ('think', 12124),
 ('see', 11630),
 ('would', 11617),
 ('us', 11048),
 ('really', 11046),
 ('get', 10841),
 ('time', 10540),
 ('laughter', 10353),
 ('world', 10350),
 ('way', 9047),
 ('actually', 8894),
 ('years', 8753),
 ('things', 8585),
 ('could', 8548),
 ('want', 8222),
 ('go', 8090),
 ('well', 8076),
 ('make', 7963),
 ('right', 7687),
 ('first', 7294),
 ('something', 7270),
 ('said', 7223),
 ('two', 7173),
 ('much', 6794),
 ('also', 6692)]
```

Well, not very interesting. must do pos_tag from nltk.

```
In [ ]:
```

Most common word used in comments

```
In [104]: words_in_all_comments=dict()
          for x in data['words_of_comments']:
              for key,value in x.items():
                  words_in_all_comments[key]=words_in_all_comments.get(key,0)+value
```

```
In [105]: words_in_all_comments
```

```
Out[105]: {'Funny': 393895,
           'Beautiful': 490349,
           'Ingenious': 384386,
           'Courageous': 420045,
           'Longwinded': 83344,
           'Confusing': 53436,
           'Informative': 887434,
           'Fascinating': 801119,
           'Unconvincing': 134558,
           'Persuasive': 561220,
           'Jaw-dropping': 377547,
           'OK': 207157,
           'Obnoxious': 66303,
           'Inspiring': 1352048}
```

```
In [ ]: # sorted_w=sorted(words_in_all_comments.items(), key=lambda x:x[1])
        # sorted_w
```

```
In [ ]: # x_word=[sorted_w[i][0] for i in range(len(sorted_w))]
        # x_word
```

```
In [ ]: # y_count=[sorted_w[i][1] for i in range(len(sorted_w))]
        # y_count
```

```
In [106]: x_word=list(words_in_all_comments.keys())
          y_count=list(words_in_all_comments.values())
```

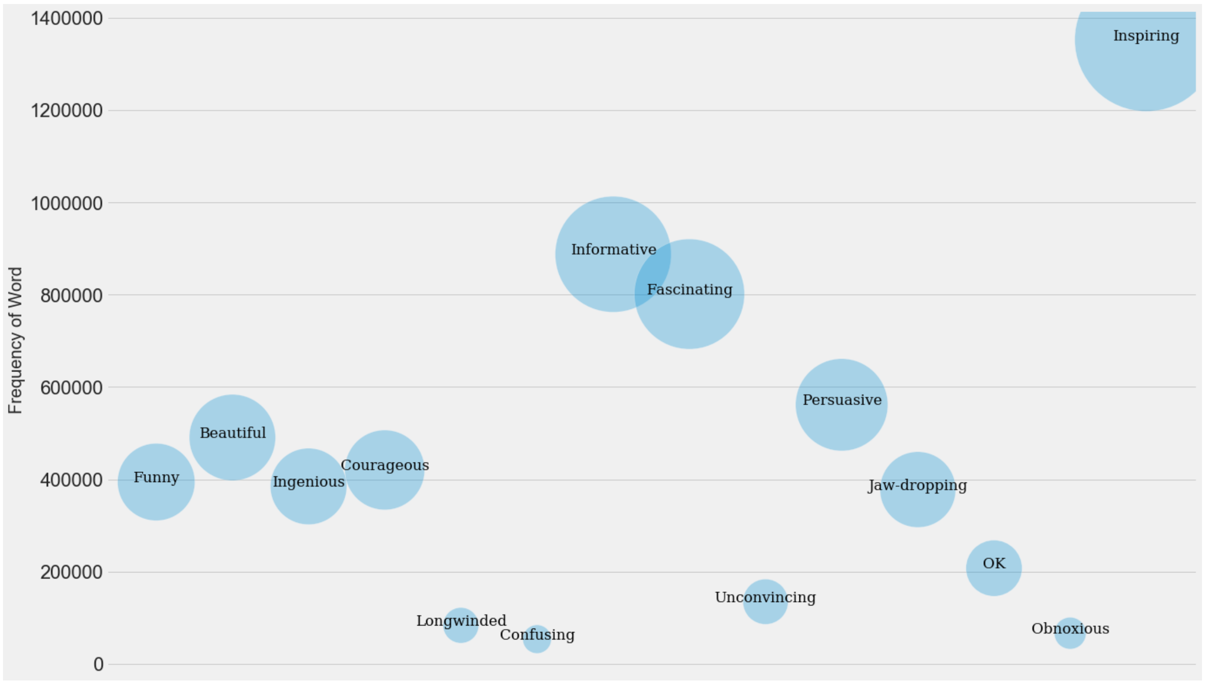
In [107]:
```
df_w=pd.DataFrame({'x' :x_word,
                   'y' :y_count,
                   's' :y_count,
                   'g' :x_word})
df_w
```

Out[107]:

	x	y	s	g
0	Funny	393895	393895	Funny
1	Beautiful	490349	490349	Beautiful
2	Ingenious	384386	384386	Ingenious
3	Courageous	420045	420045	Courageous
4	Longwinded	83344	83344	Longwinded
5	Confusing	53436	53436	Confusing
6	Informative	887434	887434	Informative
7	Fascinating	801119	801119	Fascinating
8	Unconvincing	134558	134558	Unconvincing
9	Persuasive	561220	561220	Persuasive
10	Jaw-dropping	377547	377547	Jaw-dropping
11	OK	207157	207157	OK
12	Obnoxious	66303	66303	Obnoxious
13	Inspiring	1352048	1352048	Inspiring

In [108]:
```
# sns.set(style='darkgrid',context='talk',font_scale=0.8)
# text(x,y)
# plt.figure(figsize=(20,10))
# plt.scatter(x_words,y_count)

# plt.title('The most translated TED Talks')
# plt.xlabel('',fontsize=10)
# plt.ylabel('')
# #sns.despine(offset=10,trim=True)
# plt.show()
```

In [109]:
```
plt.style.use('fivethirtyeight')
plt.figure(figsize = (20,13))

# Create scatterplot. alpha controls the opacity and s controls the size.
ax = sns.scatterplot(df_w.x, df_w.y, alpha = 0.3,s = df_w.s/50)
#ax.set(yscale="log")
for line in range(0,df_w.shape[0]):
    ax.text(df_w.x[line], df_w.y[line], df_w.g[line], horizontalalignment='cen
ter', family='serif',size='large', fontstyle='normal',color='black', weight='l
ight')

ax.get_xaxis().set_visible(False)

#plt.xlabel('Comment',fontsize=15)
plt.ylabel('Frequency of Word',fontsize=20)

plt.savefig('buuble_comments.jpeg')
plt.show()
```



Sentiment Analysis For Comments-Model 1

We need to build a model for sentiment analysis for each TED Talk.

We will use the model presented in lecture.

The model is saved in a pickle file.

In [150]:
```
data.words_of_comments[2482]
```

Out[150]:
```
{'Inspiring': 145,
 'Informative': 57,
 'Courageous': 130,
 'Beautiful': 56,
 'Persuasive': 62,
 'Jaw-dropping': 19,
 'Fascinating': 40,
 'Ingenious': 7,
 'Funny': 3,
 'OK': 1}
```

In [157]:
```
#leaning the tags with 0 frequency
for i in range(data.words_of_comments.shape[0]):
    for key,value in data.words_of_comments[i].copy().items():
        if value==0:
            del data.words_of_comments[i][key]
```

In [111]:
```
classifier_f=open("naivebayes.pickle","rb")
sentiment_classifier_one=pickle.load(classifier_f)
classifier_f.close()
```

In [112]:
```
sentiment_classifier_one.classify(data.words_of_comments[0])
```

Out[112]:
```
'pos'
```

In [113]:
```
data['sentiment_of_comments']='sentiment'
for i in range(data['sentiment_of_comments'].shape[0]):
    data['sentiment_of_comments'][i]=sentiment_classifier_one.classify(data.wo
rds_of_comments[i])
```

```
C:\Users\fayal\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
  This is separate from the ipykernel package so we can avoid doing imports u
ntil
```

data['sentiment_of_comments_1'].value_counts()

Sentiment Analysis For Comments-Model 2

In [115]:
```
nltk.download("twitter_samples")
from nltk.corpus import twitter_samples
```

```
[nltk_data] Downloading package twitter_samples to
[nltk_data]     C:\Users\fayal\AppData\Roaming\nltk_data...
[nltk_data]   Package twitter_samples is already up-to-date!
```

In [116]:
```
twitter_samples.fileids()
```

Out[116]:
```
['negative_tweets.json', 'positive_tweets.json', 'tweets.20150430-223406.jso
n']
```

In [117]:
```
positive_tweet=twitter_samples.tokenized('positive_tweets.json')
```

In [118]:
```
negative_tweet=twitter_samples.tokenized('negative_tweets.json')
```

The twitter_samples object has a `tokenized()` method that returns all tweets from a fileid already individually tokenized. Read its documentation and use it to find the number of positive and negative tweets.

In [119]:
```
def build_bag_of_words_features_filtered(words):
    """Build a bag of words model"""

    return {word:1 for word in words if not word in useless_words}
```

In [120]:
```
positive_features=[(build_bag_of_words_features_filtered(tweet),'pos')  for tw
eet in positive_tweet]
```

In [121]:
```
len(positive_features)
```

Out[121]:
```
5000
```

In [122]:
```
negative_features=[(build_bag_of_words_features_filtered(tweet),'neg')  for tw
eet in negative_tweet]
```

In [123]:
```
len(negative_features)
```

Out[123]:
```
5000
```

In [124]:
```
split = int(len(positive_features) * 0.8)
```

In [125]:
```
split
```

Out[125]:
```
4000
```

In [126]:
```
sentiment_classifier_two = NaiveBayesClassifier.train(positive_features[:split
]+negative_features[:split])
```

In [127]:
```
nltk.classify.util.accuracy(sentiment_classifier_two, positive_features[:split
]+negative_features[:split])*100
```

Out[127]:
```
99.9625
```

In [128]:
```
nltk.classify.util.accuracy(sentiment_classifier_two, positive_features[split
:]+negative_features[split:])*100
```

Out[128]:
```
99.35000000000001
```

In [129]:
```
sentiment_classifier_two.show_most_informative_features()
```

```
Most Informative Features
                      :( = 1                 neg : pos    =   2362.3 : 1.0
                      :) = 1                 pos : neg    =   1139.0 : 1.0
                     See = 1                 pos : neg    =     37.7 : 1.0
                     TOO = 1                 neg : pos    =     36.3 : 1.0
                  THANKS = 1                 neg : pos    =     35.0 : 1.0
                    THAT = 1                 neg : pos    =     27.7 : 1.0
                    miss = 1                 neg : pos    =     26.4 : 1.0
                     sad = 1                 neg : pos    =     25.0 : 1.0
                     x15 = 1                 neg : pos    =     23.7 : 1.0
                   Thank = 1                 pos : neg    =     22.3 : 1.0
```

In [158]:
```
data['sentiment_of_comments_2']='sentiment'

for i in range(data['sentiment_of_comments_2'].shape[0]):
    data['sentiment_of_comments_2'][i]=sentiment_classifier_two.classify(data.
words_of_comments[i])
```

```
C:\Users\fayal\Anaconda3\lib\site-packages\ipykernel_launcher.py:4: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
  after removing the cwd from sys.path.
```

In [164]:
```
data=data.rename(columns={'sentiment_of_comments':'sentiment_of_comments_1'})
```

In [161]:
```
data['sentiment_of_comments_2'].value_counts()
```

Out[161]:
```
pos    2542
neg       8
Name: sentiment_of_comments_2, dtype: int64
```

In [168]:
```
print(data[data['sentiment_of_comments_2']=='neg'].words_of_comments[2542])
```

```
{'Beautiful': 41, 'Courageous': 43, 'Inspiring': 35, 'Informative': 15, 'Jaw-
dropping': 3, 'Unconvincing': 5, 'Ingenious': 7, 'Fascinating': 14, 'Persuasi
ve': 2, 'Funny': 6, 'Obnoxious': 5, 'Confusing': 1, 'OK': 1, 'Longwinded': 3}
```

In [ ]:
```

```