WHEN WILL 23ANDME BECOME A DATING SERVICE?

ME 297: FORECASTING FOR INNOVATORS

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XIAO GE
ALEX GRANIERI
LINDSAY RUSSELL
ADAM SHEPPARD

INTRODUCTION

According to Sammy Davis, Jr.: "The ultimate mystery is one's own self." The quantified self movement has health nuts tracking calories, sleep quality, steps, and more in accordance with Digital Health. Our task? Forecast the future of the quantified self movement. With the rise of mobile, the advent of "big data" and an era of personal consumer health upon us, conditions appear ripe for quantified self to go mainstream. The last frontier of human knowledge is the mystery of our inner life, and quantified self offers a compelling way to understand ourselves better. Indeed, entrepreneurs, investors, and device manufacturers are hard at work figuring out how to design the future of this emerging trend. Personal genetics are, perhaps, the ultimate way to quantify one's self. We envision a world where personal data, including genetics, is seamlessly collected by a comprehensive network of sensors and made transparent to ourselves and others in a post-privacy manner. If personal data becomes core to society in this way, how might it affect how Americans date, marry, and procreate? We ask the provocative question: When will 23andMe.com—currently a personal genetics service—become a dating service (with 50% of the 18-29 year old U.S. population as users)?

SETTING THE CONTEXT

QUANTIFIED SELF

Founded in 2007 by Gary Wolf and Kevin Kelly, the contemporary quantified self movement ("QS") aims to create self-knowledge through self-tracking of personal health and lifestyle data. However, the basic concept behind QS is nothing new. Benjamin Franklin kept a list of thirteen virtues and put a check mark next to each when he violated it; the accumulated data motivated him to refine his moral compass. Pedometers became popular in the 1930s with the "Hike-o-Meter". Professional athletes have been meticulously monitoring personal metrics for decades, and patients with chronic conditions had done the same in an effort to understand how their daily behavior influenced their symptoms.

For today's generations, the ultimate goal is perhaps no longer career success or a house with a white picket fence. Instead, driven by the rise of Internet and sensor technology, the ultimate accomplishment is our quest for self-knowledge. Consumer healthcare devices have made it simpler to collect data about ourselves, and the rise of social networks makes it easier than ever to share ourselves with others.

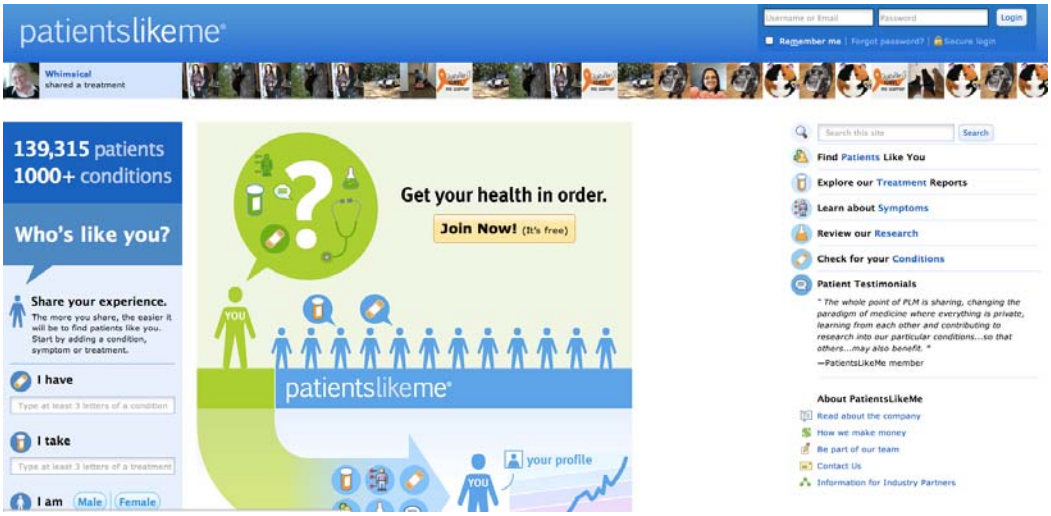
Quantified self meet-ups, run by Wolf and Kelly, have expanded exponentially. Originally held in the San Francisco Bay Area four years ago, today's quantified self enthusiasts meet in 27 location across the U.S. and in 54 locations around the world. However, our task is to analyze whether (and when) the movement rooted in individual experimentation can scale up in ways that will affect public health and other aspects of society, such as dating.

HEALTH AND WELLNESS

U.S. healthcare, universally understood to be unsustainable in its current form, is undergoing a period of great change. Healthcare reform introduces massive uncertainty into the system. Consumers and industry alike recognize the potential for consumer-led personalized healthcare and digital health trends in the future. The rapidly decreasing cost of genetics promises to revolutionize diagnostics and the pharmaceutical industry. Quantified self metrics could play an important role in the healthcare paradigm of tomorrow—particularly with patients who have a chronic disease that depends on behavior modifications. It used to be that patients who wanted to monitor their conditions were limited to hand-written spreadsheets and daily logs. Today, the growing availability of new monitoring devices and the increasing popularity of social networks promise to make self-tracking more powerful ever before and empower patients and any individual interested in their long-term health and wellness.

There are plenty of reasons to believe that people sharing data about themselves can produce powerful medical insights. Patient groups formed around specific diseases have been among the first to recognize the benefits to be derived from aggregating such information and sharing it. For example, PatientsLikeMe is a social-networking site that provides users—over 139,000 patients representing over 1,000 conditions—with tools to track their health status and communicate with other patients. CureTogether is a similar website with more than 12,000 users in 112 countries. Moreover, today's medical innovators have made incredible advances in devices such as pacemakers that send continuous heart data electronically to the doctor.

EXHIBIT X
"PATIENTSLIKEME"



SOURCE: WWW.PATIENTSLIKEME.COM

TECHNOLOGY

Technology is an important catalyst in the quantified self movement—specifically, sensors. Sensors have become more ubiquitous in recent years, from fitness devices like the Fitbit or Nike+ Fuelband to recreation applications like Nintendo's motion-sensing Wii. With the decreasing cost and size of sensors, this trend is likely to continue and sensors may one day penetrate almost every area of our lives. Today's devices rely on inexpensive, low-power wireless transceivers that automatically send data to the user's cell phone or computer. Compared with the limited snapshot of health captured during a doctor check-up, tech-enabled tools and techniques could reveal important aspects of an individual's health and provide important medical context. This has important consequences for the future of quantified self. A world of comprehensive network sensing makes data collection and visualization automatic, seamless, and action-oriented.

DATING

Just like Steve Jobs predicted, computers are a necessity in almost every home in the U.S. today, as is Internet access. According to research conducted by Stanford sociologist Michael Rosenfeld, the Internet is the fastest growing mechanism by which individuals meet their future partners. A few more statistics paint the picture of today's dating activity: according to the Pew Research Center, 65% of U.S. adults online have used social networking sites and, according to Reuters, 40 million out of 54 million single people in the U.S. have tried online dating as of January 2012. Match.com has 15 million users and OkCupid has 7 million active members. The technology, social, and political norms surrounding dating have changed dramatically from our parents' generation.

Our focal question asks whether personal genetics could ever drive dating compatability. We envision a world of "QS-enhanced" dating. Researchers report that,

when two people meet on a date, they rank personality, looks, sense of humor, career and education as their top needs. These are difficult to translate to quantified self data. In fact, every expert we spoke with expressed firm doubt that a personal genetics site like 23andMe would ever become a dating service. According to OkCupid founder Sam Yagan, information on relationship outcomes after online dating service users meet in-person is valuable but difficult to access. Some studies showed that online dating was surprisingly more successful than we thought, and it would be encouraging for online dating services to know how users feel about meeting through online data versus traditional serendipity.

Another interesting insight we learned from Yagan is that any data input can be used in the dating process. There is an entire class of online services that are explicitly not dating sites, but nevertheless offer an opportunity for singles to meet and mingle. Yagan terms this "implicit dating sites". For example, car sharing website ZimRide could be understood as an implicit dating service—people who don't know each other can build up relationships through car sharing. The information provided by the online community is empowering people to make more well-informed decisions about their relationships, while giving them the sense of security and comfort of relative anonymity until they feel comfortable meeting in person. Connected information could affect dating, and will be discussed comprehensively later. Note that we are forecasting the dating situation in thirty years, and therefore use the term "digital dating" instead of "online dating websites".

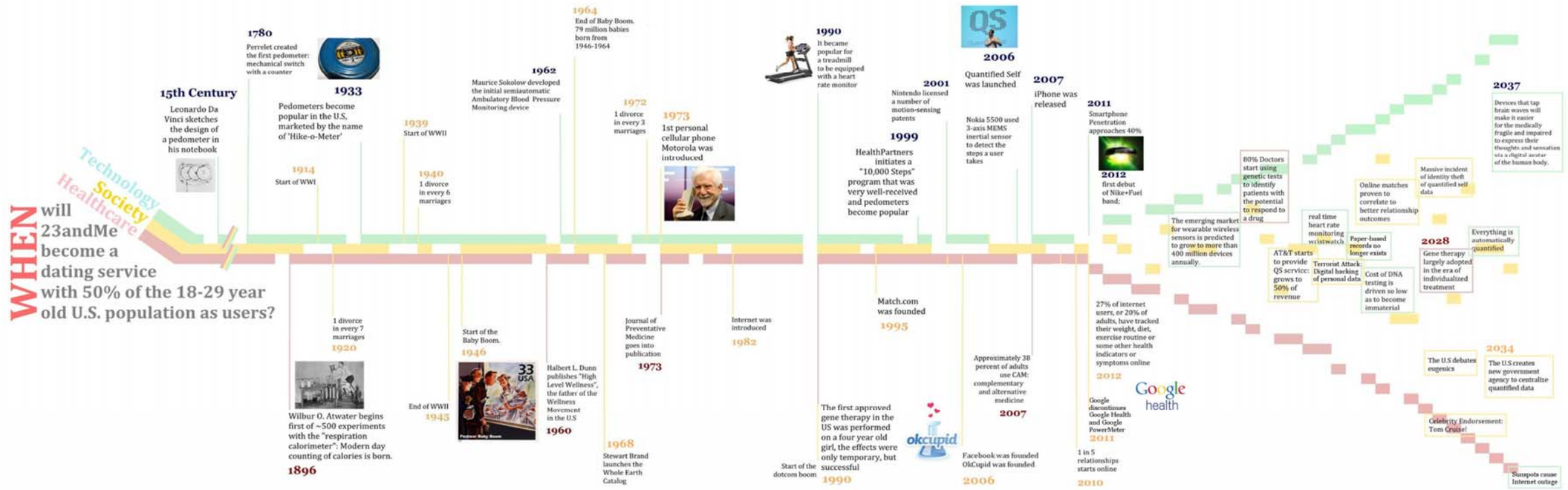
WHEN WILL 23ANDME BECOME A DATING SERVICE?

Our task is to forecast the future of the burgeoning quantified self movement. We chose to tackle this by asking the focal question, "When will 23andMe.com become a dating service (with 50% of the 18-29 year old U.S. opulation as users)? Our logic is that personal genetics represents one extreme application of the quantified self mentality. Our forecast lies at the intersection of health and wellness, technology, and dating.

Each of these three areas touches on issues of consumer privacy related to data sharing. Privacy is a broad term. To define "privacy" in this project, we analyze it to involve three aspects. First, security: the desire to avoid cyber-attack. Second, our desire to avoid any commercial exploitation of our personal information such as direct marketing. Third, or general openness to sharing personal information across our social graph. The first two we assume to be basic needs in today's connected society. When we consider aspects of privacy in our forecast, we refers primarly to the third aspect of society's openness to sharing.

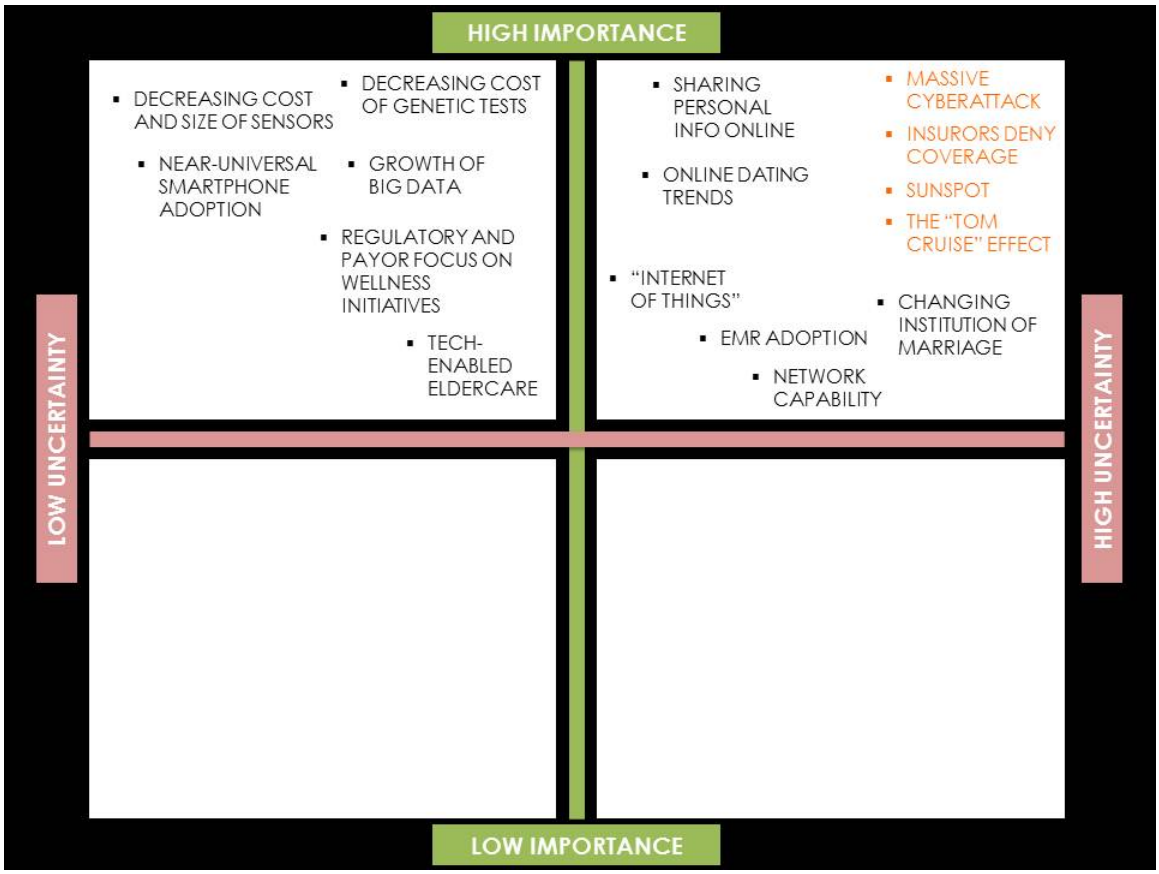
The timeline below presents both a historical timeline of events that relate to our focal question. It also depicts the "cone of uncertainty" we foresee developing. In terms of our forward-looking forecast activities, we use the year 2030 as a benchmark time period for our focal question, a little over fifteen years into the future.

TIMELINE


WHEN will 23andMe become a dating service with 50% of the 18-29 year old U.S. population as users?
Technology
Society
Healthcare
15th Century
Leonardo Da Vinci sketches the design of a pedometer in his notebook
1780
Perrelet created the first pedometer: mechanical switch with a counter
1914
Start of WWI
1933
Pedometers become popular in the U.S, marketed by the name of 'Hike-o-Meter'
1939
Start of WWII
1940
1 divorce in every 6 marriages
1962
Maurice Sokolow developed the initial semiautomatic Ambulatory Blood Pressure Monitoring device
1964
End of Baby Boom. 79 million babies born from 1946-1964
1972
1 divorce in every 3 marriages
1973
1st personal cellular phone Motorola was introduced
1990
It became popular for a treadmill to be equipped with a heart rate monitor
2001
Nintendo licensed a number of motion-sensing patents
1999
HealthPartners initiates a "10,000 Steps" program that was very well-received and pedometers become popular
2006
Quantified Self was launched
Nokia 5500 used 3-axis MEMS inertial sensor to detect the steps a user takes
2007
iPhone was released
2011
Smartphone Penetration approaches 40%
2012
first debut of Nike+Fuel band;
27% of internet users, or 20% of adults, have tracked their weight, diet, exercise routine or some other health indicators or symptoms online
2012
Google discontinues Google Health and Google PowerMeter
2011
1 in 5 relationships starts online
2010
1 divorce in every 7 marriages
1920
Wilbur O. Atwater begins first of ~500 experiments with the "respiration calorimeter": Modern day counting of calories is born.
1896
Start of the Baby Boom.
1946
End of WWII
1945
Halbert L. Dunn publishes "High Level Wellness", the father of the Wellness Movement in the U.S
1960
Journal of Preventative Medicine goes into publication
1973
1968
Stewart Brand launches the Whole Earth Catalog
Internet was introduced
1982
Match.com was founded
1995
Start of the dotcom boom
1990
The first approved gene therapy in the US was performed on a four year old girl, the effects were only temporary, but successful
Approximately 38 percent of adults use CAM: complementary and alternative medicine
2007
Facebook was founded
OkCupid was founded
2006
The emerging market for wearable wireless sensors is predicted to grow to more than 400 million devices annually.
80% Doctors start using genetic tests to identify patients with the potential to respond to a drug
AT&T starts to provide QS service: grows to 50% of revenue
real time heart rate monitoring wristwatch
Terrorist Attack: Digital hacking of personal data
Paper-based records no longer exists
Online matches proven to correlate to better relationship outcomes
Cost of DNA testing is driven so low as to become immaterial
Massive incident of identity theft of quantified self data
2028
Gene therapy largely adopted in the era of individualized treatment
Everything is automatically quantified
2037
Devices that tap brain waves will make it easier for the medically fragile and impaired to express their thoughts and sensation via a digital avatar of the human body.
2034
The U.S creates new government agency to centralize quantified data
The U.S debates eugenics
Celebrity Endorsement: Tom Cruise!
Sunspots cause Internet outage

DRIVING FORCES

Our analysis produced close to fifty potential driving forces we foresee impacting the future of quantified self as well as the outcome to our focal question. For the purposes of this paper, we selected nine of the most crucial driving forces. The majority of these are located in the upper right quadrant: high importance and high uncertainty. A few key driving forces discussed here are sourced the upper left quadrant: high important and lower uncertainty. Wildcards are shown in orange font.



INCREASING RATE OF ONLINE DATING

Today, 1 in 4 couples meet online and 1 in 5 marriages started as online relationships. The increasing popularity of online dating and the trend towards "people discovery" websites, also known as implicit dating sites, will have a significant impact on the future of QS-enhanced dating. Studies show a clear trend toward alternative means of finding a romantic partner. According to a 2010 Stanford University sociological study, the most common way that couples meet is still through friends and family—but the gap is being quickly closed by online dating. The power of information supplied by the Internet opens up a new avenue of dating possibilities and communities.

OkCupid has introduced data-driven trends into the minds of its uses. For example, its trends report revealed that on average, its users are two inches shorter in real life than reported in profiles, and users are 20% poorer than they say they are. The site gathers information from the profiles of its millions of active users to distill these conclusions. This is an important because as the Quantified Self movement gathers steam, individuals will suddenly be armed with copious numerical information about themselves. What people will do with this information is still uncertain, but it's perhaps not unimaginable that at least some of QS information such as calories or blood pressure could become fodder for online dating sites.

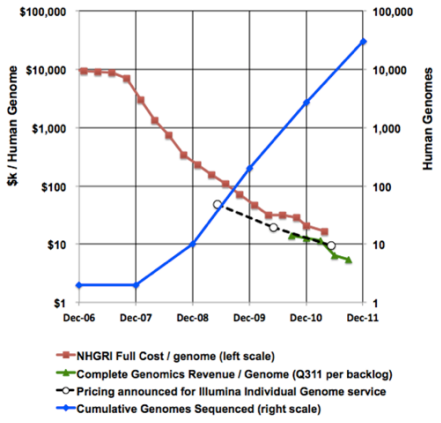
Additionally, online dating can expose individuals who would otherwise not have the ability to meet because of social stigmas, geographical limitations, or lack of diversity. Studies reveal that inter-faith and inter-racial couples are more likely to be connected via the Internet rather than by traditional means. The information provided by the online community is empowering people to make well-informed decisions about relationships, while giving them the sense of security and comfort of relative anonymity until they feel comfortable meeting in person. What if the algorithms used to match people online were sophisticated enough to incorporate quantified self data to further refine matches and introduce a completely new level of intimacy.

The online dating community is an extremely fragmented landscape. Large, public companies, with memberships in the millions like Match, eHarmony, and OkCupid, dominate the market. However, there are hundreds of smaller, niche online communities whose members total a few hundred. Examples include LoveBitten.net (for vampires), FarmersOnly.com (for "down to earth folks only"), ChristianSingles.com, and DateCraft (for Warcraft fans). The rising popularity of online dating and the growth of mobile technology could present the perfect environment for QS-enhance dating to take hold and begin to flourish.

DECREASING COST OF GENETIC TESTING

Over the last five years, the exponential increase in processing power and accelerating decease in cost has caused the cost of gene sequencing to drop dramatically. Simultaneously, the cumulative number of genomes sequenced has risen steadily. Today there are dozens of firms working to push the cost of sequencing an entire human genome below $1,000. According to Clifford Reid, founder of Complete Genomics: "In my mind, researchers and clinicians should be anticipating that, within the decade, a whole human genome will be comparatively priced to a comprehensive blood test. In other words, if there is a compelling medical reason to sequence a genome, cost will likely not be the barrier." The evolution of the price of genomic testing mirrors that of chips in the semiconductor industry. The decreasing cost of chips transformed the cost of computing and made personal computer ownership financially feasible for the average American.

EXHIBIT X
"RAPIDLY DECREASING SEQUENCING COSTS"



SOURCE: PERSONALIS, INC.

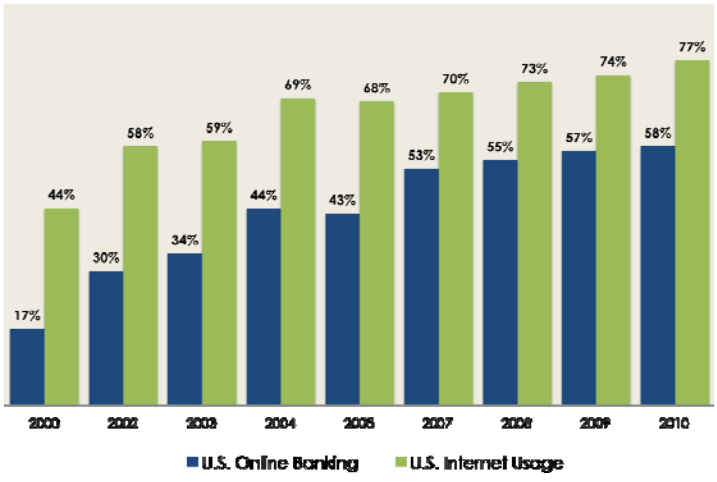
Personal genetics testing isn't useful to anyone if it costs $10 million per sequenced genome—which it did in 2006, according to this chart. Therefore, the falling cost of gene sequencing is an essential ingredient to the popularization of personal genetics and the increased usage of it as a medical diagnostic tool. Today's genetic sequencing companies have an incentive to move down the cost curve as quickly as possible and gain market share accordingly. In a world where genetic sequencing costs no more than blood work, genetic testing—both from a populist 23andMe perspective and a rigorous medical perspective—could become mainstream. With the price of genetic testing steadily decreasing and the number of sequenced genomes steadily increasing, we are poised for genetics to revolutionize medicine and transform our knowledge of ourselves. Therefore, it is a key driving force behind a quantified self future in which 23andMe is a dating service.

INCREASED SHARING OF PERSONAL INFORMATION ONLINE

A quantified self activity could be as simple as tracking calories consumed using pen and paper. However, our vision of quantified self in the future assumes that the collection of personal information will be sensed, captured, transmitted wirelessly over a network, and then visualized to the user and stored online for later historical analysis. Therefore, a necessary component of this network-based future is society's trust in sharing personal information online. There is a security component to this (Will my personal data be secure and protected from cyberattack?) as well as a mindset component (Am I comfortable with sharing sensitive personal information online and sharing it with others?). This latter is difficult to measure, but can perhaps be approximated by the adoption of online banking.

According to the Pew Internet & American Life Project, 17% of survey respondents had done online banking in 2000. By 2010, this had risen to 58%. Internet usage clearly trends up during this period as well, but outpaces the rate of online banking. The average gap between the two usage rates over this ten-year period is 22%. One benign interpretation of this data is that some Internet users simply had no need for online banking. However, a different interpretation is that this data reveals a gap in trust of web activity. Not everyone using the Internet is willing to share personal information about their finances online. They fear security breaches that could threaten their financial security. They worry about data privacy. Or they simply don't like it, don't have need of it, or prefer to do their banking traditionally, in-person. The data around online banking activity in the U.S. shows the presence of a trust gap: for a portion of the user population, a discomfort with personal information on the web. Certainly, in any future scenario, there will be individuals who opt not to share their information. However, generational forces need also be taken into account. Today's adults are, in general, less tech-saavy and more concerned about privacy than future generations will be—and this could reduce the trust gap observed here with the online banking data.

EXHIBIT X
"IF AN INTERNET USER, HAVE YOU EVER PAID BILLS OR BANKED ONLINE?"



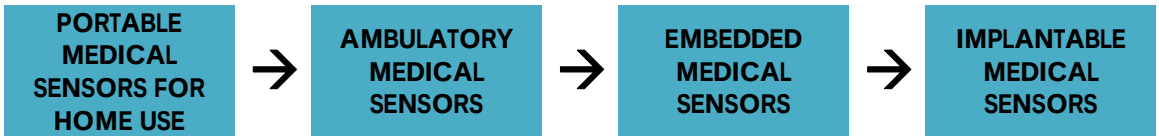
SOURCE: PEW INTERNET & AMERICAN LIFE PROJECT.

DECREASING COST AND SIZE OF SENSORS

A sensor is a device that receives and responds to a signal. A world of ubiquitous, networked sensors is essential to drive mainstream adoption of quantified self. Therefore, it is essential to understand the development of sensor technology (or embedded wireless communication technology) and how it applies to smart devices.

There is a long history of using sensors in medicine and public health. There are generally two kinds of medical sensors. First, there exist sensors that combine transducers to detect electrical, thermal, optical, chemical, or genetic signals with physiological origin with signal processing algorithms to estimate features indicative of a person's health status. Second, there exist sensors that directly measure an individual's health state. For example, location and proximity sensing technologies are being used to improve the delivery of patient care and workflow efficiency in hospitals. Traditionally, medical sensors have been too costly, large and complex to be used outside of clinical environments. However, advances in technologies such as microelectromechanical systems (MEMS), imaging, and microfluidic and nanofluidic lab-on-chip are leading to new forms of chemical, biological, and genomic sensor-based analysis available at the point-of-care. Recently, MEMS is getting smaller as NEMS technology has shown up. Recent advances in microelectronics and computing have medical sensing widely accessible to individuals at home or work. The graphic below shows the evolution of medical sensor development, towards smaller and more convenient devices. Additionally, sensors became capable of interfacing to external devices via wired, wireless and mobile connections, allowing them to communicate directly with cloud computing services. This enables convenient data sharing between doctor and patient.

EXHIBIT X
"MEDICAL SENSOR DEVELOPMENT"



sdf

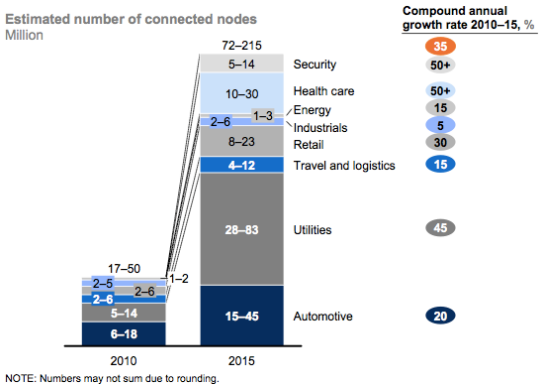
Additionally, sensor technology has developed in the fitness industry. From the creation of pedometers all the way back in 1780 to the emergence of accelerometers designed with piezoelectric pressure transducers in the early nineteenth century, the sensor industry today depends on electronics and information technology. Modern pedometers and fitness devices rely largely on MEMS and programmed software, which improves the accuracy of measurement and increases its design opportunities. Current sensors used in fitness devices like the Fitbit or the Nike+ Fuelband are MEMS altimeters and MEMS 3-axis accelerometers. Although the sensors themselves are key technology, the high price (the Fitbit costs $99.95, while the Nike+ Fuelband costs $149) is partly due to the revolutionized way of applying this sensor technology in fitness devices.

The decreasing cost and size of sensors represents "low uncertainy" on our matrix of driving forces. However, the sensor technology development is critical to our forecast. The fitness device boom reflects robust customer demand, and as the price will inevitably be driven down both by high-volume production and new technology, its market will be further stimulated.

MOMENTUM BEHIND "INTERNET OF THINGS"

Technologists have long hailed the dawn of the "Internet of Things"—where sensors and devices are embedded in our physical world and connected to us over networks. The McKinsey Global Institute recently published an in-depth report with the chart shown below, which suggests that the number of connected nodes will increase dramatically. Connected nodes are networked sensors that capture and transmit data to be used for analytics and decision-making. McKinsey estimates that the overall number of connected nodes around the world will grow by a 35% compound annual growth rate from 2010 to 2015, to an aggregate number of 72-215 million in 2015 (from 17-50 million estimated in 2010). The industries estimated to be the most impacted by the proliferation of connected nodes by 2015 are utilities, automotive, healthcare, and retail.

EXHIBIT X
"DATA GENERATED FROM THE INTERNET OF THINGS WILL GROW EXPONENTIALLY"



SOURCE: MCKINSEY GLOBAL INSTITUTE.

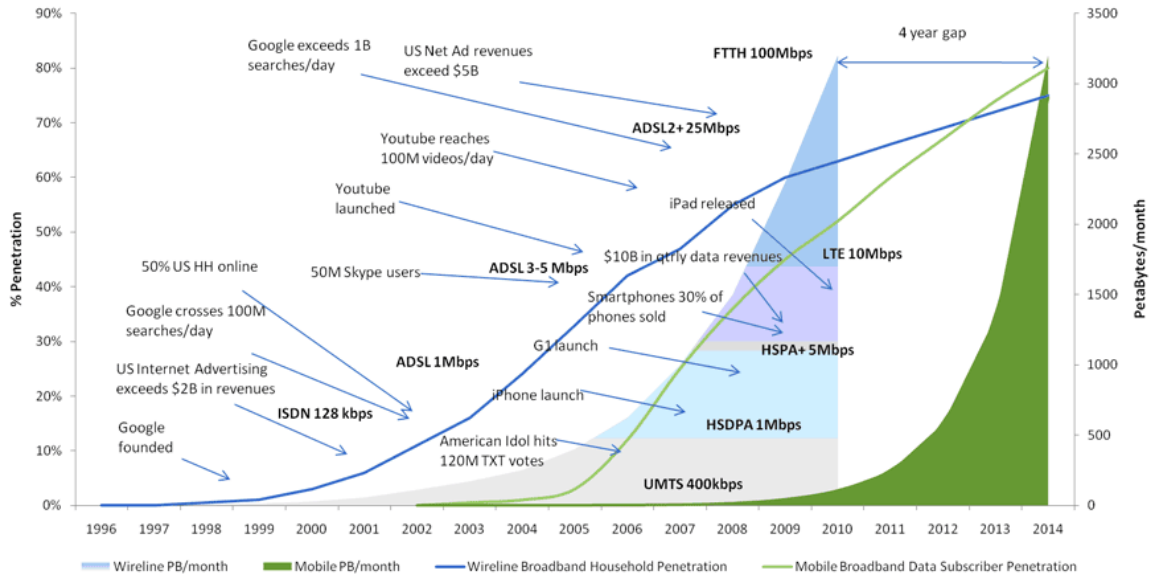
Indeed, the applications are easy to imagine and quite compelling. In utilities, operators could install smart meters and smart appliances; in healthcare, sensors could be drive the growth of remote health monitoring; in retail, RFID tags could transform shopping behavior and marketing insights; in the automotive industry, sensors will increasingly be installed in vehicles to track driving patterns and driver behavior (already being done by some car insurance providers). This data can be used for information and analytics, or even automation should human intervention in response to the data become unnecessary. The falling cost and decreasing size of chips used in sensors, combined with the massive increase in computing power available to crunch large amounts of raw data, suggest that the environment is ripe for a true emergence of the Internet of Things.

This is applicable to the future of quantified self because if the "Internet of Things" takes off, it signals that society is that much more comfortable with quantifying many aspects of our environment and activities. In the past, even a basic idea such as a smart meter met with resistance from the public because of privacy concerns. A society that resists a smart meter measuring in-home water usage will likely be equally unreceptive to quantifying and publishing personal data! But perhaps the tides are turning. Recently, Kleiner Perkins-backed (and Palo Alto-based!) Nest Labs released a "smart" thermostat that learns in-home heating and cooling preferences and can be controlled remotely. The thermostat had a year-long waiting list within a week of its release.

INCREASING NETWORK CAPABILITY

With the rise of companies focused on "big data" and the increase of network speeds available to consumers, network capabilities are expected only to rise in the coming years. Companies like Google, focused on compiling all of the world's information, push the boundaries of contextual awareness available online. Mobile connectivity only increases the power of this technology and allows for newer forms of interaction to be documented and discovered. The chart in Exhibit X represents the penetration rates of both mobile and wired communication rates over the past 18 years. As the chart suggest, it is possible that over the next several years, the amount of data used and the availability of mobile technology will surpass that of fixed line services. We forecast a world of ubiquitous sensing and connectivity—but that depends on sufficient network capability. In this world, the essential lifestyle and health and wellness data will be captured, quantified and visualized back to the user in a near real-time interaction. This shift in human perception will fundamentally change the way in which people relate to one another and could impact dating rituals.

EXHIBIT X
"BROADBAND PENETRATION AND TRAFFIC FOR WIRELINE AND MOBILE (U.S.)"

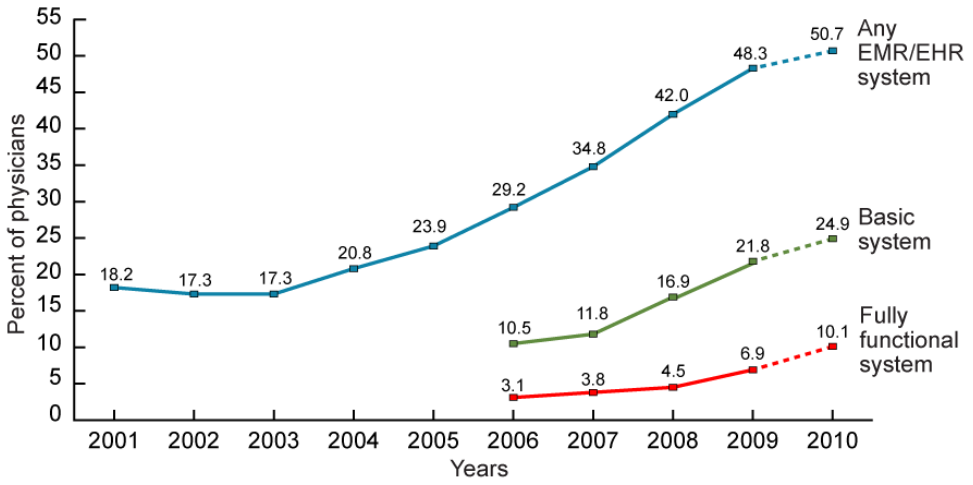


SOURCE: XYZ.

SLOW PACE OF ADOPTION OF ELECTRONIC MEDICAL RECORDS

The healthcare industry in general has been slow to adopt either electronic medical records (EMR) or electronic health records (EHR). To be specific, an EMR is regarded as the patient record that is used to form the EHR. The electronic health record is a system in which caregivers across hospitals and medical institutions can access an individual's accumulation of electronic medical records. As of 2010, roughly one in every two doctors in the United States had implemented some sort of EMR/EHR. Later versions of this survey indicate that, by 2011, this same metric has risen approximately 6%. If the trend continues at this pace, it will be another ten to fifteen years until the healthcare system fully embraces EMR/EHR systems.

EXHIBIT X
"PERCENT OF PHYSICIANS UTILIZING EMR/EHR SYSTEM"



SOURCE: CDC/NCHS, NATIONAL AMBULATORY MEDICAL CARE SURVEY.

As part of healthcare reform, the U.S. government has allocated billions dollars to develop of health IT and health professionals will be incentivized to adopt some form of electronic health records by 2015. So why have hospitals been so slow to adopt this technology? One issue often raised is the long-term financial situation of healthcare providers. Many hospitals and institutions face an economic loss with more efficient healthcare delivery, especially in a fee-for-service situation. In an environment based on social services, the increase in efficiency offered by an electronic health system can lead to a number of job losses. While technology, in the end, may create more jobs than it destroys, a slow adoption rate of such tech-enabled tools is proof of the social restructuring underway today. Additionally, electronic medical systems require time to both implement and learn. This is time taken from the health provider—time that could otherwise be used to see additional patients. Slow adoption rates of EMR signals an area ripe for change. The healthcare industry as a whole is a defragmented system that lacks proper communication channels to share information. However, assuming this changes, it is highly relevant to the future of quantified self. EHR signals a tech-enabled society and, if universally adopted, could offer a centralized platform to consolidate all personal health info.

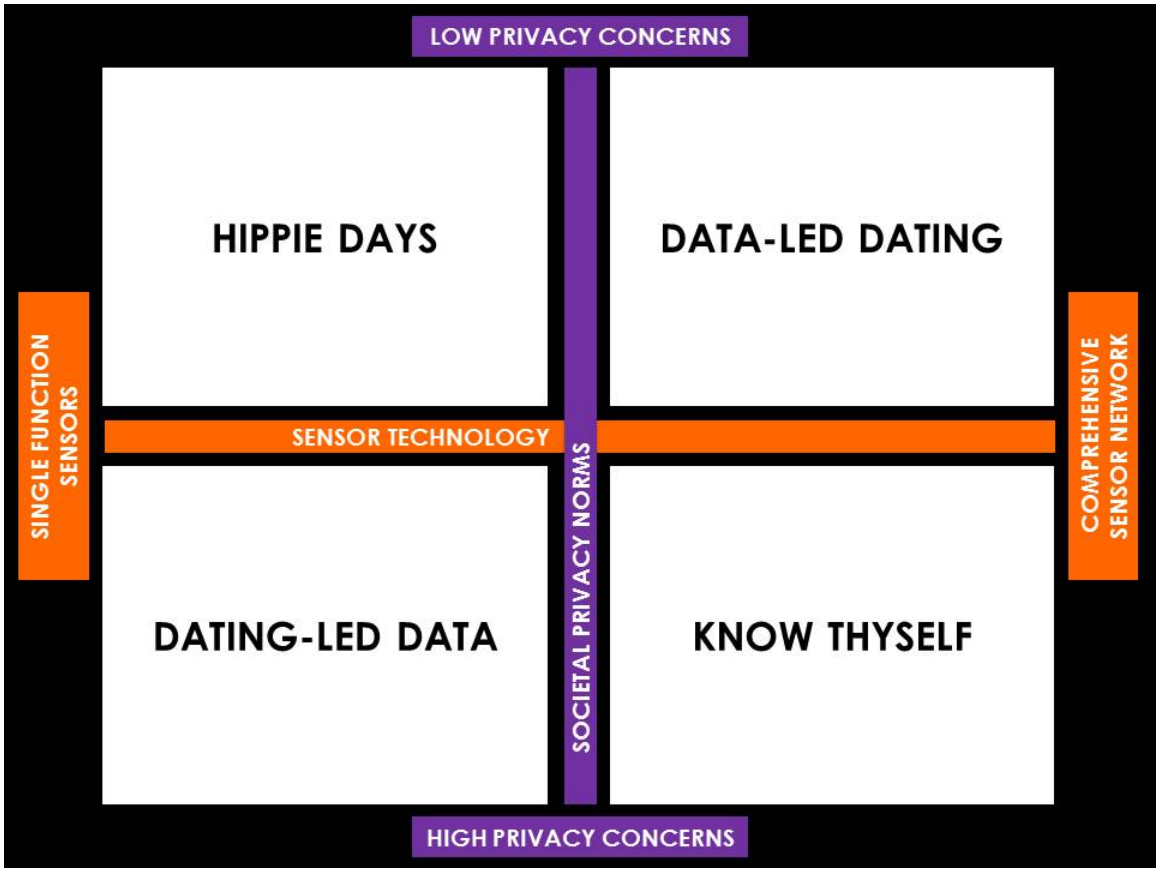
CHANGING INSTITUTION OF MARRIAGE

The changing institution of marriage could influence the adoption of QS-enhanced dating. QS-enhanced dating might help make better initial matches, thereby helping to develop well-matched couples with the potentiail to stay together over the long-term. Statistics surrounding marriage rates are ambiguous at best and downright misleading at worst. However, when taken in aggregate over the nearly half a century, several interesting trends reveal themselves. Throughout the past half century, the percent of married adults has been steadily declining. According to U.S. Census Data, the percent of married adults was approximately 70% in the 1950s, yet today hovers at just over 50%. According to the analysis of Paul Saffo at DISCERN Investment Analytics, the future of marriage in the U.S. is a rather bleak proposition: "If the current rate of decline continues, marriage will become a custom practiced by a minority of Americans before this decade is over and by 2050 less than one quarter of U.S. adults will be in marriage relationships. Marriage is a social arrangement with profound economic effects touching everything from the size of the cars we buy to the shape of the homes we live in. As fewer adults marry, the economic consequences are certain to hold more than a few surprises." However, given human nature, a war or national disaster might cause people to flock to the safety and traditional structure of marriage. This pattern has been observed around wars in America's past.

Along with the declining rate of marriages is the oscillatory trend of divorce. Data from the Marriage in Contemporary America reveals a cyclical trend. In 1920, 1 in 7 marriages ended in divorce. In 1972, 1 in 3 marriages did so. In the 1980s, the divorce rate was 1 in 5 and 1 in 6 by 2009. A higher divorce rate might logically lead to a lack of faith in the institution of marriage. Yet, the pool of eligible singles swells with every divorce and separation. The dating choices of divorced individuals is unclear. Perhaps they lose faith in lasting relationships and pursue self-gratifying casual relationships. Alternatively, an influx of recently single individuals is the perfect demographic to use technology and innovative dating tools, like online dating or QS-enhanced dating, to help coach them into a more healthy and fulfilled relationship. Overall, the changing institution of marriage—specifically the declining rate of marriage—could be a driving force behind QS-enhanced dating.

SCENARIO MATRIX

While there are numerous single scenario matrix axis combinations that would lead to interesting and illuminating forecast scenarios, we decided to focus on the duality between technology (sensor technology) and humanity (societal privacy norms).



RATIONALE FOR AXES

X-AXIS: SENSOR TECHNOLOGY

The x-axis of sensor technology articulates the rate of sensor technology innovation. Sensor technology is a key driver for our focal question because all QS-related development hinges on the ease of use and transportability of self-monitoring sensor technology. Since sensor-based research and development is unlikely to slow or stop entirely, it was decided that the best way to structure this axis was as a rate of change of sensor technology innovation, starting from the current level of technology and projecting forward. The left extreme of the axis is described as a single function sensor environment (SFS), representing a slow progression from the status quo. The rigiht extreme of the axis is termed a comprehensive sensor network (CSN), representing a fast progression from the status quo. A world with SFS technology as the norm would be one in which the average consumer would use devices like pedometers or FitBits to count the number of steps taken and the number of calories burned. The information might be

displayed on a small LCD screen for the user to see immediately or sent wirelessly to a web server to be displayed on an online dashboard. The gathering and displaying of information is piecemeal, one-off, and captured by a handful of different sources and metrics. By contrast, a world with CSN technology as the norm would be one in which the average consumer exists in an environment saturated with sensors and monitoring devices. CSN technology represents an infrastructure-based system that connects all sensors—from the most basic pedometers to the most sophisticated mood-monitoring devices—together to form a network of metrics, centrally stored and easily accessible.

Driving forces that could affect the rate of sensor technology development are primarily the continued demand for advancements in mobile technology, the growth in computing power and big data analytics, and the reduction in size of integrated circuits/processors. These driving forces would have tremendous impact on our forecast because QS-enhanced online dating assumes there is sophisticated technology in place to gather QS data. However, given likely continued progress of sensors discussed earlier, it is unlikely that sensor technology stagnates or ceases to innovate.

Y-AXIS: SOCIETAL PRIVACY NORMS

The y-axis of societal privacy norms articulates the default level of social openness to traditionally private information, such as healthcare or personal biometric information. The axis has as its extremes "Low Privacy Concerns" and "High Privacy Concerns". On the top extreme, Low Privacy Concerns represents a society where openness is paramount and individuals are by default opted into information sharing networks and open to sharing personal information. Only in rare instances will people opt out. In contrast, the bottom extreme of High Privacy Concerns represents a society where privacy is paramount and individuals are by default opted out of information sharing networks and averse to sharing personal information. Only in rare instances will people opt in.

An example of a world with Low Privacy Concerns is one in which the average person is very comfortable sharing both medical and biometric information within specific social groups. These groups could be either purely medical in nature, like an electronic medical record, or recreational sharing across one's social graph of family and friends. The polar opposite world, one that has High Privacy Concerns, is one in which medical and biometric information is safeguarded and kept strictly private. People are averse to sharing records and only do so under necessary circumstances—and even then, might only do so anonymously. Another explanation for this world would be to simply take the status quo of 2012 privacy norms projected into the reality of 2030, namely all of the privacy policies and opinions toward information sharing of today remaining quasi-constant until 2030.

Together, these axes successfully correlate technology with human bias and opinions on privacy. The four quadrants that are generated offer substantially different worlds, all of which have the possibility of occurring.

DESCRIPTION OF EACH QUADRANT

Each of our quadrants describe a different world of dating.

LOWER LEFT QUADRANT | "DATING-LED DATA"

In this world, single function sensors collect and organize real life situations. This is a world in which the feedback loop of a dating service, like OkCupid, must be entered manually, akin to a food journal logged by hand. This quadrant most approximates the status quo, where online dating occurs and data observed and collected in person drives relationship outcomes. In this scenario, people enter dating metrics and computers try desperately to keep up with rapidly changing nature of human interaction.

UPPER RIGHT | "DATA-LED DATING"

In this world, algorithmic, QS-enhanced dating is implemented. Personal genetic information and massive streams of quantified self data are made transparent during the dating process. This allows for more choice, selectivity, and efficiency in online dating. Perhaps Artificial Intelligence algorithms are used to suggest possible matches to individuals in a personalized fashion. Depending on your preferences, this world is one where people can tweak their "dating dashboard" in order to connect with their potential significant others.

LOWER RIGHT | "KNOW THYSELF"

In this world, people are empowered by the comprehensive sensor network that has become part of everyday life. Behavioral metrics are automatically tracked and analyzed for further self-development. This is a world in which designer genes become a cosmetic medical intervention used by people at their own discretion.

UPPER LEFT | "HIPPIE DAYS"

Here, we have a return of the "free love" movement of the 1960s. Humans connect and interact on a deep emotional level without the aid of technology or analytics. We are in the era of a technological renaissance in motion.

WILDCARDS

Wildcards are events whose probability of occurring are lass the 10% but whose impact is universally transformative and will dramatically alter the outcome of any given forecast. When viewed in the context of a forecast, more specifically a cone of uncertainty, the wildcards help to define the outer bounds of what is possible and probable. They are the edge cases to that help focus and contain the uncertainties relating to the given forecast.

For the purposes of forecasting the role of quantified self information in the world of dating and relationships, we consider four wildcards. The following passages are written in the era of our focal question, 2030, and detail the global implications and effect on the scenarios. In some cases, wildcards have the ability to transform the forecasting landscape in such a way that none of the outlined scenarios hold true. For these cases, a new scenario will be proposed.

SUNSPOT (ELECTROMAGNETIC PULSE) KNOCKS OUT ALL ONLINE DATA

Infrastructure as we have come to know it grinds to an alarming halt. Airliners are grounded. Mass transit is rendered useless. Digitized information is completely lost and irretrievable. We are back in the pre-IC era of technology. Society is in a state of shock and susceptible to anarchist movements and religious fanaticism. As the country begins to rebuild, a growing distrust for technology begins to take hold of the population as people begin to fully understand the level of societal dependence on technology. With the economy and major institutions reeling, more traditional values become the focus of society. People become more focused on family, close friends, and staying connected to those close to them. Now that the infinite reach of the internet and technological connectivity is gone and people shrink their social circles, making society resemble what is was before rise of mobile and the Internet.

Similarly, not only do many people begin to look more toward non-technological means of going about their day-to-day lives, they lose their focus on social media and in turn technology-enhanced dating takes a major hit. Proximity becomes the main driver in finding a compatible partner. Even if the digital infrastructure gets back up and running relatively quickly, the social landscape will be fundamentally changed for a period of perhaps five to ten years. In conclusion, a massive Internet black-out would reshape the social landscape in such a way that would render the thought of Internet dating a past folly not to be revisited until quite some time later.

HEALTHCARE/HEALTH INSURANCE USE QS INFO TO /DENY COVERAGE

The insurance agencies now have real-time access to the QS data of every potentially-insurable individual. Perhaps this information is granted by individuals, or perhaps the insurers access it surreptiously. Insurance policies can be completely fluid or adjusted based on lifestyle choices and health levels as much as their predisposition to disease. Standard health insurance policies can be voided, nullified, or altered at any time based on the QS data that comes in. (Note: This is a split wildcard in that either QS information can help people get coverage or it can cause them to be denied coverage. This will explore just the case of QS information being used to deny coverage.)

Assuming that QS has elevated from a grass-roots movement to the mainstream, the effects of this shift in medical insurance policy would be widespread. If the result of QS is

a potential reduction in healthcare, the adoption rates of QS will plummet and all QS-related ventures such as QS-enhanced dating will crumble as well. All in all, this would be disastrous for mass adoption of QS and its applications in the dating world. If insurance companies can access QS data to deny coverage or raise rates, then there is little hope that a QS-enhanced dating venture will ever gain traction. If one were to already exist, then it is doomed to fail immediately.

MAJOR CYBER ATTACK TARGETS HEALTHCARE INFORMATION

The next major terrorist attack could be a cyber attack on all repositories of healthcare information, centralized or not. According to a March 2012 article in the New York Times, this is a real possibility, with the FBI reporting that terrorists have shown interest in pursuing hacking skills. If you were a bad guy, what might you do with access to all of America's personal information? An attack might irreversibly erase or corrupt medical records or, worse, alter micro-bits of information so that improper, untraceable medical advice or prescriptions are prescribed. Pacemakers are an example of a medical device that can be monitored online and, if hacked, could malfunction and cause disastrous harm to its users. Were all pace makers, respirators, and Da Vinci robotic surgical units suddenly being controlled by hackers (or simply switched off), the results would be catastrophic. Any and all healthcare-related fields would be in crisis. Paper records would become the standard again until public fears could be assuaged about the security of the medical records.

As a result, public opinion towards sharing medical information becomes heavily biased toward complete privacy. While quantified self is still a tangential component to hospital records, mass panic and hysteria surrounding a widespread cyber attack would cause Americans to lose faith in the security of their data online. It is hard to imagine a situation where people would still feel comfortable using any form of medical-related information to help make a compatibility match given its potential for fraud. In short, any cyberattack on the healthcare industry would bring a swift and immediate end to the credibility of all online medical services or communities like QS and any QS-enhanced dating sites.

THE "TOM CRUISE EFFECT"

If a celebrity or major public figure, like Tom Cruise or Barack Obama, became a public advocate of data-driven dating, it could be a wildcard driver of the upper right quadrant scenario. Perhaps this celebrate discloses that they met their beloved partner utilizing QS-enhanced dating and are incredibly happy as a result (think Tom-Cruise-jumping-on-Oprah's-couch-happy). The effects of such a high-profile public endorsement would cause a massive rise in the popularity and use of QS and QS-enhanced dating ventures. New ideas, projects, and applications would start as a result. QS-enhanced dating will become "all the rage": the next social fad like the Snuggie or the Slap Chop. If people find it useful, the potential for sustained success is very real. But, in all likelihood, the momentary popularity fades as the excitement behind the endorsement wears off. Perhaps a smaller group of people begin to see QS as a quasi-religion, and adoption picks up like Scientology did when Tom Cruise came out publically endorsing it. This group will see QS as the only true means of determining compatibility and "ideal" matches will be formed based almost entirely off QS information. These groups will become the avant-garde of the QS movement, perhaps driving QS 2.0.

UNINTENDED CONSEQUENCES

MASSIVE HIT TO OUR ATTENTION SPAN

In a world of constant connectivity and information overload it can be difficult to concentrate on what it is we need to do from moment to moment. What do I eat for lunch? Where do I go shopping for clothes? Making personal decisions is a very subjective experience and more distracting than anything is the constant bombardment from advertisers looking to sell you "exactly what you are looking for." With the flood of emails and notifications from the host of Social Networking Services we sign up for, having yet another layer of abstracted interaction is bound to confuse you at one point or another.

THE CREATION OF THE "DESIRABLES" AND THE "UNDESIRABLES"

Just as we see the Occupy Movement drawing a line between the 1% and the 99%, an integrated model of humanity used for dating could segregate the population even further as we draw yet another line in the sand. Is this evolution in its natural form or a synthetic form of Darwinism based on the very essence of a quantified existence?

OUR DIGITAL SELF COMPETES WITH OUR REAL SELF FOR OUR TRUE IDENTITY

Imagine a world in which a digital avatar runs free from the oppression of daily existence and interacts in another world with other fellow digital beings. Sounds like a video game or a James Cameron movie. As digital media accelerates growth in our mental space online persona have taken on more of our will to be what we truly desire. What happens when that comes in direct contact with our physical identity? When the line between virtual and real become blurred beyond recognition who is to say which is which.

NEW GOVERNMENT AGENCY FORMED TO REGULATE CONSUMER DIGITAL DATA PRIVACY

In light of the recent SOPA and PIPA acts by the United States Government imagine an entirely new branch of government formed on the basis of digital privacy. Would the government have the authority to tax your data rights? Would Internet criminals such as online bullies and hackers fill our prison? As the powers that be struggle to understand the advance communication technologies based on these systems, more regulation is not unforeseeable in the near future.

CONCLUSION

FORECAST
AREAS OF OPPORTUNITY
RECOMMENDATIONS

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JULIA RUSSELL, INTERACTIVE CORPORATION

ERNESTO RAMIREZ, QUANTIFIEDSELF.COM

ZAK HOLDSWORTH, WELLNESSFX

DAVE HODGSON, WELLNESSFX

TEAM

XIAO GE
STANFORD MECHANICAL DESIGN ENGINEERING
MOST LIKELY TO QUANTIFY: STITCH PATTERNS OF ANYTHING KNITTED

ALEX GRANIERI
STANFORD MECHANICAL DESIGN ENGINEERING
MOST LIKELY TO QUANTIFY: AVERAGE SNEEZE VELOCITY... ACHEW!

LINDSAY RUSSELL
STANFORD GRADUATE SCHOOL OF BUSINESS
MOST LIKELY TO QUANTIFY: TRIPS TO ART MUSEUMS ANNUALLY

ADAM SHEPPARD
STANFORD CENTER FOR DESIGN RESEARCH
MOST LIKELY TO QUANTIFY: NUMBER OF ALBUMS LISTENED TO DAILY

APPENDIX: TEAM DATABOOKS

1. GET YOUR GOALS CHEERED BY QUANTIFYING YOURSELF (XIAO)
2. ENJOY YOUR NEED DIET (XIAO)
3. DATING IN THE MELTING POT (XIAO)
4. COULD THE AGING SOCIAL NETWORK SAVE ONLINE DATING AT 23ANDME? (XIAO)
5. OPEN TO OPENNESS (ALEX)
6. A TOTAL HEART-RATE THROB (ALEX)
7. INTERNET BREEDS DIVERSITY WITHIN ROMANCE (ALEX)
8. VIRTUAL FIRST DATES A REALITY TODAY (ALEX)
9. 80%: DARN CLOSE (A TECHNICAL TERM) TO 100% (LINDSAY)
10. MIND THE (TRUST) GAP (LINDSAY)
11. "X" MARKS THE SPOT (LINDSAY)
12. TODAY, THE INTERNET; TOMORROW, THE INTERNET OF THINGS (LINDSAY)
13. ELECTRONIC MEDICAL RECORD ADOPTION (ADAM)
14. PREVENTATIVE CARE AND THE DOCTOR PATIENT RELATIONSHIP (ADAM)
15. BROADBAND ADOPTION (ADAM)
16. QUANTIFIED SEX (ADAM)