radware

PROGRESSIVE IMAGE RENDERING:

GOOD OR EVIL?

Fall 2014

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Executive Summary

There have been countless studies demonstrating the relationship between faster web pages and improvement to a vast array of business metrics – including page views, bounce rate, user retention, customer satisfaction, conversion rate, and revenue. These effects are felt at companies of all sizes – from multinational internet giant Yahoo!, which found that making pages just 400 milliseconds faster resulted in a 9% traffic increase[i], to online auto parts retailer AutoAnything, which cut its page load times in half and experienced a 13% increase in sales.[ii]

For most websites, images represent a huge untapped area of opportunity for optimizing performance. Images comprise more than half of a typical page's weight: among the top 1,000 websites, images comprise 58% of the average page's total weight.[iii] This makes images fertile ground for serving a better, faster user experience.

Which Image Format Delivers the Best User Experience?

Optimizing images so that they render more quickly in the user's browser should be a priority for every site owner. There are a number of image optimization techniques – ranging from basic to advanced – that site owners can leverage, but selecting the best image rendering format is the first step on the path toward fully optimized images.

There is a great deal of unresolved debate about which image rendering format yields the best user experience. This is not surprising when one considers the myriad of rendering formats available to site owners, including:

- Baseline images (which load line by line, or in "chunks")
- Progressive images (which load in layers that gradually increase in resolution)
- Other techniques, such as PerfectImage, a proprietary format developed at Radware

Much of the debate over image rendering can be reduced to baseline versus progressive images. This has been a contentious issue among designers and developers since the early days of the public internet. The progressive faction believes that this format improves perceived performance by showing the user something while they look at the screen. Proponents of baseline images, however, believe that watching an image load progressively increases user frustration. The latter belief could explain why only 5-7% of web pages currently use progressive JPEGs.[iv]

Adding Neuroscientific Insight to the Debate

Throughout the web development community, strong opinions abound about image rendering, but until now there has been little to no data-driven evidence that proves whether progressive image rendering helps or hurts the user experience. This is due in part to the fact that, until recently, we have not been able to measure the impact of these different approaches on user response patterns in any meaningful way.

Fortunately, the very latest tools now allow us to measure emotional/non-conscious response objectively, and with almost forensic granularity. In this study, we set out to uncover how to optimize image performance through measuring emotional response to different image-rendering formats online in different scenarios.

Study Design Overview

This study used a range of proven state-of-the-art neuro-research tools in order to better understand the emotional and non-conscious response to three different image rendering approaches. This allows us to identify which image-rendering technique delivers the most effective overall consumer response, and ultimately enables us to optimize website design and performance.

We deployed a combination of neuroscience methodologies to measure user response at a deep non-conscious level. This approach is the only way to effectively evaluate emotions objectively, sensitively, and with meaningful granularity. Test results were collated from a powerful and revealing combination of methodologies:

- **Facial Action Coding** – Measures moment-by-moment emotional responses in facial expressions.
- **Implicit Response Test** – Extracts relative measures of frustration and emotional engagement.

Using these methodologies, we tested three different image rendering methods, measuring the relative ability of each to generate speed and intensity of emotional response. Test participants were served sets of pages for five workflows[1], and were asked to complete tasks that relied on either textual or visual cues. Each set of pages rendered images differently:

- **Original** – Standard lossless image.
- **Progressive JPEG** – Image is downloaded in lower resolution, displayed in the browser, then "progressively" downloaded and re-displayed until the full resolution is shown.
- **PerfectImage** – Lossy image that is carefully degraded using a DCIM (Digital Camera Images) human vision algorithm. This technique results in a 5% loss in image quality with a much smaller filesize.

Our hypotheses were threefold:

1. When the information the subject is focused on is contained within the textual content of the page, then progressive image rendering techniques are preferred.
2. When the information the subject is focused on is contained within the image content, then progressive rendering techniques are NOT preferred.
3. When a "hand tailored" image is built to suit the context of the content being displayed and created, with the smallest possible size given the context, it is preferred over all other formats.

Key Findings

Our key findings are summarized below, with detailed discussion on the following pages.

Results Summary

- Among the three image rendering formats, PerfectImage was the clear overall leader in both the Facial Action Coding test and the Implicit Response test.
- In the Facial Coding test, PerfectImage was stronger amongst women than men.
- Overall Emotion [Happiness] reactions were stronger for women than men.
- As well as having the highest average Emotion [Happiness] measures, PerfectImage also tended to have the highest peaks of intense Emotion [Happiness] when looking at the data second-by-second.
- In the Implicit Response test, PerfectImage was the superior rendering format among men on visual tasks, but for women all formats were about equal for visual tasks.
- On the text tasks, PerfectImage was superior for women, while original and PerfectImage were about equal for men on text tasks.
- Progressive JPEG format was particularly negative for men.

[1]The test sites were Gap.com, Moonpig.com, Youtube.com, Vodafone.com, and Amazon.com. It should be noted that we did not test on the actual websites. We created our test pages for each site based on these sites, replacing the original images with images in each of the formats being tested.

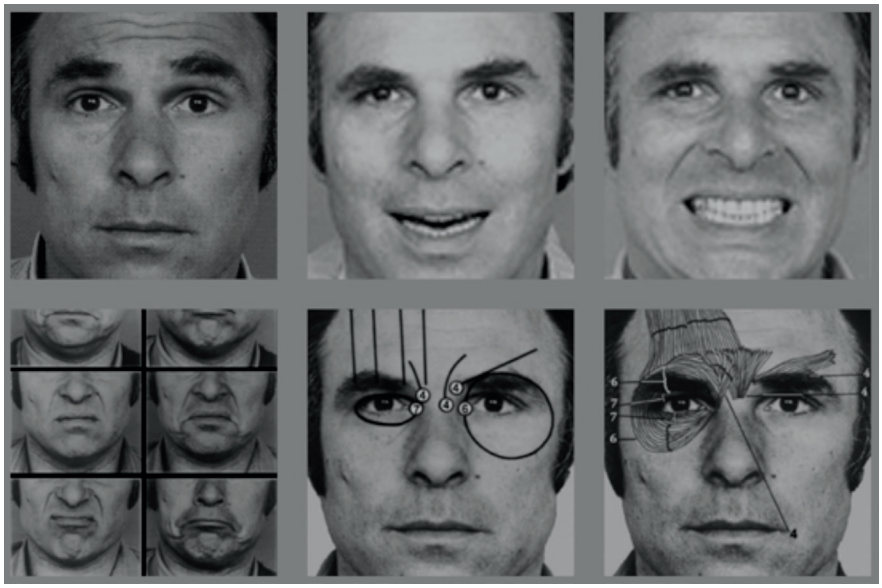
TECHNIQUE	ORIGINAL	PERFECTIMAGE	PROGRESSIVE JPEG
Overall Positive Associations			
Overall Emotional Engagement			
Positive for Men			
Positive for Woman			
Overall Text Task			
Overall Visual Task			
Male Text Task			
Female Text Task			
Male Visual Task			
Female Visual Task			

Test 1: Facial Action Coding

Building on the work of psychologists, biologists, and anthropologists over decades, six universal facial emotions can now be detected and measured: disgust, anger, fear, sadness, surprise, and happiness.

In this blind study, we focused on one emotion – happiness – and carefully selected positive visual stimulation intended to evoke it. Respondents sat in front of a webcam-enabled computer within their homes and viewed videos of standard user paths through three different websites. Throughout each video, facial analysis software mapped the changing contours and muscular positions of their faces in real time.

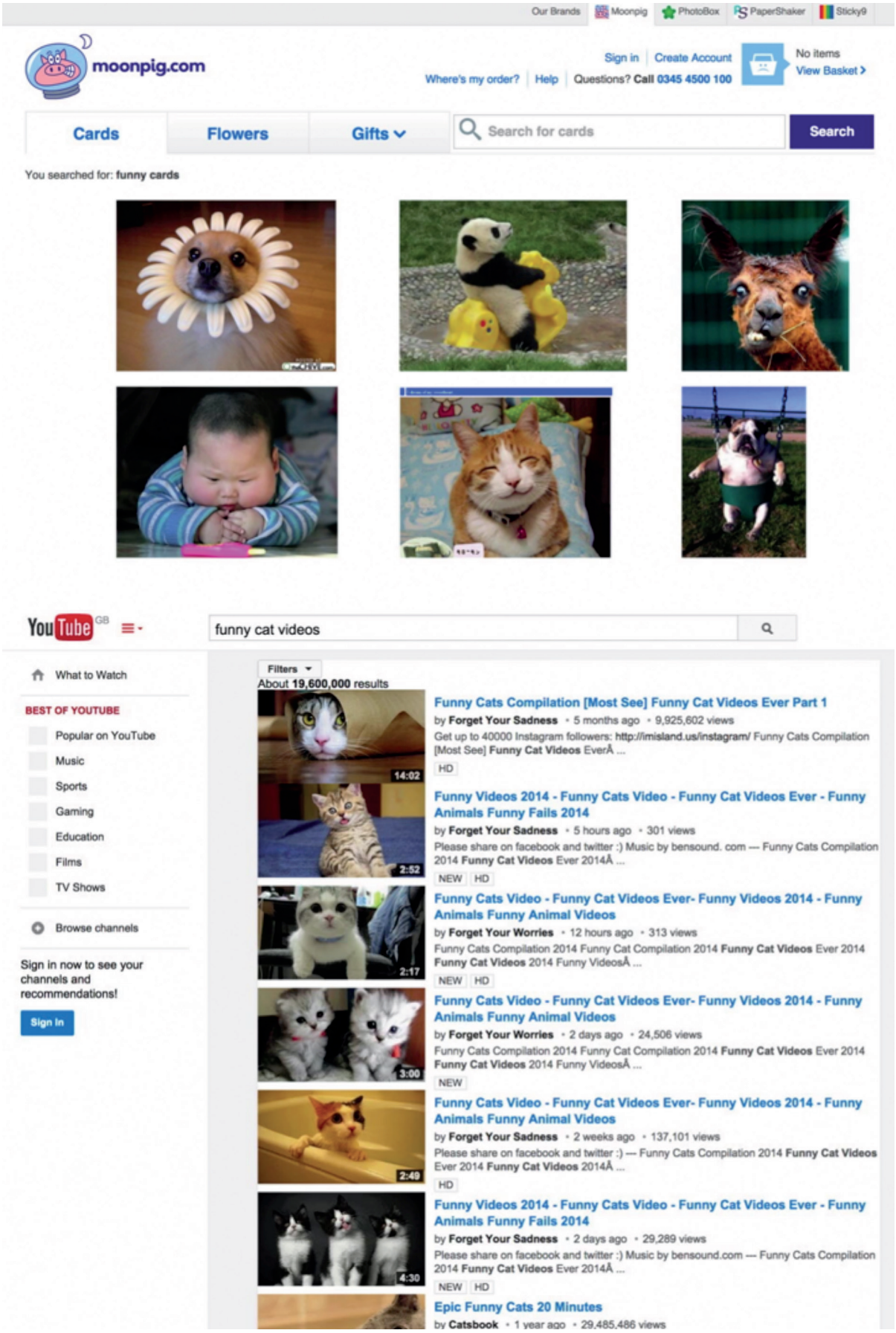
We also used a heart-rate metric to indicate shifts in engagement levels. To do this, we used a pioneering new webcam technique that tracks subtle changes in facial skin color, undetectable to the naked eye.



Study Design

- 280 Respondents (50% male, 50% female) recruited online in UK
- 9 videos tested: 3 websites (Gap.com, Moonpig.com, Youtube.com)[2] X 3 image-loading methods
- Each respondent saw a randomly ordered batch of the three pages, each using the same image-rendering method.
- Pages were constructed to appear real/natural, but also to evoke the Happiness expression.
- All Facial Coding results = % of people exhibiting Happiness expression (% figures may appear low overall, but this is normal for the method). 2%-3% = threshold of statistical significance.
- Heart-rate results = the changes in rate (line moving up = HR changing, moving down = returning to norm, straight-line = unchanging HR)

[2] As discussed earlier in this paper, it should be noted that we did not test on the actual websites. Test sites were comprised of mockups based on these three sites, in which images were replaced with images in each of the formats being tested.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PhotoBox
PaperShaker
Sticky9
moonpig.com
Sign in
Create Account
No items
View Basket
Where's my order?
Help
Questions? Call 0345 4500 100
Cards
Flowers
Gifts
Search for cards
Search
You searched for: funny cards
YouTube GB
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What to Watch
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Gaming
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Films
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Sign in now to see your channels and recommendations!
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About 19,600,000 results
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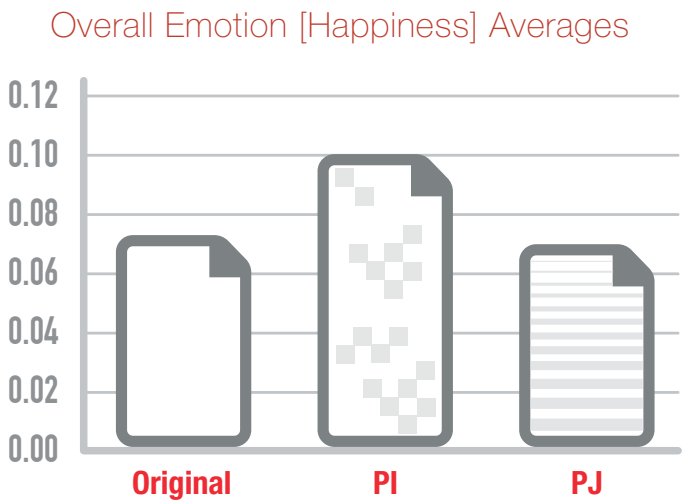
Results Summary

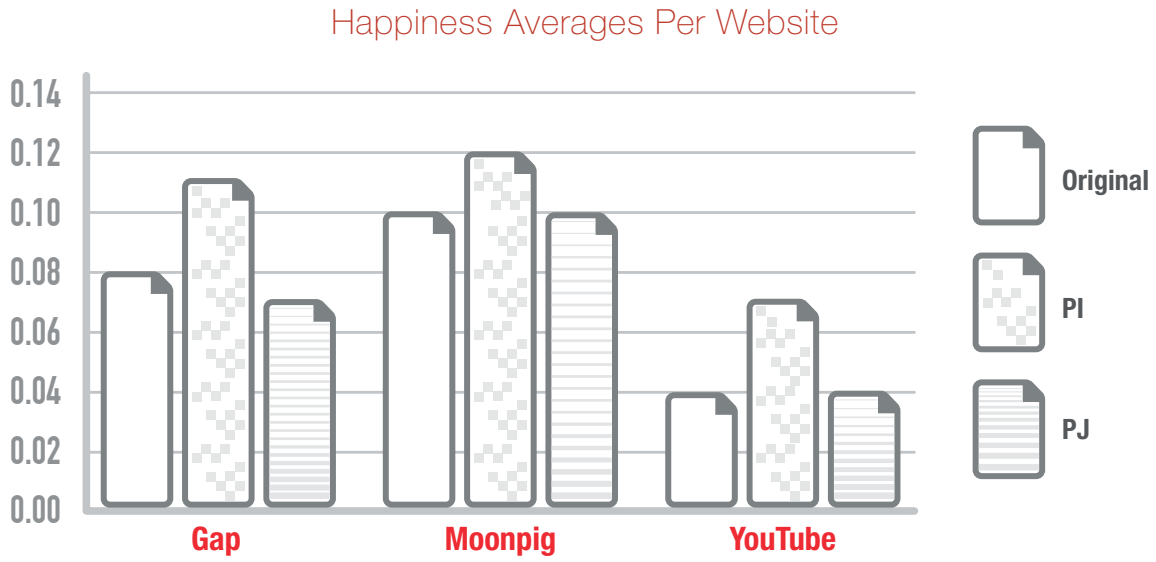
- Overall, the highest levels of Emotion [Happiness] were evoked under the PerfectImage rendering condition.
- PefectImage was strongest for both genders and across all three websites.
- PerfectImage was stronger amongst women than men.
- Overall Emotion [Happiness] reactions were stronger for women than men.
- As well as having the highest average Emotion [Happiness] measures, PI also tended to be the most likely to have the highest peaks of intense Emotion [Happiness] when looking at the data second-by-second.

Detailed Results

Overall, the higher average level of Emotion [Happiness] was in the PerfectImage loading condition.



The PerfectImage (PI) rendering format evoked the highest average levels of Happiness across all three sites. The Original format was the next strongest on Gap, with Progressive JPEG (PJ) the weakest, while Original and PJ were equal with Moonpig and YouTube.

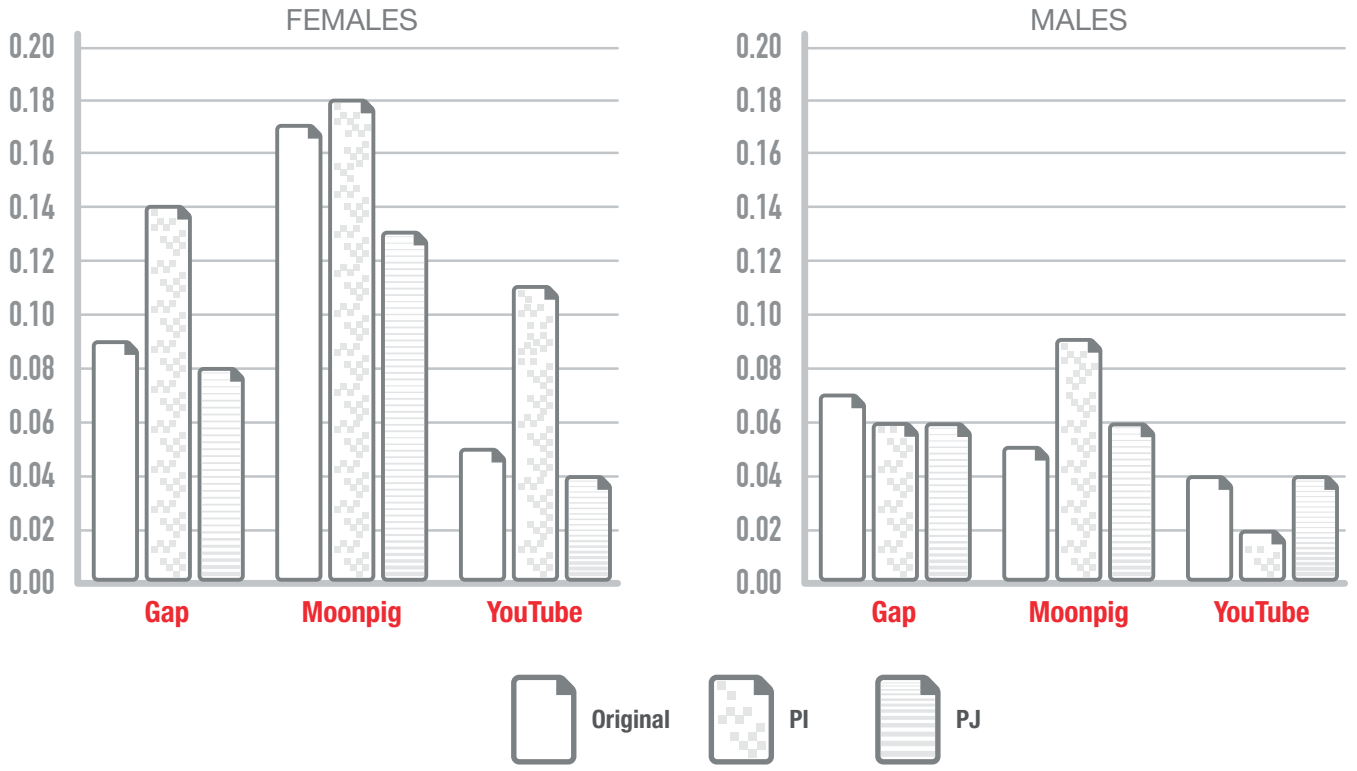


PerfectImage created the highest average Happiness levels for both women and men. Original was stronger than PJ for women, but for men Original and PJ were about equal. Overall, there was a far larger measurable Happiness effect for women than for men.

Overall Happiness Averages By Gender

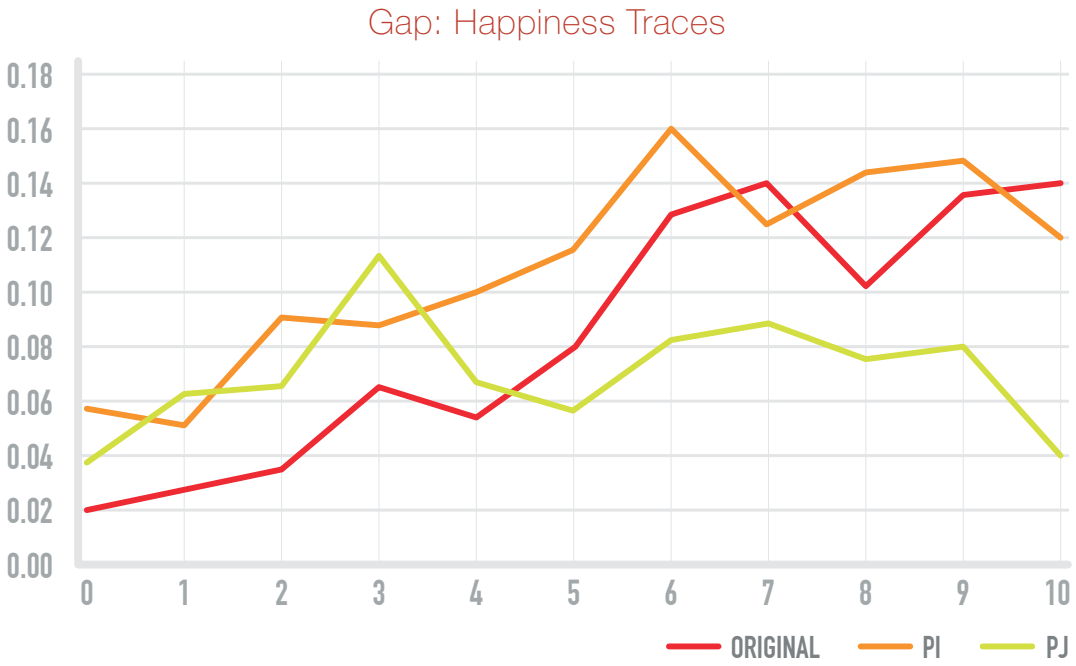
When looking at women's and men's responses to the different websites, a more complex picture emerges. While PerfectImage (PI) was consistently the best at evoking Happiness for women, on two of the websites it was weaker for men than Original (Gap) and Original & Progressive JPEG (YouTube). However, the differences are quite small.

Happiness Averages Per Website By Gender

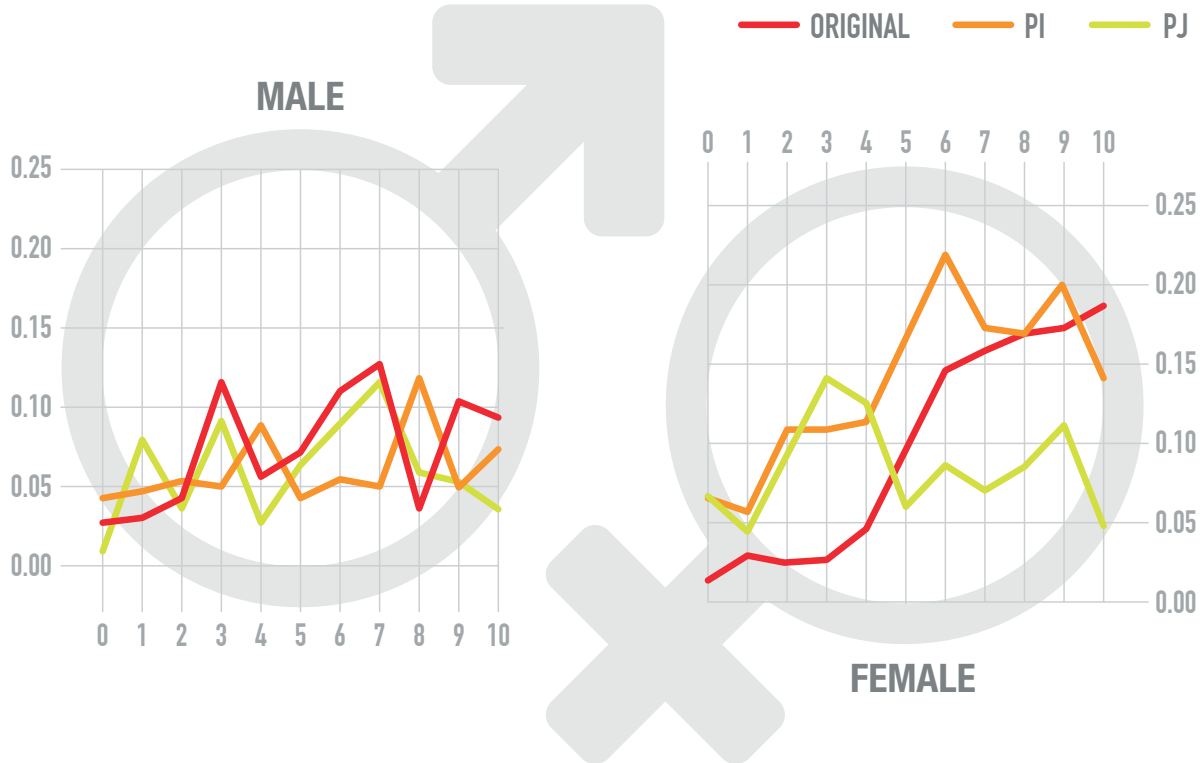


Detailed Results: The Gap

As well as having the highest overall average happiness score, PerfectImage (PI) also achieves the highest peak of happiness during the second-by-second traces. While Progressive JPEG (PJ) has a strong early peak, it drops off to a considerably lower level, and then plunges towards the end.

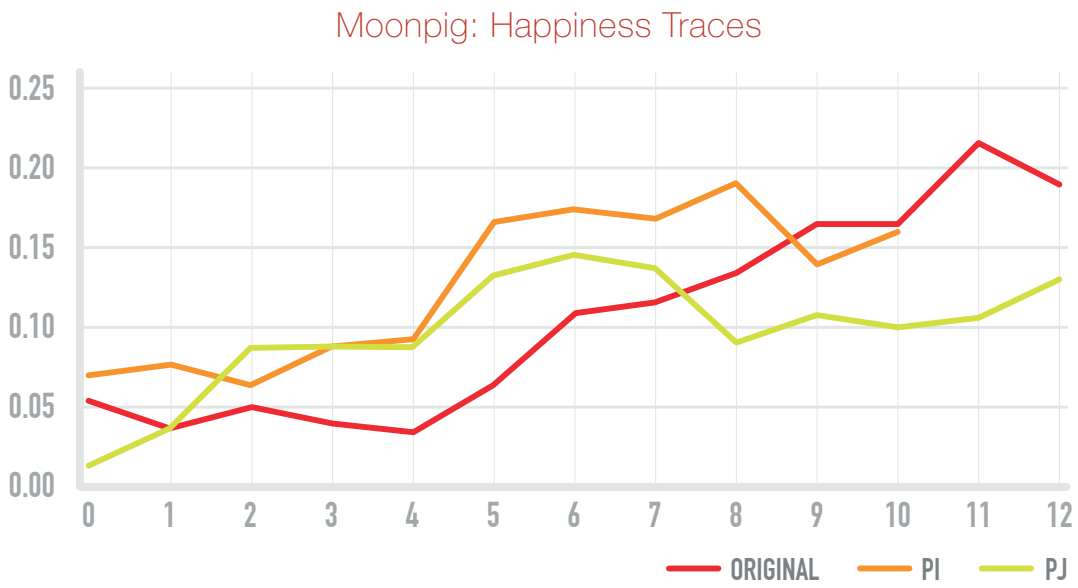


There is a clearer differentiation of response amongst the women to the three rendering formats than amongst the men. The overall traces and number/intensity of happiness peaks amongst the men were more comparable for the three rendering formats. However, PerfectImage had fewer/shallower troughs than the other methods, and ended on a higher point than Progressive JPEG amongst the men.

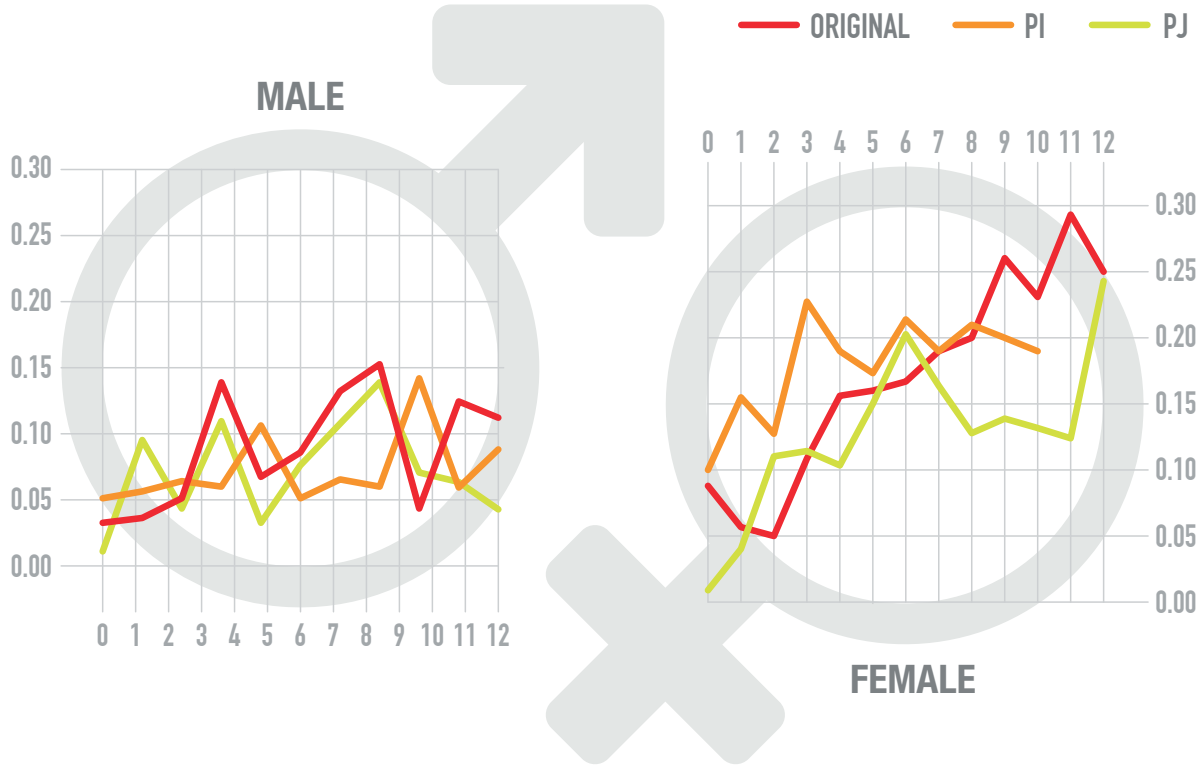


Detailed Results: Moonpig

The PerfectImage (PI) Moonpig video evoked high levels of happiness early on (4 seconds), whereas the other two methods took several more seconds to reach their highest levels. From 4 seconds onwards, the Progressive JPEG (PJ) trace stays consistently below PI, whilst Original only manages to go higher than PI after around 9 seconds.

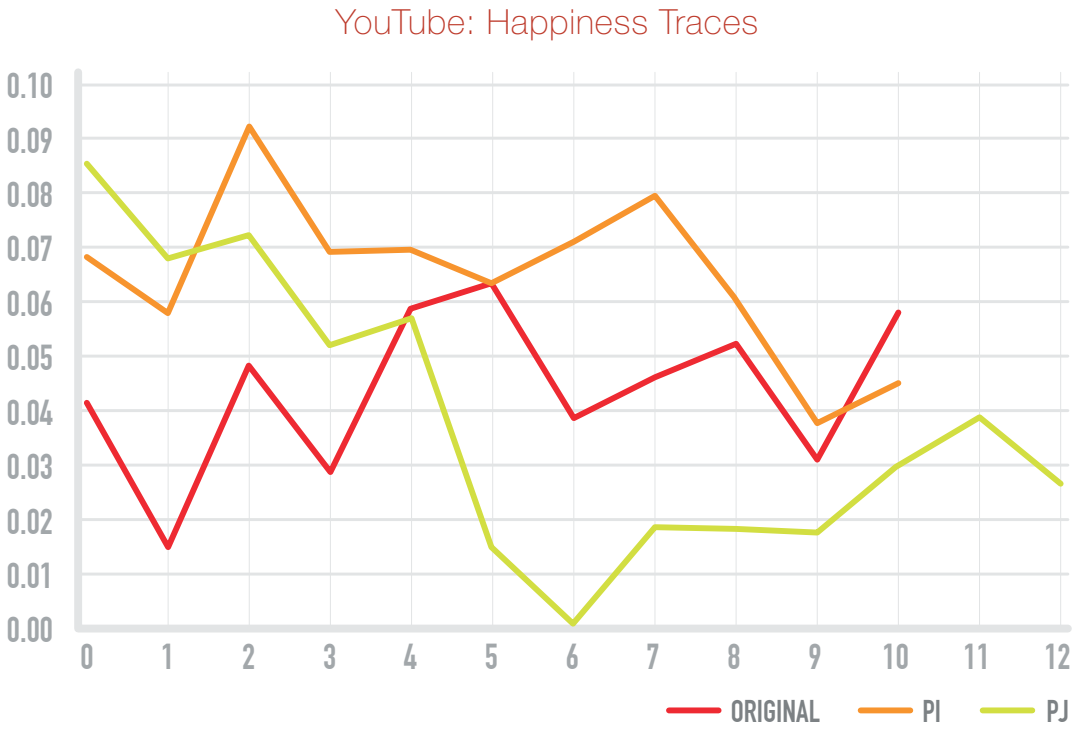


The PI video achieves an early lead for both men and women, but it particularly spikes (compared to the other videos) for men (between around 3 and 8 seconds). For women, there is more of a steady high plateau for PI.

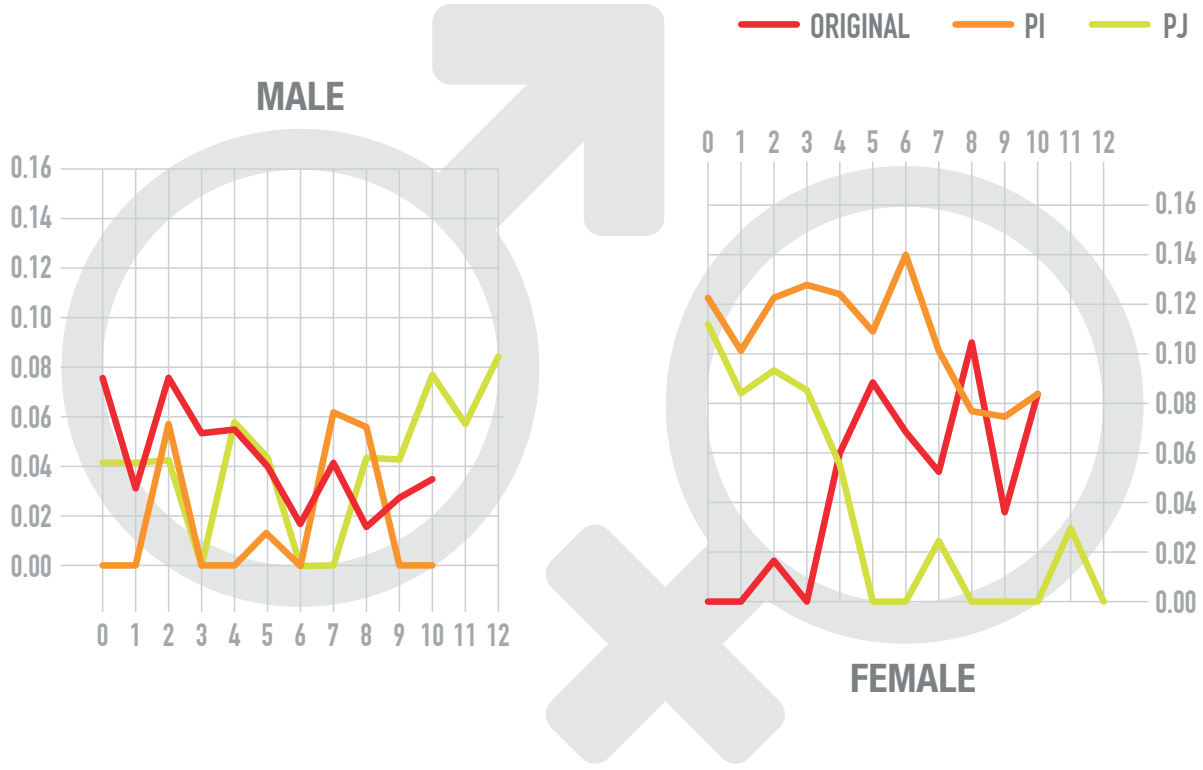


Detailed Results: YouTube

In contrast to the other websites, the YouTube page shows traces that start relatively high but then diminish over time. The highest peaks are evoked by the PerfectImage (PI) rendering method.

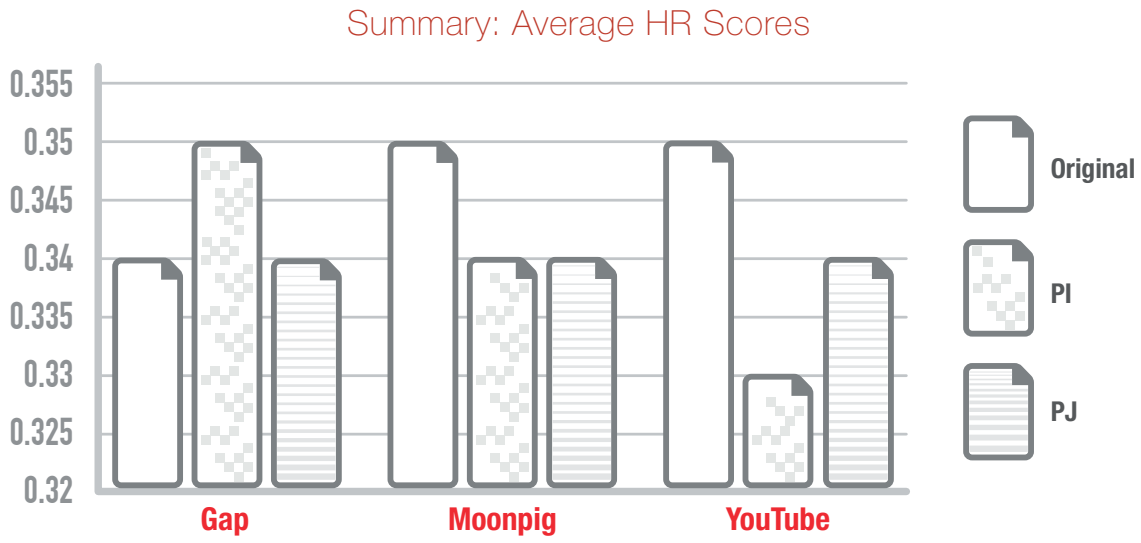


The traces by gender show overall lower Happiness levels for YouTube than for the other sites, as there are several moments for both women and men in which the responses hit 0.

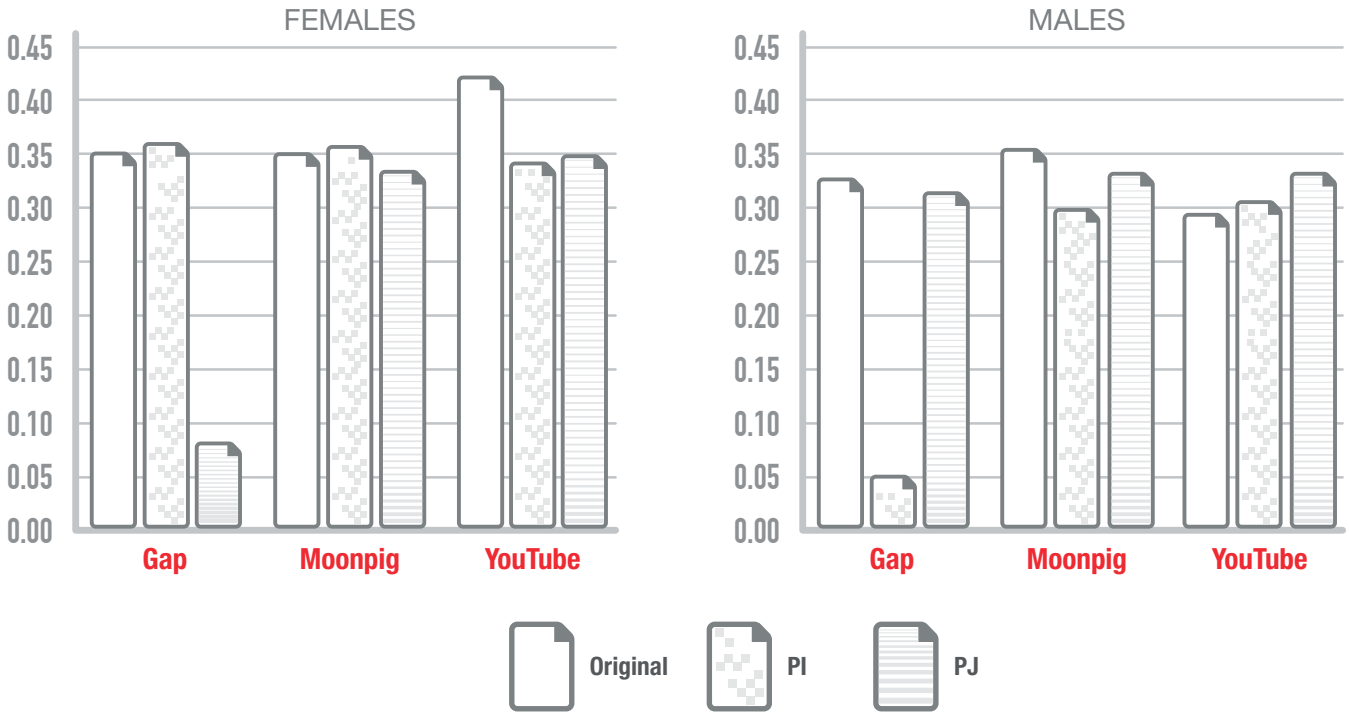


Heart Rate Averages

There was more heart rate variation for PerfectImage (PI) on Gap, and for Original on Moonpig and YouTube. Unlike the Happiness metric, there were no large overall differences between the sites, except for PI being substantially lower on YouTube than on the other sites.

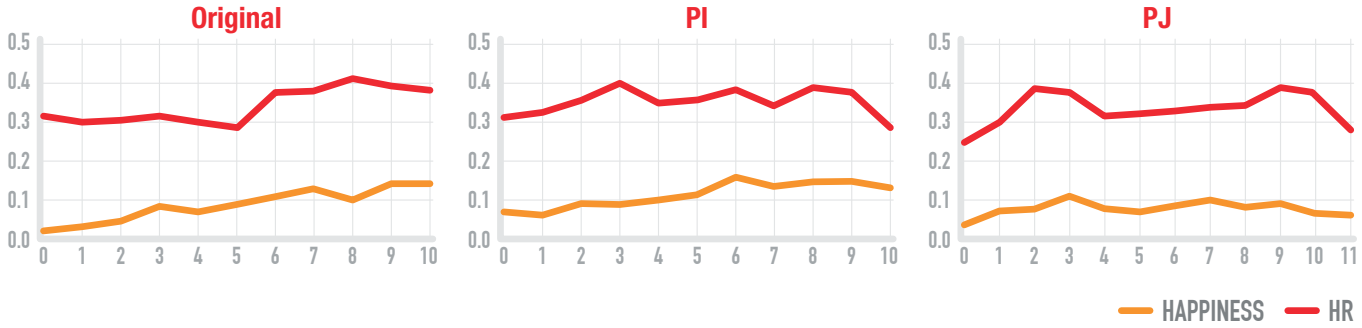


While women had higher levels of happiness than did men, the average HR variation scores are more comparable across the genders. For women, PI is just about the highest on two of the sites (Gap and Moonpig), while for men it is the lowest on Gap, yet more comparable to the other rendering methods on the other two sites.



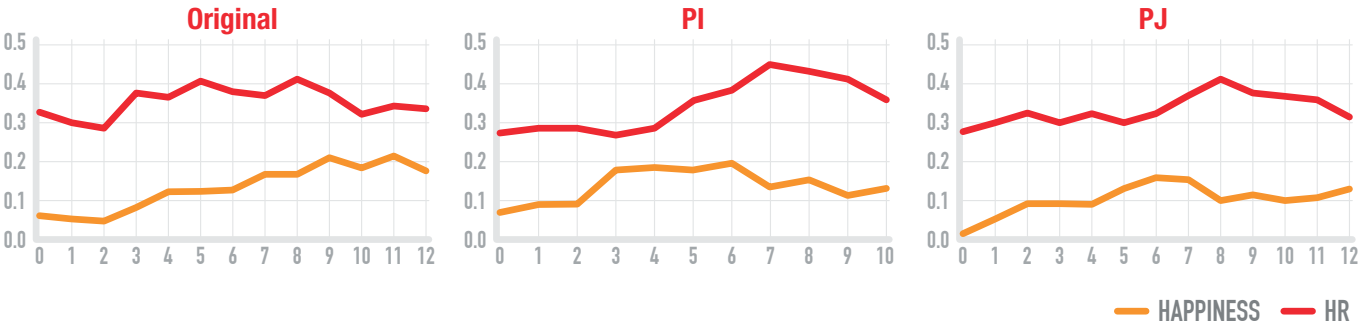
The Gap: Comparing Heart Rate Changes with Happiness Traces

Despite the differences in scale (and the fact that the heart rate metric is showing 'changes' not absolute values) a comparison of the heart rate and Happiness traces shows some broad similarities. This suggests that the HR changes metric could be considered a confirmatory signal that participants are emotionally engaged.



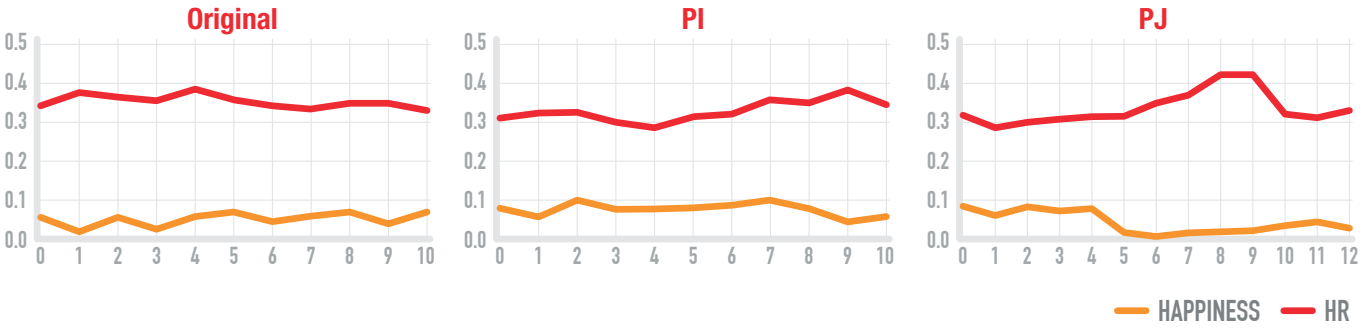
Moonpig: Comparing Heart Rate Changes with Happiness Traces

In the Original graph, there is a fairly level trace between 0-2 seconds for both lines, then a gradual moving up of both until both level off again. In the PerfectImage graph, there is again a fairly level trace for both lines until around 2 seconds. Then move begin to move up, although the Happiness line levels off sooner than the HR line. With the PJ graph there is a general upwards movement in both lines between 0 and 7 seconds.



YouTube: Comparing Heart Rate Changes with Happiness Traces

The Original graph shows a consistently flatter trace for both lines. On both PerfectImage and Progressive JPEG there is movement of both lines (between 7-10 on PI and 4-7 on PJ) but in opposing directions. However, while happiness is falling and the HR trace is rising, the HR could be falling in absolute value (the increasing line just shows divergence from the mean HR level).



Test 2: Implicit Response Test

This is a groundbreaking methodology, which deploys the neuropsychology behind Implicit Reaction Speed Testing, but with a moment-by-moment readout (every 2 seconds).

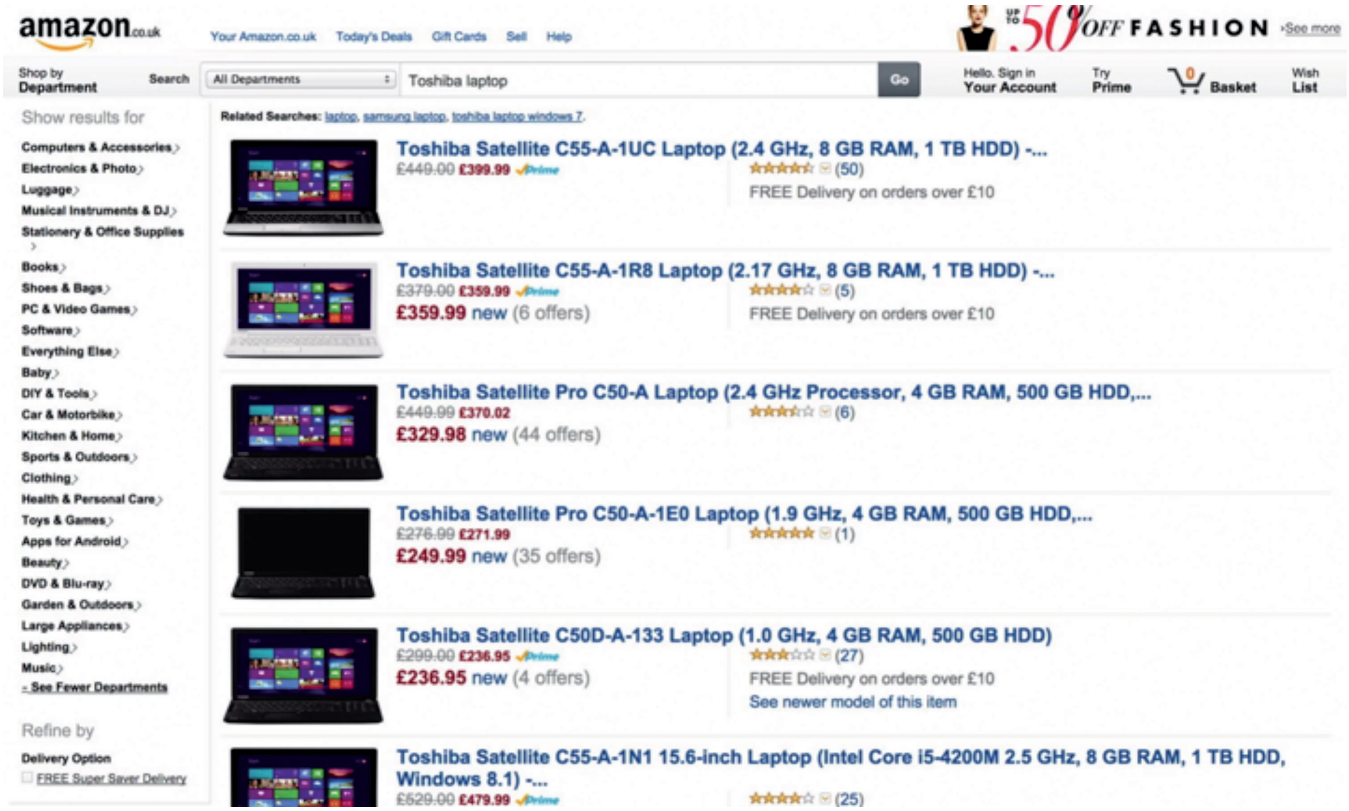
Respondents undertake an attribute priming test before being exposed to a recorded interaction on two different websites. Attributes represent different facets of negativity and positivity to provide a robust measure of how it tracks throughout the website interaction task.

The video task shows the transaction process (searching, browsing, comparison, and selection) of shopping for a smartphone on the Amazon and Vodafone websites.[3]

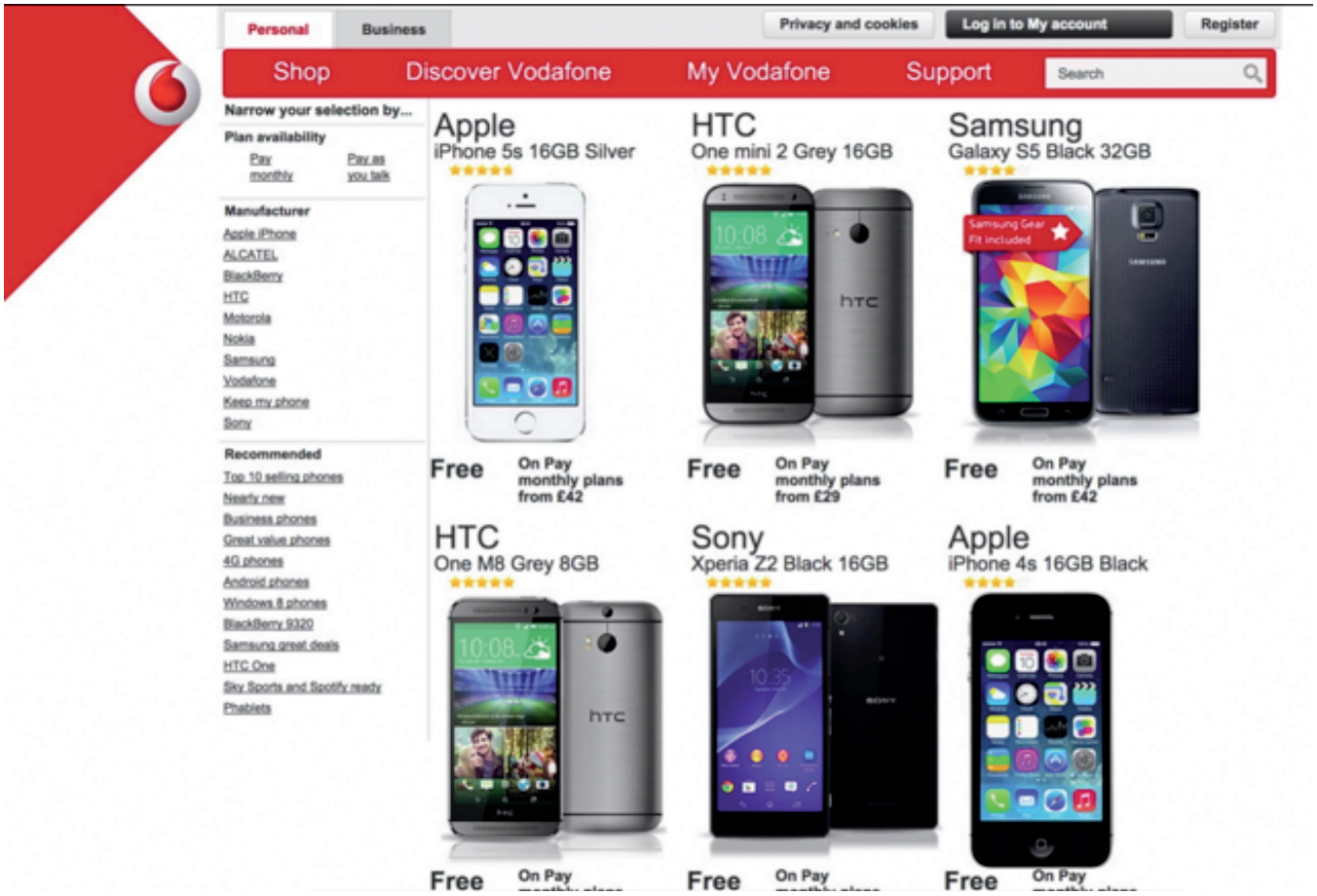
The results provide a measure of the % of respondents who felt positive or negative at every 2-second interval. This highlights how response levels are affected by slower page loads.

Study Design

- 462 respondents (262 female, 198 male) recruited online in the UK
- 2 different website videos X 3 different image rendering methods X 2 different task conditions (giving 12 different conditions in total)
- Each respondent experienced 2 videos (one for Amazon and one for Vodafone) with 1 image-loading method and 1 task type (a visual choice, or a text-based choice)
- In implicit testing, respondents can become faster at key pressing over time, so results are statistically filtered to adjust for this (by comparing results with a control brand, for which respondents didn't see a webpage)
- Result units represent a "connection index": the higher the index score, the greater the connection between the word attribute and the website experience



[3] As mentioned earlier in this paper, we did not test on the actual websites. Test sites were comprised of mockups based on these two sites, in which the original images were replaced with images in each of the formats being tested. Other aspects of page layout and design were also altered in order to ensure a comparable user experience across both sites.

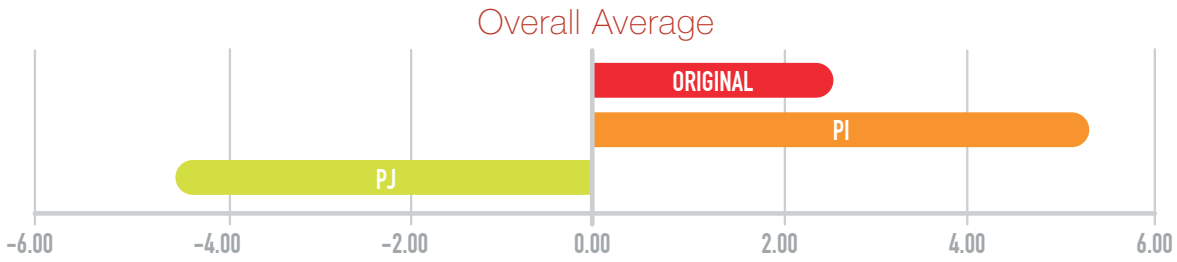


Results Summary

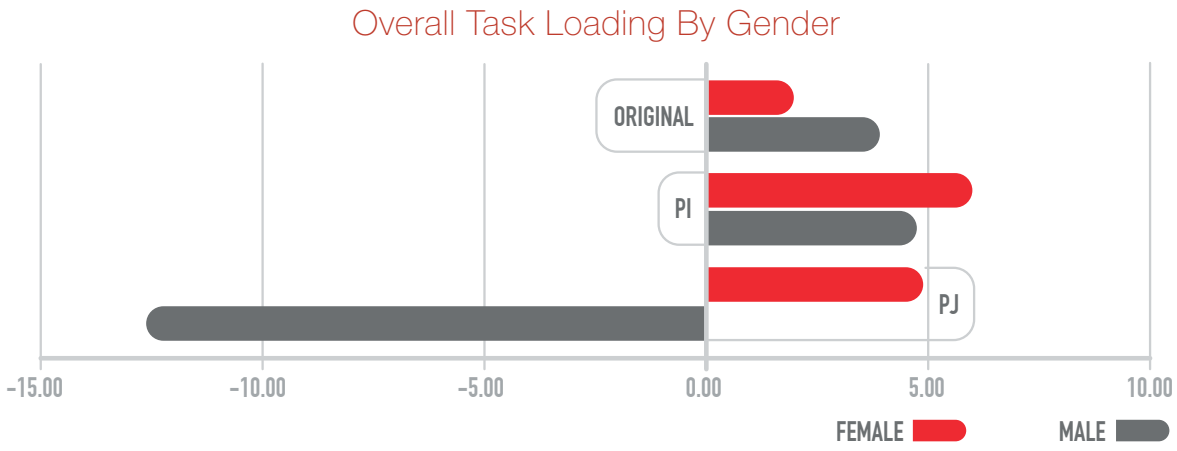
- Overall, there was a stronger positive association with the PerfectImage (PI) loading method than for Original or Progressive JPEG (PJ).
- PI was more positive than the other loading methods among both men and women. It was particularly stronger than PJ for men (which received especially negative scores).
- PI was more positive on the Vodafone than on the Amazon pages. In the Amazon visual task it was about as positive as Original, and on the text task it was less positive than Original.
- For the visual tasks, Original was nearly as good as PI, but for text tasks PI was the only method that evoked an overall positive association.
- PI was the superior loading method among men on the visual tasks, but on those tasks all methods are about equal with women. It was only on the text task that PI is superior for women, and original and PI were about equal for men.
- PI was strongest in the Vodafone visual task for both genders (with Vodafone text being about as strong for women).

+/- Associations with Each Rendering Method

Overall, there was a stronger positive association with the PerfectImage (PI) loading method than for Original or Progressive JPEG (PJ).

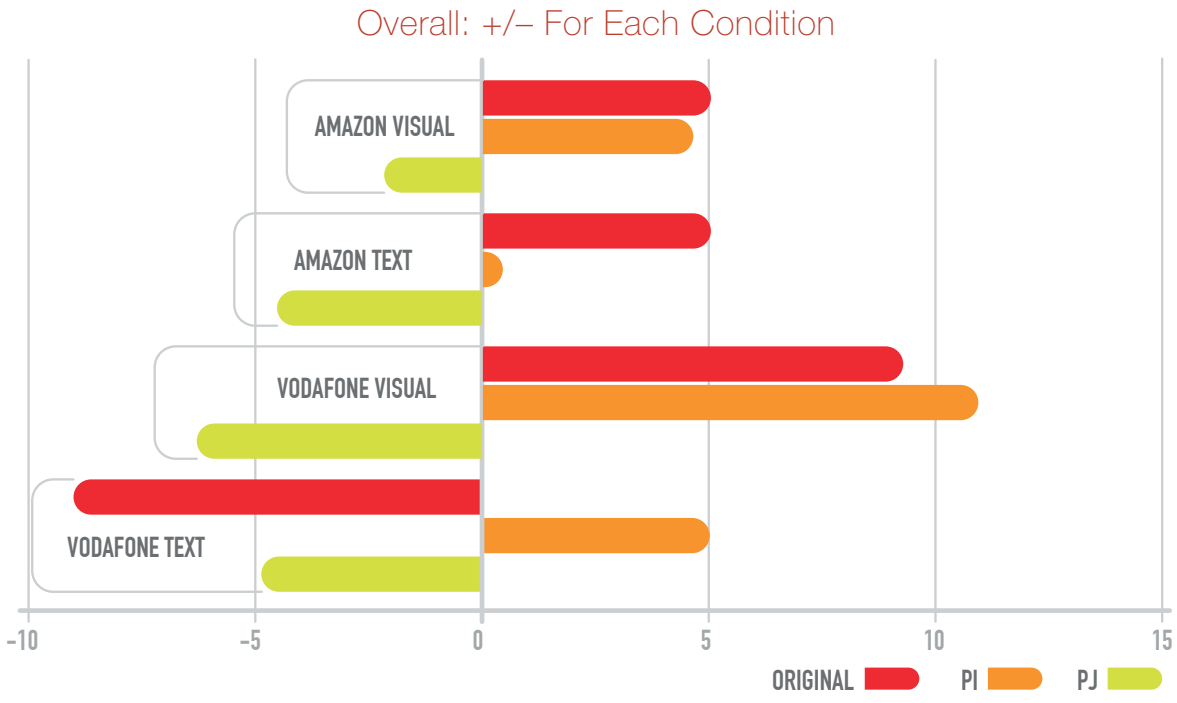


PI was more positive than the other loading methods among both men and women. It was particularly stronger than PJ for men.



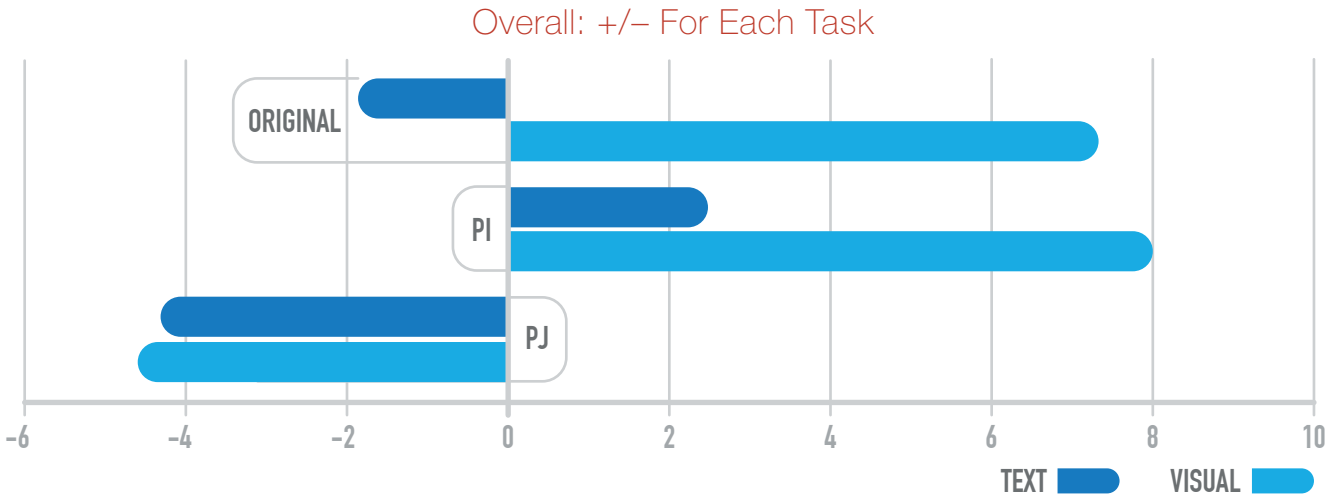
+/- Associations Triggered by Each Condition

PerfectImage was more positive on the Vodafone than Amazon pages. In the Amazon visual task, it was about as positive as Original, and on the text task it was less positive than Original.



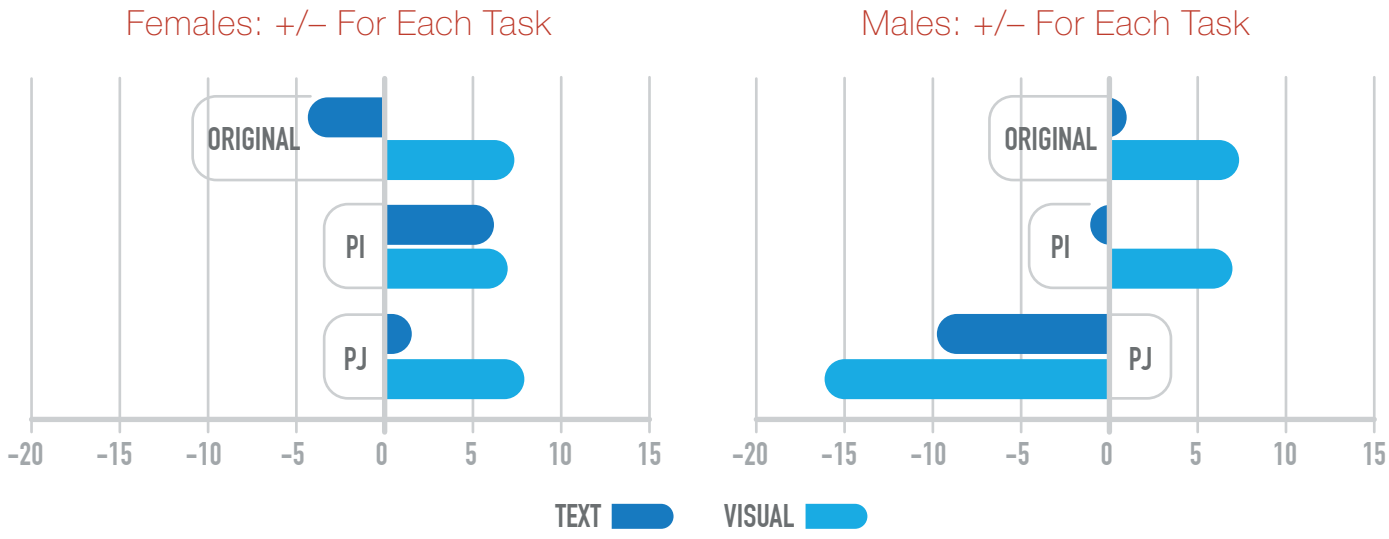
+/- Associations Triggered by Each Task

For the visual tasks, Original was nearly as good as PerfectImage (PI), but for text tasks PI is the only method that evoked an overall positive association.



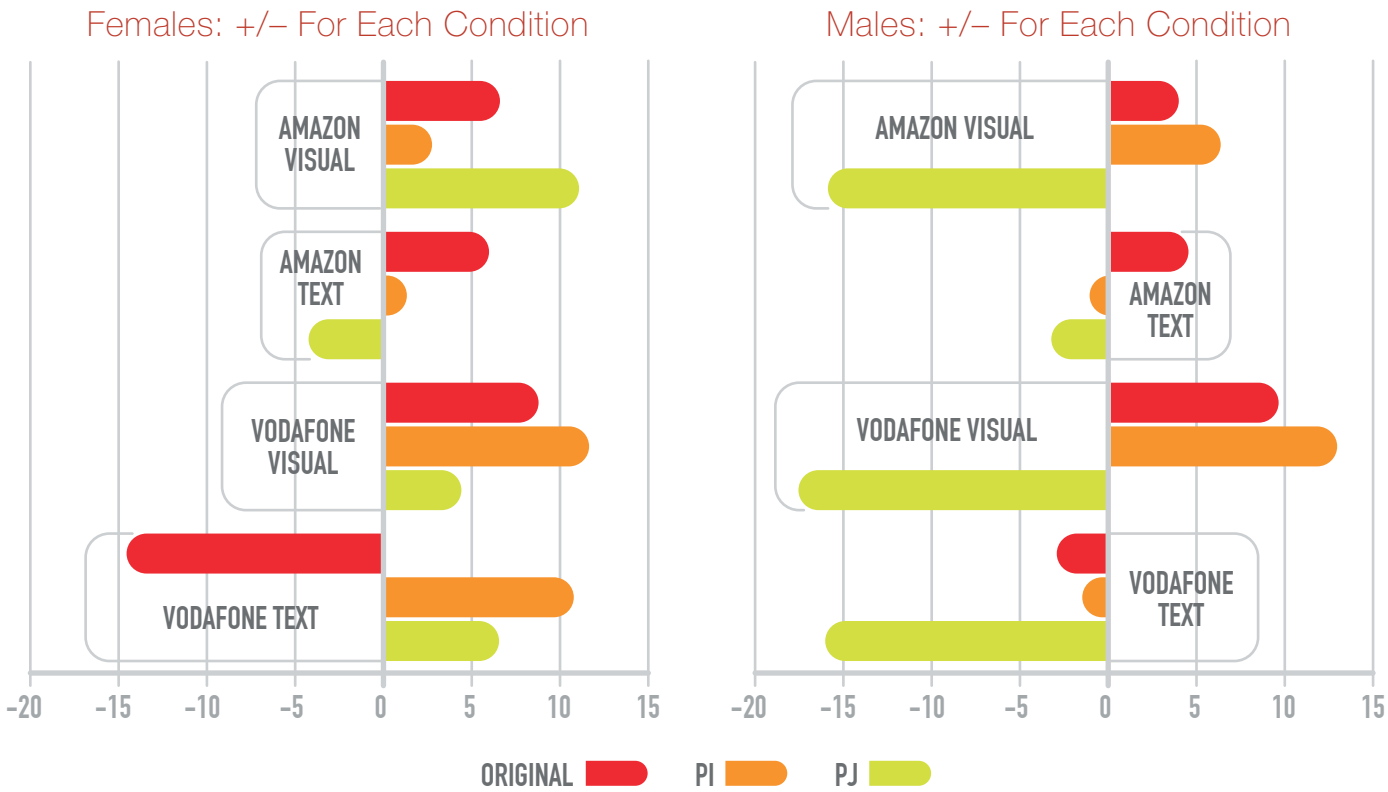
+/- Associations Per Task Per Gender

PerfectImage (PI) was the superior loading method among men on the visual tasks, but on those tasks all methods are about equal with women. It was only on the text task that PI was superior for women, and Original and PI are about equal for men.



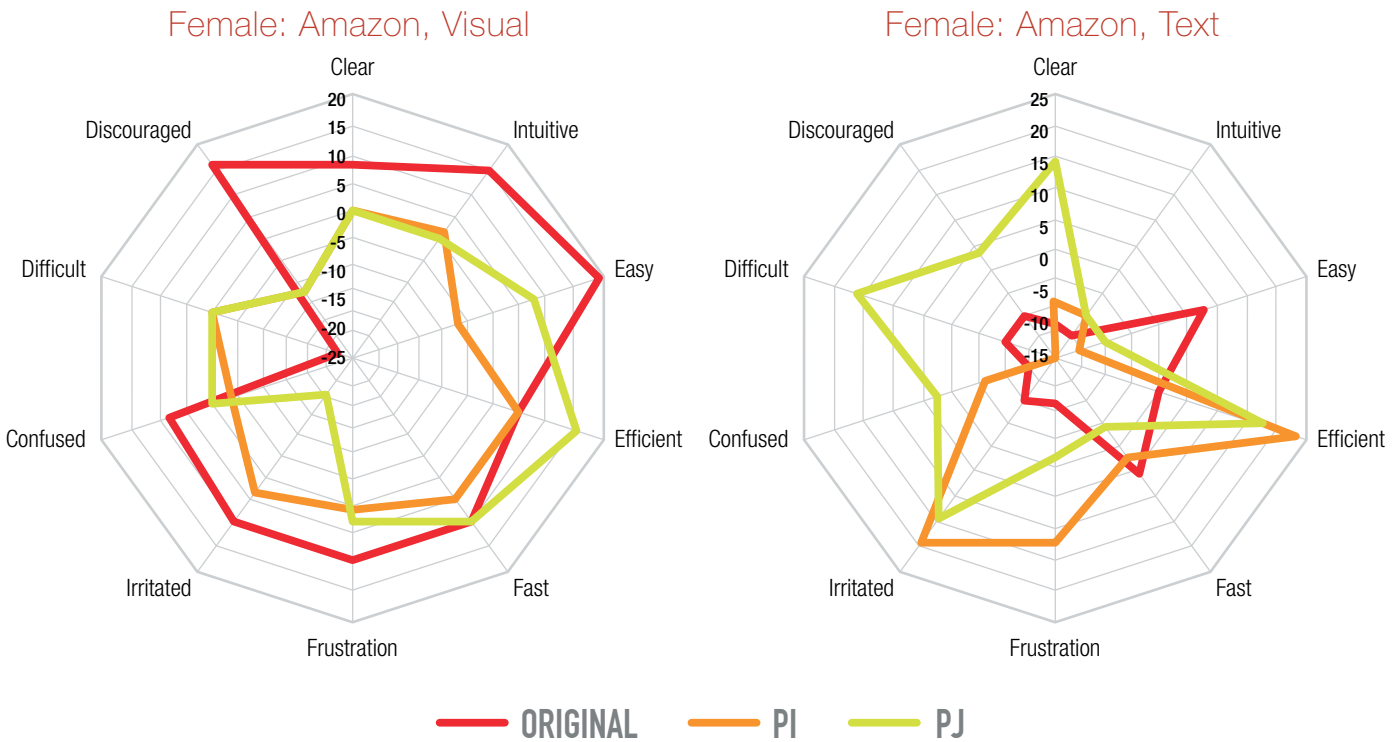
+/- Associations Per Condition Per Gender

PerfectImage was strongest in the Vodafone visual task for both genders (with Vodafone text being about as strong for women). The Progressive JPEG format was particularly negative for men.



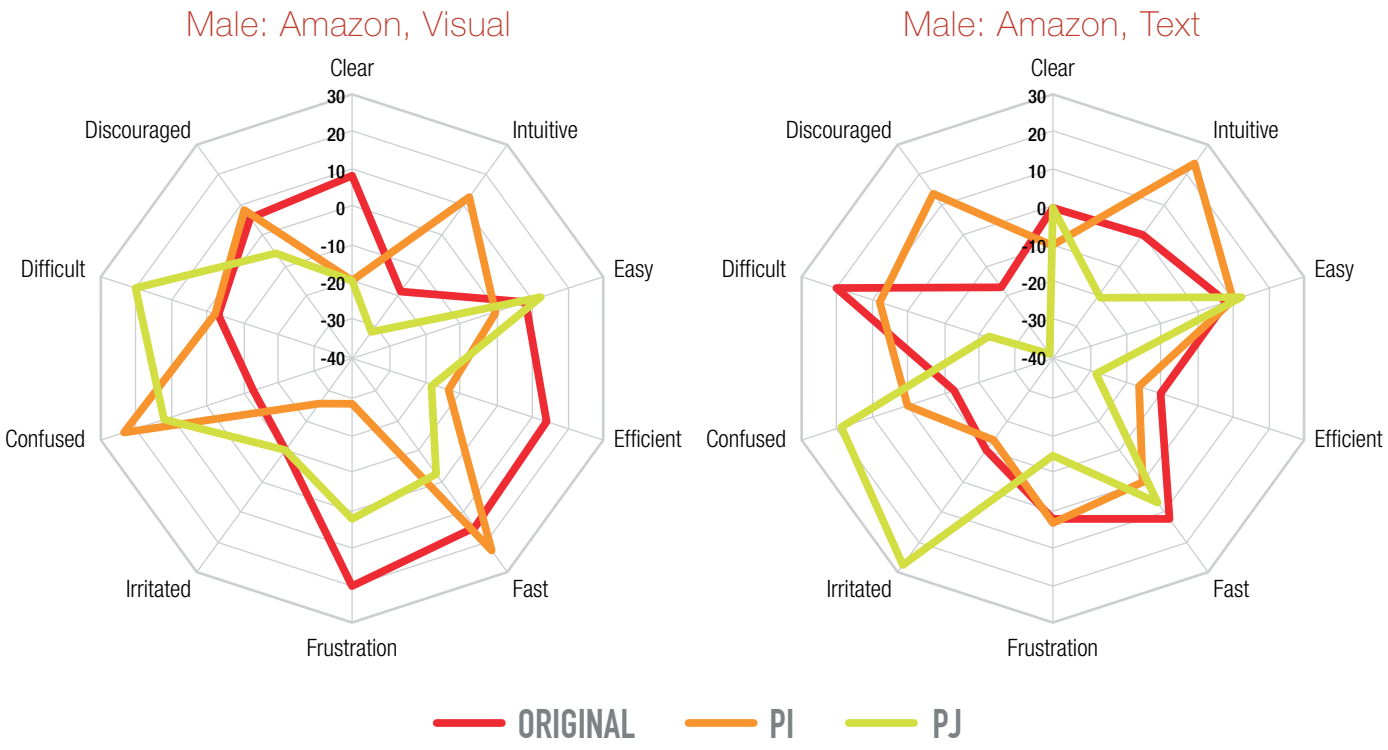
Female: Attributes for Amazon

All three methods perform strongly for 'Efficient' on the Amazon visual task – perhaps reflecting the quick-and-easy user experience for that site in general. However, on the text task it is PerfectImage in particular that scores strongly (closely followed by Progressive JPEG).



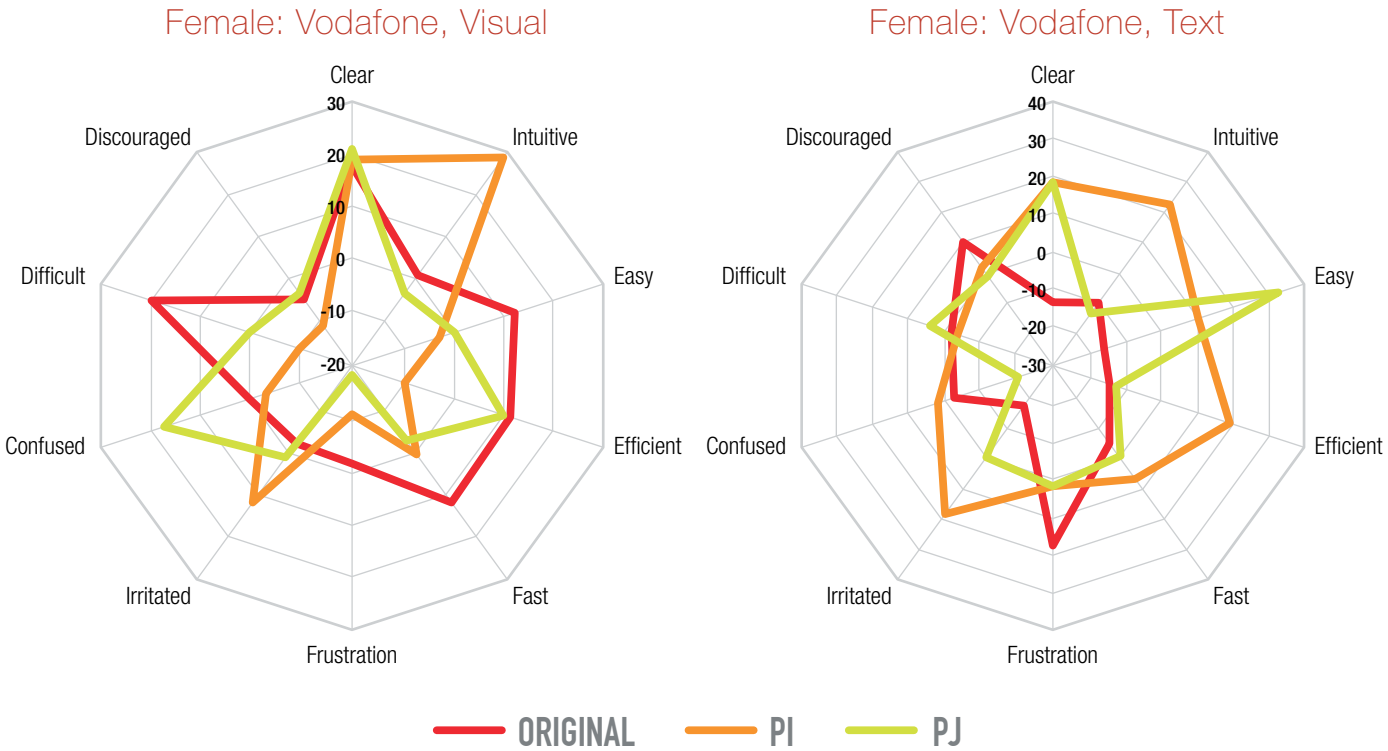
Male: Attributes For Amazon

PerfectImage performs strongly on 'Intuitive' in both conditions for men. It also performs particularly strongly for 'Fast' in the visual task condition.



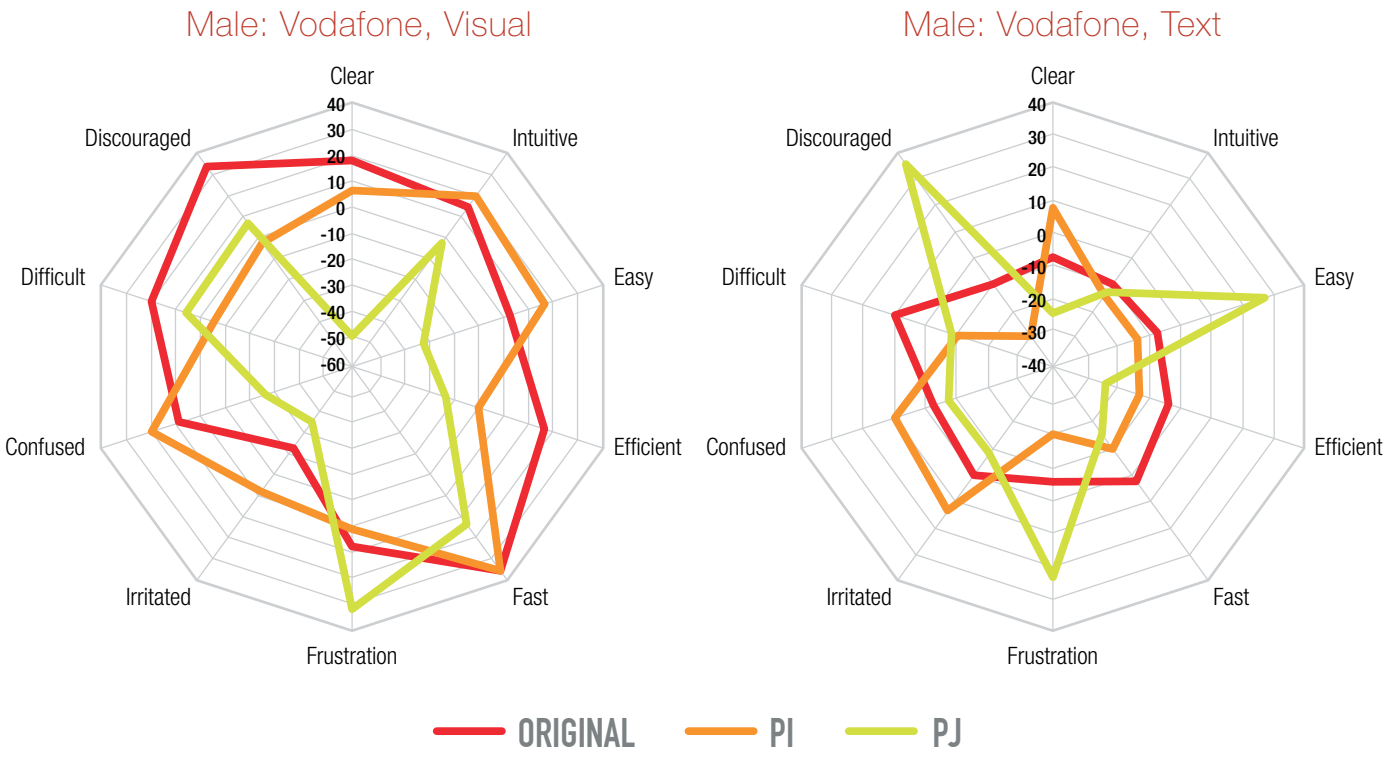
Female: Attributes for Vodafone

PerfectImage performs particularly strongly on 'Intuitive' on both conditions for women.



Male: Attributes for Vodafone

As with female participants, PI performed strongly on Intuitive for the Visual task.



Participant Survey

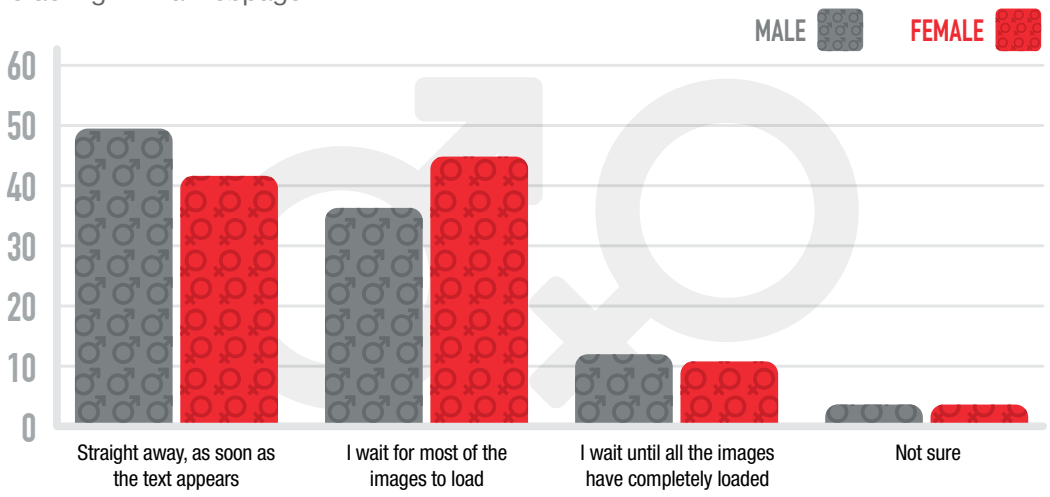
Upon completing the Facial Action Coding and Implicit Response tests, participants were asked to complete a short exit survey, which asked for their feedback about how they perceive images on the web.

1. Around half of people claim to wait for images to load before beginning to interact with a web page.
2. Around 1 in 10 claim to wait until *all* the images have loaded before interacting with the page.
3. Women are more likely than men to wait for a web page's images to load before interacting with the page.
4. Around one third of respondents claim that they notice how images load. Only 1 out of 10 think that people don't notice.
5. Around half claim the way images load affects people's experience of the page, with a further 4 out of 10 claiming people are affected if the images are slow.
6. **69% of women and 62% of men have felt frustrated by images taking a long time to load**.

While people were able to consciously recognize (in the survey questions) that the way images load is important to the user experience, their verbal descriptions were less able to pull apart their reactions to the different loading methods than were their implicit responses. This exemplifies the superior ability of non-conscious techniques to identify important differences traditional research simply cannot detect or quantify.

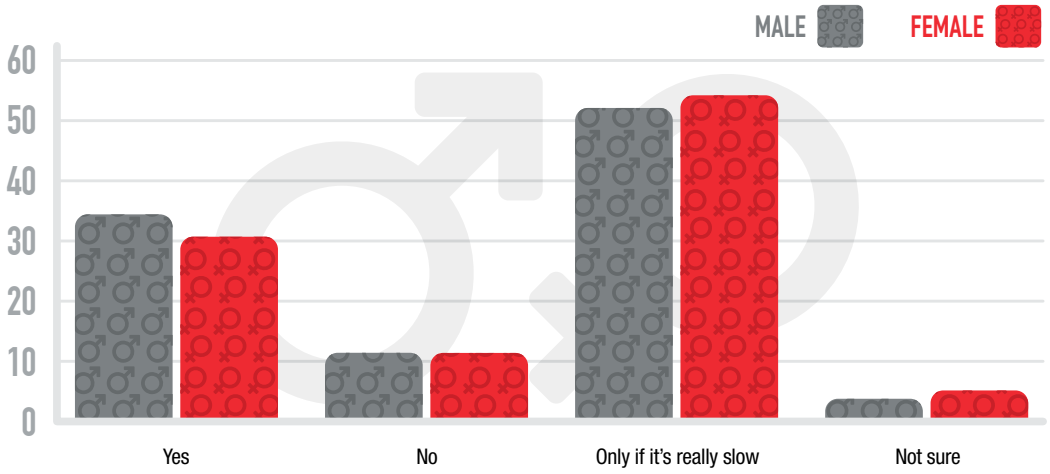
Question: When do you start to interact with a web page?

Around half of men (47.5%) and women (55.35%) wait for the images to load (either most or all of them) before they begin interacting with a webpage.



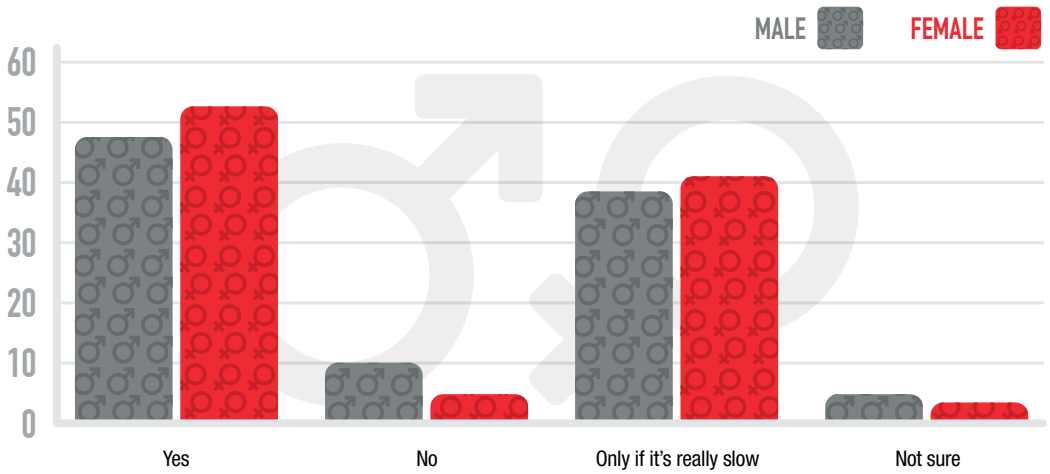
Question: Do you think most people notice the way that images load on a website?

Around one in ten of men (12%) and women (12%) think that people don't notice the way that images on a website load.



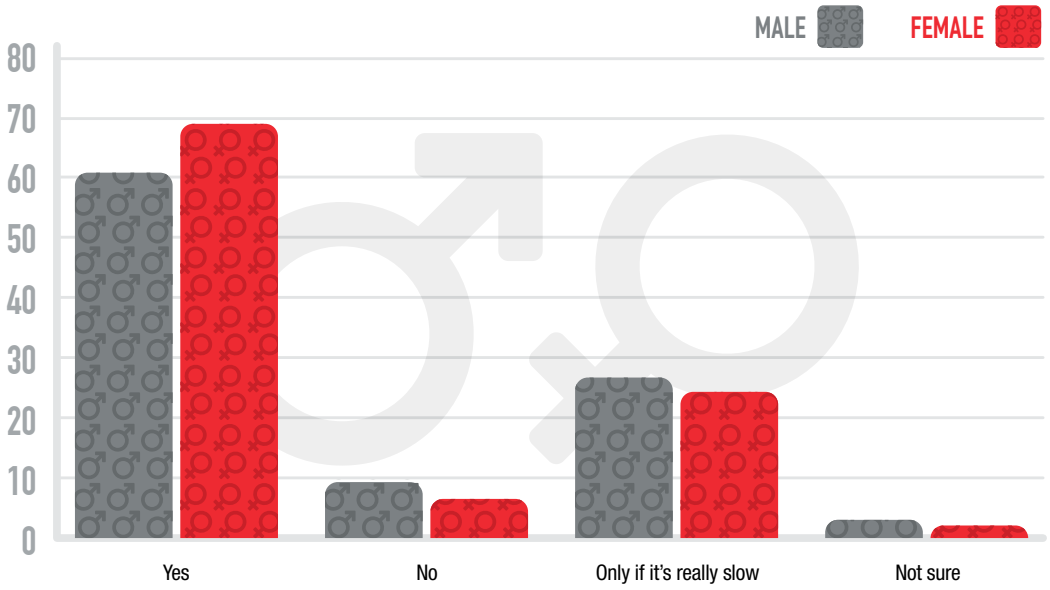
Question: Do you think the way images on a web page load affects people's experience with that page?

Around half of men (48%) and women (52%) think that image-loading method affects people's web-browsing experience.



Question: Have you ever felt frustrated by images taking a long time to load?

Slightly more women than men (69% versus 62%) said they had felt frustrated by images taking a long time to load.



Conclusion

We live in a visual age. Imagery is what grabs our attention and sustains our emotional engagement. Yet, prior to this study, there has been very little inquiry into how the actual delivery of images can affect a viewer's response. This is because the impact needs to be measured at an emotional/non-conscious level. Traditional research tools cannot measure emotional/non-conscious response accurately, nor can they detect the extremely subtle, though often crucially important, response differences evoked from apparently similar image-rendering formats.

In this study, we set out to uncover how to optimize image performance through measuring emotional response to different image-rendering formats online in different scenarios.

Our findings yielded some clear takeaways:

- The PerfectImage rendering technique was clearly favored in both the Facial Coding and Implicit Response tests. This is a powerful endorsement of this format.

- While PerfectImage had superior user perception overall, men and women had somewhat different preferences depending on the nature of the task (text-based versus visual-based searching). This suggests that, when implementing image optimization techniques, site owners should be sensitive to both their audience and their audience's objectives.

- While people were able to consciously recognize (via survey questions) that the way images render is important to the user experience, their verbal descriptions were less able to analyze their reactions to the different loading methods than were their implicit responses. This exemplifies the value of neuroscientific techniques to identify important differences that traditional research cannot detect or quantify.

Best Practices for Image Optimization

PerfectImage emerged as the clear winner in this study. This proprietary image format is still in the research and development phase, and as such is not currently available to site owners. There are, however, a number of other image optimization techniques that would benefit most websites.

Image Compression

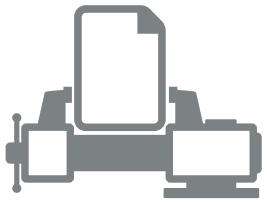


Image compression is a performance technique that minimizes the size (in bytes) of a graphics file without degrading the quality of the image to an unacceptable level.

Reducing an image's file size has two benefits:

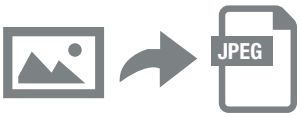
- Reducing the amount of time required for images to be sent over the internet or downloaded.
- Increasing the number of images that can be stored in the browser cache, thereby improving page render time on repeat visits to the same page.

Despite the benefits of image compression, 43% of pages failed to implement this technique.

Sprite Images

Spriting is a CSS technique for consolidating images. Sprites are simply multiple images combined into a rectilinear grid in one large image. The page fetches the large image all at once as a single CSS background image and then uses CSS background positioning to display the individual component images as needed on the page. This reduces multiple requests to only one, significantly improving performance.

Reformat Images



Inappropriate image formatting is an extremely common performance culprit. An image that is saved to the wrong format can be several times larger than it would be if saved to the optimal format. Images with unnecessarily high resolution waste bandwidth, processing time, and cache space.

As a general rule of thumb, these are the optimal formats for common image types:

- **Photos** – JPEG, PNG-24
- **Low complexity (few colors)** – GIF, PNG-8
- **Low complexity with transparency** – GIF, PNG-8
- **High complexity with transparency** – PNG-24
- **Line art** – SVG

Ensure That Feature Images Are Optimized to Load Early and Quickly

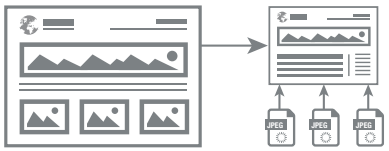
Site owners should be aware of the usability consequence of delaying the rendering of feature content: a user who experiences instantaneous page rendering spends 20% of their viewing time within the feature area of a page, whereas a user who endures an eight-second download delay spends only 1% of their total viewing time looking at the featured space on a page.

Defer Rendering "Below the Fold" Content

Ensure that the user sees the page quicker by delaying the loading and rendering of any content – including images – that is below the initially visible area, sometimes called "below the fold." To eliminate the need to reflow content after the remainder of the page is loaded, replace images initially with placeholder <img> tags that specify the correct height and width.

Preload Page Resources in the Browser

Auto-preloading is a powerful performance technique in which all user paths through a website are observed and recorded. Based on this massive amount of aggregated data, the auto-preloading engine can predict where a user is likely to go based on the page they are currently on and the previous pages in their path. The engine loads the resources (such as images) for those "next" pages in the user's browser cache, enabling the page to render up to 70% faster.[vii]



Note that this is a data-intensive, highly dynamic technique that can only be performed by an automated solution.

Appendix: Additional Commentary by Dr. David Lewis

Dr David Lewis-Hodgson, BSc (Hons), D.Phil. FRSM. AFBsPS, FISMA. FINSTD. C.Psychol, Chairman Mindlab International Ltd. Author: Impulse: *Why We Do What We Do Without Knowing Why We Do It and The Brain Sell: When Science Meets Shopping.*

In 1834, a French philosopher name Guillaume Ferrero[xiii] formulated what he named the **Law of Least Effort**. During the 1930s, Edward Chace Tolmen, an American psychologist, developed this idea further.[ix] Simply put, the Law states that people prefer to do short and simple tasks rather than lengthy or difficult ones. While this might seem to be little more than common sense, its implications where the human brain is concerned are considerable.

On around **20 watts of power**, the brain carries out all the numerous demands made on it, from regulating physiological functions essential for survival – such as ventilation, circulation, digestion, and operating more than 600 different muscles – to thinking, analysing, imaging and dreaming. As neuroscientist Reed Montague put it, "No matter how one divides this energy consumption among ongoing neural computations, one arrives at an unavoidable conclusion: **evolved nervous systems compute with almost freakish efficiency**."

What's more, by using parallel distributed processing, this 1,500-gram organ, which would fit inside a shoe-box, is able to perform computations at great speed. Dr Dharmendra Modha, who heads the IBM SyNAPSE Team, estimates that the brain operates at about 1 exaflops (1,000 petaflops). Translated from "geek speak" this means performing **20,000,000,000,000,000 operations per second!** The world's fastest computer, at the time of writing IBM's Sequoia supercomputer, operates at 16.325 petaflops.

In order to accomplish so much so fast, and on so little energy, the brain uses two approaches. **First it follows some simple rules of thumb, or heuristics, in order to make sense of incoming information. Second, it performs the vast majority of its operations below the level of conscious awareness. Indeed, of the billions of bytes of information flooding into the brain every second, only about 11 bytes ever reaches consciousness.**

There are two systems at work. One, which I term System I (for Intuitive), is unconscious, fast, and frugal in its energy demands. The other, System R (for Rational), comprises those thought processes of which we are consciously aware. It is slower and energy demanding. Indeed, research has shown that, just like the fuel in a car, the more it is used the more rapidly it becomes depleted. A busy office worker or a time pressed consumer, for example, struggling to process a relentless flow of complex information on a website may quickly experience mental fatigue unless that information is provided in the most easily accessible form.

This means the **most crucial aspect of web design is usually the speed and ease with which new information, whether in the form of text or images, can be acquired and made sense of. The term used by neuropsychologists to describe this process is "cognitive fluency"**. Any aspect of a website that inhibits cognitive fluency is likely to have a detrimental affect on those visiting it. The two main issues, identified by this study, are speed of delivery and ease of comprehension of what is delivered.

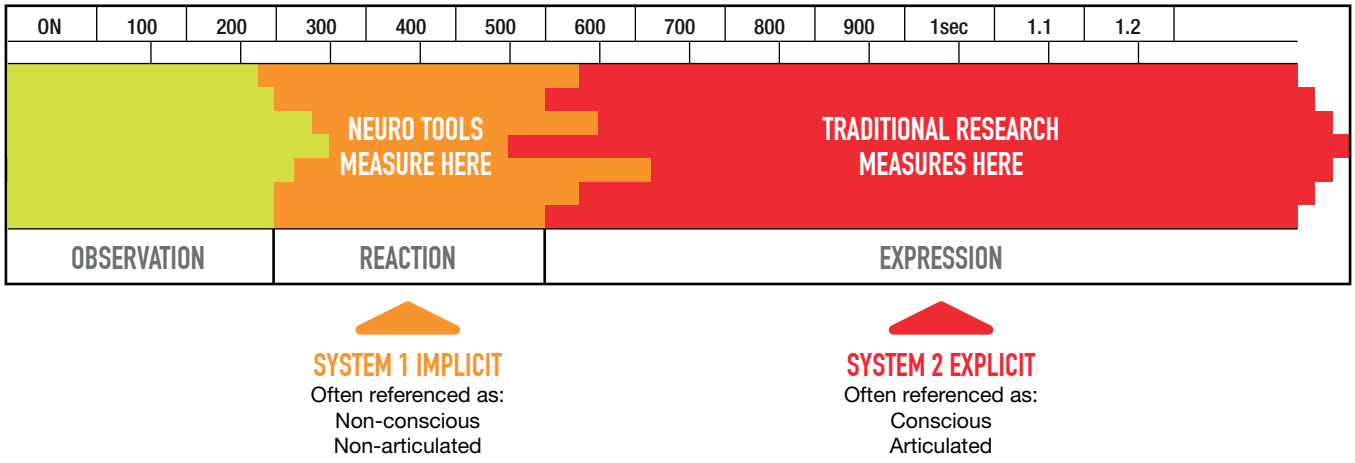
When it comes to speed, a recent study by Radware showed that almost half the sites studied last year are slower than this year. As bandwidth, image resolution, and functionality increases, so too do frustration levels with the speed at which images load.

We live in a visual age, with younger consumers especially being highly visually literate. What grabs our attention and triggers emotions, whether positive or negative, are images. For most people, therefore, the speed with which images load is an important issue. **When, as with the Progressive JPEG method, image rendition is a two-stage process in which an initially coarse image snaps into sharp focus, cognitive fluency is inhibited and the brain has to work slightly harder to make sense of what is being displayed.**

Why Traditional Market Research Fails

When attempting to evaluate the extent to which incoming data aids or impairs cognitive fluency, there is little or nothing to be gained by asking people how easily they acquired that information, since such a question is addressed to System R whereas the work has been undertaken by System I.

Simplified Cognitive Timeline



For this reason, traditional market research tools, such as questionnaires (however carefully constructed) or focus groups (no matter how expertly facilitated), are unable to provide much insight. It is only by bypassing the conscious brain and monitoring subconscious processes that accurate and reliable data can be obtained.

What this research, which by measuring electrical activity in the brain is able to record the neural correlates of System I thinking, revealed were the cognitive and emotional consequences of slow image rendering. These included frustration, physical tension, and mental exhaustion – emotions and feelings that, research indicates, can reduce the impact of a brand and create negative perceptions among retailers.

This new study demonstrates that different image-rendering methods impact consumer perception of usability (in the context of images) by revealing detectable differences between these methods. While these may appear subtle to the naked eye, the research shows they do have a significant impact on perception through non-conscious processing and, therefore, exert a more positive – or negative – impact on response. These are vital considerations when designing any B2B or B2C website.

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