Attention and selection behavior on "Universal Search" result pages

Report about an eye tracking pilot study commissioned by Hot Maps Medien GmbH

Institute of Communication and Media Research

GERMAN SPORT UNIVERSITY COLOGNE

- May 20th, 2011 (updated May 25th, 2012) -

1. Introduction

The pilot study as described in the following illustrates an empirical approach regarding the distribution of attention and the selection behavior on "Universal Search" result pages.

The ISO Norm line 9241-11 states as the three criteria for usability: effectiveness, efficiency and satisfaction. One tries to adjust the interface design to these criteria for example by user tests, interviews, heuristic evaluation by experts or modeling the expected user behavior.

In markets with a large variety of offers and little possibility of differentiation, providers can gain a decisive competitive advantage by user oriented interfaces. A precondition of this is that relevant information can be obtained for entrepreneurial decisions to this regard.

Commissioned by Hot Maps Medien GmbH, the Institute of Communication and Media Research (IKM) at the German Sports University Cologne (DSHS) developed and realized a suitable procedure. In the following

1. the main findings are presented,
2. the methods are discussed
3. individual results are explained and
4. some recommendations for actions are offered.

2. Short report

(1) Miniaturized Google maps show a vampire effect

It is known from advertising research that advertisements with big name celebrities will attract almost the entire attention of the viewer in such a way that the actual information about the product is hardly noticed and not remembered. Such a skewed distribution of attention always showed up when Google SERPs (search engine result pages) were shown as “Universal Search” result pages including miniaturized Google Maps.

(2) Users' decision making processes are not shortened by miniaturized Google Maps on SERPs and thus not made easier.

The use of miniaturized Google maps is leading to intended targets and thereby fulfills the criterion of effectiveness. Yet usability is negatively affected because the users spend extremely long time looking at the miniaturized map before making a decision. Therefore this design feature does not fulfill the criterion of efficiency. Users are distracted from the

intended goal of gaining information, which potentially reduces the rate of the criterion of satisfaction.

(3) The visual attention for individual links on the SERPs is influenced by specific factors.

The distribution of the visual attention for individual links on the SERPs depends on A) their positioning on the SERP and B) the users' familiarity with the target of the search. Links that are positioned very high in the display are selected much more often than those on lower ranks. The scanning behavior is moderated by the cognitive representation of the target location (Hannover vs. Houston. It may be assumed that the city of "Hannover" had a stronger cognitive representation in the subjects than the city of "Houston". Accordingly Hannover was anchored stronger in the memory of the users. The scanning behavior of the subjects was different compared between the two search terms (without the miniaturized Google maps),

and the test subjects showed a wider spaced page scanning behavior looking for the city "Houston" than for the city "Hannover".

(4) The "ads" on the SERPs' sides were not clicked on nor viewed.

Based on the search words or terms entered, Google presents to users so-called ads in the right column of the SERPs which can be clicked on. These advertisements were neither noticed visually, nor clicked on.

3. Setup of the study

The study presented here represents a user oriented study using the methods of observation and interviewing.

By interviewing, general usage habits regarding the users' preferred web browsers, a specific search engine or a specific mapping service can be learned. Data on questionnaires cannot represent the behavior retrospectively because this is affected, for example, by memory effects. Therefore an eye tracker was used additionally. This was a high resolution device of the company Tobii, based on the cornea reflex method. The use of this elaborate method is necessary in order to catch spontaneous user behavior that is not adulterated by willful processes. In respect to methodology, it is assumed that the user's visual attention is focused on the object that is also the object of

the cognitive processing **(eye-mind hypothesis)**. It is further assumed that the time of fixation corresponds to the time of cognitive processing **(immediacy assumption)**.

20 subjects were recruited. Men and women were evenly represented. Twelve persons were under 30 years old, eight were older. Three persons did not hold the general baccalaureate. Half of them indicated that they utilized computer programs but did not configure them by themselves and that they would consult other persons when having problems using computers. The other half of the subjects was rated as experienced computer users, judged by this criterion.

The specification was to generate SERPs for a national (Hannover, Germany) and an international city (Houston, Texas, USA), with and without miniaturized Google maps. In order to have identical Google advertisements and SERPs for all subjects, screen shots were produced for the three search terms "Stadtplan Hannover“ (= city map Hannover), "Hannover Stadtplan Innenstadt" (= Hannover inner city map) and "map Houston“.

In order to hide the purpose of the test from the subjects and to preserve their attention for the stimuli used during the entire measuring cycle, a special test setting was created.

The subjects sat about 2 meters in front of a 46-inch plasma screen monitor that showed various images. The eye tracker stood about 70 centimeters (= 2,297 ft) in front of the subjects and therefore was outside the regular sight field of the participants. All instructions, stimuli and

questions were shown on the screen to avoid distortions caused by the experimenter. In order to get the subjects used to the situation and gain their attention they were informed that they were participating in a perception experiment. They were presented with a Stroop test of word recognition and thereafter with a geometrical-optical illusion. Then the subjects were asked to look at an advertisement for eight seconds. In the advertisement, a spokesperson with a visible physical handicap was promoting a fictional automobile brand. Besides the car brand, we questioned the subjects about any conspicuous issues concerning the spokesperson. Then the subjects got written instructions to click on an item they desired in an on-line advertisement. The next page offered showed a screen shot from eBay with integrated advertising.

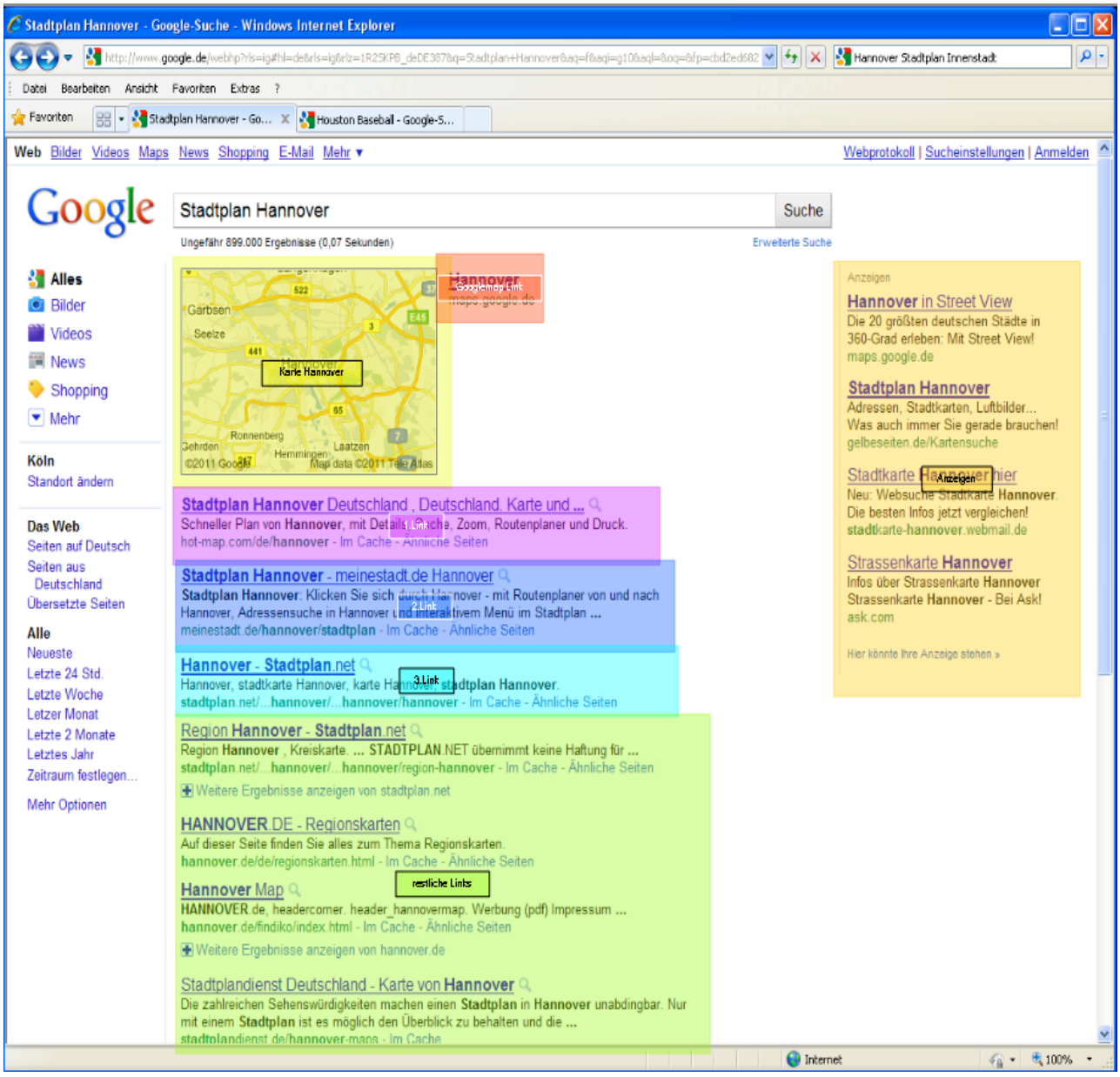
Then they were asked about any sponsors visible on this site. Next the subjects were shown a picture of a table tennis athlete in a tuxedo and asked to assign a name to him from a list of choices. Then the participants were shown a picture of the same athlete performing his sport and were asked for a name choice. The following instruction was: "Imagine you are in Hannover and are looking for the AWD-Arena to watch a game". A search term was to be selected from a prepared list. The next page showed the information: "In the following you will find a search result page one could for example get by searching for the terms 'Stadtplan Hannover = city map Hannover' Please choose spontaneously anything guiding to the target".

Then a city map of Hannover will be shown to you for ten seconds during which you are to memorize distinctive points." Then the screen shot of the Universal Search SERP "Hannover with miniaturized Google map" followed. After a click on a random area of the screen shot an excerpt of the city map of Hannover with the area around the AWD-Arena was presented for ten seconds. Then the subjects were asked to choose from a list the option corresponding to a detail in the map section just shown. Then the following instruction was presented: "Imagine you are on vacation in Houston, Texas and want to attend a basket ball game in the Toyota Sports Center". Then the question about the preferred search term followed again and the presentation of the screen shot of an ordinary SERP, without the miniaturized Google map. Here again, an area guiding to the target was to be selected by mouse click.

After the click a map detail appeared again, this time from Houston. On this map section the participants were to memorize details one of which was asked about through a menu of choices. Half of the subjects participated under these conditions. The other, structurally equal half received the complementary content, which is a SERP from Hannover without the miniaturized Google map and that from Houston with miniaturized Google map in the SERP. Following that and after an eye tracking test, all subjects replied to a questionnaire about their web browser, search engine and mapping service usage preferences.

The eye movements and fixations were recorded at a rate of 120 Hertz during the entire measuring section. Video and audio of all subjects was recorded with a webcam in parallel and integrated with the stimuli presented and the tracking data into an overall view.

Therefore, the test procedure chosen here follows the precondition of constructive behavioral measuring. This procedure has the advantage that no reduction of data occurs during the acquisition of the raw data. Furthermore, various parameters can be determined from the raw data. For this purpose so-called areas of interest (AOI) are defined. For the four used SERPs the determined AOI are marked in color in the following four pictures.


Stadtplan Hannover - Google-Suche - Windows Internet Explorer
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Ungefähr 899.000 Ergebnisse (0,07 Sekunden)
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Stadtplandienst Deutschland - Karte von Hannover
Die zahlreichen Sehenswürdigkeiten machen einen Stadtplan in Hannover unabdingbar. Nur mit einem Stadtplan ist es möglich den Überblick zu behalten und die ...
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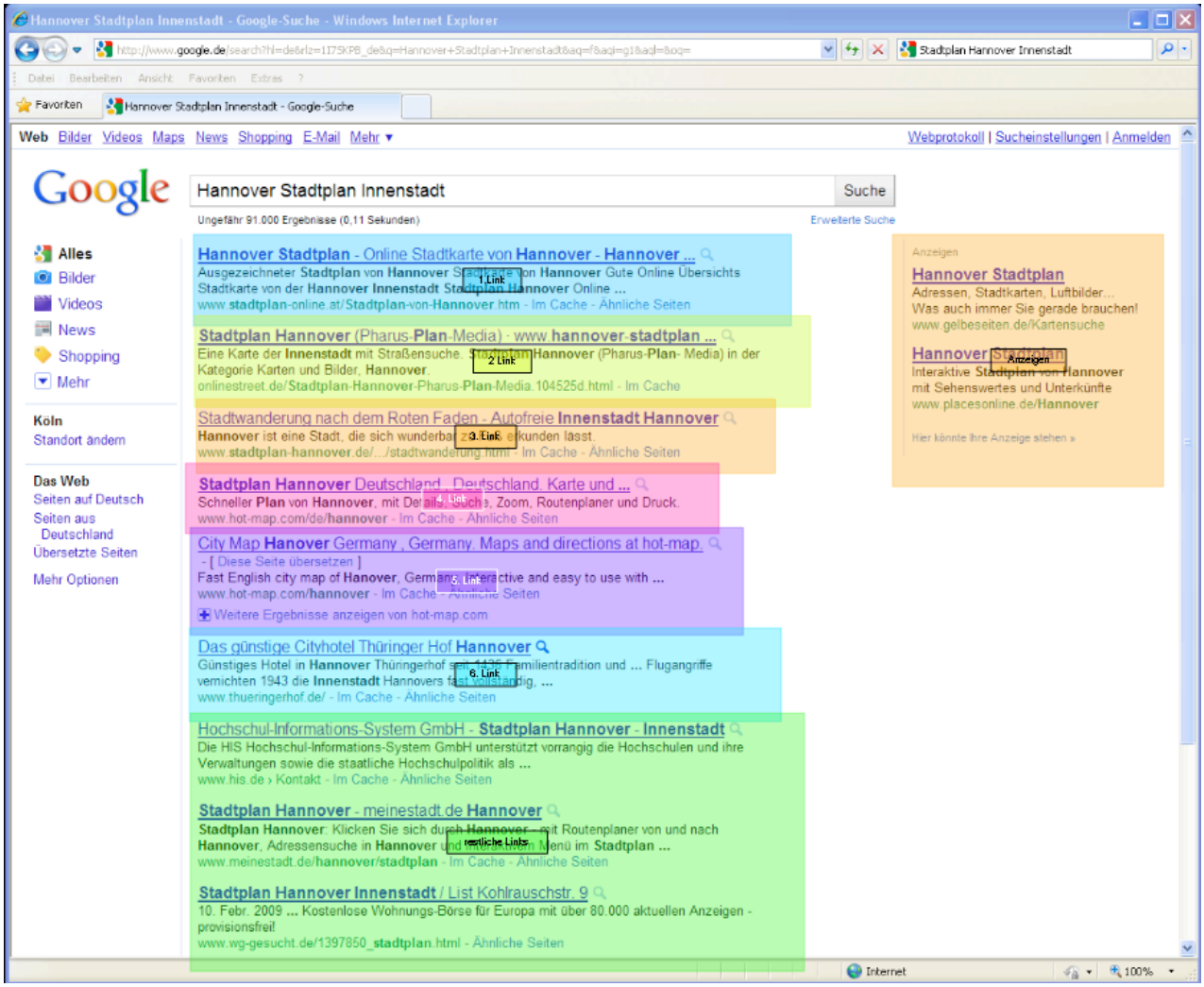
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2.Link
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Stadtplan Hannover Deutschland, Deutschland, Karte und ...
4.Link
City Map Hanover Germany , Germany, Maps and directions at hot-map.
5.Link
Weitere Ergebnisse anzeigen von hot-map.com
Das günstige Cityhotel Thüringer Hof Hannover
6.Link
Hochschul-Informations-System GmbH - Stadtplan Hannover - Innenstadt
Stadtplan Hannover - meinestadt.de Hannover
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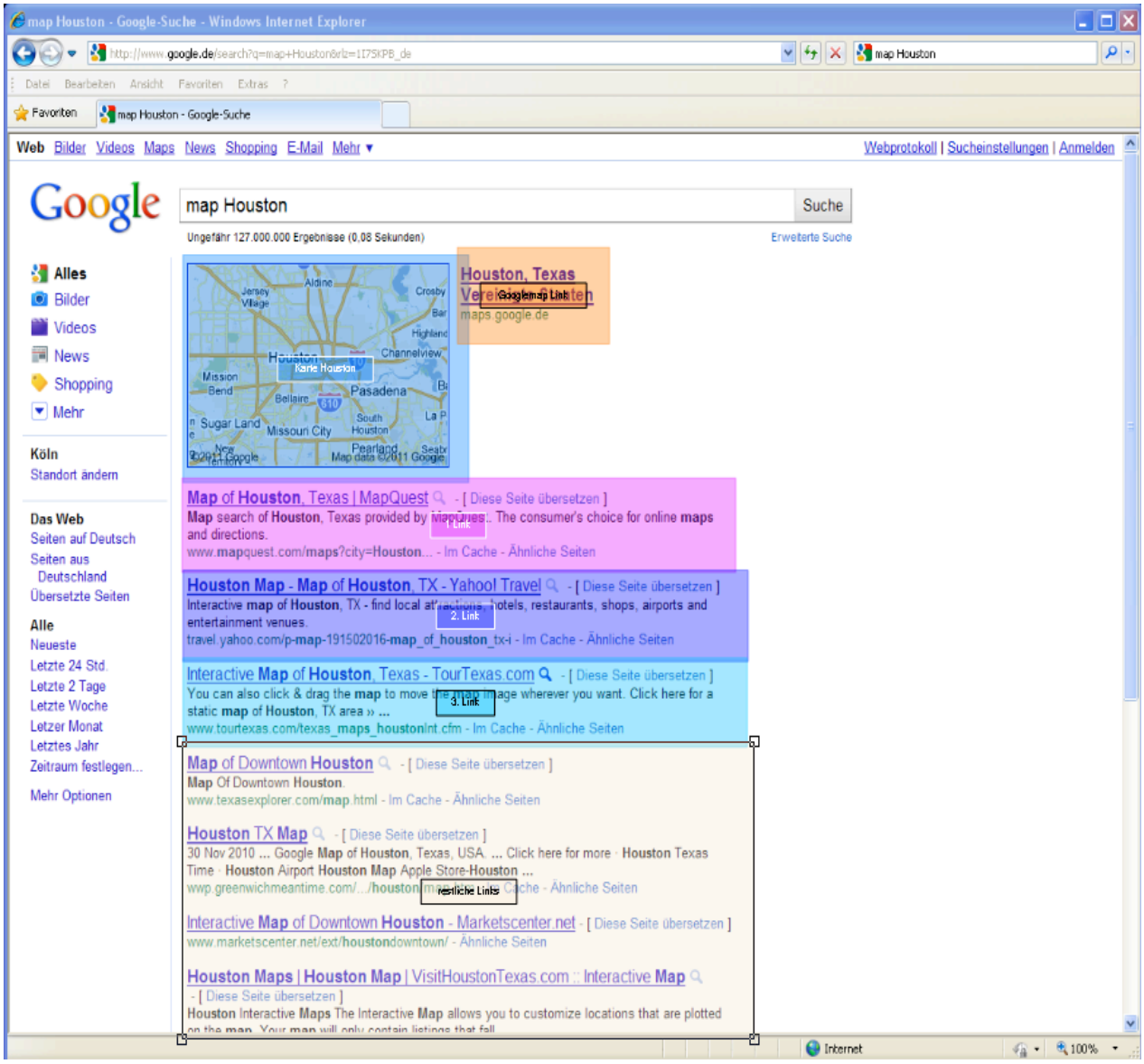
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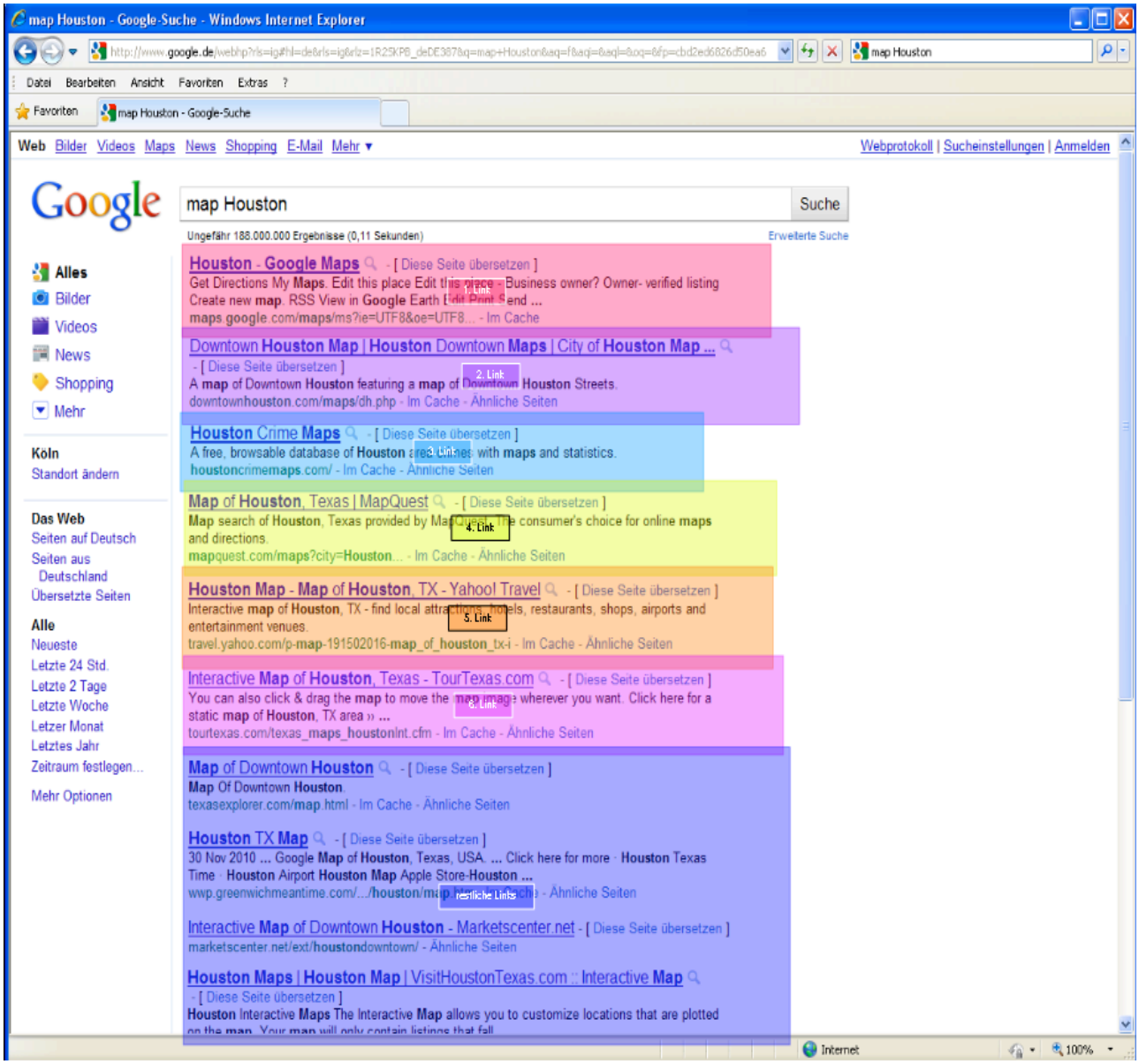
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For each AOI, four parameters were computed from the raw data:

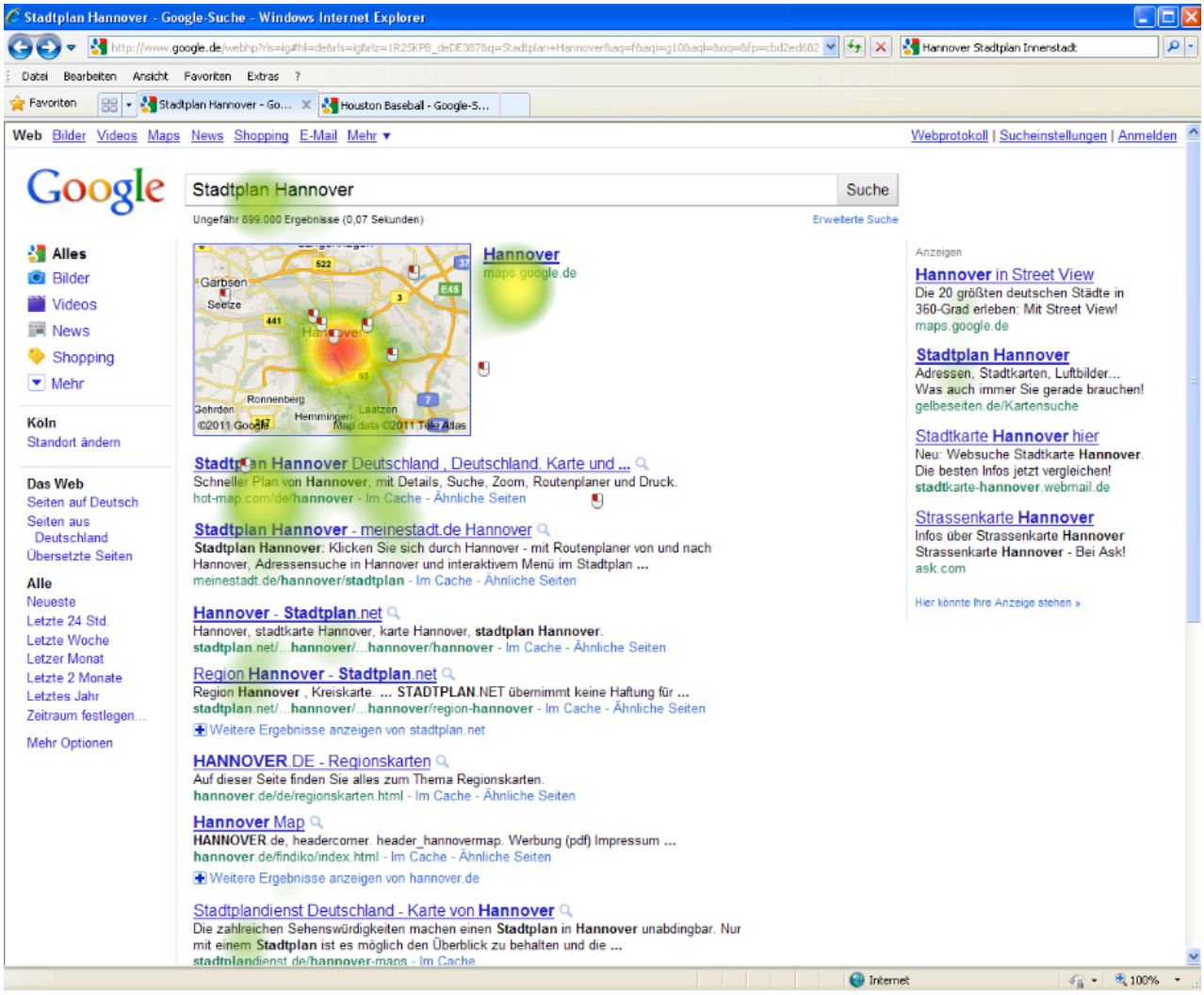
1) **Fixation count**
2) **Absolute duration** of the fixations
3) **Time to first fixation**
4) Time until first mouse click (**decision interval**)

A fixation occurs when an eye movement rests for at least 200 milliseconds on an area of 50 pixels.

The results arrived at are described in detail in the following chapter.

4. Detailed results of the study.

As the first analytical step, the left mouse clicks of the subjects were marked in the four target pictures as symbolized () mouse-left-click. At the same time these data were to be complemented by the data of the eye movement. Therefore corresponding heat maps were generated. In these heat maps, a color code indicates the diverse intensities of the visual attention triggered by the four SERPs in the viewers. Analog to a traffic light, the color red represents the maximal viewing time and the color green the minimal duration. In all areas without color assignment there was no fixation. For optimal comparability, each heat map is shown on a single page.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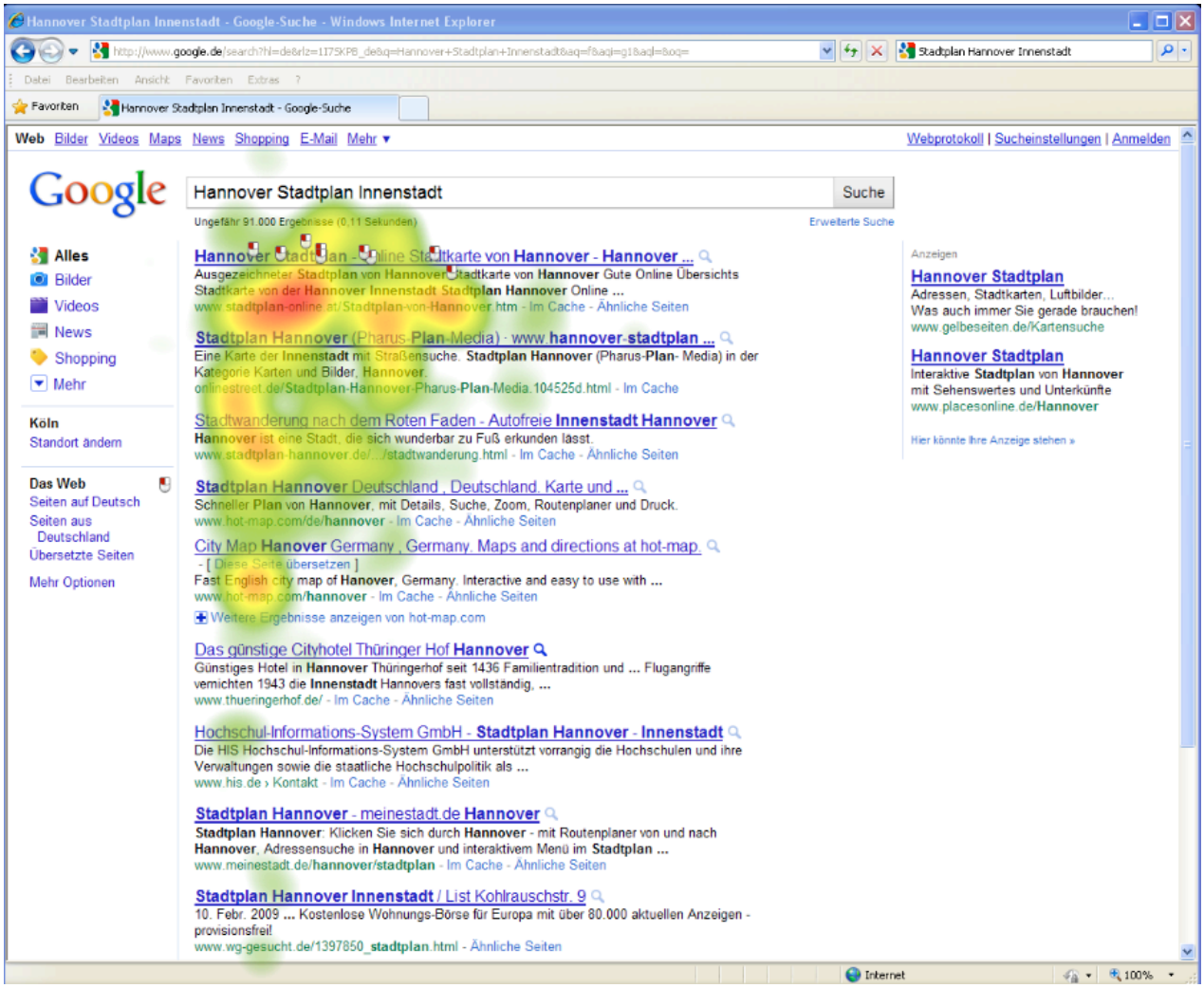
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www.meinestadt.de/hannover/stadtplan - Im Cache - Ähnliche Seiten
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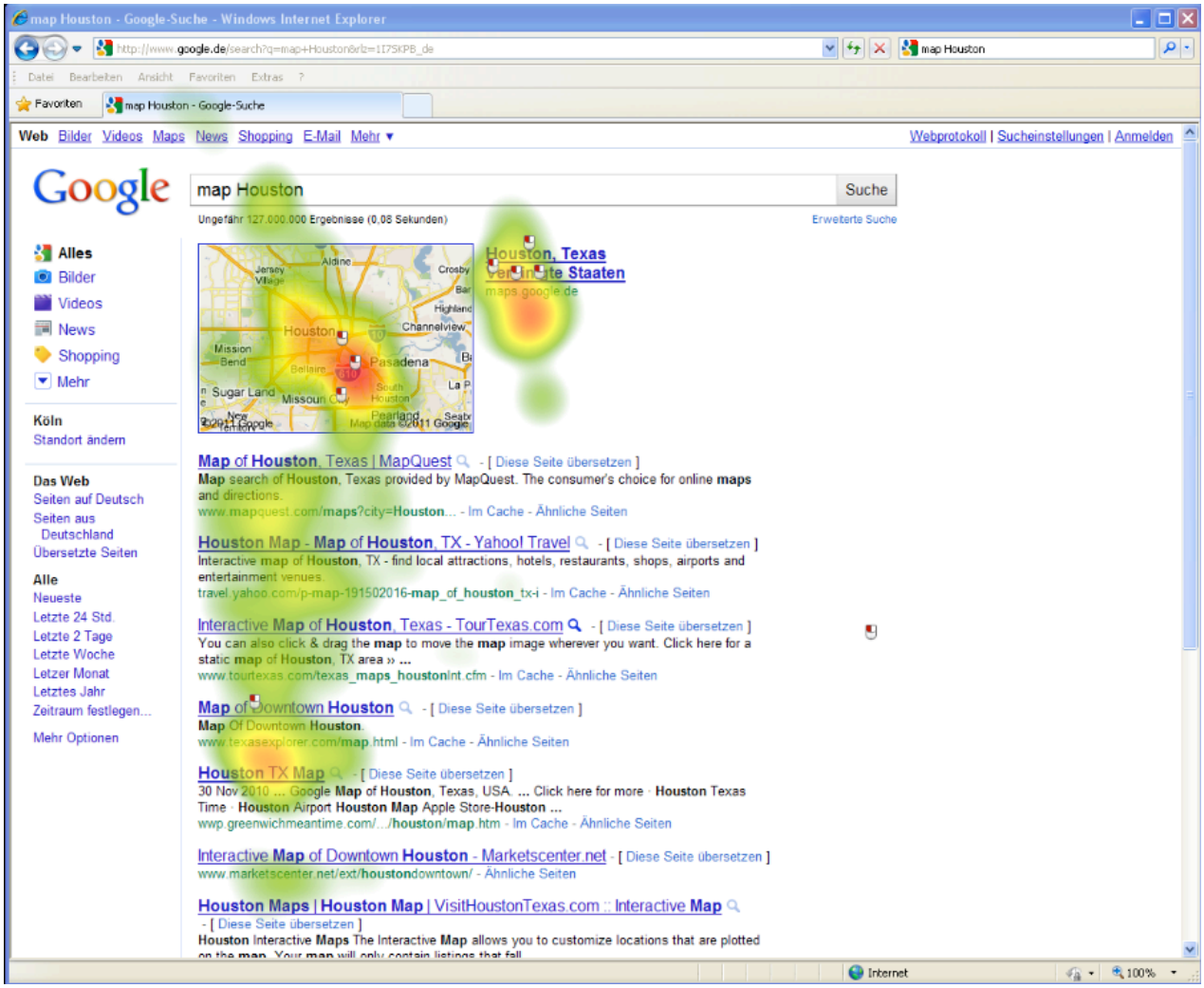
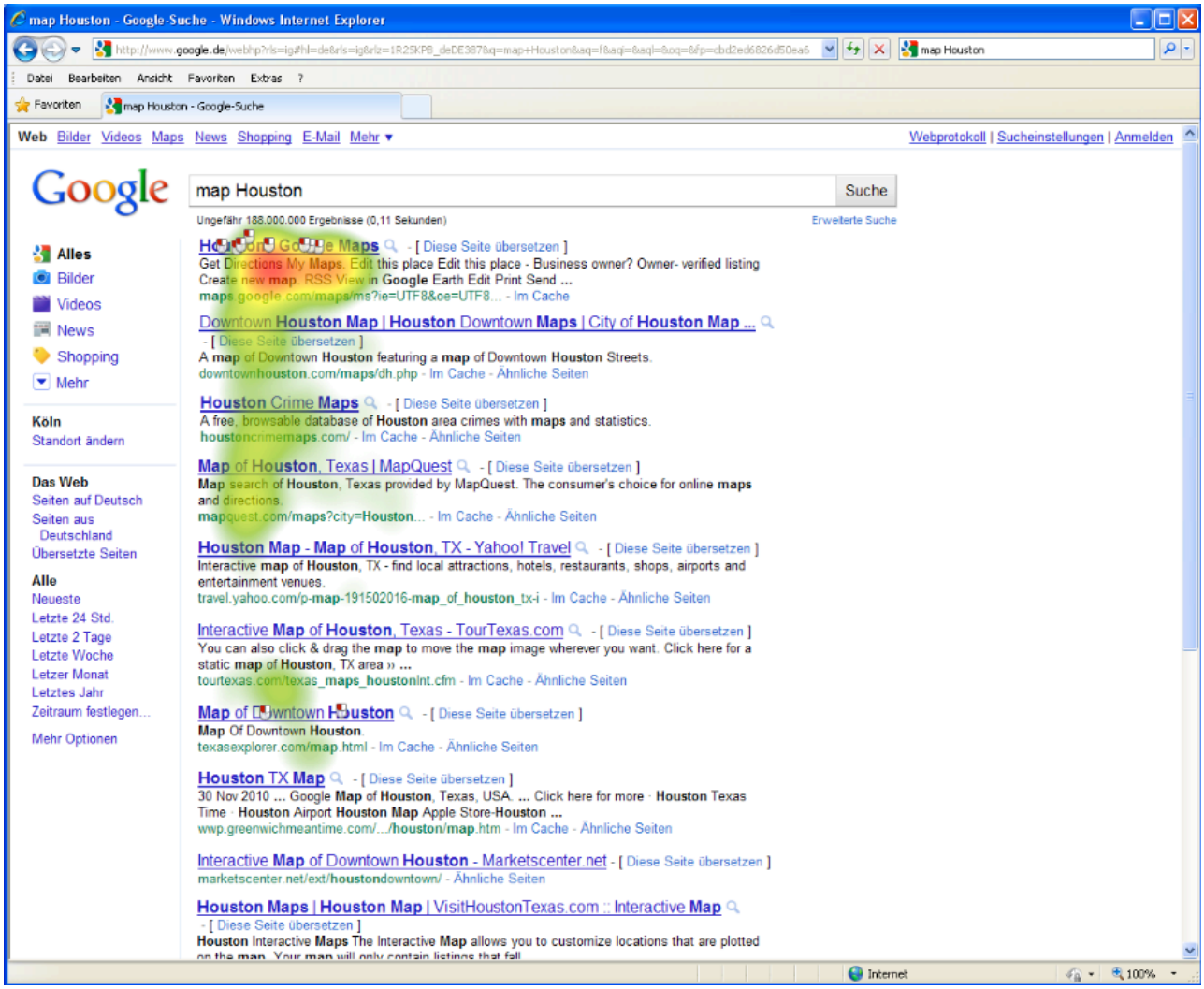
10. Febr. 2009 ... Kostenlose Wohnungs-Börse für Europa mit über 80.000 aktuellen Anzeigen - provisionsfrei!
www.wg-gesucht.de/1397850_stadtplan.html - Ähnliche Seiten
Internet
100%


map Houston - Google-Suche - Windows Internet Explorer
http://www.google.de/search?q=map+Houston&rlz=1I7SKPB_de
map Houston
Datei Bearbeiten Ansicht Favoriten Extras ?
Favoriten
map Houston - Google-Suche
Web Bilder Videos Maps News Shopping E-Mail Mehr ▾
Webprotokoll | Sucheinstellungen | Anmelden
Google
map Houston
Suche
Ungefähr 127.000.000 Ergebnisse (0,08 Sekunden)
Erweiterte Suche
Alles
Bilder
Videos
News
Shopping
Mehr
Köln
Standort ändern
Das Web
Seiten auf Deutsch
Seiten aus Deutschland
Übersetzte Seiten
Alle
Neueste
Letzte 24 Std.
Letzte 2 Tage
Letzte Woche
Letzer Monat
Letztes Jahr
Zeitraum festlegen...
Mehr Optionen
Houston, Texas
maps.google.de
Map of Houston, Texas | MapQuest - [Diese Seite übersetzen]
Map search of Houston, Texas provided by MapQuest. The consumer's choice for online maps and directions.
www.mapquest.com/maps?city=Houston... - Im Cache - Ähnliche Seiten
Houston Map - Map of Houston, TX - Yahoo! Travel - [Diese Seite übersetzen]
Interactive map of Houston, TX - find local attractions, hotels, restaurants, shops, airports and entertainment venues.
travel.yahoo.com/p-map-191502016-map_of_houston_tx-i - Im Cache - Ähnliche Seiten
Interactive Map of Houston, Texas - TourTexas.com - [Diese Seite übersetzen]
You can also click & drag the map to move the map image wherever you want. Click here for a static map of Houston, TX area » ...
www.tourtexas.com/texas_maps_houstonInt.cfm - Im Cache - Ähnliche Seiten
Map of Downtown Houston - [Diese Seite übersetzen]
Map Of Downtown Houston.
www.texasexplorer.com/map.html - Im Cache - Ähnliche Seiten
Houston TX Map - [Diese Seite übersetzen]
30 Nov 2010 ... Google Map of Houston, Texas, USA. ... Click here for more · Houston Texas Time · Houston Airport Houston Map Apple Store-Houston ...
wwp.greenwichmeantime.com/.../houston/map.htm - Im Cache - Ähnliche Seiten
Interactive Map of Downtown Houston - Marketscenter.net - [Diese Seite übersetzen]
www.marketscenter.net/ext/houstondowntown/ - Ähnliche Seiten
Houston Maps | Houston Map | VisitHoustonTexas.com :: Interactive Map - [Diese Seite übersetzen]
Houston Interactive Maps The Interactive Map allows you to customize locations that are plotted
Internet
100%


map Houston - Google-Suche - Windows Internet Explorer
Datei Bearbeiten Ansicht Favoriten Extras ?
Favoriten
map Houston - Google-Suche
Web Bilder Videos Maps News Shopping E-Mail Mehr ▾
Webprotokoll | Sucheinstellungen | Anmelden
Google
map Houston
Suche
Ungefähr 188.000.000 Ergebnisse (0,11 Sekunden)
Erweiterte Suche
Alles
Bilder
Videos
News
Shopping
Mehr
Köln
Standort ändern
Das Web
Seiten auf Deutsch
Seiten aus Deutschland
Übersetzte Seiten
Alle
Neueste
Letzte 24 Std.
Letzte 2 Tage
Letzte Woche
Letzer Monat
Letztes Jahr
Zeitraum festlegen...
Mehr Optionen
Houston Google Maps - [Diese Seite übersetzen]
Get Directions My Maps. Edit this place Edit this place - Business owner? Owner- verified listing Create new map. RSS View in Google Earth Edit Print Send ...
maps.google.com/maps/ms?ie=UTF8&oe=UTF8... - Im Cache
Downtown Houston Map | Houston Downtown Maps | City of Houston Map ... - [Diese Seite übersetzen]
A map of Downtown Houston featuring a map of Downtown Houston Streets.
downtownhouston.com/maps/dh.php - Im Cache - Ähnliche Seiten
Houston Crime Maps - [Diese Seite übersetzen]
A free, browsable database of Houston area crimes with maps and statistics.
houstoncrimemaps.com/ - Im Cache - Ähnliche Seiten
Map of Houston, Texas | MapQuest - [Diese Seite übersetzen]
Map search of Houston, Texas provided by MapQuest. The consumer's choice for online maps and directions.
mapquest.com/maps?city=Houston... - Im Cache - Ähnliche Seiten
Houston Map - Map of Houston, TX - Yahoo! Travel - [Diese Seite übersetzen]
Interactive map of Houston, TX - find local attractions, hotels, restaurants, shops, airports and entertainment venues.
travel.yahoo.com/p-map-191502016-map_of_houston_tx-i - Im Cache - Ähnliche Seiten
Interactive Map of Houston, Texas - TourTexas.com - [Diese Seite übersetzen]
You can also click & drag the map to move the map image wherever you want. Click here for a static map of Houston, TX area » ...
tourtexas.com/texas_maps_houstonInt.cfm - Im Cache - Ähnliche Seiten
Map of Downtown Houston - [Diese Seite übersetzen]
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texasexplorer.com/map.html - Im Cache - Ähnliche Seiten
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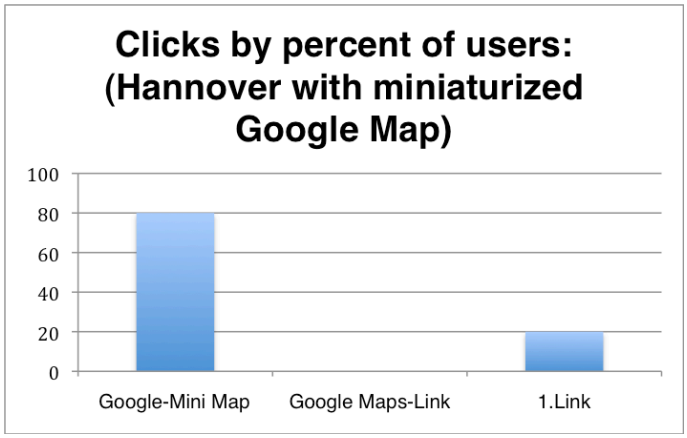
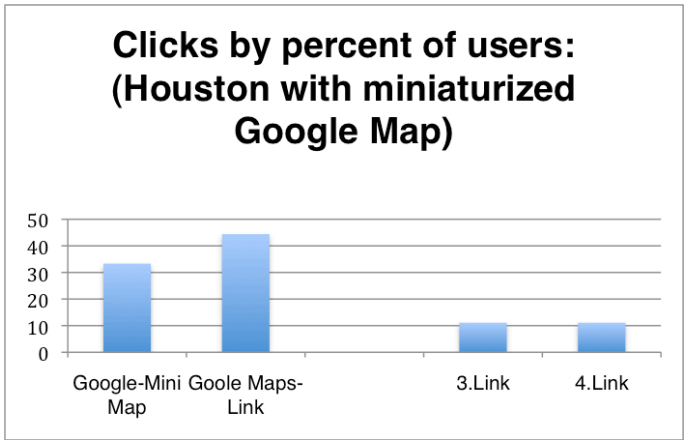
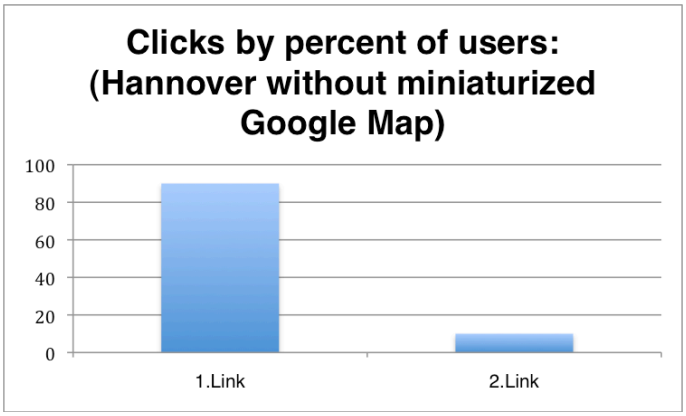
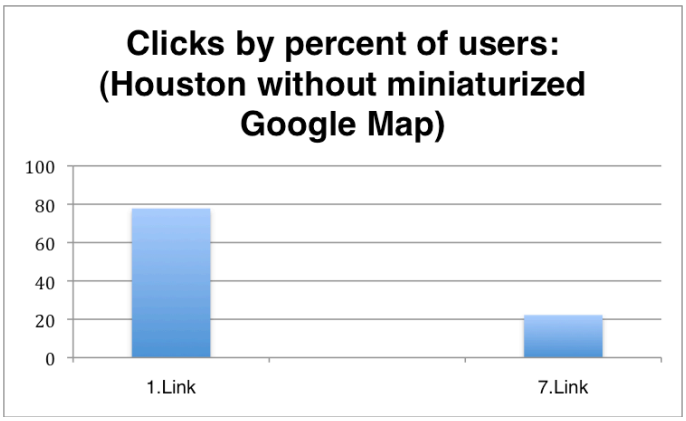
30 Nov 2010 ... Google Map of Houston, Texas, USA. ... Click here for more · Houston Texas Time · Houston Airport Houston Map Apple Store-Houston ...
wwp.greenwichmeantime.com/.../houston/map.htm - Im Cache - Ähnliche Seiten
Interactive Map of Downtown Houston - Marketscenter.net - [Diese Seite übersetzen]
marketscenter.net/ext/houstondowntown/ - Ähnliche Seiten
Houston Maps | Houston Map | VisitHoustonTexas.com :: Interactive Map - [Diese Seite übersetzen]
Houston Interactive Maps The Interactive Map allows you to customize locations that are plotted
Internet
100%

The two SERPs with miniaturized Google maps show that these elements draw the major portion of the viewers' visual attention to them, in the sense of a vampire effect. A remarkable difference exists between the national and the international target, relating to the **number of mouse clicks**, as shown in the following graphic representation of the click distribution in percentages of the users.


Clicks by percent of users: (Hannover with miniaturized Google Map)
100
80
60
40
20
0
Google-Mini Map
Google Maps-Link
1.Link


Clicks by percent of users: (Houston with miniaturized Google Map)
50
40
30
20
10
0
Google-Mini Map
Goole Maps-Link
3.Link
4.Link





For the search word "Hannover" the Universal Search SERP's miniaturized Google Map received 8 clicks (80%), double the number of clicks for the Google map on the SERP for the

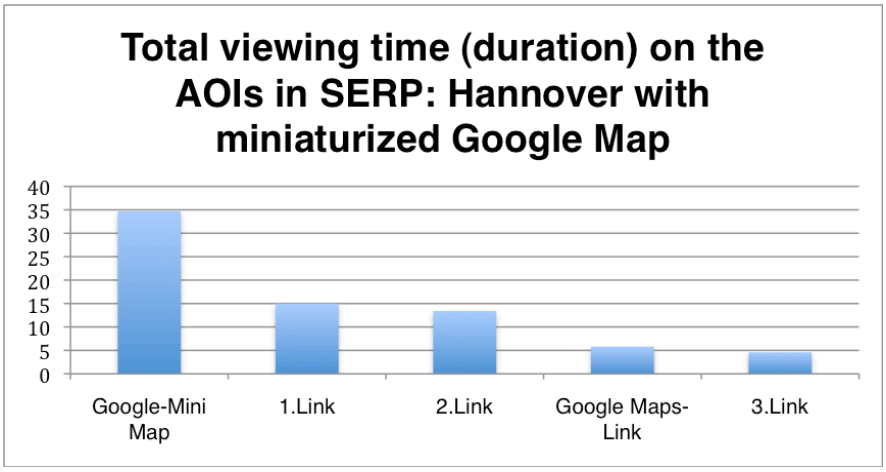
search word "Houston“ (three clicks 33.3%). On the last mentioned SERP the Google-Link was chosen the most, with four mouse clicks. This suggests that the selection behavior is actually influenced by the kind of the cognitive representation of the target.

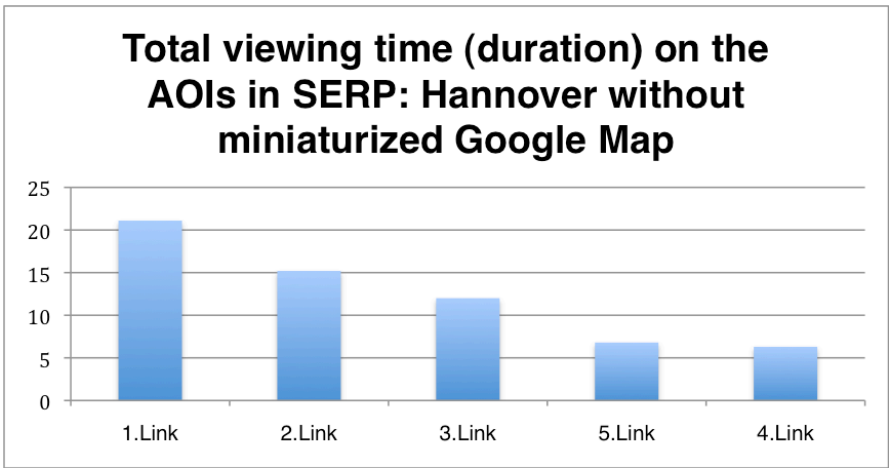
This assumption is supported by the two SERPs that have no miniaturized Google Map. The SERP for "Hannover Stadtplan Innenstadt" (= Hannover inner city map) shows a **total viewing time** of 21.1 seconds and with a click amount of 90% of the subjects a distinct focusing on the first link. For the "map Houston" without map

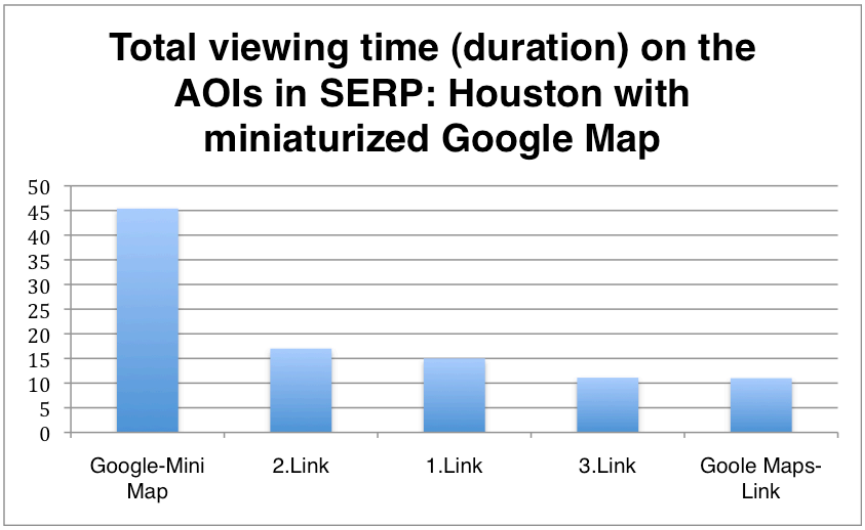
the duration on the first link is also highest with 25.6 sec, yet two subjects chose the seventh link. An explanation for this behavior cannot be delivered in the context of a pilot study, but should be further pursued in regard of the significance of cognitive representation.

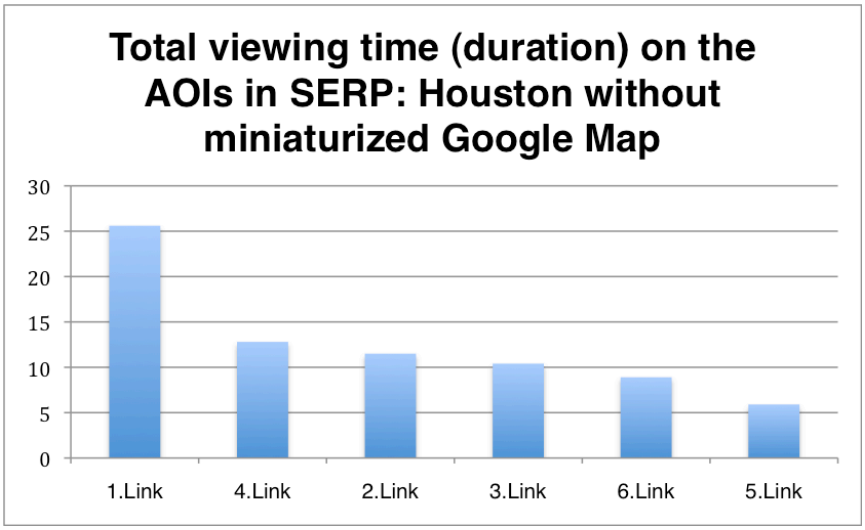
It is remarkable that the miniaturized Google Maps do not contribute to quicker decision making and clicking behavior but rather make the decision finding less efficient. On average, ten subjects needed 16.03 **seconds up to the click** (Houston) or 12.47 seconds up to the click respectively (Hannover). With the SERPs without miniaturized Google Maps it was only 7.69 sec (Houston) or 6.72 sec (Hannover). At the same time these data show once more under complementary conditions that the length of time on the page and therewith the cognitive load for the national destination (Hannover) is less as opposed to the international destination (Houston).

The distribution of the **total viewing time in seconds** on the AOI in the four SERPs in seconds (duration) figures as follows:






Total viewing time (duration) on the AOIs in SERP: Houston with miniaturized Google Map
50
45
40
35
30
25
20
15
10
5
0
Google-Mini Map
2.Link
1.Link
3.Link
Goole Maps-Link


Total viewing time (duration) on the AOIs in SERP: Houston without miniaturized Google Map
30
25
20
15
10
5
0
1.Link
4.Link
2.Link
3.Link
6.Link
5.Link

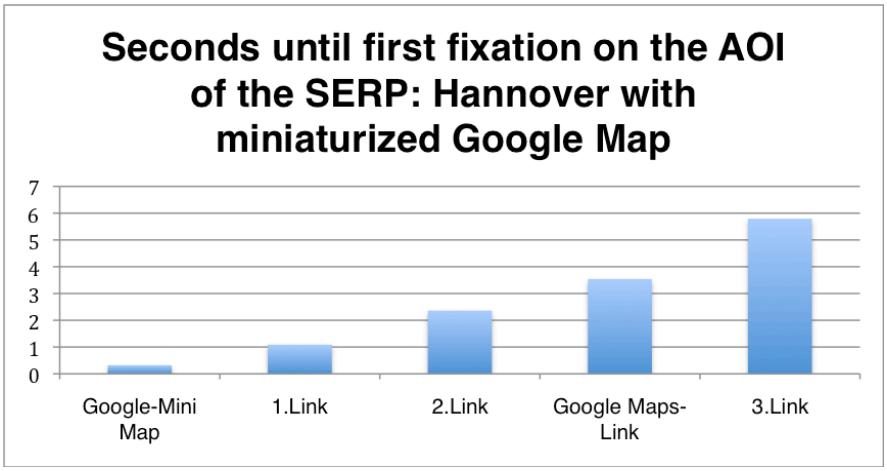
These data illustrate the high relevance of the top two links for gaining visual attention. Because the Google advertisements are missing in this listing for lack of fixation on any of them, their ineffectiveness is revealed by the eyes of their viewers.

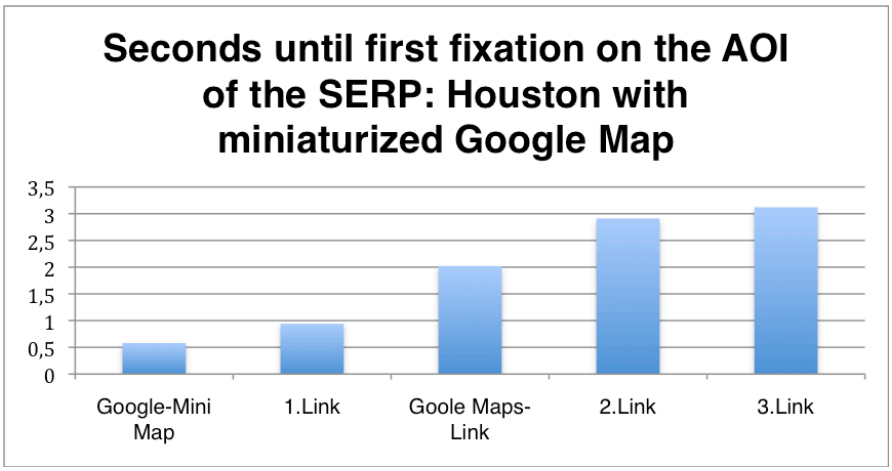
If the assumption is correct that the elements in the upper half of the SERPs have a special significance, this should show up in the parameter that indicates the time interval from the beginning of the presentation of the SERP until the first fixation on the defined AOI. The shorter this time interval is, the quicker the visual attention of the user is won. For methodical reasons the processing of the data does not start at zero but at 300 milliseconds. This is necessary because the eyes are directed towards the screen before the showing of the SERP. If this parameter was determined right from the moment of showing, there would be a risk that the data would be subjected to a

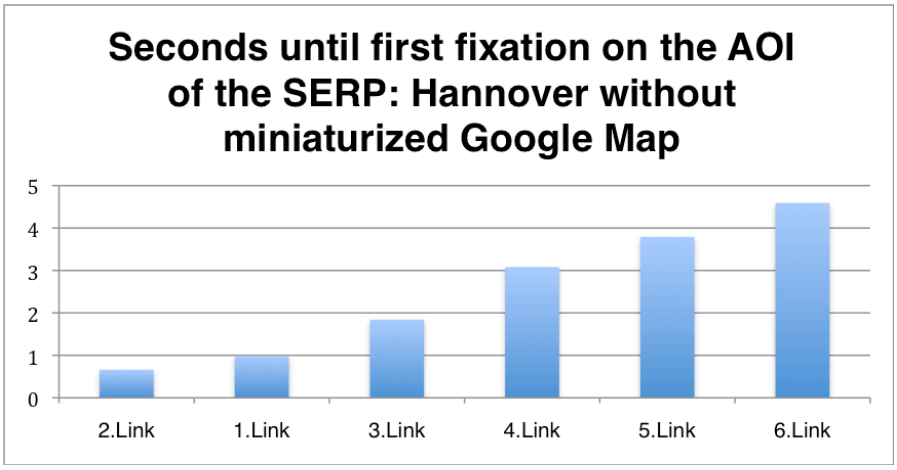
transmission effect. The 300 milliseconds consider this condition and allow enough time for orientation. Additionally a pre-test was used to determine a value that limits the interval upwards. A random sample of ten additional subjects recruited for this pre-test did not need more than three seconds until the click. If it is interesting how soon the subjects of the pilot study devoted their interest to the various AOI on the four SERPs, the onset of the measurement relates to the moment 0.3 sec after showing the respective SERP.

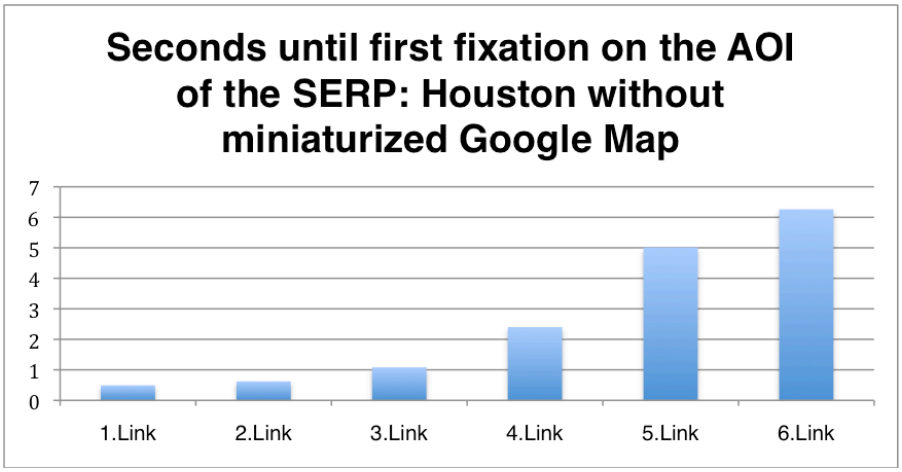
All initial fixations later than 3.3 sec after showing have to be regarded as critical in respect of the potential processing because, on average, after this point in time a decision already had been made.

In the following the average values for the **time elapsed until the first fixation** (in seconds) on the AOI of the four SERPs is listed.


Seconds until first fixation on the AOI of the SERP: Hannover with miniaturized Google Map
7
6
5
4
3
2
1
0
Google-Mini Map
1.Link
2.Link
Google Maps-Link
3.Link

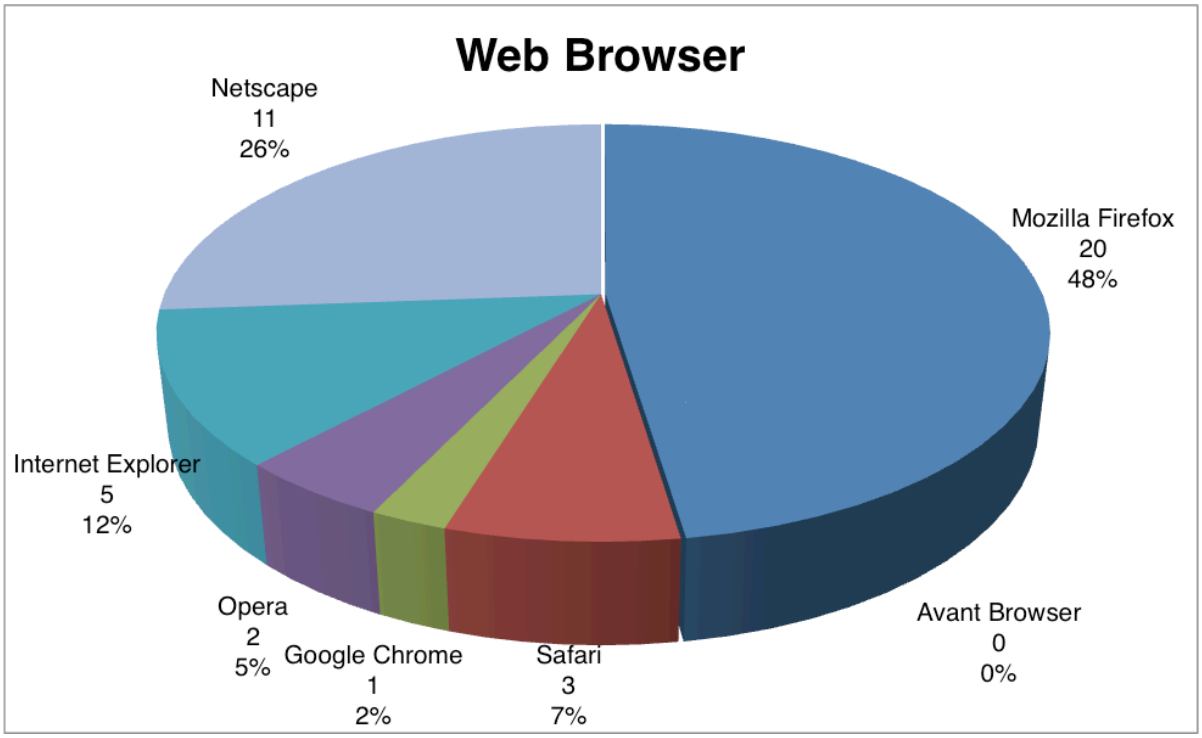

Seconds until first fixation on the AOI of the SERP: Houston with miniaturized Google Map
3,5
3
2,5
2
1,5
1
0,5
0
Google-Mini Map
1.Link
Goole Maps-Link
2.Link
3.Link


Seconds until first fixation on the AOI of the SERP: Hannover without miniaturized Google Map
5
4
3
2
1
0
2.Link
1.Link
3.Link
4.Link
5.Link
6.Link


Seconds until first fixation on the AOI of the SERP: Houston without miniaturized Google Map
7
6
5
4
3
2
1
0
1.Link
2.Link
3.Link
4.Link
5.Link
6.Link

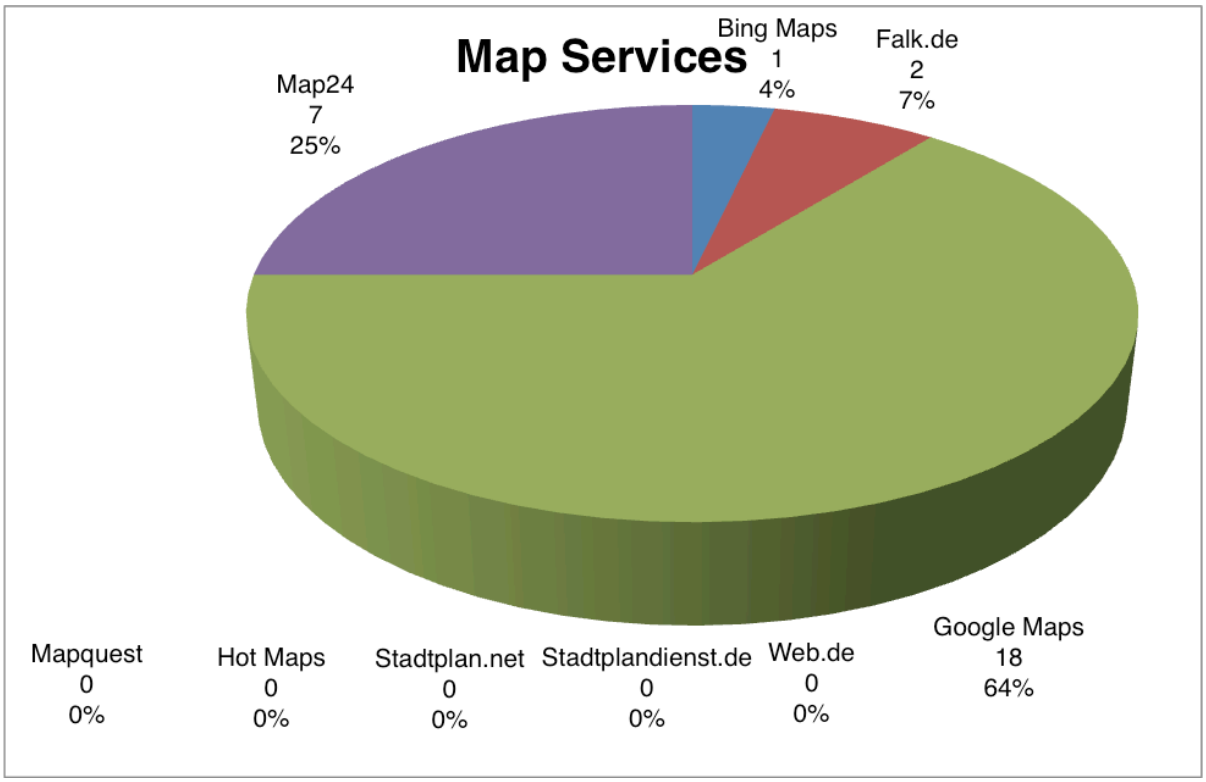
The distribution of the fist fixation on the AOI of the four SERPs clarifies that pictures strongly attract visual attention. The upper design elements, like the miniaturized Google maps, the first four search result links and in part the Google maps links attract a strong spontaneous attention.

After the eye tracking test the 20 subjects stated their preferred web browser.



Search engine and map service indicated in a list of choices. The preferences within this sampling are clearly visible. It is noteworthy that a kind of market dominance by Google could not be shown for web browsers. This can be explained by the fact that the subjects had to actively remember (recognition) during the questioning, and that this memory could be

distorted as opposed to the actual usage. On the other hand, this company has a strong position among search engines and especially among map services.



5. Action Recommendations

In conclusion, some recommendations for actions can be pronounced:

1. **Improve position on search engine results pages (SERPs):** The map service by Hot Maps will be more noticed and chosen by users the higher up it is presented on a SERP. Because 77.7 to 80 percent of the clicks, depending on the search query, occurred on the space of miniaturized Google maps and Google map links, the amount of clicks resulting from the following lower placements is very small.
2. **Avoid investing in Google advertisements:** The behavior of the subjects toward Google advertisements

was clear without ambiguity. The subjects did not notice this offering at all and it therefore has to be judged as not effective.

3. **Increase brand awareness.** Hot Maps was not in the relevant set for the subjects. Therefore, measures to counteract this condition are recommended.

4. **Accompanying visual information is to be used cautiously:** On search result pages, the visual attention of potential customers can be effectively enhanced by accompanying visual information. But this goes to the detriment of efficiency and subsequently also of user satisfaction. This kind of own product promotion is currently Google's UAP (Unique Advertising Proposition).

5. **Clarification of the factor of geographic knowledge presentation.** Indications were found in this pilot study that viewing and clicking behavior can be related to geographic cognition. This circumstance is to be taken into account in additional studies in order to examine it for systematics. Should the finding be verified, the presentation of the service should be adjusted to these expectations of the users.

6. Updates

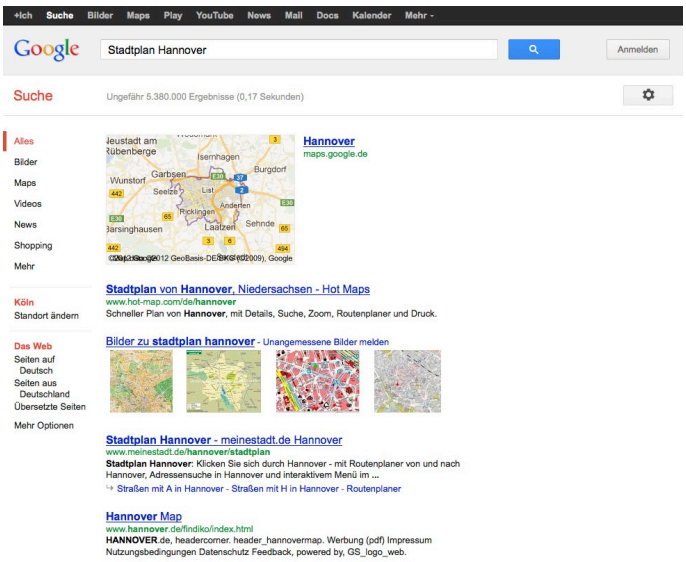
Since the submission of this final report to Hot Maps Medien GmbH, the subject of this pilot study has raised a lot of interest, both among practitioners as well as within the fundamental research community (cf. Möller & Schierl, 2012 in the Journal of Eye Tracking, Visual Cognition and Emotion, 2, p.1-10). Furthermore, the measures taken by Google itself show that the influence exerted upon the decision making behavior of individuals who use the services of a search engine is still of great relevance.

As Google has made significant modifications to the presentation of their SERPs, the question about the effects of the presentation modes of the concerned SERPs on the user has definitely not become obsolete, and we have decided to expand the original report by this chapter, after consultation with Hot Maps Medien GmbH. This

shall take into account the latest changes and explain the reasons for expanding the original investigation.

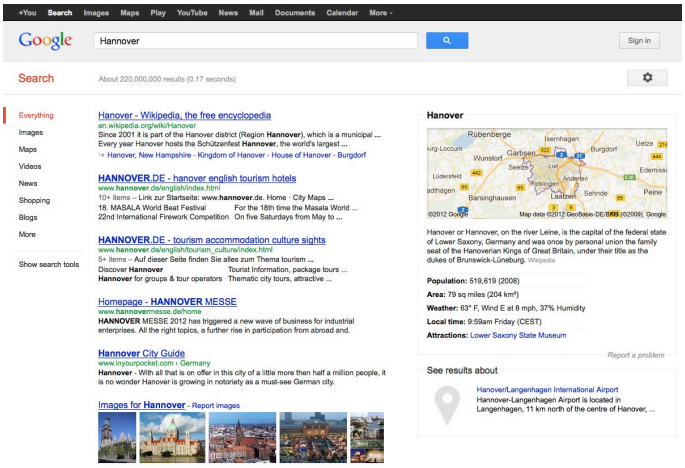
First, it can be determined that Google, for requests from IPs in Germany, kept the obviously proven principle of placing a "visual anchor" at the beginning a SERP in form of a corresponding miniaturized Google Map. Therefore, it may be assumed that the effects described in the final report, are continuing to be caused in the same way by the current SERPs.

As the following screenshot shows, a new feature – for our tested queries – is that Google has implemented its own image search ("Google Images") within the top search result links in the German version of Google.

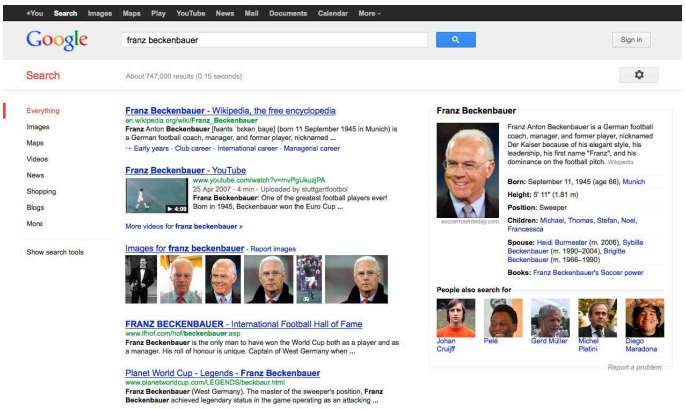


This enhancement of the visual information will bind the attention of the user even more to Google's own products and services and thus distract in same manner from search result links to potential competitors.

The latest development undertaken by Google, in regards of control of visual attention and user behavior, so far appears only on the English presence Google.com. In the following screenshot it can be seen that in addition to the miniaturized map and the "Google Images" the Google SERPs are enhanced with additional information, the so-called "Google Knowledge Graph", including a miniaturized map in this example, which strongly sucks up visual attention.



In searches for well known personalities for instance, it appears that this new product from Google seemingly answers the users further questions before they are asked.



The combined representation of various information by, and of course, from Google clearly shows in its visually prominent way that Google hereby intends to exert a significant influence on the perception and with it the behavior of users. The screenshots also suggest the conclusion that this channeling of visual attention will bind Google users even more closely to Google products. One must

conclude that other websites will have more difficulty in the future to attract the attention of users to their links on Google SERPs. "Google Knowledge Graph" therefore will have great impact on competition. According to our latest information, the product "Google Knowledge Graph" will also be implemented in Germany in the near future.

Overall, this suggests that the changes in the presentation of information on the SERPs from Google give reason to believe that the effects already demonstrated in the pilot study will be further aggravated by these modifications, and will have a lasting impact on the behavior of users. For this reason, we strongly recommend to investigate this assumption by a suitable empirical investigation along the lines of the pilot study.

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