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The Intersection of Behavioral Science and Digital Health: The Case for Academic-Industry Partnerships

Melanie Hingle, PhD, MPH, RD, The University of Arizona, College of Agriculture & Life Sciences, Department of Nutritional Sciences, 1177 E 4th Street, Shantz Building, Room 328, Tucson, AZ 85721, hinglem@email.arizona.edu

Heather Patrick, PhD, Carrot Inc., 1600 Seaport Blvd, Redwood City, CA 94063, heather@carrot.co

Paul M. Sacher, PhD, RD, Slimming World, 2404B S Stemmons, Lewisville, TX 75067, paul.sacher@slimmingworld.com

Cynthia Castro Sweet, PhD, Omada Health, Inc., 500 Sansome Street, Suite 200, San Francisco, CA 94111, cynthia@omadahealth.com

Corresponding author: Melanie Hingle, PhD, MPH, RD, The University of Arizona, College of Agriculture & Life Sciences, Department of Nutritional Sciences, 1177 E 4th Street, Shantz Building, Room 328, Tucson, AZ 85721, hinglem@email.arizona.edu

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Abstract

A decade after the first health app became available, the field of digital health has produced a range of health behavior insights and an expanding product portfolio. Despite sustained interest and growth fueled by academic and industry interests, the impact of digital health on health behavior change and related outcomes has been limited. This underperformance relative to expectations may be partially attributed to a gap between industry and academia in which both seek to develop technology-driven solutions but fail to converge around respective, unique strengths. An opportunity exists for new and improved collaborative models of research, innovation, and care delivery that disrupt the field of behavioral medicine and benefit academic *and* industry interests. For those partnerships to thrive, recognizing key differences between academic and industry roles may help to smooth the path. Here we speak specifically to concerns particular to academics and offer suggestions for how to navigate related challenges.

Key words: digital health, behavior change, public-private partnerships, health apps

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Introduction

A decade after the first health app was released to consumers (Dolan, 2010), the field of digital health has thrived, moving well beyond its early origins to produce a range of insights about human behavior and an expanding portfolio of products including sensors, websites and platforms, text messaging programs, and mobile applications. However, despite sustained interest and growth in public and private sector offerings, the overall impact of these products on health behavior (e.g., improved diet quality, exercise and sleep) and related health outcomes has yielded few successes (Vandelanotte et al., 2016; Raaijmakers, Pouwels, Berghuis, & Nienhuijs, 2015). This underperformance relative to expectations may be attributable, in part, to a lesser known "digital divide": the gap between industry and academia who both strive to develop quality digital products that influence health behavior, but operate in parallel rather than as a collaboratively, on different timelines, and with distinctly different economic incentives. The gap is further widened by real and perceived differences in respective approaches, most notably industry's rapid and iterative development and scaling and data- and user-driven designs, in contrast to academia's reliance on theory-driven research and development, methodological preference for 'frozen' study designs and complex methods of measurement, and where incremental progress remains the norm. The result has been a disjointed pace of development and production shared by both sectors, limiting the capacity of industry and academic to impact health behaviors and outcomes at scale through dissemination and implementation or commercialization in the mass market. A recent example of this was observed in a review of behavioral weight loss digital applications, wherein little evidence was found that commercially available apps were well-grounded in either theory or in evidence-based behavioral science, and at the same time, theoretically robust, evidence-based apps had limited uptake and use by

consumers, and weak evidence of sustained behavior change (Pagoto, Schneider, Jojic, DeBiasse, & Mann, 2013).

It is our perspective that there is a need for more integrated, collaborative research and development work between digital health industry and academia as it pertains to health behavior change. In this commentary, we describe the need for collaborative efforts, and propose ways in which to close current gaps between these two very different sectors, both of which are pursuing knowledge discovery and developing health behavior-focused products in digital health.

The Need for Collaborative Research and Evaluation

Digital health academic leaders have called for new and improved collaborative models of research and development; models that benefit *both* academic and industry scientists and produce technologies that create new avenues for behavioral science research and result in measureable and clinically significant impacts on health (Sucala, Nilsen, & Muench, 2017). For example, the US National Institutes of Health Office of Behavioral and Social Sciences Research identified priorities related to advancing behavioral and social science research (Riley, 2017). These include improving synergy between basic and applied science, promoting cumulative and integrated infrastructure, methods, and measures, and facilitating adoption of findings into practice. Realizing these priorities would enhance integration of behavioral and social sciences research findings across all phases of the digital health solution development cycle. Similarly, international academic experts in digital health released a set of recommendations designed to guide digital health science for maximal impact. Topics included rapid and efficient development, understanding and promoting engagement, evaluating effectiveness (and cost-

effectiveness), and ensuring regulatory, ethical and information governance standards of digital health products and their delivery (Michie, Yardley, West, Patrick, & Greaves, 2017).

Analogous shifts in industry are also promoting the transfer of behavioral science research into the development, dissemination, and evaluation of digital health products. Increasingly, companies are differentiating themselves and creating competitive advantage in the marketplace by infusing the academic evidence base into health technology products and validating product claims with original, rigorous scientific evaluation. With the addition of scientific advisory boards, companies have gained behavioral science expertise through their experts' contributions to product development, strategy, and evaluation. Finally, executive leadership is becoming more inclusive of behavioral scientists (e.g., Chief Behavioral Officer; Vice President of Behavioral Science). At the same time, entrepreneurial behavioral scientists are branching out to start their own digital health businesses with evidence-based programs underlying product cores. These types of changes are exemplified by some of the more successful commercialization efforts, for instance, the growing number of digital health products available for diabetes prevention, a majority of which are based on evidence-based strategies identified during the landmark Diabetes Prevention Program clinical trial. (Bian, Piatt, Sen et al., 2017).

These advancements in digital health science and practice represent successful *co-opetition*, a neologism describing "cooperative competition" (Gnyawali & Byung-Jin, 2009), in which organizations sharing market space and interests work together to develop new knowledge and reach a higher value product compared to that which would be developed without this interaction. Importantly, these interactions can occur simultaneously and at different levels in the value chain, making it possible for industry and academia to work together to discover new

knowledge and develop scientifically-informed products while achieving what is perhaps their most important bottom line – health behavior change and positive health outcomes among end users, at a scale that is difficult without commercialization efforts.

Challenges and Opportunities

In the spirit of promoting such collaborations, professional organizations in the digital space have increasingly developed interdisciplinary workshops, webinars, seminars, trainings, and conferences focused on the intersection between behavioral science and the digital health product life cycle. Many of these events actively engage participants across disciplines and settings in team-based learning, thought experiments, discussions, and even concrete planning in which they are confronted with scenarios typical of academic/industry partnerships. Both industry and behavioral scientists have a responsibility to actively pursue the ongoing development and proliferation of these and similar trainings, particularly given increasing interest in non-academic career paths and scarcity of traditional tenure-track jobs (Goldstein, Minges, Schoffman, & Cases, 2017), as well as the need for in-depth behavioral science expertise in industry alternatives. It is likely that a greater shift toward "co-opetition" will be observed as academically-trained scientists bring the methods, design, and rigor of academic research to real-world applications in digital health industry.

Several notable points of friction exist between academic and industry within the context of a partnership, and increased recognition of these points may help to smooth the path for greater "co-opetition" in the field of digital health. These three points include: (1) (for the academic) striking the "right" balance between cultivating a relationship with industry partners while navigating the practical considerations and constraints of academic appointments; (2) agreeing upon ambitious but feasible timelines and deliverables to meet industry demands; and

(3) selecting appropriate outcome and evaluation metrics that stand up to the rigor of academic research while remaining responsive to market-values and industry priorities. Though challenging, we contend that addressing these differences will lead to benefits on both sides. Below we offer lessons learned from real-world experience and recent training sessions which may help to foster successful partnerships.

Balancing Competing Demands: Industry Partnerships and Academic Responsibilities. Industry leaders seeking a partnership with academics are often challenged with finding researchers who have the time and availability to "plug in" to a growing company. For many academics, particularly those early in their career, pursuing industry partnerships is an extracurricular activity reserved outside of the hours required to develop a program of research, manage funded projects, maintain a prolific publication pipeline, and mentor students. Most academic appointments allow outside consulting time, the parameters of which should be established at the outset of the appointment and reviewed regularly. For those wishing to embark on their own businesses borne out of their academic discoveries, universities frequently have centers for commercialization, or technology transfer units, though the challenge can be finding the requisite understanding of behavior science innovations to appropriately support and assist enterprising faculty. When opportunities to consult arise or are created, the success of those collaborations and partnerships—like any relationships—will take time, energy, and responsiveness to grow. In developing such partnerships, it is important for industry to be aware of potential limits in the academic partner's availability (e.g., they may have specific days and times set aside for non-academic projects or have competing deadlines related to grant application cycles or the academic calendar that take priority. Academic partners must be self-aware of their capacity to commit to an ongoing industry partnership, and structure the

arrangement within those boundaries. This can include prioritizing the activities that they wish to be involved in that are commensurate with the limited available time, being realistic when committing to deadlines and deliverables, and inviting conversation regarding how the goals of the industry partner might also serve the academic partner's needs (e.g., for publications or industry-based training opportunities for the academic partner's students and/or post-doctoral fellows, access to datasets, or opportunities to add additional measures that align with the academic partner's program of research).

Structuring Ambitious but Feasible Timelines and Deliverables. One of the most notable differences between industry and academia are the timelines and primary objectives. For academics, studies unfold predictably over the course of the 2- to 5-year funding period typical of various grant mechanisms. For industry, market demand and competition create the need for rapid iteration and launching of product development, implementation, and evaluation to occur at a much faster pace. Academics often think in terms of time-limited and finite funding cycles, in which product development is often a one-shot opportunity to "get it right." Industry has built into the product development life cycle repeated iterations with a resource-sensitive approach, so often the first goal is to get to a prototype or minimally-viable product (MVP), knowing that there will an opportunity to improve and expand the offering over time. Academics also often calibrate their efforts against the "gold standard" of a randomized clinical trial, whereas industry responds to market research, client testimonials, case studies, and less rigorous study designs intended to validate a prototype or MVP. The desired approaches can be quite different as they are motivated by different drivers. The arguably more agile approaches employed by industry experts allow for some understanding of feasibility and acceptability of a product before it is developed and ready for more rigorous evaluation. Because markets shift direction quickly,

resources are limited, and growth is essential, it is critical to recognize the role of less scientifically precise evaluation, particularly early on in the product development life cycle. As digital health science has evolved, new methodologies have been developed—e.g., pragmatic trials, fractional factorial designs and MOST (multiphase optimization strategy)— to respond to the shorter timelines and iterative processes that reflect real-world applications in digital health. Health behavior academics classically trained in clinical trial designs now have opportunities to integrate adaptive and iterative designs and methods more appropriate for the faster moving technologies in the field of behavior change. Newer methodologies offer practical, scientifically-rigorous solutions for responding to more ambitious timelines needed for successful academic-industry partnerships—although they may still be more time-intensive than is feasible in some industry settings. At the same time, industry partners must also acknowledge the benefit and need for highly rigorous trials (even at the expense of time), particularly when developing technologies have the potential for integration into healthcare services or policy.

Even though these developments in digital health science can be useful tools for navigating the challenge of the more ambitious timelines needed to meet industry partners' needs, to form successful partnerships, academic and industry collaborators must be explicit about trade-offs, changes in scope, and other competing priorities that can get in the way of deliverables. For example, in the earlier phases of product development, the industry engineering team may identify limits to what they can code with regard to functional specifications of a digital health product, given market demands for delivery by a specific time. This may mean that the prototype or MVP-version of the product will offer something less comprehensive, less intensive, less aligned with the evidence base or theoretical model, and/or less rigorous than originally planned. Academic partners in this circumstance are well positioned to clearly

describe what these changes in scope will mean for the possible impact of the product on the behavior or condition targeted (e.g., “you can save resources by cutting out X feature, but it might cost you by not obtaining Y outcome”).

Selecting Appropriate Metrics. Another challenge to navigate in academic-industry partnerships involves selection of outcomes metrics. In traditional academic settings, there are often gold-standard metrics for determining intervention efficacy, whether that is achieving a certain biometric outcome (e.g., BMI, blood pressure, HbA1c), matching a particular behavioral standard (e.g., sustained tobacco abstinence, minutes of physical activity per week), or some other clinical or behavioral standard. While these gold standard metrics can certainly be a part of rigorous evaluation of digital solutions, often industry partners are interested in other metrics, particularly early on in the product development and dissemination life cycle. For example, in digital health industry, a key outcome to demonstrate use to potential clients is engagement. Further, in the initial MVP version of a digital health product, it may be more useful to consider metrics that indicate the product is heading in the right direction—intermediate outcomes (i.e., mediators and moderators) that are known to be in the pathway to the desired gold-standard outcome. Of additional interest may be whether there are subsets of the population of initial users for whom the product is more or less effective or with whom there is more or less engagement, rather than the more traditional evaluation focused on the group average. Thus, thinking flexibly about metrics and how to conceptualize and contextualize outcomes is key. Academic experts bring to these partnerships a wealth of experience and knowledge about subgroup analyses, mediator and moderator variables that may be of interest, and, importantly, insights on how to understand the behavior of users and promote better engagement with a digital solution. Academic experts can also be powerful advocates for rigorous measurement of behavioral and

health outcomes; this is particularly compelling later in the product life cycle when user stories and engagement metrics are enhanced by additional indicators that a digital approach having the desired impact (e.g., statistically significant improvement in health and/or behavior outcomes). Further, through these partnerships, academics have the opportunity to learn about the information, understanding, and data that can be gained by the methodologies employed by digital solution development experts—including designers and engineers—including A/B testing, user testing, and co-creation experiences that engage a user population as part of the product development process.

Next Steps: Paving the Path Forward

To effectively engage in and facilitate successful academic-industry partnerships, an open mind and an equally open dialogue are necessary to ensure that all parties understand and respect the professional disciplines and areas of expertise represented, which in turn will cultivate mutually agreeable benchmarks for success. Academic partners should be ready to think flexibly about a range of outcomes that could indicate the potential viability of a digital health product, and remain open to working in partnership with industry to create engaging, evidence-informed and, ultimately, evidence-based digital health solutions. For instance, academics could examine whether, when, and to what extent commercially-developed products affect behavior change - even when they do not appear to reflect evidence-based principles or wholly subscribe to a unifying behavioral theory. At the same time, industry could more transparently identify the ways in which their products are aligned with the theoretical and evidence base (or not) and more rigorously evaluate behavior change outcomes, as well as shifts in mediating and moderating variables that have been shown to ultimately impact behavior change including motivation, self-efficacy, knowledge, and attitudes. Industry also must acknowledge the need for rigorous science

of the end product or service, to ensure that the transfer of behavior change knowledge still produces the change in targeted health behaviors and health outcomes as originally intended. If industry fails to achieve similar results with their own original users and data, the digital health "solution" is an unsuccessful enterprise.

Cultivating these partnerships will ask us to go beyond our usual comfort zones. In behavioral science, there is a great opportunity to be ambassadors to other industries. Often, those who have great design and technical expertise necessary for digital product development do not have the same depth of knowledge in the established evidence base in health behavior change that could inform the substance and structure of digital health solutions. Adding to that challenge is a dearth of opportunities and experiences for academics to describe the evidence base in practical terms that resonate with non-scientific audiences. As developing evidence-based digital solutions becomes increasingly crucial—for both regulatory and commercial necessity—behavioral medicine experts will be called upon to serve on Scientific Advisory Boards, review product content and scope, and offer clinical and scientific expertise. There is also an opportunity to become engaged in workshops and conferences that are likely to be attended by those who are developing commercial digital health products, to begin to expand our professional networks in ways that are likely to facilitate industry interest in what academic behavioral medicine has to offer. Behavioral scientists spend extraordinary time understanding why and how people act; this same mindset can readily translate to appreciating how digital health industry behaves, and what the motivators, facilitators, and inhibitors can be. With the rapid growth of digital health focused on behavior change, and trends in policy moving to make prevention and lifestyle behavior management a prioritized part of health care, it is an exciting time for behavior scientists to translate their traditional academic work into industry applications and play an active role in

ensuring their intellectual pursuits take shape more rapidly and to greater scale in real-world settings.

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