



Sorting the Healthy Diet Signal from the Social Media Expert Noise

Evidence from the #healthydiet discourse on Twitter

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Full Professor of Digital Business
Associate Dean for Strategic Projects

DCU Business School

About Theo Lynn

Professor Theo Lynn is (Full) Professor of Digital Business at DCU Business School and is Associate Dean (Strategic Projects) at DCU Business School. Professor Lynn specializes in the role of digital technologies in transforming business processes. His main teaching areas are strategy and digital marketing.

Prof. Lynn was Centre Director at the Irish Institute of Digital Business (2018-2019), Principal Investigator of the Irish Centre for Cloud Computing and Commerce, an EI/IDA funded Cloud Computing Technology Centre (2011-2018), Associate Dean (Industry Engagement and Innovation) at DCU Business School (2015-2017), Business Innovation Platform Director for DCU (2015-2016) and Director of the Leadership, Innovation and Knowledge Research Centre at DCU (2009-2011). He has won over 200 grants representing over €20m in total project funding. He was a PI on the Horizon 2020 CloudLightning Project (2015-2017) and Horizon 2020 RECAP Project (2017-2019); he is currently a PI on the Horizon 2020 RINNO project (2020-2023).



safe food

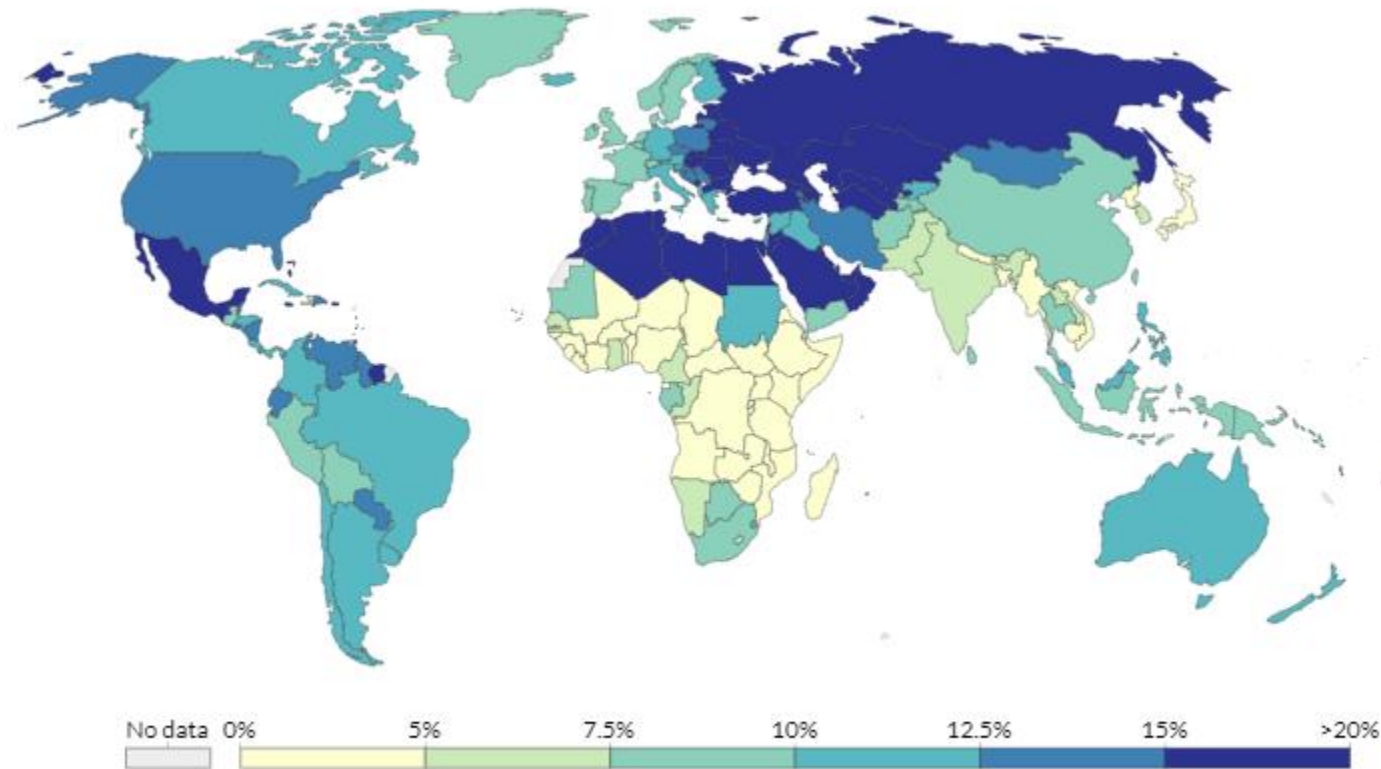
GOAL 3

A red heart with black brushstrokes inside, set against a green background with a white heartbeat line.

ENSURE HEALTHY LIVES AND
PROMOTE WELL-BEING FOR ALL AT ALL AGES

OBESITY IS RESPONSIBLE FOR 4.7 MILLION PREMATURE DEATHS EACH YEAR

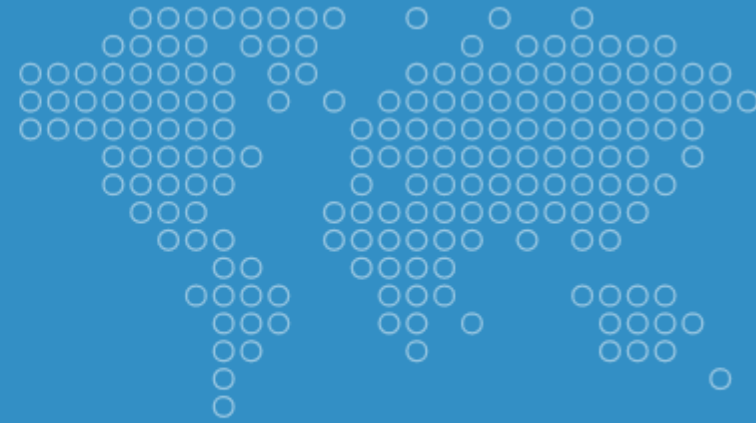
Obesity is responsible for 4.7 million premature deaths each year



Source: IHME, Global Burden of Disease

1.9 billion
adults worldwide

were obese in 2016, with 650 million obese



In the WHO European Region

1 in 3 
11-year-olds is
overweight
or
obese

OB_S__Y
is a cause of cancer

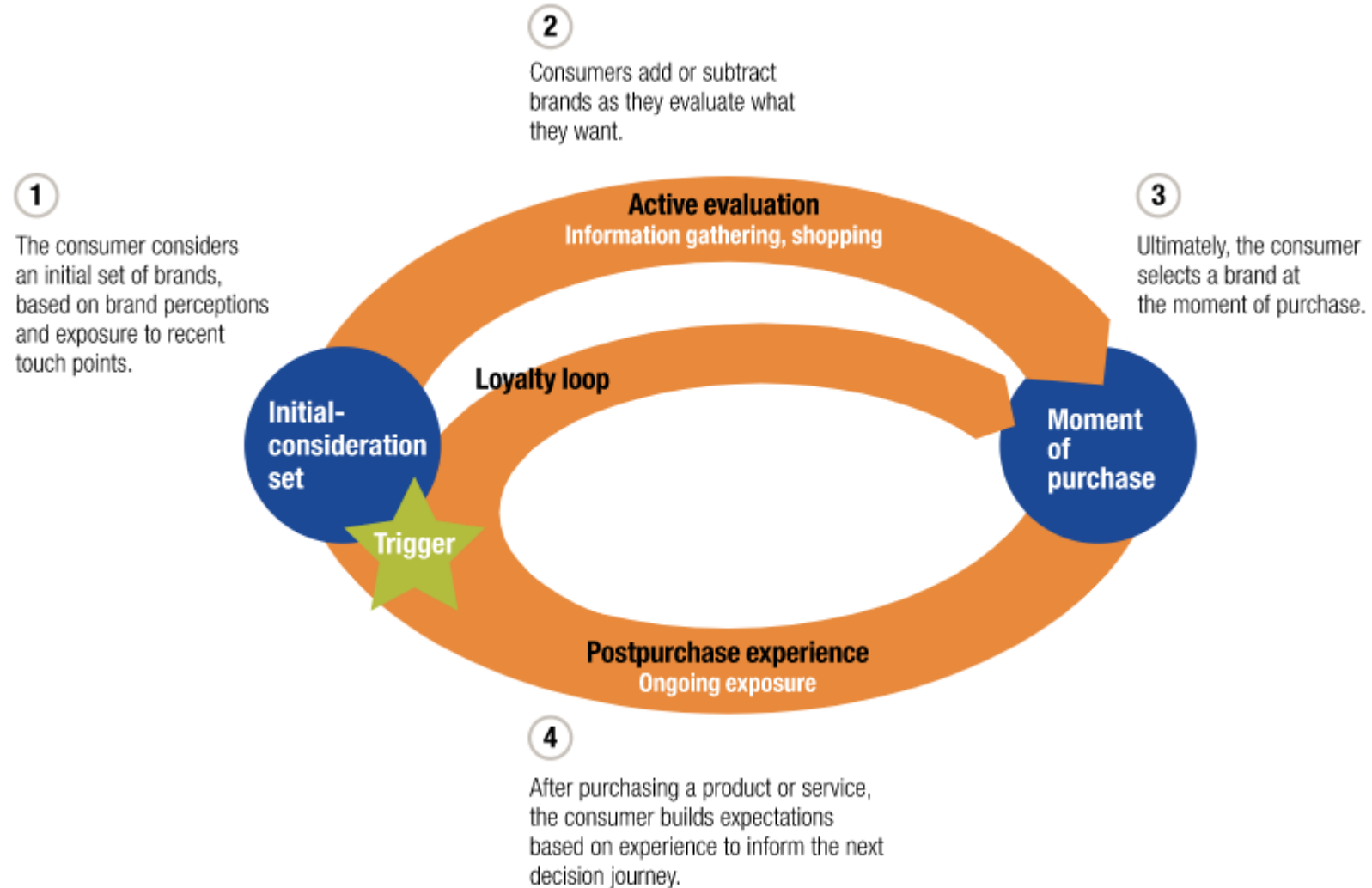
Guess what is the biggest preventable
cause of cancer after smoking.

LET'S BEAT CANCER **SOONER**



Cancer Research UK is a registered charity in England and Wales (2029494), Scotland (SC249556) and the Isle of Man (1045). © Cancer Research UK 2016.

If marketing has one goal, it's to reach consumers at the moments that most influence their decisions.



CONTINUED DISTRUST

Trust Index

Global Trust Index increases 1 pt., with increases in 16 of 26 markets measured

12 of 26 markets are distrusters, down 2 from 2019

2020 Edelman Trust Barometer. The Trust Index is the average percent trust in NGOs, business, government and media. TRU_INS. Below is a list of institutions. For each one, please indicate how much you trust that institution to do what is right. 9-point scale; top 4 box, trust. General population, 26-mkt avg.

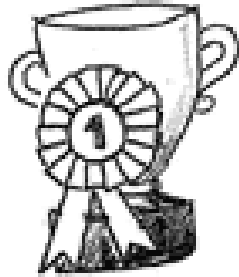
▲ 2019 General population

53	Global 26
79	China
73	Indonesia
72	India
71	UAE
70	Saudi Arabia
62	Singapore
59	Malaysia
58	Mexico
56	Canada
55	Hong Kong
54	The Netherlands
52	Colombia
49	U.S.
48	Australia
46	Argentina
46	Brazil
46	Italy
46	S. Korea
45	S. Africa
44	France
44	Germany
43	U.K.
42	Ireland
40	Spain
39	Japan
29	Russia

▲ 2020 General population

54	Global 26
82	China
79	India
73	Indonesia
65	UAE
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62	Singapore
61	Saudi Arabia
60	Malaysia
57	The Netherlands
53	Canada
53	Colombia
51	Brazil
50	Hong Kong
50	S. Korea
49	Argentina
49	Italy
47	Australia
47	U.S.
46	Germany
45	France
45	Ireland
45	Spain
44	S. Africa
42	Japan
42	U.K.
30	Russia

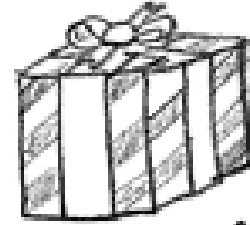
THAT WAS BEFORE COVID19



SOCIAL PROOF



COMMITMENT



RECIPROCATION

INFLUENCE



LIKING



AUTHORITY



SCARCITY

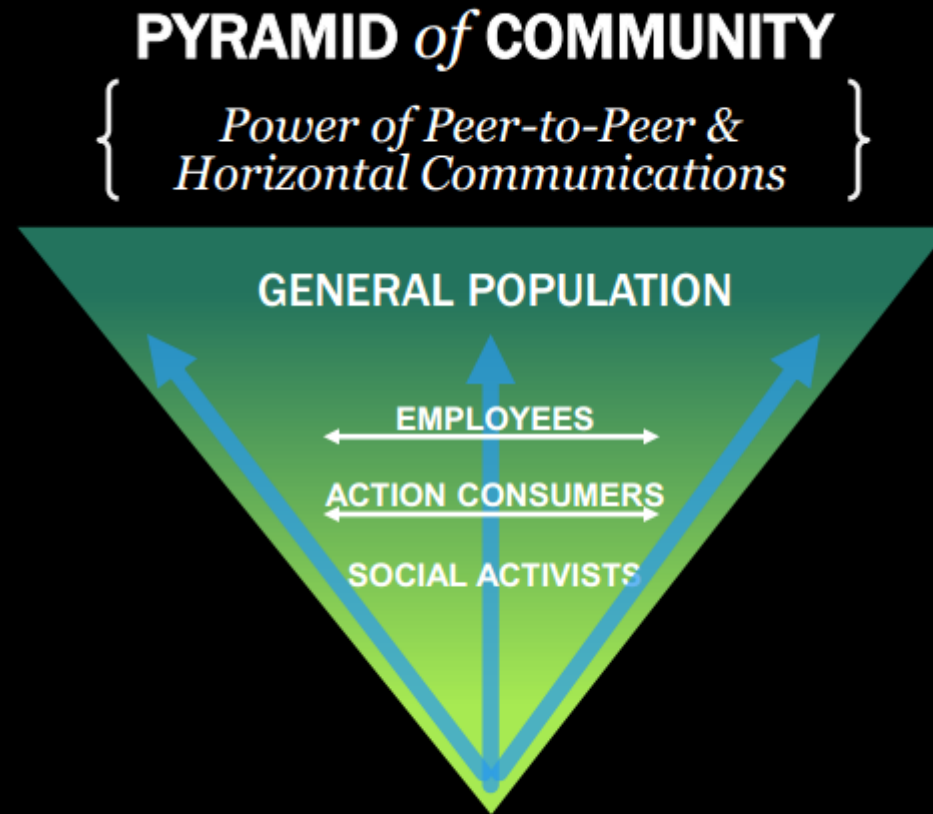
**OLD MODELS
NO LONGER
WORK
IN ISOLATION**

PYRAMID *of* INFLUENCE

{ *Vertical Flow &
Controlled Information* }



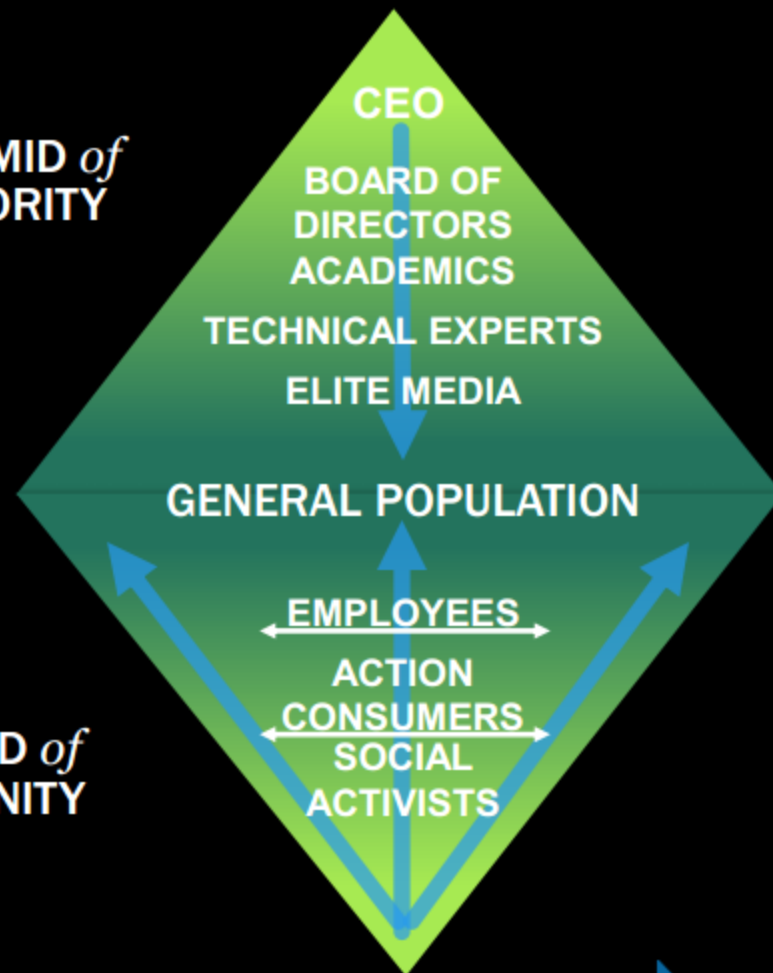
New models
are firmly
established



**DIAMOND of
INFLUENCE**
{ The new dynamic }

PYRAMID of
AUTHORITY

PYRAMID of
COMMUNITY



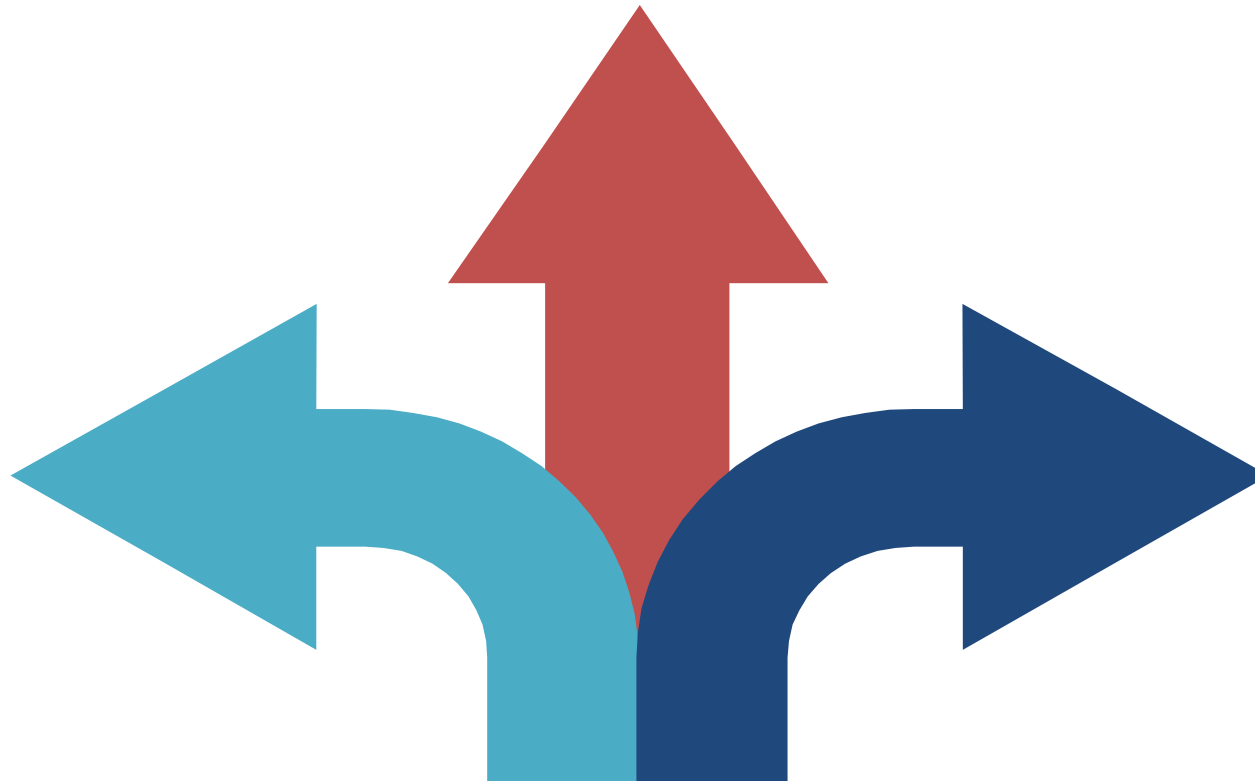
Influencers have above average ability to informally influence the attitudes and behaviours of others in a desired way.

01 Who they are?

What they know?

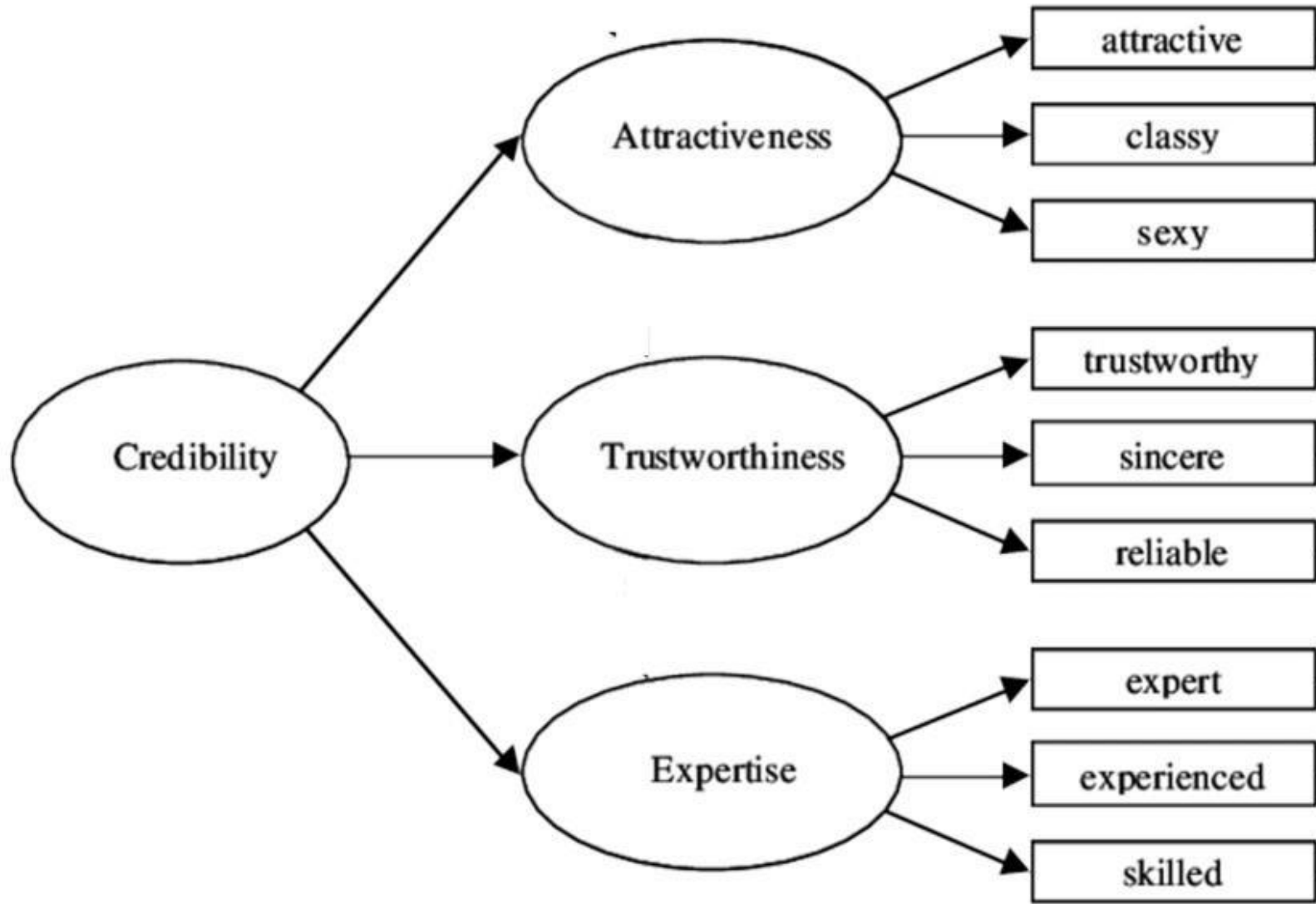
02

03 Who they are connected to?





INTERESTING



Relatable





Peters
MAXIRON
[4] FULL SIZE
CARAMEL ROUGH NUT

BEN & JERRY'S
Salted Caramel
COTE

BEN & JERRY'S
Chocolate Chip Cookie
Dough

Signature Butter Milk
VANILLA
ICE CREAM

IKKS UNIV
MELB

IKKS
ROAD

EST.

1987



Swedish watch-maker Daniel Wellington focussed on micro-influencers on Instagram with pets

INTOTHEGLOSS

HOME // #ITGTOPSHELFE // CECILIA GORGON, STUDENT

Cecilia Gorgon, Student

A screenshot of a social media profile for Cecilia Gorgon. The profile picture shows a young woman with dark hair. The bio reads: 'My name is Cecilia Gorgon (@ceciliagorgon). I'm from southwest Detroit, but I'm a student at the University of Michigan, so I live in Ann Arbor. I'm majoring in Fine Arts. In the past I've done a lot of photography and drawing, but my focus lately has been more geared towards ceramics and illustration. I'. The profile has a 'DON'T MISS' section with several featured posts, including 'THE EXTRAS: How To Be A Person Who Has Their Life Together', 'OPEN THREAD: What's Everyone Reading?', 'THE REVIEW: For Every Top Shelf, There's a Bottom Shelf', 'GUIDE: How Not To Mess Up Your At-Home Hair Color', 'THE EXTRAS: The Makeup Bags Of Glossier HQ, Extreme Makeover Edition', and 'GUIDE: Find Your Tinted Moisturiser Soulmate'. There are social media sharing icons on the left and a 'Sign in for email' link at the bottom right.

Skincare retailer Glossier worked with Cecilia Gorgon, a student at the University of Michigan with 8,500 Instagram followers.

Consumers do not equate social media influencers with marketing.

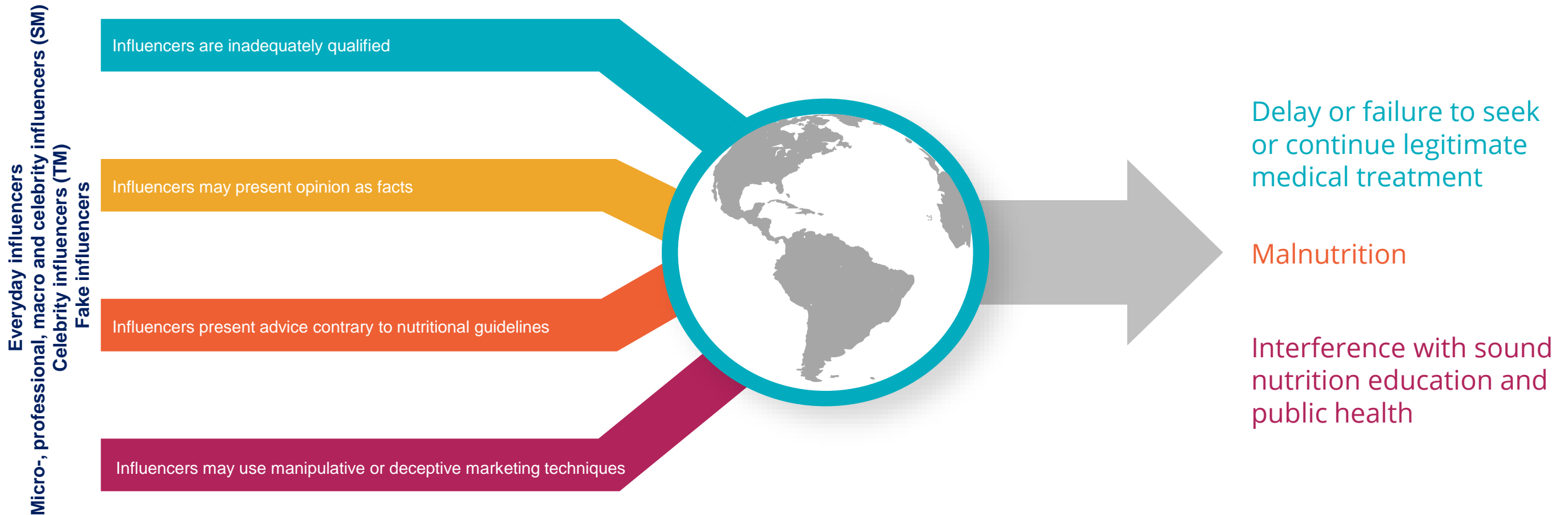
They see them as cool, interesting, inspirational, relatable etc.



107,000,000



Health information on social media (SMH) is not subject to the same degree of filtering and quality control by professional gatekeepers. It is prone to being out of date, incomplete, and inaccurate.



What we wanted to know...

01



Who are the most influential users in the healthy diet discourse on Twitter?

02



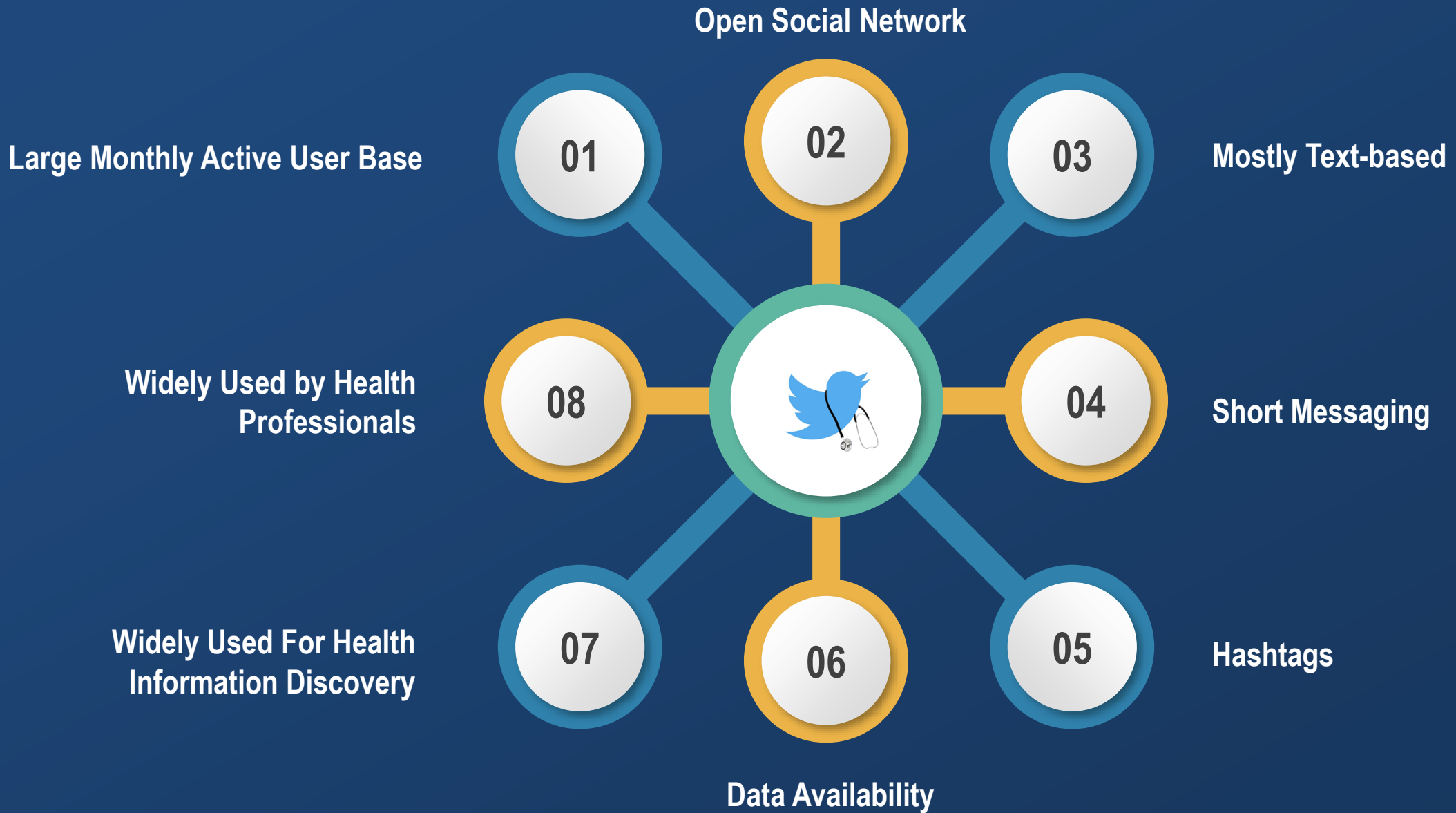
What are the most prevalent topics and sub-topics in the healthy diet discourse over a sustained period?

03



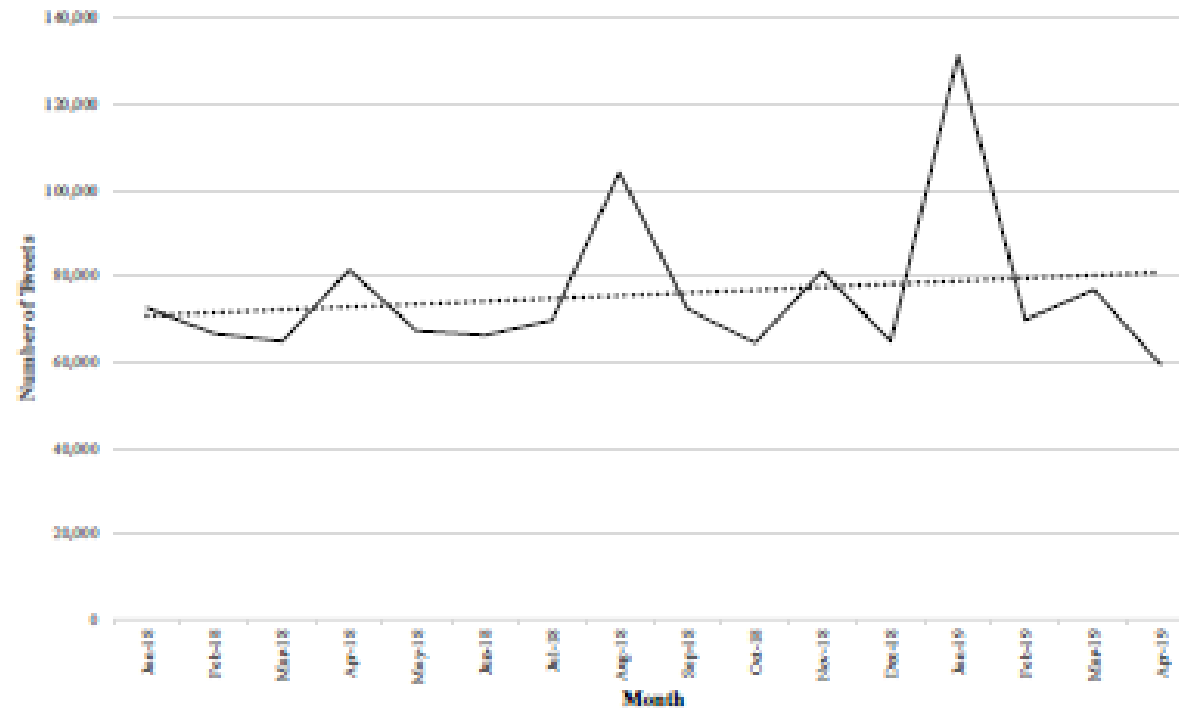
How effective is deep learning for identifying high quality and low quality nutrition and diet information (sources) and content (tweets)?

Why Twitter?



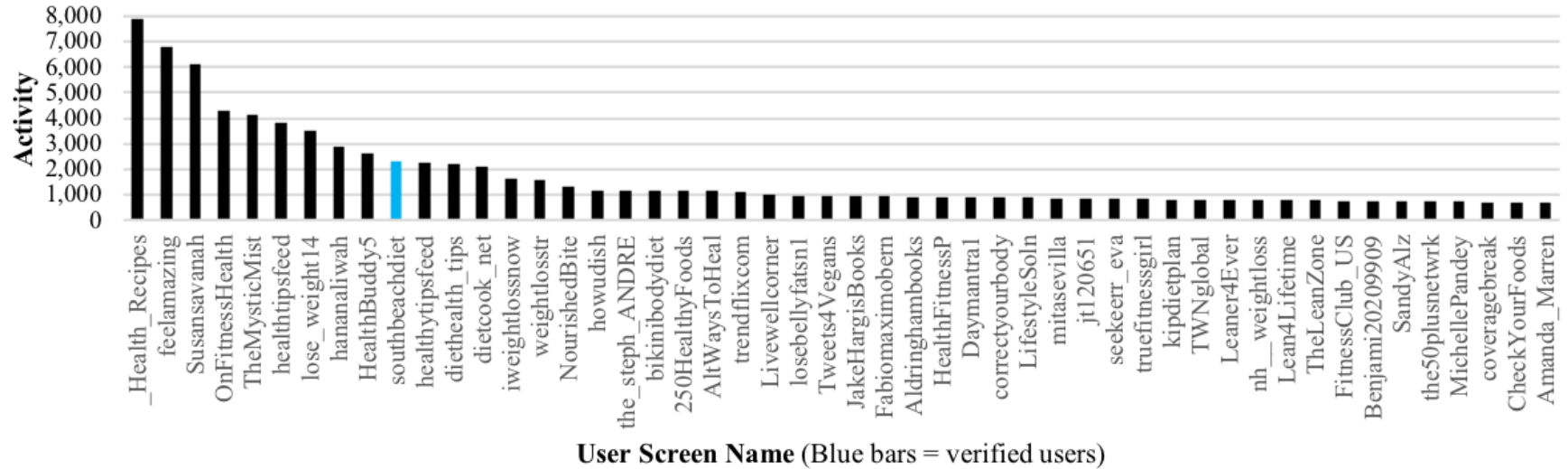
The data is historic raw data from Twitter from January 2018 until April 2019)

Message Type	Full sample (629,608 users)		Verified Users (7,300 users)	
	No. of Tweets	% of Tweets	No. of Tweets	% of Tweets
Original Tweets	545,543	45%	11,009	58%
Retweets	581,913	48%	4,740	25%
Replies	84,862	7%	3,362	17%
Total	1,212,318	100%	19,111	100%

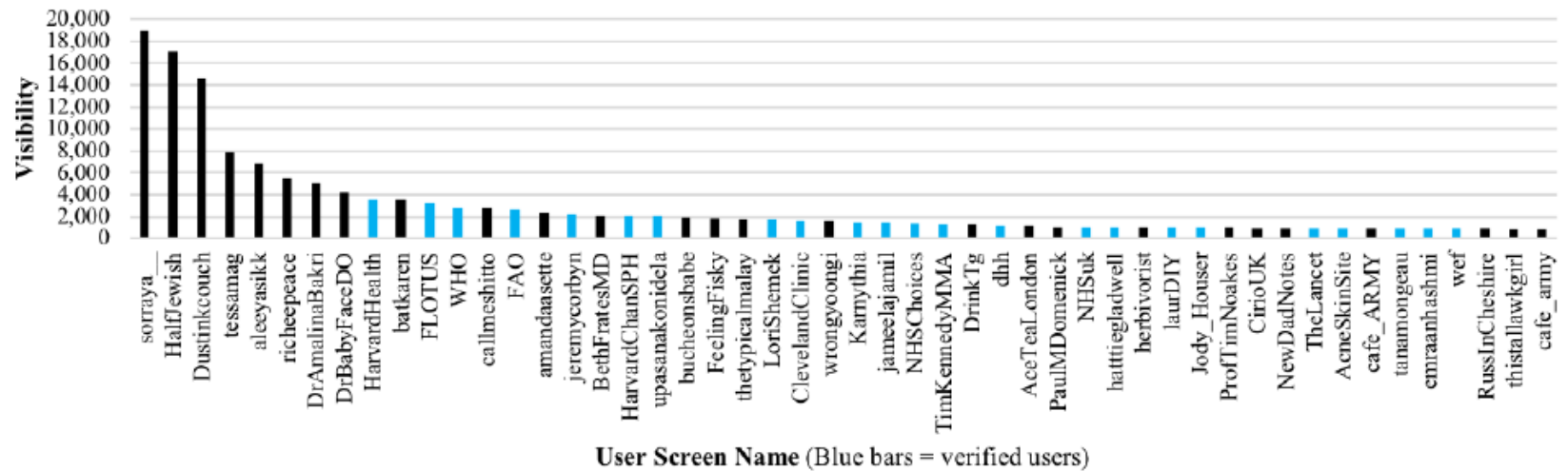


Who are the most influential users in the healthy diet discourse on Twitter?

- The most active users are not verified.
- The most active users make use of advanced software for communication.
- A significant proportion are bots and/or spam.



While more visible accounts are verified, they are not active and nutrition and diet are the not their primary topic.



What are the most prevalent topics and sub-topics in the healthy diet discourse over a sustained period?

Original Tweets (N=545,543)				
Topic	Frequency	Top 10 Subtopics	No. of Tweets	% of Tweets
Health	528,540	diet*	304,884	57.68%
		health/healthier/healthiest	32,188	6.09%
		life/live/lives/living	26,267	4.97%
		exercis*/fitness*/workout*	26,250	4.97%
		fat/fats	21,469	4.06%
		nutrtion*	17,231	3.26%
		diabet*	10,973	2.08%
		disease*	6,466	1.22%
		cancer*	5,067	0.96%
		vitamin*	4,561	0.86%
Ingest	496,143	diet*	304,884	61.45%
		eat/eating	93,517	18.85%
		food*	58,396	11.77%
		weight	55,292	11.14%
		fat/fats	21,469	4.33%
		meal*	13,730	2.77%
		veget*	12,202	2.46%
		fruit*	11,596	2.34%
		cook*	11,242	2.27%
		drink*	8,056	1.62%
Body	270,379	body*	21,131	7.82%
		fat	16,182	5.98%
		heart	12,955	4.79%
		skin	6,746	2.50%
		brain*	4,316	1.60%
		sleep	4,106	1.52%
		blood	3,980	1.47%
		eye*	2,540	0.94%
		gut	2,263	0.84%
		belly	1,941	0.72%

Original Tweets - Verified Users (N=11,009)				
Topic	Frequency	Top 10 Subtopics	No. of Tweets	% of Tweets
Health	10,833	diet*	6,994	64.56%
		health/healthier/healthiest	775	7.15%
		exercis*/fitness*/workout*	585	5.40%
		nutrition*	344	3.18%
		life/live/lives/living	523	4.83%
		disease*	207	1.91%
		cancer*	198	1.83%
		fat/fats	297	2.74%
		physical	142	1.31%
		diabet*	141	1.30%
Ingest	10,096	diet*	6,994	69.27%
		food*	1,486	14.72%
		eat/eating	1,878	18.60%
		weight	734	7.27%
		veget*	294	2.91%
		fruit*	280	2.77%
		meal*	277	2.74%
		drink*	190	1.88%
		fat	297	2.94%
		snack*	159	1.57%
Body	5,888	heart	324	5.50%
		body*	262	4.45%
		fat	178	3.02%
		blood	132	2.24%
		brain*	126	2.14%
		skin	77	1.31%
		gut	63	1.07%
		bodi*	62	1.05%
		eye*	60	1.02%
		sleep	60	1.02%

When we take spam and low quality accounts out of the mix, preliminary results suggest the overall discourse is more similar to verified accounts.

Popular diets are not as prominent as we imagined but are promoted by low quality accounts.

Original Tweets (N=545,543)			Original Tweets - No Spam (N=394,360)			Original Tweets - Verified Users (N=11,009)		
Diets	No. of Tweets	% of Tweets	Diets	No. of Tweets	% of Tweets	Diets	No. of Tweets	% of Tweets
Keto/ketogenic	15,625	2.86%	Keto/ketogenic	10,395	2.64%	Vegan/Vegetarian	225	2.04%
Vegan/Vegetarian	12,461	2.28%	Vegan/Vegetarian	9,764	2.48%	Keto/ketogenic	174	1.58%
Paleo	5,922	1.09%	Paleo	2,789	0.71%	Low Carb/Carb Free	48	0.44%
Gluten Free	2,558	0.47%	Low Carb/Carb Free	1,655	0.42%	Gluten Free	45	0.41%
Low Carb/Carb Free	2,228	0.41%	Gluten Free	957	0.24%	Paleo	13	0.12%
Atkins	536	0.10%	Atkins	297	0.08%	Atkins	6	0.05%
Zone	148	0.03%	Zone	113	0.03%	Zone	4	0.04%
Dairy free	98	0.02%	Dairy free	74	0.02%	Ornish	2	0.02%
Weight Watchers	52	0.01%	Ornish	43	0.01%	Dairy free	1	0.01%
Ornish	48	0.01%	Macrobiotic	29	0.01%	Macrobiotic	1	0.01%
Macrobiotic	30	0.01%	Weight Watchers	25	0.01%	Pritikin	0	0.00%
Dukan	19	0.00%	Dukan	17	0.00%	Weight Watchers	0	0.00%
Pritikin	11	0.00%	Pritikin	11	0.00%	South Beach	0	0.00%
South Beach	2	0.00%	South Beach	2	0.00%	Dukan	0	0.00%

Analysis of co-occurring popular diets revolve heavily around two clusters Low Carb/Carb Free and Vegan/Vegetarian themes

Katz (1957) posited that the strategic social location of a focal person contributes to influence.

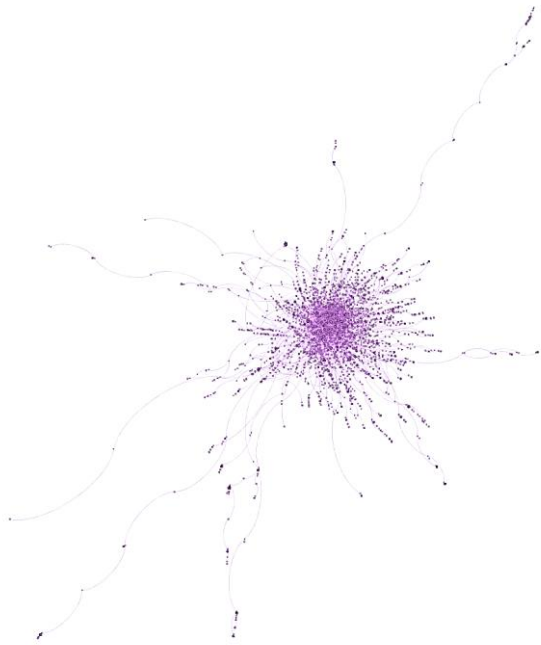


The healthy diet discourse on Twitter has 114,190 nodes (users) and 77,725 edges (replies).

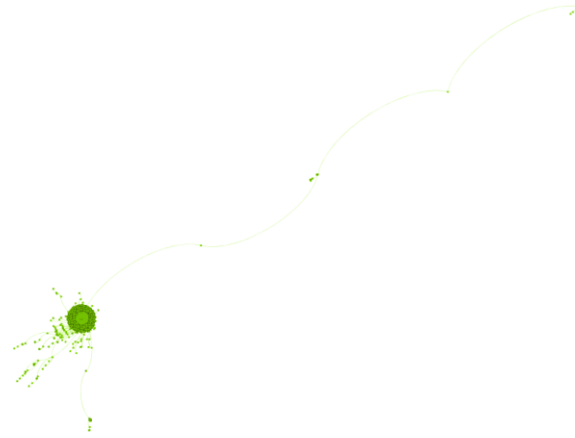
Network diameter is 31.

It is highly sparse.

Chae (2015) suggested that the degree of connectness of a given node in a Twitter network can be an indicator of influence.



SC1 is the largest and is a more general and distributed community



SC2 is structured around one key influencer – the South Beach Diet



SC3 is more dispersed and is centred on vegan diet and lifestyle

What about the traditional media and public health communicators?

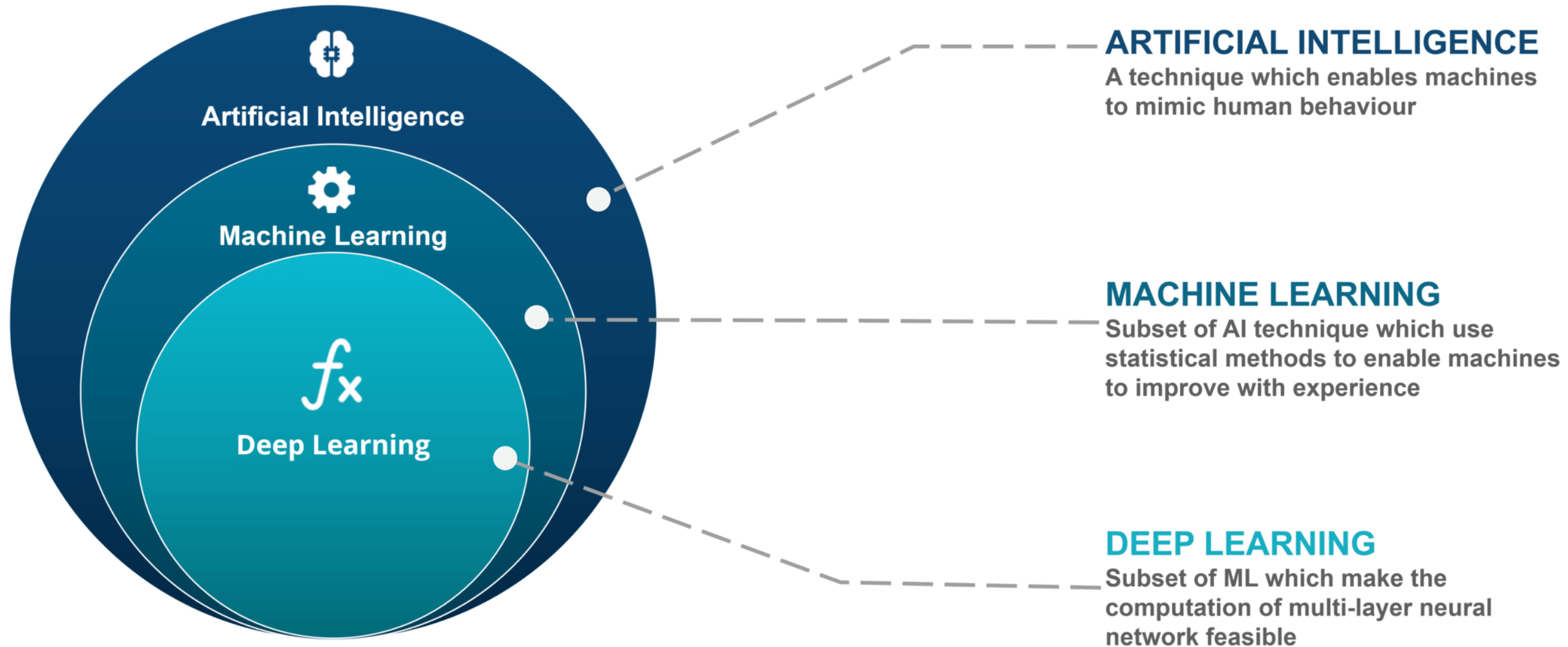


SC4 is media centred

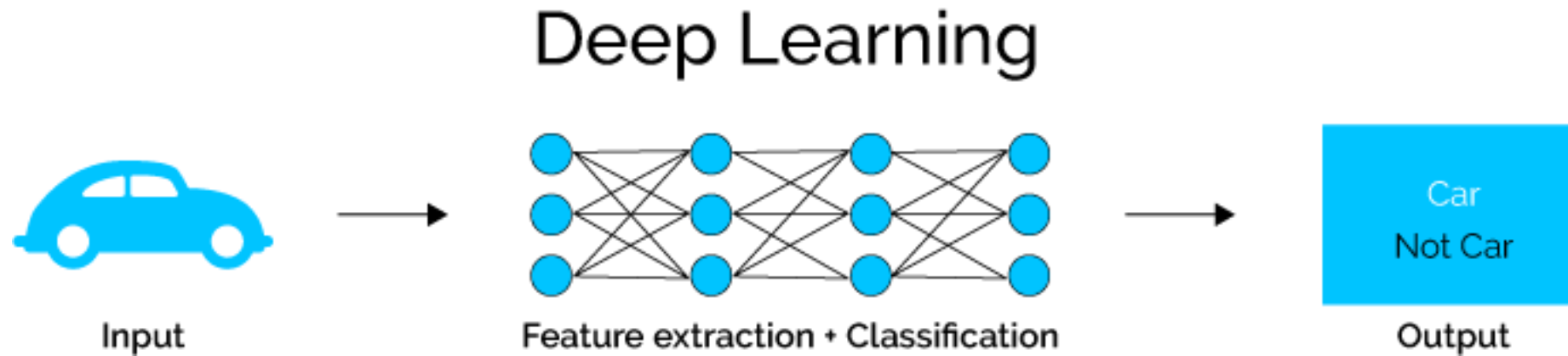
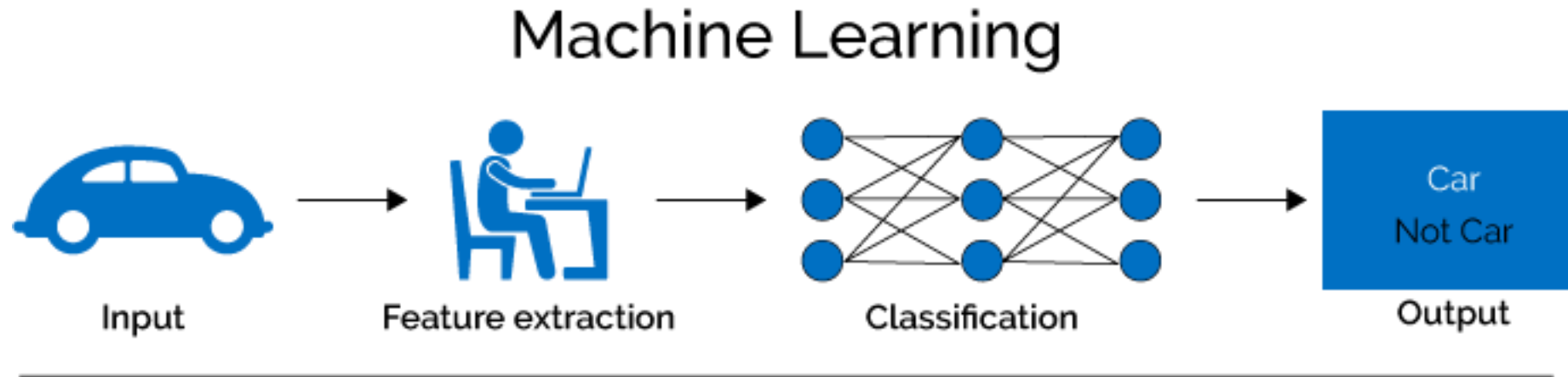


SC5 is centred on public health organisations and qualified individuals

Deep Learning v. Machine Learning v. Artificial Intelligence



Deep learning in a nutshell



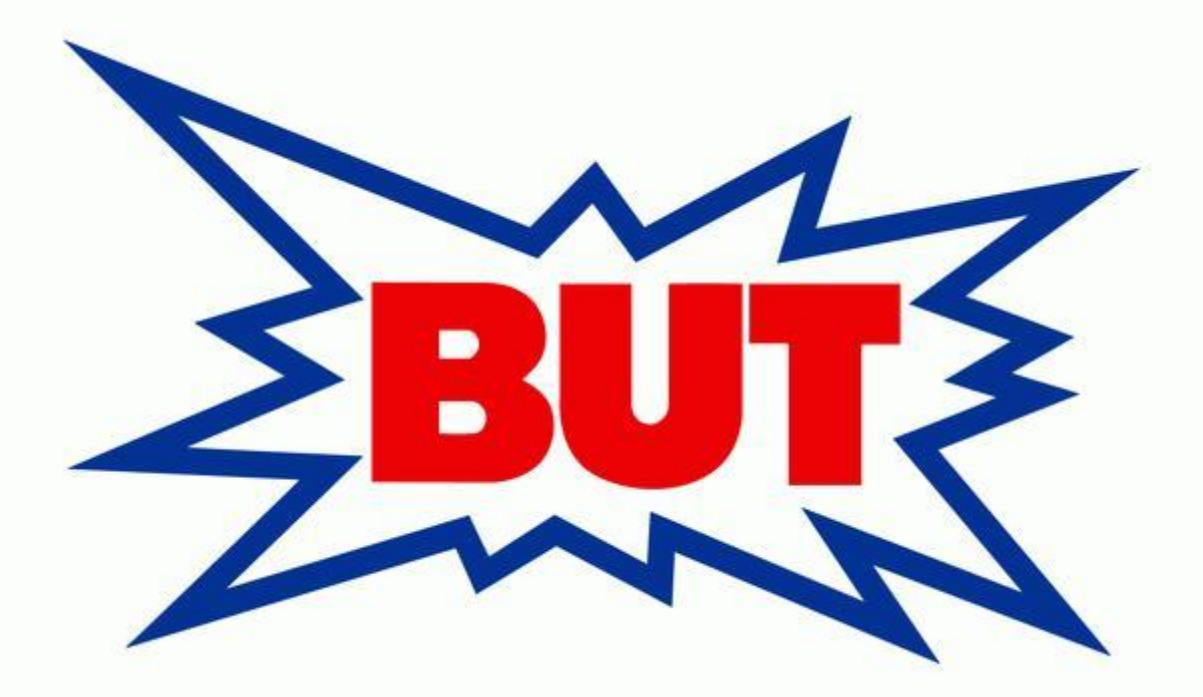
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The deep learning models were trained manually classified data from three coders who had studied nutrition.

LSTM, a form of recurrent neural network, was used to deal with the high dimensionality in the data.

	Accuracy	Sensitivity	Specificity	Precision	F1-score
LSTM	0.8720±0.0145	0.9388±0.0155	0.4711±0.0925	0.9147±0.0131	0.9263±0.0084
Bi-LSTM	0.8801±0.0164	0.9506±0.0214	0.4576±0.1297	0.9134±0.0172	0.9314±0.0095

96% | 79%



While DL performed well against the training set, it didn't classify well known accounts as reliable

Category	User Screen Name	Bio
Accounts classified incorrectly	NHS	Each week a new person curates @NHS and shares their NHS story. #HelloMyNameIs Tom, I'm a Clinical Nurse Educator working @GolborneMedical and @WLondonCCG #Copper4Life
	WHO	Official Twitter account of the World Health Organization, the United Nations' health agency
	wef	The international organization for public private cooperation. Follow us for research, insight and analysis on global issues
	NINR	Official Twitter account of NIH National Institute of Nursing Research. Following & followers do not equal endorsement. Privacy policy: http://go.usa.gov/Dz4C .
Accounts classified correctly	daradietitian	Mum of 3. Registered Dietitian. GI nutrition, Low FODMAP & IBS, Sports Nutrition, Anti-diets. Allergic to Nutribabble. MINDI, SEDI, CORU.
	judithdietitian	I am dietitian with an interest in the diets of children and their parents. I have set up my private practice to work flexibly around my own young family.
	conorkerley	Clinical Research Specialist & Dietitian. MINDI. @TrueHealthINIT Council. Asthmatic and PwMS. Evidence over tradition/opinion!
	christianassad	Preventive Interventional Cardiologist/ Director of The CardioMetabolic Clinic/Interested in therapeutic applications of LCHF/iFasting/Ketogenic/RealFood diets
Advice classified incorrectly	GI	Therefore it is important to not simply add olive oil or nuts to one's current diet but to adopt the [Mediterranean diet] plan in its entirety
	AGE	Mediterranean diet nutrients tied with healthy brain aging https://t.co/2Y1Vc7BPCP
	FAO	A healthy diet starts with safe food. We need to ensure availability and access to safe food now and in the future. http://bit.ly/2VFqtF2
	NHS	So to help with increased appetite and missing the hand to mouth action of smoking, rather than going for the crisps and biscuits try a bag of carrot sticks, celery and mage tout (my daily snack pack for work days - you get used to it #behaviourchange)
Advice classified correctly	healthguide911	#Fruit #juice is a far less #healthy option than a real piece of fruit https://t.co/jE2pMCwJoh #healthydiet
	GoMediiOfficial	Eating a diet rich in some vegetables and fruits as part of an overall healthy diet may protect against certain types of cancers. #cancer #wellness https://t.co/0BvEI5Qup2
	DrCopperAfrica	Start your week by being healthy. Fruits and vegetables are an essential part of a balanced diet along with keeping properly hydrated. #DrinkWaterBetter with an original @DrCopperAfrica bottle. #Copper4Life
	Go_Go_Beauty	Eat a healthy diet! A healthy diet can help you look and feel your best. Eat plenty of fruits, vegetables, whole grains and lean proteins.

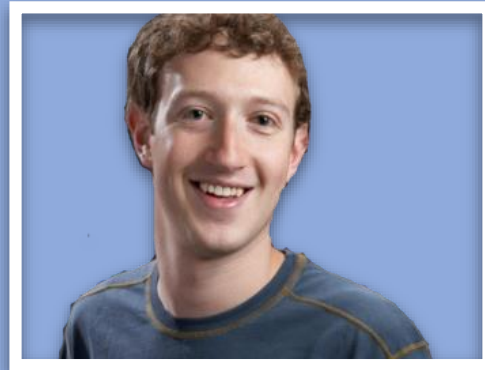
SO WHAT ?!



Some key high level takeaways



I just believe strongly that Facebook shouldn't be the arbiter of truth of everything that people say online. In general, private companies probably shouldn't be, especially these platform companies, shouldn't be in the position of doing that.



Mark Zuckerberg
CEO, Facebook

theo.lynn@dcu.ie

