



ERICSSON

CONTENT IN THE BLINK OF AN EYE

USING NEUROSCIENCE TO UNDERSTAND THE IMPACT OF
VARYING NETWORK PERFORMANCE ON SMARTPHONE USERS



In collaboration with:



vodafone

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EXECUTIVE SUMMARY

In today's fast-paced digital world, mobile devices are becoming ever-more advanced, and services such as video streaming and other data-heavy applications are increasingly common. Millennials or so-called 'digital natives' are evolving into streaming natives; they have grown up expecting instantaneous access to services like video streaming, and this demand for anywhere, anytime access will only increase in the future.

Network performance is known to have a strong correlation with smartphone usage behavior. Understanding the effects that a negative network performance experience has on a consumer's feelings and their perception of a mobile operator brand can provide invaluable insights for optimizing a mobile operator's network service and offerings. However, gathering this information directly from the consumer presents challenges. Poorly articulated or misleading questions often yield conclusions that are dependent on the respondent's interpretation; every consumer can read different things into a particular question.

In a first-of-its-kind collaborative study, Ericsson and Vodafone utilized the latest neuroscience technology to ascertain the subconscious behavioral reactions of a sample of smartphone

users in Düsseldorf, Germany. Ericsson ConsumerLab together with Neurons Inc used state-of-the-art wireless electroencephalography (EEG) and eye-tracking technology, users completed a series of predetermined smartphone tasks under different network performance scenarios, while their stress and emotional brand engagement (motivation) towards mobile operators was monitored.

Neuroscience could complement traditional Net Promoter Score (NPS) indexing and can be used to uncover how much stress a user is under, unlocking the true relationship between network experience and the user's loyalty to, and perception of, an mobile operator's brand.

The results signified scientific proof of the direct correlation between consumers' subconscious, their

physical reactions and time-to-content on apps. Interestingly, for those who faced no network performance i.e no time-to-content delays, perception of the mobile operator increased significantly. On the other hand, higher time-to-content delays on video streaming apps had a negative impact on not just the mobile operator brand but also other industry ecosystem players, such as the content providers and handset manufacturers. This indicates that it is in the interest of the industry as a whole to work together to improve app experience to meet users' expectations.

The information gathered from the study enables Vodafone and Ericsson to consider how to provide the required level of service expected from users, addressing their growing 'need for speed'.

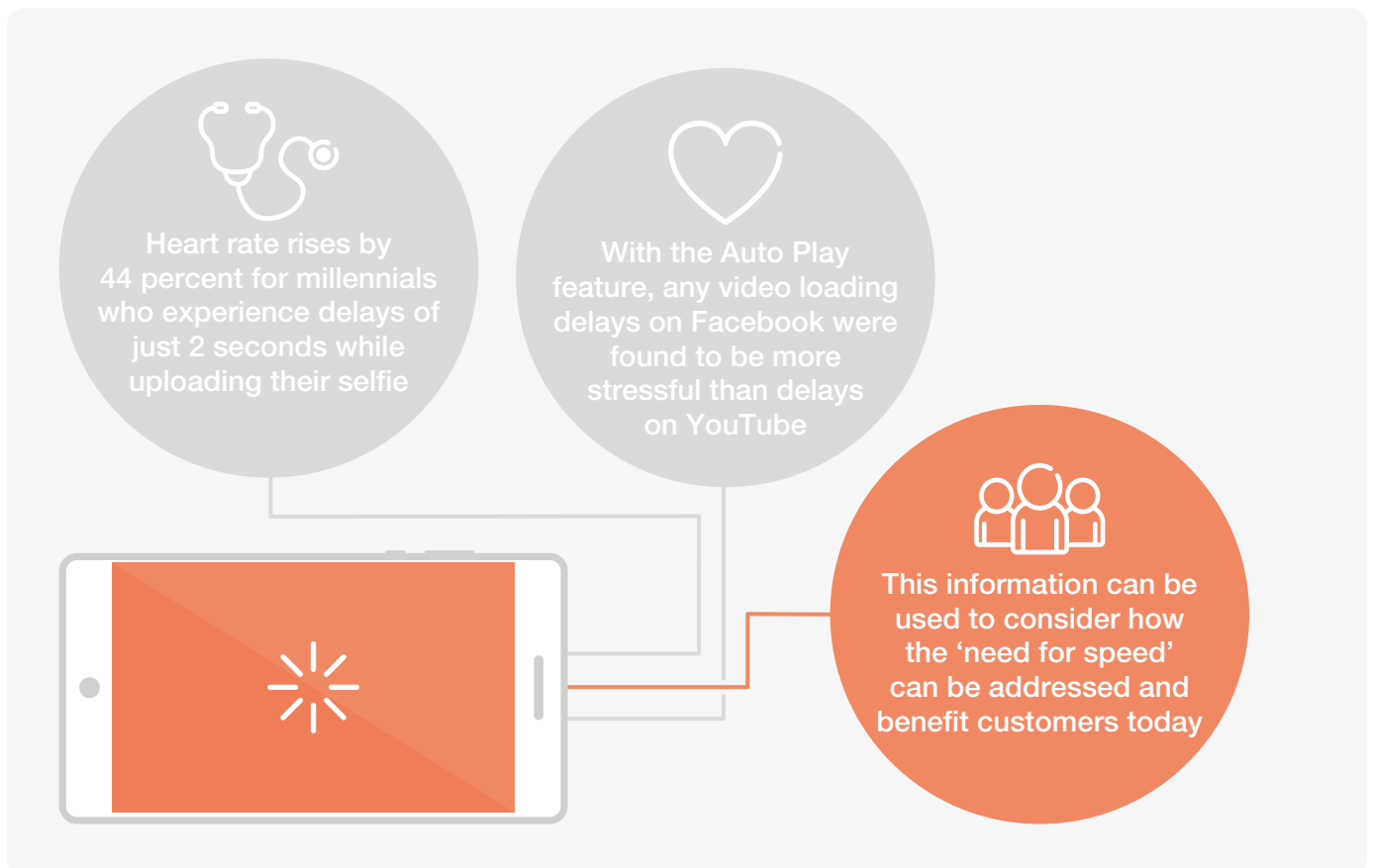
PRINCIPAL OBJECTIVES

In an exciting and innovative collaboration, Ericsson and Vodafone Germany aimed to redefine the way mobile operators benchmark network performance, by measuring real emotional reactions and customer experiences. Using neuroscience, the study looked at users' emotional responses to varying network performance, and what impact that had on their perception of a mobile operator's brand.

The study set out to understand the stress and emotional brand engagement a user experiences as a result of network degradation for a variety of smartphone interactions. The benefits of knowing the point at which a user becomes frustrated with mobile delays while using apps on the network – and the associated physiological effects – are invaluable. Not only will it help mobile operators understand and meet user expectations, it will also enable them to redefine Service level Key Performance Indicators (SKPIs) – the performance measurements used to evaluate the quality of a specific service, such as video streaming or web browsing. With this information, mobile operators could optimize the network towards these SKPIs and improve user experience. In other words, the results will shape how networks will be built – now, and in the future.

The key objectives of the study aimed to:

- > Establish how variations in network performance impact smartphone user emotions, and how this effects their perception of the mobile operator brand in Germany
- > Gather unbiased, subconscious feedback from smartphone users on acceptable quality thresholds, such as load times, especially for mobile video streaming related services



MEASURING NEURO RESPONSES

The study aimed to uncover new insights into how a user's emotional engagement with a mobile operators brand as well as consumer advocacy (measured using Net Promoter Score) changes based on network performance experience.

Ericsson ConsumerLab had 150 smartphone users from Düsseldorf, Germany, participate in this survey. Half of the respondents were Vodafone subscribers aged 18–50, and 68 percent of them were 4G users. All participants were divided into three groups.

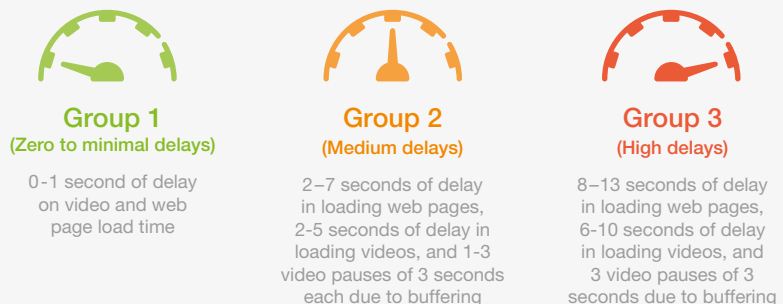
The participants were required to complete 13 tasks in 10 minutes using a customized mobile web page on a smartphone. This was done to simulate consumer response to poor network performance when under some sort of time pressure, in order to mirror the need for immediacy to receive content. The tasks included browsing certain web pages, streaming videos online over the YouTube app, and certain tasks on the Facebook app such as browsing particular pages and uploading a 'selfie', among other exercises. The smartphones were programmed to appear as if they were using a mobile broadband network connection while they were not even connected to any cellular network. Unbeknownst to the participants, they were subjected to varying levels of network performance that generated mobile delays, such as delayed mobile web page loading, video load time delays and buffering effects. Based on this, participants would experience high, medium or no delays, depending on which group they were assigned to. The order in which the tasks were presented was pseudo-randomized to eliminate any influence.

Before and after participants performed these tasks, they were shown different brand logos on a computer screen. While viewing the logos, the participants' emotional and cognitive responses were measured through

the EEG equipment, which was then used to calculate their unconscious brand engagement towards their current mobile operator, referred to as "motivation". The participants were made to believe that the mobile broadband connectivity provider behind these tasks was their own mobile operator. In addition to this,

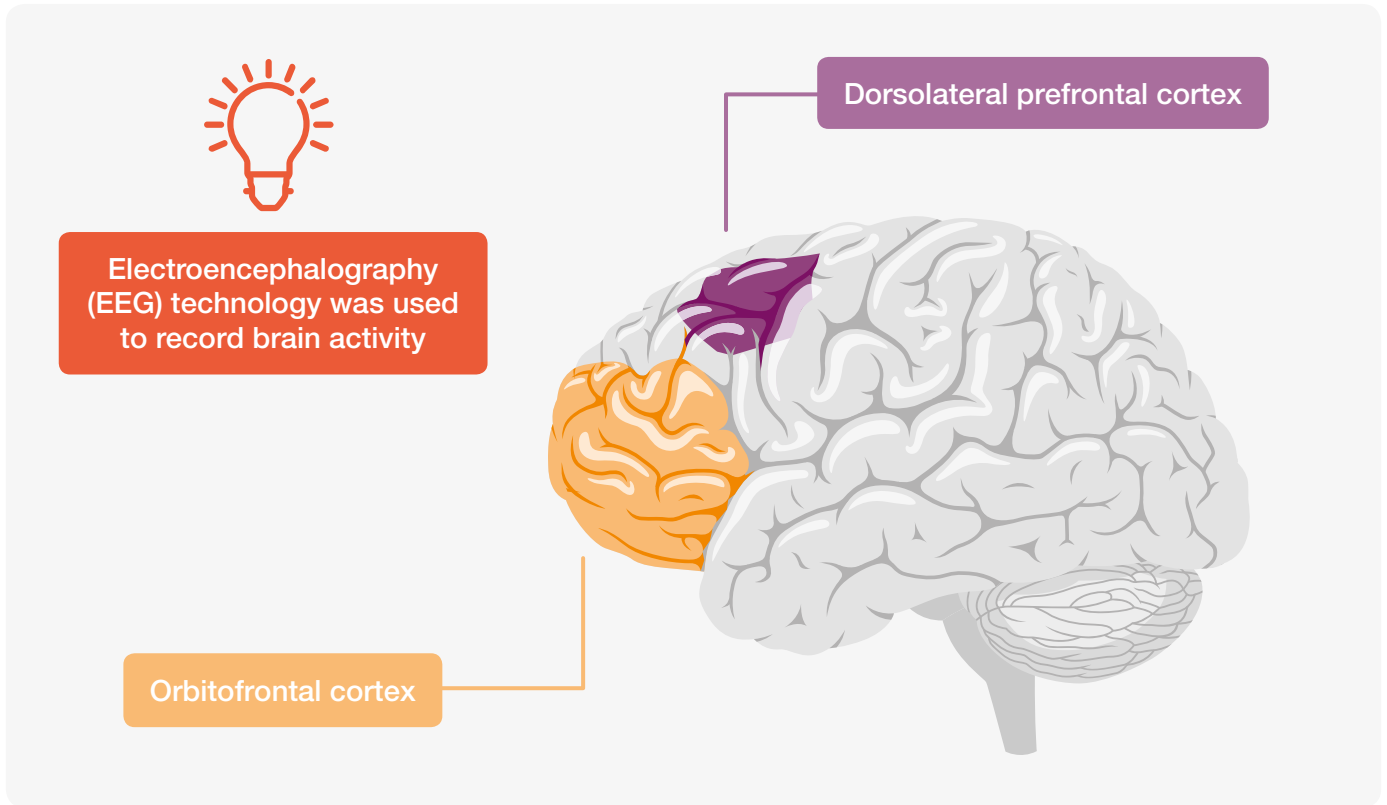
respondents performed a short online survey to evaluate perception, willingness to recommend, and state their satisfaction levels towards their mobile operator and some other content provider brands. The tests were administered both before and after the web, video and Facebook tasks, in order to measure changes in responses.

Figure 1: The three groups



Key findings

- > Smartphone users in Germany were found to be stressed even at one second of video delay (if a buffering icon were to appear on the screen), indicating high expectations around video streaming experience
- > A two-second delay in uploading selfies on Facebook is enough to cause "selfie stress" among smartphone users
- > Millennial and streaming natives were found to be less tolerant to delays in loading online videos. On average they were 35 percent more stressed with mobile delays than adults aged 35 years and over
- > Net Promoter Scores for all mobile operators in Germany fell from a high positive score to a negative with each incremental mobile delay
- > A negative app experience has a direct effect on the whole mobile ecosystem, not just the brands directly involved



STATE-OF-THE-ART ANALYSIS

The study used a number of scientific tools to measure reactions in participants, including the latest lightweight, wireless electroencephalography (EEG) technology to measure electrical signals in the brain. The study focused on two parts of the brain – the dorsolateral prefrontal cortex and the orbitofrontal cortex – which are responsible for cognitive load and emotional engagement/motivation, respectively.

Eye-tracking equipment was also used to provide insights into what users are looking at on their smartphone and when they lose focus and look elsewhere. A pulse meter allowed heart rate to be measured and provided an indication of stress levels.

A RICH SOURCE OF DATA

The experiment yielded around 2.7 million data points for each smartphone user, which were analyzed to understand what impact key events – especially mobile delays – have on stress levels, attention and emotional engagement with the mobile operator’s brand during the study.

The measurements from the online survey taken before and after the tasks were performed to gain a better understanding of how mobile app experience influences the emotional brand engagement and Net Promoter Score (an indicator to gauge a customer’s satisfaction and loyalty with a brand). Participants were assessed to determine if they have a positive, neutral or negative engagement with each brand shown, and if this changes based on their network performance experience while performing the tasks.

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IDENTIFYING THE BREAKING POINT

Significant insight was gathered into a user's subconscious experience of an app – specifically, the point when that experience becomes stressful to the consumer, due to delays in the network. Understanding this threshold is crucial to meeting consumer expectations.

Mirroring the trends of past research from the Ericsson ConsumerLab study in February 2016, “The stress of streaming delays” found that poor network performance had a negative emotional effect on the participants. However, one of the most insightful statistics ascertained was the time taken for participants to feel stressed when dealing with performance issues. This is defined as the point at which a participant is actually stressed as a result of network delay.

THE CRUCIAL SECOND

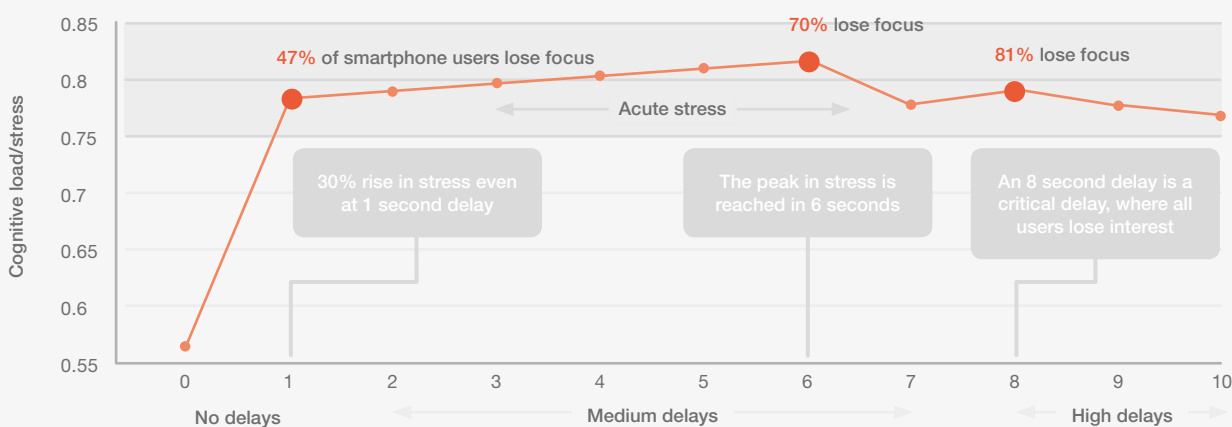
During the video streaming exercise, participants experienced a 30 percent rise in cognitive load or stress after only a 1-second delay, but continued to watch the video. Forty seven percent of respondents seem to have lost attention at this point, but still persevered with the video (Fig. 2). The rise in stress even at a one-second delay could be explained by the fact that the buffering icon briefly appeared on the screen for this duration before the video loaded. This offers a significant insight into the participant's negative association with the buffering icon and also highlighted their exceptionally high expectations; if video services take longer than one second to load, users experience a negative cognitive reaction as they anticipate more interruptions in their video streaming experience. This illustrates that smartphone users expect content to be instantaneous. Interestingly, those participants who were made to believe that they were

using 3G mobile broadband services were more tolerant and showed less stress towards delays as opposed to 4G users, which implies that people who are accustomed to 4G speeds have less tolerance towards video loading delays.

The study also looked at the negative effects video buffering has on users' stress levels. In a short video on YouTube, a single buffer can cause a 24 percent rise in stress. Each additional buffer increased the user's stress response by an additional five to seven percent, which had a negative impact on their emotions towards the brands related to the task (i.e. both YouTube and the mobile broadband service provider), as well as the task in general. In fact, buffering was found to be more stressful and cause more negative emotions when the video stream was of high resolution i.e. 720p. It was found that smartphone users would prefer to watch a fast-loading, lower quality video as opposed to a slow loading or interrupted high-definition (HD) video.

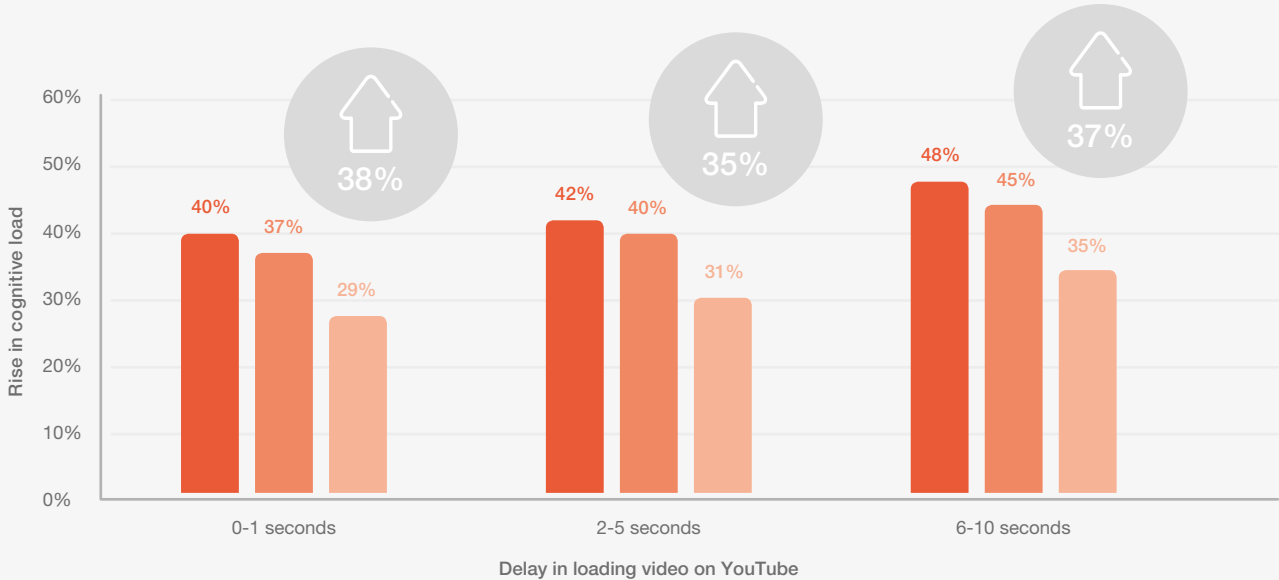
Each incremental mobile delay resulted in a negative perception of the mobile operator brands. The average Net Promoter Score for all German mobile operators fell from a high positive score of +31 to a negative (-15) with just 1 second of delay in loading videos on YouTube. These results indicate high expectations among German smartphone users and that poor network performance has a detrimental impact on consumer loyalty.

Figure 2: The breaking point while streaming video



Source: Ericsson ConsumerLab Content in a blink of an eye, 2016
Base: Smartphone users aged 18–50 from Düsseldorf, Germany

Figure 3: Rise in stress caused by time-to-content video delays among different age groups ● 18-24 ● 25-34 ● 35+



Source: Ericsson ConsumerLab Content in a blink of an eye, 2016
 Base: Smartphone users aged 18-50 from Düsseldorf, Germany

WHO ARE MILLENNIALS?

Millennials or ‘digital natives’ represent users aged between 18 and 35, who are the first generation to have grown up entirely in the internet age. The internet is an integral part of their every day, as is social media. For example, of the millennials surveyed in Düsseldorf, 80 percent said they stream videos daily.

Streaming natives represent 16-18 year olds, the younger generation of digitally savvy consumers who stream and watch more digital content than any other generation. Around 46 percent of streaming natives spend at least an hour or more on YouTube every day.*

The results of the video task also revealed that consumers are most stressed at six seconds of video delays, and after eight seconds, they completely lose interest in watching the streamed video all together (Fig. 3). The frustration with mobile video load times is highest within the younger millennials (18-24) age group, with a 40 percent rise in stress after only a 1-second delay as opposed to 29 percent for those aged 35 and above. This rise in stress was found to be 38 percent higher on average compared to participants aged 35+. This trend is mirrored with mobile web page load times; after a 4 second delay, millennials experience a rise in stress that’s 17 percent higher than the stress levels experienced by older age groups.

WHERE TO PIN THE BLAME?

Results from the survey indicated that users who experienced delays when streaming a YouTube video didn’t only blame their mobile operator; a negative viewing experience also had a direct result on the emotional brand engagement with the content providers (e.g. YouTube), and even the mobile device manufacturers.

When compared to a similar pilot experiment conducted in Copenhagen as well as research performed in Jakarta, Indonesia, the participants in Düsseldorf, Germany, had a much lower tolerance for any delays in the network, and much higher expectations from their mobile operator. This indicates that each market will be different and assumptions of user expectations can’t be made from one country to another, based on pre-existing findings.

72 percent of German millennial smartphone users lose interest in watching mobile videos if delays exceed 4 seconds.

* Ericsson ConsumerLab 10 hot consumer trends 2016

THE SELFIE GENERATION

The 'selfie' phenomenon is popular worldwide. However, what may come as a surprise is the level of frustration experienced by users when delays occur in uploading content over social media apps.

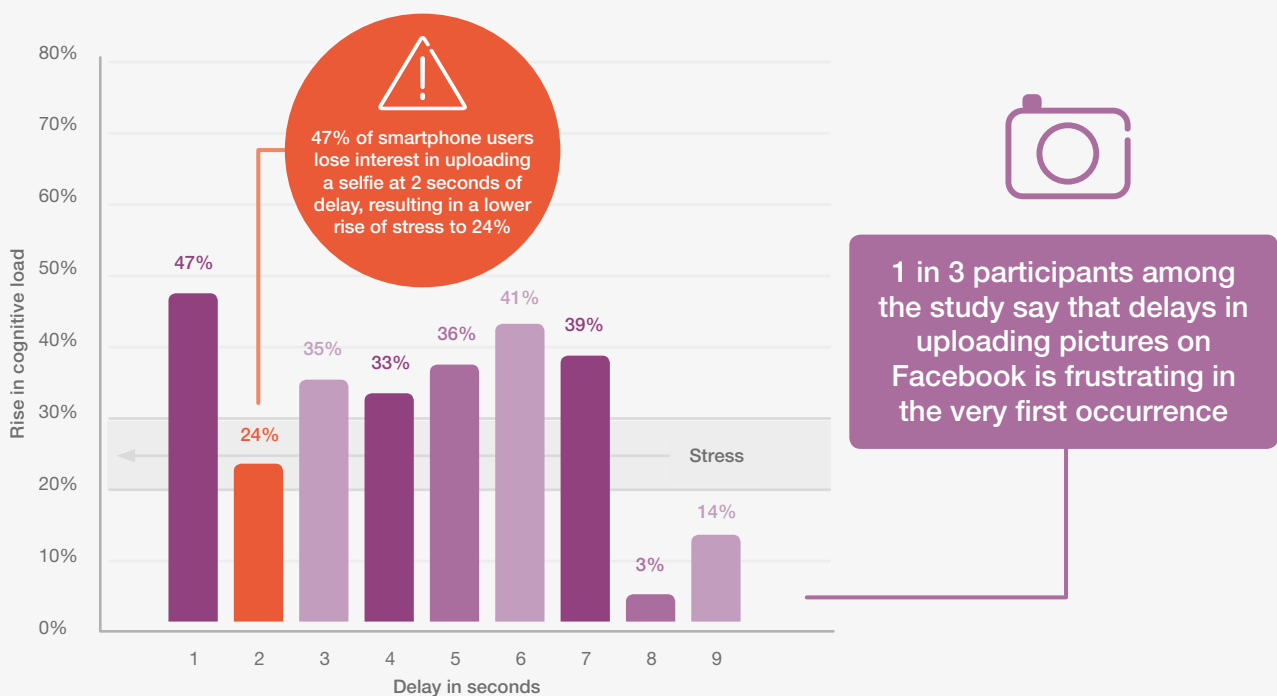
All participants of the study were made to perform certain tasks on the Facebook app, with varied network performance for each individual. Of the study's participants, one in three in our survey stated that delays in uploading pictures on Facebook were very frustrating. With a 1-second delay in uploading a selfie, participants show a significant increase in cognitive demand – a 47 percent rise in stress (Fig. 4). However, after a 2-second delay, 47 percent of participants lose attention and temporarily resign from the task, causing a drop in cognitive load to 24 percent – indicating that this is the crucial user experience threshold (Fig. 4). At around eight seconds, most participants gave up on uploading their selfie completely.

These results suggest that even a few seconds of delay in uploading content (in this case, a selfie) over social media causes consumers to feel mentally taxed initially, and eventually give up when delays persist.

These findings are significant in a number of ways; first they tell us that, from the point of view of smartphone users in Germany, almost any delay in uploading a picture is unacceptable. They also demonstrate that the first eight seconds is critical as it's the time period in which customers are still willing to wait for something to load, in order to complete a task.

Most interestingly, however, the findings show that it is not just download speed waiting times that are important to users; upload waiting time also plays a significant role in meeting their expectations. This was particularly true in the case of the millennials group, who experienced higher levels of stress, evident from the rise in their heart rates compared to other age groups during selfie upload delays.

Figure 4: A two second delay is enough to cause selfie stress



Source: Ericsson ConsumerLab Content in a blink of an eye, 2016
Base: Smartphone users aged 18–50 from Düsseldorf, Germany

FUTURE IMPLICATIONS

This study shows that poor network performance impacts not only smartphone users, but the entire industry; every stakeholder in the mobile ecosystem – including handset manufacturers and content providers – saw a drop in brand engagement as a direct result of a negative network experience. Consequently, the responsibility of providing a positive experience rests on all those involved, and future-proof network solutions will need to be worked on collaboratively in order to meet evolving consumer expectations and prevent churn.

Having identified the key user thresholds for the German market, Vodafone has extended its understanding of users' subconscious reactions to different network performance quality, and can define new key performance indicators in order to align network performance benchmarks with user expectations. This means optimizing the network to meet the expectations of millennials and streaming natives, improving upload speeds and minimizing buffering to meet the increasing video-streaming user behaviors.

Other services can also benefit from the findings. App developers should consider the implications of a slow video load time, and measure the importance of video quality over the time taken to load. Similarly, the study proved that participants become frustrated as soon as they see a buffering symbol, suggesting that improvements could be made in terms of the usability as well.



Future-proof network solutions will need to be worked on collaboratively in order to meet evolving consumer expectations

PREPARING TOMORROW'S NETWORK, TODAY

Changing behaviors in smartphone users makes consumer research imperative in the continually evolving marketplace. Understanding what makes them frustrated and what impacts their perception of a brand is key to preventing churn and keeping customers happy.

This study has enabled Vodafone and Ericsson to gain a unique and deep appreciation of what consumers really feel, thanks to the neurological scientific

evidence. Vodafone can use this information to consider how the 'need for speed' can be addressed and benefit customers today, and into the future.

ERICSSON

Ericsson is a world leader in communications technology and services with headquarters in Stockholm, Sweden. Our organization consists of more than 111,000 experts who have provided customers in 180 countries with innovative solutions and services. Together we are building a more connected future where anyone and any industry is empowered to reach their full potential. Net sales in 2016 were SEK 222.6 billion (USD 24.5 billion). Ericsson is listed on NASDAQ OMX stock exchange in Stockholm and the NASDAQ in New York.

Read more on www.ericsson.com

VODAFONE

Vodafone Germany is a leading integrated telecommunications company and Germany's largest cable television operator, offering fixed broadband, mobile communications, internet and TV services. As a gigabit company, Vodafone is a key contributor to the development of Germany's 5G infrastructure. The Düsseldorf-based company's continuous investments in faster fixed and mobile networks are taking Germany forward into the gigabit society.

Vodafone Germany offers a comprehensive ICT portfolio for enterprise customers, networking people and machines, facilitating secure corporate networks and storing enterprise data in the German cloud. Around 90 percent of all DAX-listed companies and 15 of Germany's 16 federal states are already Vodafone customers. Vodafone Germany has 14,000 employees and generates annual revenue of EUR 11 billion with 43.7 million SIM cards, 6.1 million fixed broadband customers and numerous digital solutions.

Vodafone Germany is the largest operating company of the Vodafone Group, one of the world's largest telecommunications companies with mobile operations in 26 countries and partners with mobile networks in 49 more. It also has fixed broadband operations in 17 countries. Vodafone has around 470 million mobile customers and 14.3 million fixed broadband customers around the world.

Visit the website at www.vodafone-deutschland.de for further information