IPG MEDIABRANDS

AD VISION

Using Machine Learning Power of Google's Cloud Vision API to

EXECUTIVE SUMMARY

Introduction

In this research we used the machine learning technology of Google's Cloud Vision API for the first time ever to test ad effectiveness. We tested over 9.000 online ads from over 50 product categories. We ran these ads through the Vision API to find out what ad characteritics drive the most success in terms of CTR. As far as we know, this is the first ad effectiveness study using Machine Learning as the basis of the methodology in the Netherlands.

Methodology

To collect all ads and their performance metrics from our ad servers we used the DCM/DFA Reporting and Trafficking API and Java client libraries. We loaded all creatives for which performance metrics were still available, and stored them specified per day. We uploaded all images into Google Cloud Vision API requesting Label, Text, Landmark, Logo Detection, Face Detection and Dominant Colors, and stored the results for analysis. Google provided funding for this research.

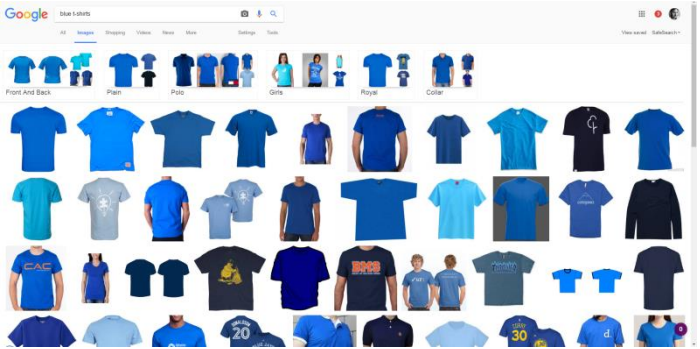
Most important findings

- **Size** does matter: the bigger ad format the better the results
- **Horizontal** is the best shape
- The best **colors** to use are blue and black
- A **logo** adds value and increases CTR
- The suggested position of the **logo** is bottom-left
- Either few or a lot of **text** increases the chance on a high CTR
- A call to action works: '**win**' or '**bekijk**' work best
- **Multiple CTA's** are contra productive: it scores lower than one CTA

AD EFFECTIVENESS USING MACHINE LEARNING TECHNIQUES

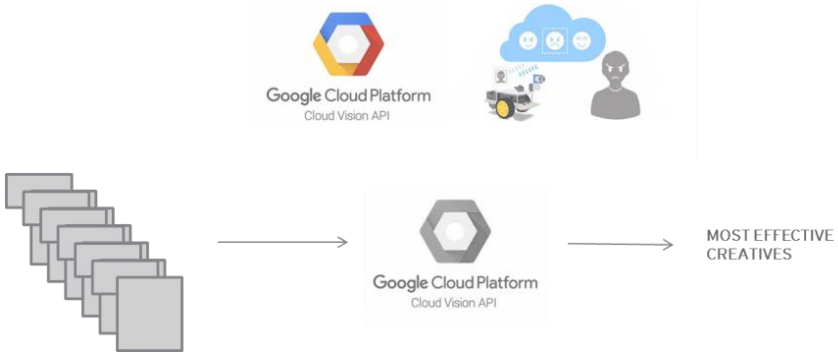
Google Images Search

When you use Google Search images, and you search for 'blue t-shirts', you will get images with blue t-shirts in it, even though they are not specifically tagged with 'blue' and 't-shirt'. The technology used by Google is trained to recognize visual characteristics of images, using machine learning. The machine recognizes color, logos, texts, fonts, faces, animals, et cetera. It also recognizes context and can, for instance, associate pink with 'female' in a fitting context.



Google Cloud Vision API

We used this technology to test the effectiveness and characteristics of thousands of online display and animated ads. And we studied the impact of these characteristics on the click through rate (CTR) that the ads have had. As far as we know, this is the first ad effectiveness study using Machine Learning as the basis of the methodology in the Netherlands.



 Ad checking using Google Vision API machine learning technology

METHODOLOGY

Getting all images from DCM

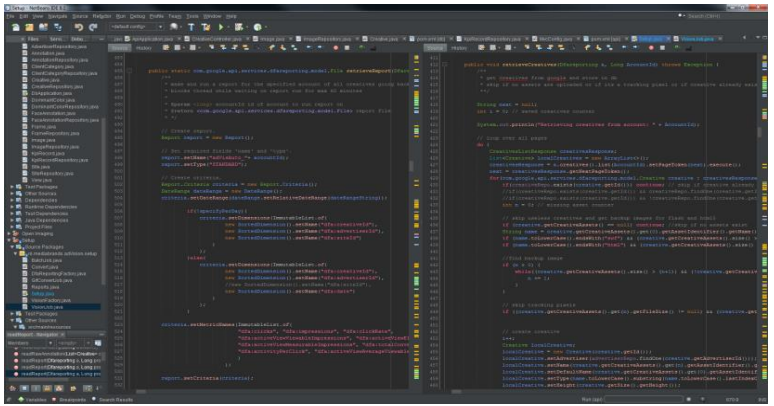
To collect all ads and their performance metrics from our ad servers we used the DCM/DFA Reporting and Trafficking API and Java client libraries. We loaded all creatives for which performance metrics were still available, and stored them specified per day. For animated ads, the URL's where reconstructed and then each of the ads was automatically opened for 30 seconds using PhantomJs or SlimerJs. During these 30 seconds, screen captures where taken 10 times each second, giving us up to 300 frames for each ad.

Getting key frames from animations

We created a python script that analyzes animations based on the frame to frame changes to select important frames from the 300 we collected before. From this we also acquired properties of the animation, like animation length, the number of loops and the type of animation (continuous or presentation). The script also calculated the number of unique colors in each frame, whereas a low number of unique colors indicates a large amount of text or drawings, and a high number of unique colors indicates photography.

Running Cloud Vision API

Finally we uploaded all images into Google Cloud Vision API requesting Label, Text, Landmark, Logo Detection, Face Detection and Dominant Colors, and stored the results for analysis.



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RESULTS

CHARACTERISTICS

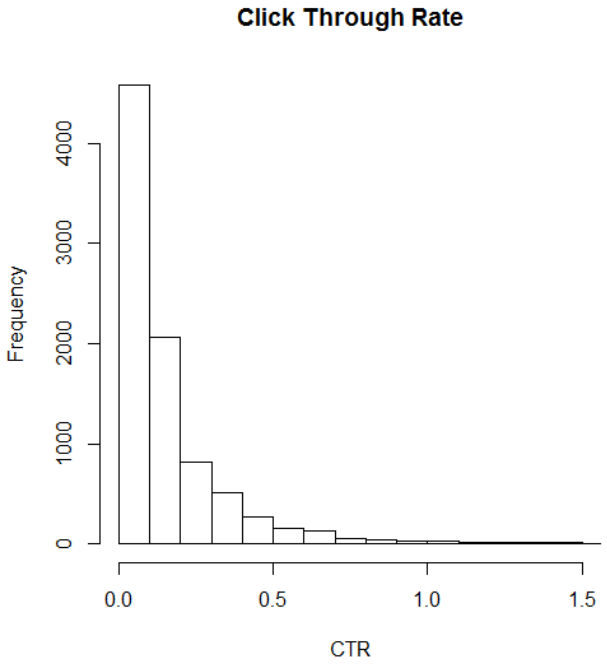
What did we test?

We tested over 9.000 ads and ran them through Cloud Vision API. Only such ads were included that had at least one click and more then 5.000 impressions. For video formats we created a script that broke the video down into frames.

The machine came back with an output of characteristics such as colors (RGB), size, fonts, logo, logo positions, text, text in capitals, client category, call to action (CTA).

The average CTR of all ads was 0,28%.

	CTR (%)
Min	0.000232
Max	19.73185
Mean	0.284659
Median	0.097299



LABELING ASSOCIATIONS & RECOGNIZING OBJECTS

From object recognition to facial expressions

It is definitely interesting to see how "the machine" works and what associations it makes. It not only measures the number of letters, pixels, RGB colors, fonts and logos, but also recognizes animals, famous buildings like the Eiffel Tower, objects like a sail boat or a car, and facial emotions of people like joy, sorrow and anger. Moreover, Cloud Vision API associates colors and visuals. An example from our analysis: An ad with a dominant pink color and a heart shape in it was not only labeled 'pink' and 'heart' but also as 'female'.

Most of the time the application is right, like when it recognizes that the JBL ad on the top-right displays clothing, a swimmer, etc. However, sometimes we see some strange associations, like with the organ donor ad on the bottom-right. Probably because of the limited and zoomed image of the bodies, Cloud Vision API was not able to recognize the human bodies in it.

Clothing	Swimmer	Muscle	Sports	Water sport
0,902	0,814	0,725	0,649	0,575

Clothing	Wallet	headgear	Personal protective equipment
0,981	0,596	0,555	0,509

LABELING ASSOCIATIONS & RECOGNIZING OBJECTS

The limits of Vision API

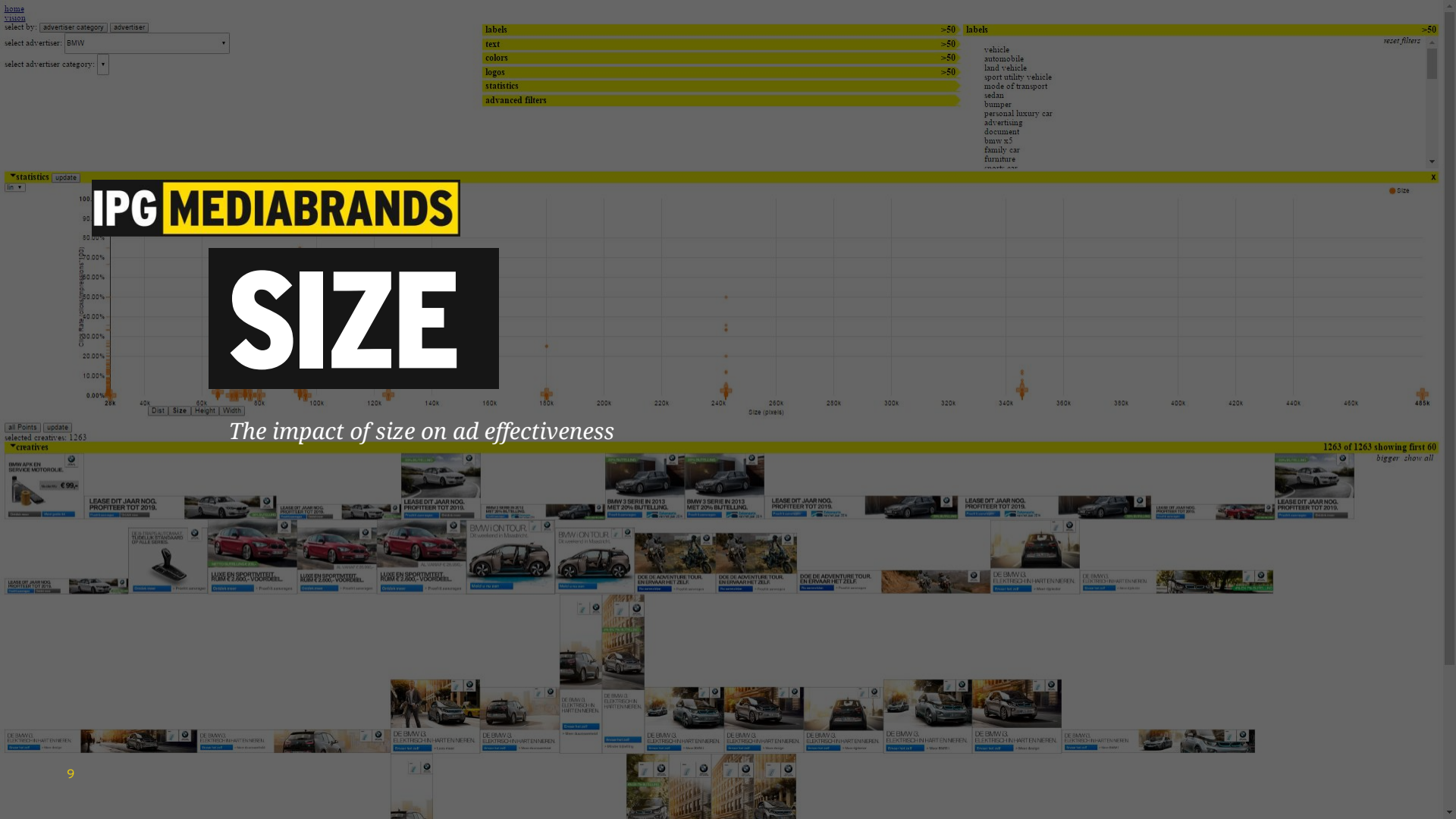
We found that the Cloud Vision API not always understands all elements in the ads. Many times it labeled the ads just as 'advertising', which is correct ☺.

It didn't recognize 'hearing device' and 'lip stick'. Although the hearing device was not recognized as such, the Vision API understood that it is a small appliance. The rest of the associations were wrong.

The lipstick surprised us to be honest. It is such an ordinary shape. Vision API is correct in understanding 'Lip' but is wrong on the other associations. Text is correct, but 'Major Appliance' and 'Gadget' isn't.

ASSOCIATION	LIKELIHOOD
Small appliance	0,553
Home appliance	0,550
Plumbing fixture	0,530
Energy	0,502

Text	0,950
Major appliance	0,789
Feature phone	0,777
Gadget	0,743
Lip	0,708



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SIZE

The impact of size on ad effectiveness

THE IMPACT OF AD SIZE

The impact of size: the bigger the better & horizontal is good

Most of the ads we tested were in the same size range (50.000 and 100.000 pixels), with an average CTR of 0,1222. Larger ads tend to have a higher average CTR. The 300.000-350.000 pixel-sized ads have an average CTR of 3,36.

Moreover, the shape of the ad has serious impact on its CTR. Horizontal ads are more effective (average CTR of 0,3275) than vertical and squared ones, though we have to be mindful that there were only 23 squared ads in our data set.

	Number of occurrences	CTR (%)
Vertical	2807	0.1917
Horizontal	6180	**0.3275**
Squared	23	0.1065

Ad checking using Google Vision API machine learning technology

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COLOUR

The impact of color on ad effectiveness

THE IMPACT OF DOMINANT AD COLOUR

The impact of color: blue and black

We tested the impact of the dominant colour of the ad. The dominant colour of an ad with multiple frames, is the most common color in all the frames in our calculations. On average, 14.044 colours (RGB values) are used in the ads.

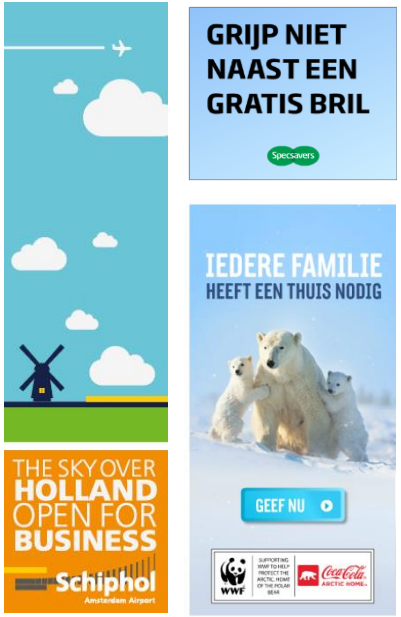
Highest CTR

The colours with the highest CTR are blue and black. Red, green and white perform less with small differences between each other.

Color	#	CTR (%)
red	3158	0,2538
blue	2003	**0,3539**
green	2152	0,2418
black	426	**0,3698**
white	1270	0,2964

Mean colors	
Min	2
Max	174623
Mean	14044
Median	8676

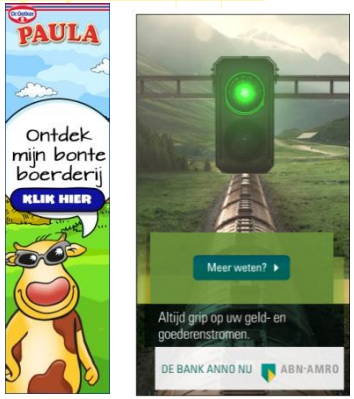
EXAMPLES DOMINANT COLOURS



Dominant colour=blue

Dominant colour=red

Dominant colour=white



Dominant colour=green

Dominant colour=black

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LOGO

The impact of a logo on ad effectiveness

THE IMPACT OF A LOGO AND ITS POSITION

A logo delivers extra CTR

66% of the ads contain a logo and these ads perform better than the ads without a logo. Some ads (9%) even have multiple logo's, which did not add any performance but was even detrimental to CTR. Moreover, the use of multiple logos can confuse Cloud Vision API.

Positioning the logo

The lower left corner is the best position in our test, with an CTR of 0,53. Second best is to place the logo at the upper left corner of the ad.

Logo	#	CTR (%)
Yes	5970	**0.3018**
No	3040	0.2509

>1 Logo	#	CTR (%)
Yes	798	0.2653
No	8212	**0.2865**

Position	#	CTR (%)
Upper left	725	**0.43563**
Upper right	276	0.16233
Lower right	1255	**0.40654**
Lower left	828	**0.53244**
Above	424	0.24234
Left	381	0.21206
Under	848	0.15284
Right	329	0.10802
middle	604	**0.32050**

EXAMPLES OF ADS WITH MULTIPLE LOGOS.

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TEXT

The impact of text on ad effectiveness

THE IMPACT OF THE USE OF TEXT

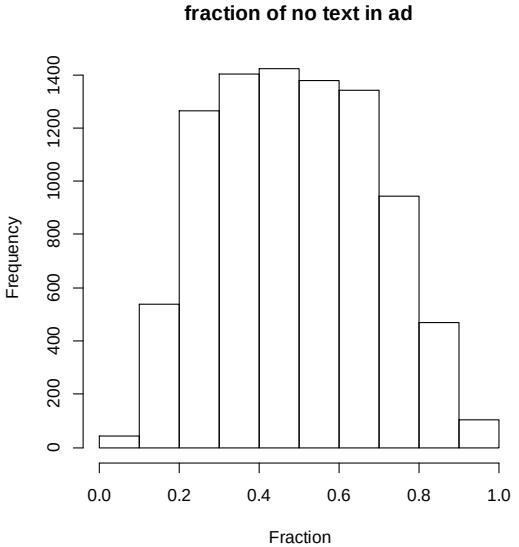
No clear impact of text

Text seems to have a positive impact on the CTR of online ads. This works in two ways: no or almost no text results in a higher CTR, as well as a lot of text.

CAPS

We didn't find a clear impact of the use of CAPITALS.

Range	#	CTR (%)
0 - 0.1	43	**0.425388**
0.1 - 0.2	539	**0,2894636**
0.2 - 0.3	1265	0,2384041
0.3 - 0.4	1402	0,2833354
0.4 - 0.5	1422	0,2559616
0.5 - 0.6	1380	**0,2875990**
0.6 - 0.7	1343	**0,3024298**
0.7 - 0.8	943	0.2672225
0.8 - 0.9	470	**0,4407644**
0.9 - 1	102	**0,5331673**



Fraction of no text in ad	
Min	0,04774
Max	1
Mean	0.49040
Median	0.48650

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CTA

The impact of a call to action on ad effectiveness

THE IMPACT OF A CALL TO ACTION

Will a call to action in an ad increase the CTR? We defined six variables to flag the existence of commonly occurring Calls to Action (CTAs):

- Click
- Download
- Win
- Ontdek
- Bekijk
- Meer (lees meer, meer weten, meer voordeel, meer info, meer deals)

CTR is highest if the ad contains 'win' (0,534) or 'bekijk' (0,4). We found some ads with up to 3 different CTAs, but did not find a higher CTR when multiple CTAs are used. Knowing that the average CTR for ads without CTA is 0,24 the positive impact of a CTA is clear.

	Klik	Download	Win	Ontdek	Bekijk	Meer	CTA*	>1
Perc	11%	3%	1%	14%	10%	11%	46%	5%
CTA (%)	**0.373**	**0.369**	**0.534**	**0.292**	**0.418**	0.229	**0.337**	0.278

* Sum of CTA's included

THE EFFECTS OF FACIAL EXPRESSION

98952|2 NColors: 68709

Although the Vision API is very capable of recognizing facial expressions, we didn't have enough data points (not enough ads with faces in it) to find clear results. Our hypothesis was that happy faces result in higher CTR's.

See below the correct interpretation of Vision API regarding facial expression of the Cruyff Foundation ad left.

ANNOTATIONS

Logos Cruyff Foundation

Labels human action person product brand presentation

Text CRUYFF BRENGT JEUGO IN BEWEGING Nu al ruim 50 watertappunten op Cruyff Courts dankzij de deelnemers van de Nationale Postcode Loterij. POSTCODE HLOTERIU CRUYFF BRENGT JEUGO IN BEWEGING Nu al ruim 50 watertappunten op Cruyff Courts dankzij de deelnemers van de Nationale Postcode Loterij. POSTCODE HLOTERIU

Colors blue: 182 green: 65, red: 9 blue: 16 green: 229, red: 241 blue: 35 green: 94, red: 73 blue: 52 green: 195, red: 226 blue: 26 green: 57, red: 40 blue: 202 green: 148, red: 99 blue: 249 green: 200, red: 102 blue: 144 green: 85, red: 25 blue: 156 green: 75, red: 3 blue: 253 green: 254, red: 254

FACES

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle
VERY_UNLIKELY	VERY_UNLIKELY	VERY_UNLIKELY	VERY_LIKELY	VERY_UNLIKELY	0.999953	6.05152	1.96839	3.0981
VERY_UNLIKELY	VERY_UNLIKELY	VERY_UNLIKELY	LIKELY	VERY_UNLIKELY	0.999564	9.01966	0.992587	-10.8816

Print screen from the Mediabrands Marketing Sciences Ad Vision dashboard

CONCLUSIONS

- **Size** does matter: the bigger ad format the better the results
- **Horizontal** is the best shape
- The best **colors** to use are blue and black
- A **logo** adds value and increases CTR
- The suggested position of the **logo** is bottom-left
- Either a few or a lot of **text** increases the chance on a high CTR
- A call to action works: '**win**' or '**bekijk**' work best
- **Multiple CTA's** are contra productive: it scores lower then one CTA

Fa

WWW.MEDIABRANDSADVISION.NL

Mediabrands Advision website

We created a website where you can test the probable effectiveness of your ad based on the learnings of our research.

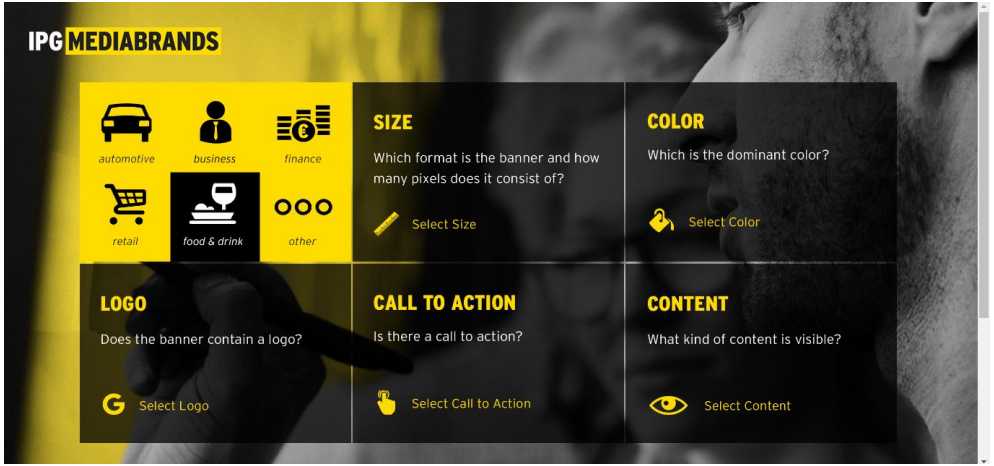
How does it work?

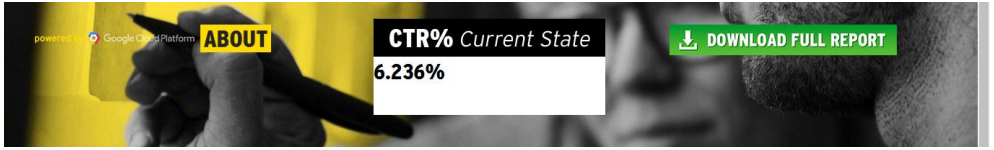
First you select the characteristics of your ad: product category, size, color, logo position (if any), call to action type (if any) and type of content that is depicted in the site. Select this by

At the bottom of the page you will see the predicted CTR based on our data.

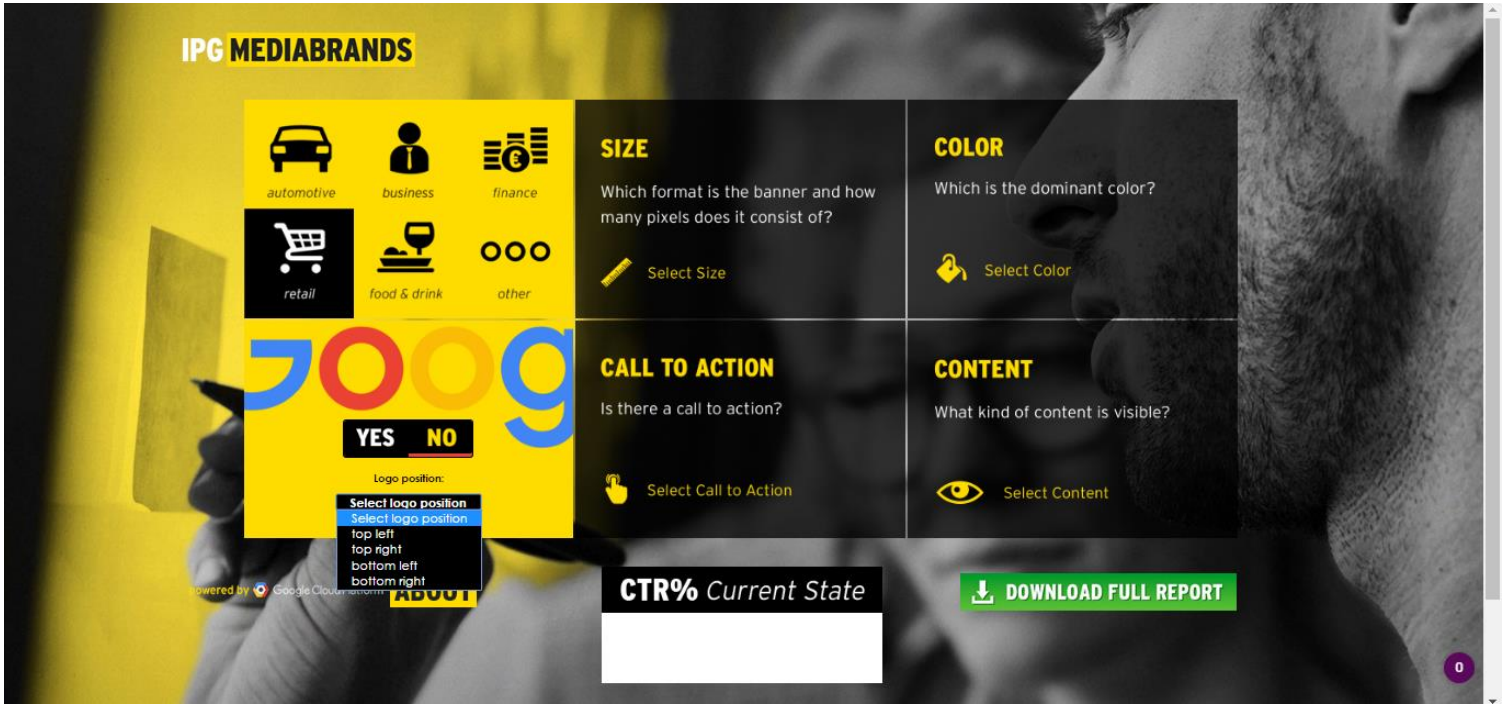
Full report

At the site you can download the full report of this project and read more about the medthodology.





WWW.MEDIABRANDSADVISION.NL



How emotion detection works?

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APPENDIX

Screendumps

THE IMPACT OF PRODUCT CATEGORY

The product category has a significant impact on the average CTR of an online ad. For benchmarking purposes we added the average for each category in this report. We indexed the CTR scores (100 is the average over all product categories). More information about average CTR's and other metrics can be found here: http://www.richmediagallery.com/tools/benchmarks .

In general, ads performed best in the following categories:

Eye care (index 269)

Energy and water suppliers (250)

Government and non-profit (225)

Food (general) (210)

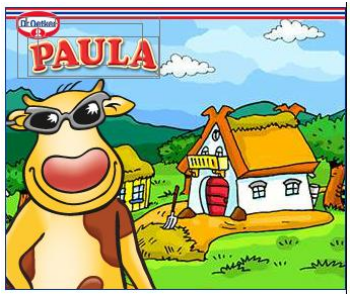
Retail department stores (190)

	Category	subcategory	CTR index
1	Automotive	General	99
2	Business and industrial	Business-to-business	48
3	Business and industrial	Employment, recruitment, staff	120
4	Business and industrial	General	39
5	Business and industrial	Information technology, high-tech	182
6	Clothing, shoes, accessories	General	72
10	Drink and beverage	Non-alcoholic, soft drinks	49
11	Education		37
12	Financial services	Banks, credit cards, loans	54
13	Financial services	General	34
14	Financial services	Insurance	51
15	Food	Fruit and vegetables	100
16	Food	General	210
17	Food	Snacks & Candy	93
18	Government and non-profit	General	225
19	Government and non-profit	Charities and voluntary organizations	162
20	Household and domestic	General	138
25	Leisure and entertainment	Hi-Fi, A/V, music players	22
26	Leisure and entertainment	Lotteries, casinos, gambling	42
27	Leisure and entertainment	Museums, attractions	69
31	Media and publishing	General	175
32	Pharmaceutical and healthcare	General	53
34	Retail	Clothing and fashion	114
35	Retail	Department stores	190
37	Retail	Electrical retailers	50
39	Retail	Furniture and furnishings	47
40	Retail	Online shopping, ecommerce	47
41	Retail	Pharmacies and drug store	90
43	Retail	Supermarkets and grocery stores	69
44	Retail	Toys	22
45	Retail	Eye care and ear care	269
46	Retail	General	38
49	Travel, transport and tourism		104
50	Utilities and services	Energy and water suppliers	250
51	Utilities and services	General	140
53	None		96

EXAMPLES OF CORRECT LOGO IDENTIFICATION

CRUYFF FOUNDATION / POSTCODE LOTERIJ

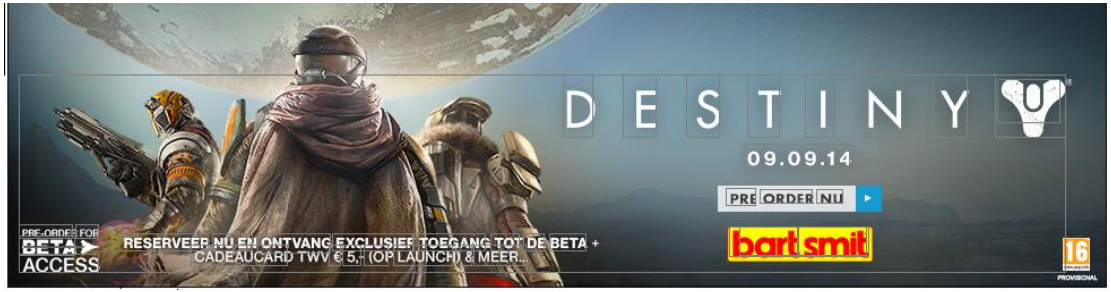
EXPERT / ZANUSSI



DR OETKER

We were amazed by the accuracy of the logo detection functionality of Vision API.

We were also surprised that Vision API didn't recognize the logo's on the next page.



BART SMIT / DESTINY

EXAMPLES OF WRONGLY IDENTIFIED LOGO'S

THE ACTUAL LOGO

Jij en Overijssel

Rockwell Automation

Bilfinger Industrial Services

Sunday Barbecue

LOGO ACCORDING TO VISION API

jij & overijs

Rockwell Automation

BILFINGER INDUSTRIAL SERVICES

Sunday
The new way of grilling

LABEL ASSOCIATIONS & RECOGNIZING OBJECTS

The limits of Vision API

At the right side we see an ad to promote Koopmans ‘pepernoten’. Vision API says ‘food’ (correct), ‘product’ (correct), plant, (strange association), mushroom (understandable since they look like it…

The Miele Vacuum cleaner is recognized as a steering wheel, which makes sense given the round shape of the tube. It is a home appliance but the other associations are wrong.

Produce	0,963
Food	0,933
Plant	0,899
Mushroom	0,795
Protea family	0,710

Steering wheel	0,742
Gadget	0,682
Home appliance	0,672
Mug	0,627
Small appliance	0,600

https://cloud.google.com/vision/

LABEL ASSOCIATIONS

Frame Data

15289|0 NColors: 246

Annotations

Logos

Labels folk dance

Text

Colors blue: 75 green: 54, red: 42 blue: 39 green: 66, red: 137 blue: 54 green: 49, red: 57 blue: 125 green: 147, red: 197 blue: 10 green: 19, red: 50 blue: 187 green: 212, red: 253 blue: 55 green: 70, red: 117 blue: 13 green: 14, red: 37 blue: 29 green: 41, red: 80 blue: 11 green: 12, red: 23

Faces

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle

RECOGNITION OF ANIMALS

FRAME DATA

32893|0 NColors: 236

ANNOTATIONS

Logos Royal Canin

Labels cat pet mammal animal british shorthair

Text ROYAL CANIN Kijk ROYAL CANIN Kijk

Colors blue: 125 green: 144, red: 153 blue: 99 green: 93, red: 176 **blue: 36 green: 52, red: 58 blue: 44 green: 52, red: 57** blue: 67 green: 85, red: 94 blue: 100 green: 118, red: 126 blue: 78 green: 87, red: 92 blue: 115 green: 123, red: 128 blue: 145 green: 153, red: 157 blue: 182 green: 188, red: 191

FACES

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle

32924|2 NColors: 234

ANNOTATIONS

Logos Royal Canin

Labels pug pet mammal animal dog

Text ROYAL CANIN Waarom zouden we ze dan wel dezelfde voeding geven? ROYAL CANIN Waarom zouden we ze dan wel dezelfde voeding geven?

Colors blue: 137 green: 128, red: 220 blue: 104 green: 99, red: 179 blue: 225 green: 219, red: 255 blue: 115 green: 120, red: 122 **blue: 47 green: 50, red: 51** blue: 82 green: 85, red: 86 **blue: 20 green: 22, red: 23** blue: 152 green: 156, red: 159 blue: 196 green: 200, red: 202 blue: 227 green: 228, red: 229

FACES

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle

RECOGNITION OF ANIMALS

15253|3 NColors: 254

ANNOTATIONS

Logos	South Africa
Labels	mammal animal meerkat vertebrate carnivoran
Text	athAfri rica Inspringnewways athAfri rica Inspringnewways
Colors	blue: 38 green: 152, red: 215 blue: 197 green: 232, red: 247 blue: 184 green: 166, red: 161 blue: 156 green: 193, red: 216 blue: 218 green: 193, red: 179 blue: 166 green: 156, red: 155 blue: 62 green: 84, red: 100 blue: 106 green: 155, red: 189 blue: 87 green: 111, red: 126 blue: 140 green: 192, red: 223

FACES

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle

RECOGNITION OF ANIMALS

Frame Data

22862|0 NColors: 255

Annotations

Logos Autodrop

Labels mammal animal pet laughter kangaroo

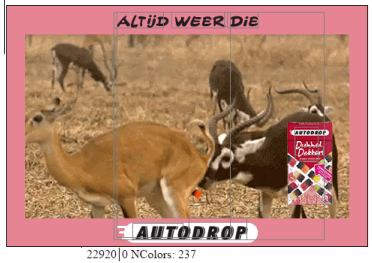
Text ALTijD WEER DIE AUTO DROP ALTijD WEER DIE AUTO DROP

Colors blue: 64 green: 44, red: 154 blue: 82 green: 61, red: 139 blue: 53 green: 76, red: 112 blue: 86 green: 110, red: 125 blue: 4 green: 27, red: 40 blue: 198 green: 199, red: 188 blue: 50 green: 78, red: 94 blue: 201 green: 203, red: 166 blue: 27 green: 52, red: 68 blue: 151 green: 135, red: 215

Faces

angerlikelihood	sorrowlikelihood	surpriselikelihood	joylikelihood	headwearlikelihood	confidence	pan angle	roll angle	tilt angle

Frame Data



22920|0 NColors: 237

Annotations

Logos Autodrop ~~Autodrop~~

Labels animal mammal vertebrate cat like mammal camel like mammal

Text ALTijD WEER DIE AUTO DROP Dekkers ALTijD WEER DIE AUTO DROP Dekkers

Colors blue: 58 green: 37, red: 157 blue: 243 green: 240, red: 250 blue: 17 green: 41, red: 70 blue: 3 green: 22, red: 51 blue: 150 green: 125, red: 235 blue: 24 green: 49, red: 70 blue: 48 green: 76, red: 101 blue: 150 green: 131, red: 230 blue: 56 green: 111, red: 156 blue: 145 green: 131, red: 230

ANALYSIS DASHBOARD

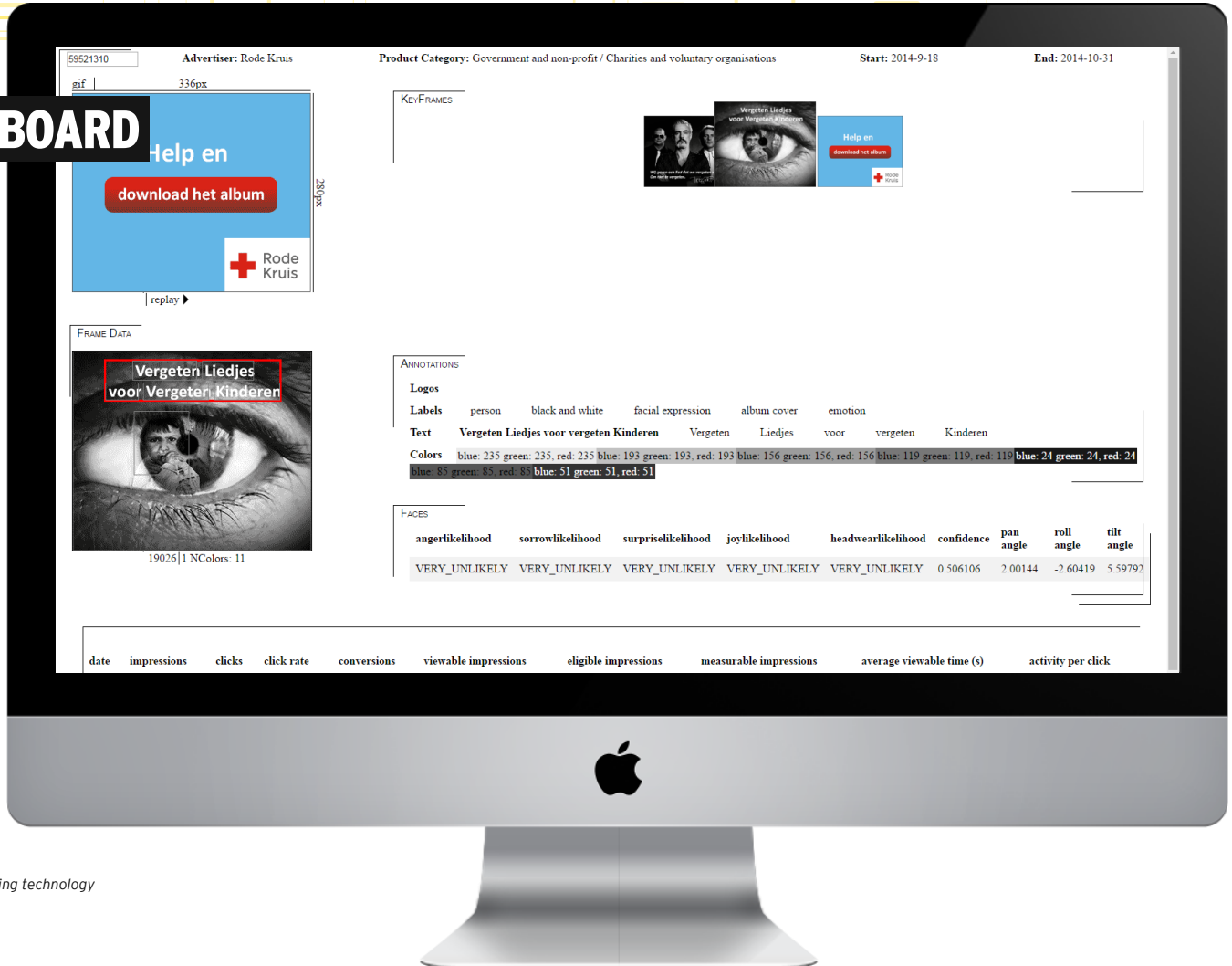
To aid in the analysis we build a dashboard that displays the results of the project. In the image on the right a screenshot of the dashboard is shown displaying information on a single banner.

On the top general information about the banner like the advertiser, product category and size can been seen next to thumbnails of all the frames of the animation and the two keyframes that where analyzed by cloud vision.

Below that information about the second keyframe is shown, with the actual image on the left and Vision results on the right. On the bottom is a table with performance metrics specified per day. (performance metrics were altered for this image)

ANALYSIS DASHBOARD

Another view of the dashboard with a banner for the Dutch Red Cross featuring a face recognition result.



ANALYSIS DASHBOARD

Screenshots on the right show the dashboard displaying an aggregate view of selected banners.

At the top banners can be selected from the database based on the advertiser or other properties. Selected banners are displayed on the bottom. In the middle graphs can be shown with the CTR of the selected banners as a function of one of several properties (performance metrics were altered for this image).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