Interdisciplinary Collaboration in Mental Health Tech

Collaboration between mental health professionals and the technology sector is in its infancy and can be difficult to achieve due to deep epistemological differences that impede trust and make cooperation difficult. However, effective partnerships offer a wealth of possibilities for both here both parties, as well as consumers. The following discussion presents an overview of typical software development trajectories and includes key benefits likely to occur as a result of collaboration, concluding with suggestions for real world opportunities to build effective cross-disciplinary teams.

Conflicting paradigms deter trust and collaboration

Mental health care and research is built on decades of carefully accumulated knowledge that operates according to highly regulated avenues of inquiry and intervention. Established methodologies act as safeguards to both patients and practitioners, minimizing injury and liability, while maximizing care outcomes. Rigorous standards also facilitate public trust in healthcare and scientific discovery by ensuring a degree of reliability and validity of methods and claims made about disease progression, treatment and outcomes. Unfortunately, current pathways for achieving mental health outcomes are lengthy and expensive, resulting in shortages of care and delays in research and development of new treatments and interventions.

The healthcare community's tendency towards slow and steady trajectories built on incremental, linear gains are in direct contrast to the founding ethos of the tech sector, whose apocryphal

mantra, circa 2004, was often cited as “Move fast and break things[1]”. Tech companies and startups notoriously operate in an altogether different fashion, with methods based on creativity, speed and innovation. Terms such as “disruption[2]” (of established standards and procedures) speak to an almost epistemological disdain for caution and deference to protocol. While these methods have potential to create groundbreaking new discoveries, the minimisation of safety precautions make it difficult to trust both the products and the processes by which they were produced.

Skipping protective checks is particularly dangerous in mental health tech because software interventions are typically released unsupervised to the public and may impact large numbers of people with no access to care or support. Traditional interventions and research studies, with far less reach, are not permitted to be conducted without proper ethical review and oversight. Therefore, it stands to reason that services delivered via software must be considered at least as carefully those conducted by practitioners.

This methodological disconnect is a barrier that can, and should, be overcome. Digital products can perform functions that support both research and treatment aims within mental health via solutions that are highly affordable and replicable in large, standardised quantities that imply low error rates. As a result, there is a potential to create opportunities for care and collection of data many orders of magnitude higher than traditional methods. However, because these

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[1] (n.d.). Jonathan Taplin Not Quite Ready to 'Move Fast and Break Things'. Retrieved January 4, 2019, from https://www.pcmag.com/article/355211/jonathan-taplin-not-quite-ready-to-move-fast-and-break-thin

[2] (2013, February 16). What “Disrupt” Really Means | TechCrunch. Retrieved January 4, 2019, from https://techcrunch.com/2013/02/16/the-truth-about-disruption/

approaches have the potential to impact the public in new ways, both positive and negative, they should not be implemented without collaborative oversight by experts in both fields.

Such epistemological differences and the relative newness of interdisciplinary strategies within the silos of academia certainly suggest that collaboration may not always come naturally. However, it is not all bad news. Unlike more traditional disciplines, the innovation arm of tech development, is already relatively open to interdisciplinary collaboration and new approaches that yield positive outcomes. This implies both a great willingness to collaborate and a familiarity and comfort with the flexibility of processes necessary to bridge paradigmatic gaps.

It also seems that a shift in tech industry values may be underway. The founder of Facebook, one of the world's largest tech companies with a reported 2.7 billion monthly users[3], said in April of 2018, "We have a responsibility to not just build tools, but to make sure these tools are used for good.",[4] implying that willingness to invest in ethical designs and quality control may be increasing. Similarly, projected 10 year job growth for user researchers in tech and design is valued at 19% and commanded an average salary of $94,670 in 2018[5].

This is not just news for potential collaborators, but news for consumers as well. Innovations in the business of mental health are booming, with the so-called "wellness" industry, reportedly

[3] (n.d.). • Facebook users worldwide 2018 | Statista. Retrieved January 4, 2019, from https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/
[4] (2018, April 9). Read Mark Zuckerberg's testimony to Congress, annotated - The .... Retrieved January 4, 2019, from https://www.washingtonpost.com/news/the-switch/wp/2018/04/09/read-mark-zuckerbergs-testimony-to-congress-annotated/
[5] (2018, August 28). UX Designer Salary Guide: From Junior to Principal Designer .... Retrieved January 4, 2019, from https://www.springboard.com/blog/ux-designer-salary-guide/

reaching a value of $4.2 trillion dollars in 2018[6]. Unlike academia and traditional science that operates under relatively strict definitions, ”wellness”, as defined by software creators can encompass essentially any service related to mental health, including anything from “neuro(science)-hacking” to CBT, Acceptance and Commitment Therapy, and disorders such as anxiety, depression and bipolar disorder[7][8].

Termed “solutions” in tech vernacular, and released for unregulated and unmonitored public consumption, software products may well approximate so called “light touch” attempts at intervention or diagnosis. Furthermore, because most products will take the form of software as a service (SaaS), discussed in more detail later, using offsite data storage and outsourcing certain functions to the internet or “cloud”, privacy issues become more complicated[9]. Development and distribution of such products without appropriate oversight may represent a danger to both public safety and trust.

Current software development models make no specific distinction, in role or process, for ethical oversight. Although some companies involve “domain experts” at certain points in product life cycles, most software development models are driven by profit and operate under “lean” or “agile” frameworks that strip away all but the barest necessities, operating instead via overlapping and shifting phases that are continuously refined following trial and error gains[10].

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[6] (n.d.). Statistics & Facts – Global Wellness Institute. Retrieved January 4, 2019, from https://globalwellnessinstitute.org/press-room/statistics-and-facts/

[7] (n.d.). Neurohacker Collective: Home. Retrieved January 4, 2019, from https://www.neurohacker.com/

[8] (2018, April 24). Top 25 Mental Health Apps for 2018: An Alternative to Therapy?. Retrieved January 4, 2019, from https://www.psycom.net/25-best-mental-health-apps

[9] (2018, June 13). How to Protect Sensitive Data in SaaS Applications | EdTech Magazine. Retrieved January 4, 2019, from https://edtechmagazine.com/k12/article/2018/06/how-protect-sensitive-data-saas-applications

[10] (2014, June 19). Lean Agile Process - Scrum Alliance Member-Submitted Informational .... Retrieved January 4, 2019, from https://www.scrumalliance.org/community/articles/2014/june/lean-agile-process

Softer concepts like trust and psychological safety have insofar not been considered profitable enough to emphasise[11]. Instead companies focus on more sales related metrics such as "engagement", or time spent on products, number of active users, and "scale" or ability to grow and manage increased demand[12][13]. Thus, although safety and precaution may not be at ideal levels, the tech sector's core strengths and emphases may be exactly what mental health needs.

Complementary needs: access and scale

Access may be the most significant challenge in current mental health care. Traditional service delivery requires complicated and costly operational pathways. As a result, mental health care shortages exist across a range of metrics with reports of 1 psychiatrist for every 100,000 in rural Australia[14], average wait times of 56 days in the UK for initial psychological treatments[15][16] and 111 million people in the US living in so called "mental health shortage areas"[17]. Statistics in developing countries are far worse, with .05 psychiatrists and .04 psychologists, per 100,000 in the lowest income countries in the world[18].

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[11] (2018, March 22). 5 Key Metrics Every Early-Stage Business Must Track | Inc.com. Retrieved January 4, 2019, from https://www.inc.com/craig-bloem/5-key-metrics-every-early-stage-business-must-track.html
[12] (n.d.). SaaS Metrics 2.0 - A Guide to Measuring and Improving what Matters .... Retrieved January 4, 2019, from https://www.forentrepreneurs.com/saas-metrics-2/
[13] (n.d.). What is Scalability? - Definition from Techopedia. Retrieved January 4, 2019, from https://www.techopedia.com/definition/9269/scalability
[14] (2018, April 15). Psychiatrist shortage of one in 100,000 in regional areas denies ... - ABC. Retrieved January 4, 2019, from http://www.abc.net.au/news/2018-04-16/psychiatrist-shortage-regionally-denies-clients-vital-help/9642058
[15] (n.d.). Waiting times - The Education Policy Institute. Retrieved January 4, 2019, from https://epi.org.uk/wp-content/uploads/2018/01/EPI_Access-and-waiting-times_.pdf
[16] (2018, October 8). Delays in NHS mental health treatment 'ruining lives' | Society | The .... Retrieved January 4, 2019, from https://www.theguardian.com/society/2018/oct/09/mental-health-patients-waiting-nhs-treatment-delays
[17] (2018, February 13). Addressing the escalating psychiatrist shortage - AAMCNews. Retrieved January 4, 2019, from https://news.aamc.org/patient-care/article/addressing-escalating-psychiatrist-shortage/
[18] (n.d.). WHO | Mental health statistical reports. Retrieved January 4, 2019, from https://www.who.int/gho/mental_health/reports/en/

However, these shortages are very good news for tech companies, for whom a gold standard, metric of success is scale, which requires serving large numbers of clients with the least amount of resources[19]. Compared with traditional mental health services requiring expensive, time consuming 1:1 service provision from highly trained professionals, tech companies strive to offer 1:infinity models. In short, tech excels in quantity, while scientists-practitioners excel in quality.

This complementarity of quality and quantity creates enormous potential for collaboration between technologists and mental health professionals, especially when applied to smartphone applications. According to Deloitte, 18-24 yr olds check their phone an average of 86 times a day, while older adults do so an average of 47 times a day[20]. What's more, 82% of people in developing countries and 80% of people in developed countries own or have access to smartphones[21]. If we combine existing engagement statistics with market penetration statistics, we find that the potential for interacting with the public via smartphones is staggering.

Even more impressive is the idea that these numbers only consider data collected through active engagement between the user and phone. They do not include the hundreds of thousands of data points mobile phone hardware and software collects passively 24 hours a day, 7 days a week that can also be used for research, diagnosis and testing. If harnessed appropriately, smartphone application reach can be leveraged for exponential increases in both research and the full spectrum of treatment regimens from testing, diagnosis, intervention, support and aftercare.

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[19] (2018, July 10). Scalability - Investopedia. Retrieved January 4, 2019, from https://www.investopedia.com/terms/s/scalability.asp

[20] (n.d.). Global Mobile Consumer Survey: US Edition | Deloitte US. Retrieved January 4, 2019, from https://www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/articles/global-mobile-consumer-survey-us-edition.html

[21] (n.d.). • Smartphone penetration worldwide 2014-2021 | Statista. Retrieved January 4, 2019, from https://www.statista.com/statistics/203734/global-smartphone-penetration-per-capita-since-2005/

Software as a third party in traditional dyadic relationships

Active information pathways

Traditional mental health models involving research, diagnostics and care are reliant on active engagement and participation between researchers/practitioners and participants/patients who generate, examine and act on data. Software operates similarly by engaging with practitioners, patients and their data, but allows for additional possibilities to augment engagement from any of the three or to outsource one or more processes to a machine.

In situ processes allow for highly personalised, sensitive and supportive information gathering and treatment strategies but are expensive, time consuming and difficult to standardise. They also require a minimum of two people agreeing and committing to a time and then working together across a set period to achieve specific goals. Outsourcing even one responsibility stream to an on-demand service provider, delivered via software, eliminates administrative costs of scheduling, decreases failure to show and can dramatically decrease lost time and resources. Because software is usually scalable and designed to perform across multiple platforms in parallel, it can instantly extend the capability of a single clinician, or intervention, to a large population of patients or participants, including those who are in crisis or are unable to attend clinical appointments due to poverty, disenfranchisement, geographic isolation, or other physical barriers. Access may extend even farther in some cases due to depersonalization of delivery methods. The anonymity, privacy and distance inherent in digitally mediated interactions may also work to decrease stigma around seeking help and increase communication in cohorts, such as teens or depressed individuals, that may find face to face service delivery uncomfortable[22].

[22] (n.d.). Web-Based Interventions Supporting Adolescents and ... - NCBI - NIH. Retrieved January 4, 2019, from https://www.ncbi.nlm.nih.gov/m/pubmed/29222079

Other advantages result from the replicability, precision and accountability of machines. Software performs identically every time it is deployed and does so with timestamping of each unique point of contact between user and machine, thereby minimising variance in service delivery and data collection, while maximising accountability all along the delivery chain.

Passive information pathways

With the exception of onsite observation or monitoring, passive strategies, are rarely possible in traditional care contexts. However, when software can be used to perform functions in lieu of humans, information can be collected and delivered using so called “passive” methodologies that require little or no attention, engagement or maintenance from either or both patients or clinicians.

Passive software functioning is extensive and increasing rapidly with multiple options currently in use across common hardware and software. A well known example is the GPS function, that measures where and when a device is at any given time, irrespective of input from phone owners. GPS can track and predict physical activity across such variables as time of day movement patterns, distance accrued across time periods or frequent locations visited. Cookies and third party tracking software, collect similar information about users’ cognitive activity and attention is at given time points. Data collected can be used by clinicians, scientists or other types of software to infer and predict future behaviors, tendencies and opinions. For instance, these data sources could be combined to predict patterns of mood and activity or location.

Software can also include threshold triggers that cue delivery of interventions, education or care at pre-specified intervals across data collection. These secondary functions can create a loop of further data collection and engagement. The possibilities are vast and not limited to phones or other traditional smart devices such as laptops and tablets. The IoT field, or internet of things, involves attaching software or hardware to offline items, such as speakers or pill boxes, providing “smart” functionality and enabling data collection by everyday devices.

Technologies for mental health

The main category of tech products likely to support mental health research and treatment are apps or websites deployed by mobile phones, laptops and other handheld devices in the form of cloud-based software as a service. Cloud-based software simply refers to the fact that data sent and received by users is stored and managed offsite, rather than traditional, closed onsite systems such as hospital databases[23]. SaaS essentially consists of different functions performed by a computer and a visual interface that allows consumers to interact with these functions comfortably[24]. Thus, SaaS can in theory perform many of the same functions as researchers and clinicians, albeit at varying levels of quality.

SaaS functionality, particularly as delivered by handheld devices, may also include aspects of Artificial Intelligence (AI) but is unlikely to include tools related to big data, machine learning, deep learning or blockchain which are more approaches to data analysis or management (blockchain) than consumer delivery systems[25][26]. Like all software, AI is a special type of code,

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[23] (2016, July 13). Cloud Vs SaaS: What's the Difference? - nChannel. Retrieved January 4, 2019, from https://www.nchannel.com/blog/cloud-vs-saas/

[24] (n.d.). What is SaaS? 10 FAQs About Software as a Service. Retrieved January 4, 2019, from https://www.softwareadvice.com/resources/saas-10-faqs-software-service/

[25] (2018, September 13). What is Blockchain Technology? A Step-by-Step Guide For Beginners. Retrieved January 4, 2019, from https://blockgeeks.com/guides/what-is-blockchain-technology/

or algorithm, that gives specific instructions to a computer and can be embedded within SaaS or other products. There are different types of AI approaches and each performs specific learning and predictive functions of varying levels of complexity[27]. Simpler forms of AI are well suited as a replacement for expert judgement and decision making, standardizing care pathways by calculating decisions according to complicated decision trees and minimising bias and errors common to humans[2829]. These approaches may suit individual consumer needs and are commonly incorporated into software products to add “smart” functionality.

Although multiple types of technologies exist, engineers and data scientists are best prepared to decide which types best suit particular tasks. There is considerable scope for collaboration between mental health professionals and data scientists working on AI and big data projects, particularly in limiting bias inadvertently built into models or fed into data sets[3031]. However, given the fact that consumer products almost exclusively rely on SaaS, the following discussion will use the Software Development Life Cycle (SDLC) as a framework for interdisciplinary collaboration[32].

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[26] (2018, July 11). What's the Difference Between AI, Machine Learning, and Deep .... Retrieved January 4, 2019, from https://blogs.oracle.com/bigdata/difference-ai-machine-learning-deep-learning

[27] (2016, July 13). Machine learning, statistical learning and the future of biological .... Retrieved January 4, 2019, from https://www.cambridge.org/core/services/aop-cambridge-core/content/view/7A6B51FCC58B10BDB8B51178AD52B50D/S0033291716001367a.pdf/div-class-title-machine-learning-statistical-learning-and-the-future-of-biological-research-in-psychiatry-div.pdf

[28] (n.d.). Should Artificial Intelligence Augment Medical Decision Making? The .... Retrieved January 4, 2019, from https://journalofethics.ama-assn.org/article/should-artificial-intelligence-augment-medical-decision-making-case-autonomy-algorithm/2018-09

[29] (2018, November 5). Clinical Decision Support in the Era of Artificial ... - The JAMA Network. Retrieved January 4, 2019, from https://jamanetwork.com/journals/jama/fullarticle/2713901

[30] (2018, March 26). The Risk of Machine-Learning Bias (and How to Prevent It). Retrieved January 4, 2019, from https://sloanreview.mit.edu/article/the-risk-of-machine-learning-bias-and-how-to-prevent-it/

[31] (n.d.). AI and bias - IBM Research - US. Retrieved January 4, 2019, from https://www.research.ibm.com/5-in-5/ai-and-bias/

[32] (n.d.). Systems development life cycle - Wikipedia. Retrieved January 4, 2019, from https://en.wikipedia.org/wiki/Systems_development_life_cycle

Ethical gaps in the SDLC

Recording and collecting of data, as well as intervening in patients' lives raises tremendous privacy and ethical concerns. Privacy of patient data is governed by strict and extensive policy guidelines in many countries, such as the Health Insurance Portability and Accountability Act (HIPAA)[33] in the US and the General Data Protection Regulation (GDPR)[34] in the EU. However, because the business of software development is relatively new, regulations to protect consumers are in their infancy. As of the beginning of 2019, the EU is the only body to have developed a regulatory framework addressing privacy and technology. The (GDPR) is mainly a privacy related measure and will likely need to be assessed and augmented as technological capabilities progress.

While established businesses, licensed health care providers and researchers operating under the auspices of formal institutions are likely to be aware of complying with ethical and privacy related regulations, most software is developed outside these structures. Typical software development processes do not yet include a standardised protocol for considering either consumer health or sensitivity of information collected. In particular, on development projects that tackle common, potentially sub-clinical mental health concerns such as anxiety, insomnia or depression, software developers typically rely on "market" or in-house research teams, with very limited training, to survey users. Although it may appear that safety testing is unnecessary, this is not always the case as has been demonstrated by the wealth of emergent evidence showing

[33] (n.d.). Health Information Privacy | HHS.gov. Retrieved January 4, 2019, from https://www.hhs.gov/hipaa/index.html
[34] (n.d.). GDPR. Retrieved January 4, 2019, from https://eugdpr.org/

negative mental health impacts of widely used products such as Facebook, Instagram and Snapchat[35].

Situating mental health professionals within the SDLC

Development teams

Most software is built within agencies or industry and startups. Agencies begin building after receiving a customer brief and are beholden to time and budget constraints as dictated by clients. Startups build products first and seek funding for development prior to finding customers. Thus, startup decision making falls to founders and investors, while agencies operate under guidance from directors, managers and clients.

Understanding of the development process is key for mental health professionals, and is necessary to negotiate optimal entry points. A typical software development project follows 5 broadly defined phases of planning, designing, implementing, testing and maintaining[36]. The following sections will provide a broad overview of each section and optimum entry points for clinicians with a summary of benefits for stakeholders.

The SDLC phases

Planning and defining

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[35] (2018, May 18). How heavy use of social media is linked to mental illness - Daily chart. Retrieved January 4, 2019, from https://www.economist.com/graphic-detail/2018/05/18/how-heavy-use-of-social-media-is-linked-to-mental-illness

[36] (n.d.). INFORMATION SYSTEM AND SYSTEM DEVELOPMENT LIFE CYCLE .... Retrieved January 4, 2019, from https://www.researchgate.net/profile/Anju_Sharma5/publication/290179000_Information_system_and_system_development_life_cycle/links/577209e908ae6219474a6470/Information-system-and-system-development-life-cycle

The initial stage of product development begins with an idea from a client or founder that involves identifying and structuring a problem and solution. In agency contexts, a brief, or description of a problem is presented and a solution is then brainstormed and sketched out. In startup contexts, best practice often claims to follow the same order, but is often more of an ad hoc approach of first having a “solution”, be it an idea or particular type of technology, then looking for a “use case” for the product. Regardless, the problem and solution entail a certain amount of planning, and at least minimal stakeholder research must be conducted in order to come up with a “ product roadmap” or a sort of “procedures” and “methods” for the path forward.

Planning draws heavily on domain research and offers extensive opportunities for clinical guidance or “expert” knowledge. Although technical planning falls to engineers and project managers, questions such as who the population of users will be, how they will use the system, what data the system needs from users as input to work and what outputs the system will provide to users are discussed. A qualified domain expert at this stage can shave time and costs off the development process by drawing on clinical and experiential knowledge to make decisions about what types of approaches are likely to be effective and safe. Ideally, less mistakes will be made later on in the design process.

The best way for mental health practitioners to become involved at the planning stage involves partnerships with digital agencies or companies with dedicated research and design teams. Startups offer less opportunities as they can rarely afford outside resourcing until well past the planning stage. However, certain investment funds are trialing portfolios of early stage startups and founders who are working towards designing solutions for so called “social innovation” issues.

Designing

The design phase is another key point of entry in the SDLC for domain experts. Designing products involves decisions about which functions the product will perform, what it will look like and how it will interact with users. This phase also often incorporates preliminary testing in order to ascertain whether the idea and design perform as expected. Because software driven communication is not sensitive and adaptive in the way that human communication can be, content needs to be constructed in a very precise manner that is normed for comprehension and efficacy across users.

Expert guidance is critical in the design and testing phases of software, resulting in improved product quality and consumer protection. Although basic design issues such as spatial decisions for buttons and response fields are unlikely to have a psychological impact on users, data collection processes and presentation of content, such as text, video or even graphics can make or break the success of a product and have significant impact on users, especially given that software content and functionality often overlap with traditional data collection and treatment methodologies. However, because software is typically created by technologists who lack training in social science or health care, reliability and validity of methods and content is unlikely to meet standards considered acceptable by traditional health service providers.

Obvious as it may seem that digital versions of psychological interventions and measurements must follow the same regulations as traditional services, particularly given their unsupervised use and distribution following public release, this rigor is often overlooked due to lack of

awareness. These errors and inefficiencies can easily be offset with involvement from healthcare professionals.

Implementing/Building

The implementation or building phase, is typically done by software engineers and project managers and offers minimal opportunities for involvement by those outside the engineering process.

Testing

During the software testing phase, the various components of a product are tested for ease of use, comprehension and efficacy. A variety of methods may be used such as eye tracking, focus groups, questionnaires, ethnographies, A/B testing and card sorting. Many of these methods approximate more rigorous qualitative and quantitative approaches taught in the social and behavioral sciences[37]. However, this testing is often done by user experience (UX) researchers with minimal formal training in research methods. As of time of writing, there is no regulatory body or certification process necessary to confer the title of UX Researcher. Nielsen Norman, considered one of the foremost UX research organizations in the world, offers 1 day basic UX courses[38]. Other courses, such as General Assembly's UXDI, attended by more than 2000 students per year across 20 countries, last 10 weeks[3940]. When compared to the multiple semesters of formal training, plus supervised lab hours logged by scientists and practitioners in

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[37] (2017, July 13). Most Common UX Design Methods and Techniques – UX Planet. Retrieved January 4, 2019, from https://uxplanet.org/most-common-ux-design-methods-and-techniques-c9a9fdc25a1e
[38] (n.d.). UX Training by Nielsen Norman Group: the UX Conference, Online .... Retrieved January 4, 2019, from https://www.nngroup.com/training/
[39] (2016, October 20). General Assembly's First Student Outcomes Report. Retrieved January 4, 2019, from https://generalassemb.ly/blog/general-assemblys-first-student-outcomes-report/
[40] (n.d.). Learn User Experience Design - UX Course | General Assembly. Retrieved January 4, 2019, from https://generalassemb.ly/education/user-experience-design

medical and behavioral sciences, these courses offer limited time to properly understand research principles, much less effective training in building or conducting reliable and valid methodologies that consider ethics, sensitivity and privacy.

Often, the UX team are the only members in the SaaS SDLC with any human subjects research training[41]. Given the reality that UX processes primarily support marketing and sales potential, this type of research may represent conflicts of interest with consumer privacy and safety. As a result, standards of ethics and safety within the SDLC are unlikely to approach those considered acceptable to mental health professionals. Thus, involvement by mental health experts is not just useful for shortening time to market (TTM), it can also be vitally important to public good.

Maintenance

The maintenance phase involves post-delivery services that keep a product running optimally. Software is a product, much like any other object or device sold to consumers and represents a key area of difference between services provided by technology and those offered by health care providers. Although a product may provide ongoing service to consumers, its impact on customers' lives and health is unlikely to be monitored the way that continued care treatment planning offers. Redefining traditional software maintenance phases to include monitoring of consumer safety and privacy concerns is a valuable avenue for future inquiry.

Given that current models of software development are driven almost entirely by marketability, it may be difficult for individual scientists or practitioners to negotiate compensation in any follow up or monitoring stages in the maintenance phase. This is where stricter regulation, enforcing

[41] (2015, October 13). Knowing Your Role on A Web / Mobile Development Team - AIM .... Retrieved January 4, 2019, from https://aimconsulting.com/insights/blog/importance-knowing-role-webdev-project/

oversight and consumer protection strategies for companies building health related products is likely to be most effective.

Building a more collaborative ecosystem

Overview of stakeholder benefits

As noted throughout, there is tremendous scope for collaboration between the two disciplines that can result in considerable potential for all parties involved. The following sections provide an overview of the potential value for major stakeholders in the mental health tech development ecosystem that can be used to advocate for greater collaboration on future projects.

Investors

Experts can be used at two main points in investor portfolios: either to guide investment decisions or to improve speed and accuracy of the development of products in existing portfolios. Experts can be used to evaluate claims made in product pitches, such as product-market fit, whether a product can actually perform as promised and any potential concerns such as privacy, safety and liability. They can also speed up development and cut resource costs because they better understand what sorts of digital products and strategies are likely to be most effective and most used by consumers, improving consumer adoption strategies. Experts are also better able to judge safety, privacy and ethical concerns, enabling them to better identify any potential harmful long term effects that can impact sales or liability.

Technologists

Design, UX and product teams will benefit most from expert guidance in the planning, design, and testing phases. The amount of data that currently exists online about almost any subject

can be overwhelming and difficult to parse. Experts can cut through noise far more efficiently than those from outside their fields, thereby identifying relevant gaps in existing knowledge or services and helping prepare and execute more focused and relevant hacks and designs. Experts can assess briefs, wireframes, MVP's, testing methods and results; run design, research or testing workshops; train research and design teams in sound methodologies and perform ethics checks on safety, sensitivity and privacy across procedures and products.

Consumers

Products developed under expert guidance come with a level of quality assurance that imply better outcomes and more appropriate protective measures for safety and privacy.

Scientists

There is enormous potential for improvement of data collection strategies, whether by simplified and increased contact with greater numbers of more diverse participants, passive acquisition of new types of data or big data approaches to analysis of complex data sets. Furthermore, scientists can share data and collaborate more efficiently with other professionals, both inside and outside their disciplines. There is also increased potential for funding opportunities and powerful partnerships that can accelerate research processes and put discoveries to practical use much more quickly than traditional academic routes.

Practitioners

Practitioners can benefit by increased access to new and existing patients, especially those who are disadvantaged, new types of less intrusive, more accurate and more cost effective monitoring strategies and better opportunities to collaborate across disciplines and settings to

provide more holistic care to consumers. Practitioners may also benefit from electronic standardisation of existing approaches that result in greater precision and accountability by minimising human error and allowing for greater learning throughout care pathways.

Opportunities for collaboration

Commercial projects

Design agencies or companies in the health or mental health sectors, often seek domain experts or psychologists to support planning, design and testing aims of product development. Startups or investor portfolios containing startups, may also seek experts, however, opportunities for paid remuneration are lower and more often tend towards mentoring.

Hackathons

Hackathons are typically 1-3 day long competitive events where professionals from a variety of backgrounds work together in teams to prototype solutions to a specific problem. A typical “hack” begins with the presentation of a brief or problem. At a minimum, each team is given background information on the topic and a set time to build a technology driven solution. Exercises to encourage creativity or cooperation may be interspersed throughout the day, as well as lectures or presentations by domain experts. The ideal team configuration involves a domain expert per team, although this is not always possible. It is also helpful to have domain experts on hand to answer questions, review ideas and judge prototypes.

Hackathons offer creative, interdisciplinary solutions to complex problems that extend beyond the event itself. Working together on common goals offers participants the opportunities to learn new methods and techniques and to form partnerships with experts from diverse fields. As a

result, hackathons may be one of the best ways to strengthen collaboration between mental health professionals and technologists.

Conclusion

There is both considerable need and considerable potential for benefit for all parties involved in the creation of mental health tech products. Technology offers scientists and practitioners in mental health sciences access to very large numbers of patients, research participants and data points. It also provides opportunities to increase skill sets and comfort levels with interdisciplinary work. Mental health experts, in turn, help tech companies and investors produce safer, higher quality products at increased speed, thereby increasing profitability and decreasing liability.

There is also a moral imperative for both sides to work together to build high quality, relevant services to supplement public mental health needs. Future inquiry would do well to consider involvement by policy makers and regulatory bodies, who have an important role to play from the consumer safety standpoint. Guidelines for protocol and outcome will likely result in better alignment of incentive for tech companies, mental health professionals and the public, thereby facilitating effective future collaboration.