

A glossary of user-centered design strategies for implementation experts

Alex R. Dopp,¹ Kathryn E. Parisi,¹ Sean A. Munson,² Aaron R. Lyon³

¹Department of Psychological Science, University of Arkansas, Fayetteville, AR 72701, USA

²Department of Human Centered Design and Engineering, University of Washington, Seattle, WA 98195, USA

³Department of Psychiatry and Behavioral Sciences, University of Washington School of Medicine, Seattle, WA 98195, USA

Correspondence to: A R Dopp
dopp@uark.edu

Cite this as: *TBM* 2018;XX:XX-XX
doi: 10.1093/tbm/iby119

© Society of Behavioral Medicine 2018. All rights reserved. For permissions, please e-mail: journals.permissions@oup.com.

Abstract

User-centered design (UCD), a discipline that seeks to ground the design of an innovation in information about the people who will ultimately use that innovation, has great potential to improve the translation of evidence-based practices from behavioral medicine research for implementation in health care settings. UCD is a diverse, innovative field that remains highly variable in terms of language and approaches. Ultimately, we produced a glossary of UCD-related strategies specifically for experts in implementation research and practice, with the goal of promoting interdisciplinary collaboration in implementation efforts. We conducted a focused literature review to identify key concepts and specific strategies of UCD to translate into the implementation field. We also categorized the strategies as primarily targeting one or more levels of the implementation process (i.e., interventions, individuals, inner context, and outer context). Ultimately, we produced a glossary of 30 UCD strategies for implementation experts. Each glossary term is accompanied by a short, yet comprehensive, definition. The strategies and their definitions are illustrated, using a hypothetical behavioral medicine intervention as an example, for each of the four levels of the implementation process. This UCD glossary may prove useful to implementation experts who wish to develop effective collaborations and “shared language” with UCD experts to enhance use of behavioral medicine research in health services. Directions for future research are also discussed.

Keywords

Implementation, User-centered design, Human-centered design, Design thinking, Evidence-based practice

Researchers have produced numerous evidence-based practices (EBPs)—interventions, assessments, and other tools that have demonstrated the ability to improve clinical outcomes in controlled research settings—yet many factors undermine the translation of EBPs from health research into health care settings [1–3]. In particular, it is increasingly recognized that EBPs often have fundamental problems with their design (i.e., form and function) that limit their impact in practice (see [4] for a review). Examples of design problems (see also [5–7]) include low ease of use (e.g., lack of flexibility), high complexity (e.g., difficult for providers and patients to understand), and poor fit with the intended delivery context (e.g., cannot fit within a typical session format). In turn, EBPs’ design characteristics strongly influence their acceptability, appropriateness, and feasibility in health care settings [8].

Implications

Practice: Use of shared language around user-centered design (as presented in this glossary) can maximize the usefulness of interdisciplinary efforts to promote the implementation of evidence-based practices through improved design.

Policy: Policymakers who wish to promote a user-centered culture in health services should consider the value of tools like this glossary in developing shared language and interdisciplinary partnerships between implementation experts and user-centered design experts.

Research: The impact of user-centered design on evidence use in health services must be tested in future research. Defining its scope of applicability within health care will be critical, as will be isolating the effects and mechanisms of user-centered design strategies.

Moreover, recent findings indicate that modifications to EBPs are common (and in some cases lead to enhanced patient outcomes) in routine clinical practice [2,9,10].

Despite the importance of considering EBP design when translating health research into health care settings, translational researchers have paid little attention to strategies that can directly address design issues. Of the many strategies have been identified that promote implementation (i.e., adoption and uptake) of EBPs in health care settings, most focus on modifying the health care setting to better accommodate a static EBP (e.g., training providers to deliver a complex EBP with high fidelity to the original design). Indeed, we [11] reviewed a recently developed compilation of 73 implementation strategies [12] and determined that only three targeted the design of the EBP itself (e.g., “promote adaptability”).

Looking beyond traditional implementation strategies, user-centered design (UCD) holds considerable potential for improving the implementation of EBPs (see [4,11]). Drawing from research

in human-computer interaction, user experience design, service design, and cognitive psychology, UCD experts apply concepts and strategies that ground the design of an innovation (e.g., an EBP or the process by which it is implemented) in information about the people who will ultimately use the innovation [13–16]. The techniques of UCD have been applied widely, although infrequently, across diverse formats (e.g., software and physical products, service delivery, training processes) and health service specialties (e.g., primary and specialty medical care, behavioral health) [17–21]. This existing research suggests that UCD could be applied to most, if not all, EBPs and implementation strategies within health care.

Over 60 distinct frameworks exist that can guide implementation research and practice [22], a few of which have recently begun to directly address the role of design in EBP creation, implementation, and evaluation [23,24]. Although groundbreaking, these recent frameworks have been primarily conceptual rather than empirical and those that have incorporated UCD principles have focused primarily on the design of digital technologies. Certain health service fields have yet to apply UCD extensively, and applications of UCD to psychosocial intervention and implementation activities remain exceptional. In behavioral health, for example, UCD has been applied occasionally to digital practices but much more rarely to the psychosocial approaches that are essential to many services [4,17]. Mohr et al. [24] recently outlined how UCD can be applied to the full breadth of services, technologies, and implementation plans that make up digital EBPs, using as an example the design of a technology-enabled care management system for treating depression in primary care. We take an even broader view of the applicability of UCD that includes non-digital technologies (e.g., training manuals, practice guidelines).

In sum, implementation experts have limited guidance on how UCD fits within their existing perspectives and strategies for the translation of health research into practice. As an important step in establishing such guidance, we developed a glossary of UCD strategies for experts in implementation research and practice. UCD is a diverse, innovative field that remains highly variable in terms of language and approaches. Glossaries—lists of terms developed to promote common understanding among different stakeholders—have been recommended as a tool to promote interdisciplinary collaboration in implementation efforts [25].

METHODS

We identified UCD strategies for inclusion in our glossary by conducting a focused literature review that emphasized iterative engagement with and interpretation of literature to develop depth of understanding in a particular area [26]. The first

two authors conducted the literature review with the goal of extracting key UCD strategies. The third author provided guidance on the identification and analysis of relevant design literature.

As part of our focused review of literature relevant to UCD, we considered the definitions and relations between various broad, overarching concepts in the field. We briefly describe those concepts here to give a sense of the scope of our literature review. First, we defined *user-centered design* as a design approach that grounds the characteristics of an innovation in information about the individuals who use that innovation, with a goal of maximizing “usability in context.” The closely related approach of *human-centered design* more explicitly seeks to integrate an innovation into human activities and systems by considering individuals beyond primary users (including those who interact indirectly with the innovation, such as clinic leaders who oversee implementation, as well as those who are unintentionally affected by it, such as family members of patients) in the design process. Both approaches involve *design thinking*—a solution-focused, action-oriented approach to solving problems through the application of user/human-centered design strategies—and *user research*—data collection and analysis that are meant to understand the needs, desires, preferences, values, experiences, and recommendations of people who will use a particular innovation.

Based on our literature review, the first and second authors generated a list of glossary terms—each describing a discrete UCD strategy—and a more comprehensive, yet still brief (<50 words), definition for each term. The third author reviewed the glossary and provided initial feedback, after which all four authors engaged in a process of discussion and consensus until they agreed on a list of terms and definitions. We primarily selected strategies from “*Observing the user experience*” [13], after concluding that it most closely matched available resources for implementation strategies [12] at a conceptual level. Additionally, we supplemented those selections with unique, complementary strategies from other resources [14–16].

Organization of strategies within conceptual categories helps experts to better understand the connections among those strategies [27]. The Consolidated Framework for Implementation Research (CFIR [28]) combines the features from other, more specific, frameworks (see [22]) into a multiphase, multilevel model that is ideal for conceptualizing implementation from a comprehensive perspective (i.e., for exploratory work such as this project). Thus, to organize the UCD strategies, the first and fourth authors reviewed each strategy and categorized it within the multilevel domains of CFIR: intervention, individuals, inner setting, and outer setting. Strategies were considered “processes,” so that CFIR level was omitted. It is theoretically possible

to target any CFIR domain with any strategy due to its intentionally broad nature, but we categorized each strategy at the level(s) where it was most likely to affect implementation outcomes. For example, we categorized many user research strategies at the individual level because they are designed to reveal individual persons' needs and preferences, even though CFIR categorizes patient needs (at a population level) in the outer setting. Nevertheless, inclusion of a strategy at a particular level does not preclude its application at other levels. The organization of UCD strategies within CFIR levels was finalized through additional discussion and consensus among all authors.

RESULTS

We identified 30 discrete UCD strategies for inclusion in the glossary. In this section, we provide illustrations of how UCD strategies can be used to target each of the CFIR domains [28], using as an example the design and implementation of a hypothetical EBP: a tobacco cessation intervention targeting adolescents in a network of primary care clinics. We envision that this EBP might be delivered by behavioral health consultants, using primarily behavioral and motivation enhancement approaches, following identification of problematic tobacco use by a nurse or physician and an immediate (“warm handoff”) referral. UCD strategies that might be employed by the team overseeing design and implementation of the EBP (hereafter, the “design team”) are indicated with italics in the text. Table 1 lists the terms and definitions included in the glossary, and also expands on the hypothetical EBP by describing specific illustrative examples of how the strategy could apply to the EBP services, technologies, and/or implementation plans. Table 2 lists the primary literature source(s) and relevant CFIR domain(s) for each strategy.

Individual level

The largest number of UCD strategies ($n = 12$; 40%) focused on characteristics of individuals involved with the EBP and/or implementation process (see [28]). Many of these involve user research, starting with *defining target users and their needs* and *recruiting potential users*. Potential target users for the hypothetical EBP include adolescents who use tobacco products and their caregivers as well as nurses, physicians, behavioral health consultants, and leaders within pediatric primary care clinics. Relevant user research techniques are consistent with the mixed-method (i.e., both quantitative and qualitative), multi-informant strategies that are recommended for implementation research [29], and include *collecting quantitative survey data*, *conducting interviews* and *focus groups*, and *conducting experience sampling* (e.g., diary studies). UCD might also involve *use of associative, dialogic*, or *generative object-based techniques* to evoke more

experiential information from potential target users regarding the tobacco cessation process. The design team may also *develop personas* and *scenarios* that represent prototypical user groups. All of these user research data can be used to inform the design of the EBP services and technologies as well as plans for its implementation.

Intervention level

Ten UCD strategies (33%) targeted characteristics of the intervention being implemented (see [28]). In terms of additional user research, application of UCD to the hypothetical EBP might *define work flows* within primary care clinics to determine the activities to be completed during EBP and its implementation plan and *apply task analysis* to determine when, how, and by whom those activities will be executed; note that these strategies might also be applied to individuals. The design team could also *conduct artifact analysis* or *competitive user experience research* with existing interventions and tools to learn more about services for tobacco cessation with adolescents or integrated behavioral health care models.

Based on the results of initial user research, the design team would then use a number of additional strategies to create EBP services, technologies, and implementation plans that address identified needs. They might *engage in cycles of rapid prototyping* and *engage in live prototyping*, in which the design team creates simple yet functional mockups of design solutions, or *conduct co-creation sessions* in which users create the prototypes themselves. *Heuristic evaluation* (drawing on the expertise of usability and design professionals) and *usability tests* (collecting data from users through structured interaction with the service, technology, or implementation plan) can be used to assess the viability of each prototype. These various strategies would typically be repeated several times as the design team *engages in iterative development* to generate, test (through additional user research), and refine design solutions for the EBP.

Inner and outer settings

Another 11 strategies (37%) concerned UCD as applied to characteristics of the inner (i.e., intra-organizational) setting, which includes features of structural, political, and cultural contexts through which the implementation process will proceed within an organization [28]—in our example, within the network of primary care clinics in which the tobacco cessation EBP will be implemented. The four (13%) remaining UCD strategies, which seek to involve decision makers such as administrators, leaders, and other stakeholders in the design process, could target the outer and/or inner setting depending on who is involved. The outer (i.e., extra-organizational) setting includes the economic, political, and social context within which an organization is located [28]. Inclusion of extra-organizational stakeholders

Table 1 | List of terms and definitions for user-centered design strategies included in glossary

Term	Definition	Illustrative example ^a
Apply process maps to system-level behavior	Define and represent system-level processes, based on user research, in terms of individuals (who), their actions (what, how, and to whom), and settings and situational triggers (when and where)	Map all youth-provider interactions that occur over the course of the intervention (e.g., when, where, and how the youth interacts with nurses, physicians, BHCs)
Apply task analysis to user behavior	Define and represent specific tasks, based on user research, in terms of the purpose, situational triggers, resources needed, actions required, and options available to the user	Define engagement strategies that the BHC can use if the youth expresses ambivalence about tobacco cessation
Build a user-centered organizational culture	Change organizational processes to make user research and design expected, and give the people who do research and design a clear role in decision making	Require, via organizational policy, that clinics demonstrate the role of user research in their plan to implement the EBP before funding will be approved
Collect quantitative survey data on potential users	Use a survey to collect information, in a structured and standardized way, from a large group of people regarding their characteristics, interests, and preferences as related to a problem or innovation	Survey providers and leaders in pediatric primary care clinics about their current screening practices for youth tobacco use
Conduct artifact analysis	Collect information about one or more artifacts (e.g., a system, tool, technique) to learn about the artifact's users and the context in which it exists or is used	Examine protocols for adolescent tobacco cessation interventions to identify required and desirable characteristics of intervention providers
Conduct co-creation sessions	Convene potential users from the community you are serving and have them design an innovation prototype alongside you	Ask BHCs to mock up, using pen and paper, a worksheet that they could use in their practice to teach youth to self-monitor tobacco use
Conduct competitive user experience research	Conduct research to better understand how people use and perceive a product or service that competes with your innovation, by comparing competitors to each other and the innovation on a set of key dimensions	Present BHCs with multiple models of behavioral health care integration (including the model currently used) and ask them to rate the appropriateness of each for a tobacco cessation intervention
Conduct design charrette sessions with stakeholders	Facilitate a participatory workshop in which key stakeholders engage in creative or complex decision-making in response to user research	Help primary care clinic leaders redesign their service operations to accommodate the increased number of BHC sessions required for the EBP
Conduct experience sampling	Provide a structured tool (e.g., diary, mobile app) that users complete on a routine basis, in everyday life, to collect data regarding specified activities, topics, or prompts	Collect daily diaries from providers to identify the points in a primary care visit when tobacco cessation is most relevant
Conduct focus groups about user perspectives	Conduct structured, moderated group discussions that are designed to gather information about the preferences, experiences, and priorities of a group of potential users	Bring together a group of leaders from primary care clinics to discuss the needs of their adolescent patients regarding tobacco cessation resources
Conduct heuristic evaluation	Have expert designers examine an innovation or prototype according to heuristics (i.e., general principles of good design) to identify possible problems	Engage user-centered design experts to review the usability of intervention manuals and worksheets
Conduct interpretation sessions with stakeholders	Facilitate a participatory workshop with key stakeholders to help them understand the results of user research or to build buy-in for addressing identified problems	Discuss with organization leadership the conflicting perspectives of families vs. providers on desired features of a tobacco cessation intervention
Conduct interviews about user perspectives	Conduct individual interviews that are designed to gather information about the preferences, experiences, and priorities of potential users	Obtain caregiver perspectives on their adolescent's tobacco use and how providers might support cessation
Conduct observational field visits	Observe the settings in which an innovation will be used to gather information about the everyday activities, environments, interactions, objects and users in that setting	Observe primary care clinic operations to identify times and places where providers might initiate conversations about tobacco use with youth patients
Conduct usability tests	Observe potential users interact with an innovation (or multiple versions of the innovation) to examine how they perform specific tasks with the innovation, while collecting data on usability and desirability from the user	Role-play each step of the tobacco cessation intervention with adolescents and their caregivers, and solicit their feedback afterwards

Table 1 | Continued

Term	Definition	Illustrative example ^a
Define target users and their needs	Identify and prioritize target problems to be solved based on the perspectives of those whom the problems affect	Define “problematic tobacco use” from the perspective of youth who use tobacco; their caregivers; and nurses, physicians, BHCs, and leaders in primary care clinics
Define work flows	Specify the set of actions (work flow), based on user research, that a user may take to achieve a goal or complete a task through use of an innovation, as well as factors that influence the efficiency of that work flow	Define the process by which e.g., the nurse/physician makes a referral to a BHC; a BHC delivers the tobacco cessation intervention; or a leader conducts audit and feedback of chart documentation
Design in teams	Collect and share information about users, innovations, and the design process across multidisciplinary teams that include design experts and stakeholders/decision makers	Include provider, clinic leader, and/or patient representatives on the design team rather than relying on design expertise alone
Develop a user research plan	Develop a plan to collect data on user experiences that includes questions to be answered; why it is important to answer them; techniques to be used; resources needed; and a schedule of when, where, and who will do each activity	Decide on a user research plan in partnership with leaders from the participating primary care clinics
Develop experience models	Define and specify models, based on user research, of the relationships between product attributes, people, organizations, places, etc. for different scenarios (“experiences”) in which an innovation will function	Create profiles of clinics where BHCs will vs. will not require expert consultation to implement the tobacco cessation intervention
Develop personas and scenarios	Define and specify profiles, based on user research, of hypothetical users and situations that represent various user groups for an innovation	Create profiles of the needs of providers with vs. without training in tobacco cessation, youth who do vs. do not want to quit tobacco, etc.
Engage in cycles of rapid prototyping	Build a simple prototype (e.g., illustration, mockup, storyboard) that represents an innovation and use the prototype to quickly obtain feedback from potential users	Draft cessation intervention scripts that can be immediately role-played with adolescent tobacco users and their caregivers
Engage in iterative development	Progressive refinement of an innovation through a cyclical, user-research-driven progression that involves examining problems, defining needs, and creating and testing solutions to address those problems and needs	Revise the intervention manual based on BHC feedback, then test generalizability of the improvements by asking different BHCs to review the revised manual
Engage in live prototyping	Provide a functional prototype of an innovation to potential users and collect feedback as they attempt to use the prototype for its intended purpose	Have physicians fill out a mock referral form for a hypothetical patient, and note problems (e.g., unclear instructions, redundant fields) in real time
Examine automatically generated data	Collect and analyze logs of how individuals routinely interact with a system (e.g., website analytics, insurance claims processing documentation) to identify patterns of activity and common problems	Review electronic medical records to determine where and how nurses and physicians currently record information about adolescent patients’ tobacco use
Prepare and present user research reports	Prepare and present written or oral reports summarizing user research to help stakeholders make decisions about the design of a product or service	Present findings about the needs of each user group to the leadership of participating primary care clinics
Recruit potential users	Determine the expected user groups for an innovation and recruit representative members of each group to participate in user research	Engage users (see “Define target users and their needs”) in different types of user research to understand their needs, preferences, and ideas for solutions
Use associative object-based techniques	Ask users to sort, rank, or organize different pre-made visuals or objects, such as card-sorting or ranking tasks, to reveal ways in which users think about problems and solutions that an innovation will seek the address	Ask adolescents to sort visuals depicting different steps of the tobacco cessation process based on what types of social support they would want (e.g., from providers vs. caregivers vs. peers)

Table 1 | Continued

Term	Definition	Illustrative example ^a
Use dialogic object-based techniques	Provide visuals or objects that prompt written or conversational responses from users regarding problems and solutions that an innovation will seek the address	Present videos of youths disclosing experiences with tobacco cessation to providers and then discuss the providers' reactions
Use generative object-based techniques	Ask users to create objects or visuals, such as collages, maps, or storyboards, that depict their experience or understanding regarding problems and solutions that an innovation will seek the address	Ask a clinic leader to create a storyboard of the steps that typically unfold after an adolescent patient discloses tobacco use

BHC behavioral health consultant; EBP evidence-based practice.

^aIllustrative examples are based on the design and implementation of the hypothetical EBP discussed in the text: a tobacco cessation intervention targeting adolescents in primary care clinics.

such as community organizations, policymakers, or academic researchers could often constitute a UCD strategy targeting the outer setting, although the distinction between inner and outer setting is dynamic and context-dependent (e.g., by involving external partners in EBP implementation, they may become part of the inner setting; see [28]). Overall, the inner and outer settings influence the design of EBP services, technologies, and implementation plans; moreover those implementation plans can be designed to modify the inner or outer setting.

At the inner setting level, the team would *develop a user research plan* by incorporating input from various stakeholders (e.g., senior leaders in the health care organization that operates the primary care clinics) into the user research questions, techniques, and schedule of activities. Beyond the individual- and intervention-level types of user research already discussed, the design team might also *conduct observational field visits, examine automatically generated data, or apply process maps to system-level behavior* to better understand the organizational context of the primary care clinics. *Co-creation sessions*, which were discussed in the intervention domain, can also be used to modify the inner setting (e.g., co-designing an organization-wide policy about the EBP to increase organizational buy-in for its uptake). Moreover, two strategies specifically seek to promote better integration of UCD into the inner setting: *design in teams* and *build a user-centered organizational culture*. A health care organization might use these strategies to incorporate UCD into their routine decision-making processes.

The setting (i.e., inner vs. outer) targeted by the remaining strategies depends on which stakeholders are involved in the process. These strategies include *preparing and presenting user research reports* that communicate findings from user research; *conducting interpretation sessions*, where the design team facilitates stakeholders' understanding of user research; *conducting design charrette sessions*, in which the team guides the decision-making process to generate a design solution with input from stakeholders; and *developing experience models* (a setting-level counterpart

to personas/scenarios) that represent various operational scenarios for the EBP. To use experience models as an example, models for scenarios in which behavioral health consultants receive consultation to support EBP delivery might address the outer or inner setting depending on whether the consultants located at an external organization (outer setting) or within the same organization as the primary care clinics (inner settings).

DISCUSSION

Application of UCD strategies during the implementation process has the potential to greatly improve the translation of evidence-based interventions, assessments, and other tools from health research into practice settings [4]. It is difficult to leverage that potential into public health impact, however, because most implementation experts do not receive training in design and thus are not familiar with UCD. We developed the glossary presented here to translate key information about UCD so that implementation experts can better understand UCD and its potential contributions to their work. Our work expands on previous collections of implementation strategies [12] by offering a complimentary set of UCD strategies and providing more formal and standardized descriptions of UCD strategies than previously published broad overviews [4]. UCD experts who are interested in the design of health services that incorporate health research evidence may also find the glossary useful in communicating with potential collaborators outside of their discipline.

Additional research will be necessary to understand better the potential for increasingly interdisciplinary collaborations within implementation science [30] to include UCD experts. First, empirical studies might examine the usefulness of this implementation glossary at various stages of the collaboration process (see [31]). We expect that the glossary will be most useful for early stages of collaboration in which experts are identifying areas of mutual interest, finding a "shared language" around those areas, and obtaining resources (e.g., writing

Table 2 | Characteristics of user-centered design strategies included in glossary

Strategy (term)	Primary source(s) ^a				Primary CFIR domain(s) ^b			
	OUE [14]	UMD [15]	CD [16]	FG [17]	OS	IS	ID	IN
Apply process maps to system-level behavior	X					+		
Apply task analysis to user behavior	X						+	+
Build a user-centered organizational culture	X					+		
Collect quantitative survey data on potential users	X						+	
Conduct artifact analysis		X					+	+
Conduct co-creation sessions				X		+		+
Conduct competitive user experience research	X							+
Conduct design charrette sessions with stakeholders		X			+	+		
Conduct experience sampling	X	X					+	
Conduct focus groups about user perspectives	X						+	
Conduct heuristic evaluation		X						+
Conduct interpretation sessions with stakeholders	X				+	+		
Conduct interviews about user perspectives	X						+	
Conduct observational field visits	X					+		
Conduct usability tests	X	X						+
Define target users and their needs	X						+	
Define work flows		X						+
Design in teams			X			+		
Develop a user research plan	X					+		
Develop experience models	X				+	+		
Develop personas and scenarios	X	X					+	
Engage in cycles of rapid prototyping		X		X				+
Engage in iterative development	X	X						+
Engage in live prototyping				X				+
Examine automatically generated data	X	X				+		
Prepare and present user research reports	X				+	+		
Recruit potential users	X						+	
Use associative object-based techniques	X	X					+	
Use dialogic object-based techniques	X						+	
Use generative object-based techniques	X						+	

CFIR Comprehensive Framework for Implementation Research; OUE Observing the User Experience; UMD Universal Methods of Design; CD Contextual Design; FG Field Guide for Human-Centered Design; OS outer setting; IS inner setting; ID individual; IN intervention; X strategy is described in that source; + strategy primarily targets that domain.

^aThe numbers in brackets refer to the citation for each source in the reference list.

^bAs assigned by the first and fourth authors through a consensus-building discussion.

grant applications). In future research, we plan to explore the potential of various resources to support collaboration around the design of EBPs and related implementation supports at different stages of the collaboration process (e.g., shared online workspaces for executing collaborative projects) and of researcher development (e.g., mentored development programs for early-career researchers).

More broadly, we need to better understand how UCD fits together with implementation science and practice. As an initial step toward that understanding, our research team is currently conducting a study [11] using concept mapping [32] to identify and characterize clusters of implementation and UCD strategies—based on sorting and rating tasks completed by expert participants—in terms of their importance, feasibility, and promise for interdisciplinary collaboration. Organizing UCD and implementation

strategies into meaningful groups is an important first step in managing the complex interrelations among strategies [12,27] and ultimately understanding which strategies are best suited to solving particular implementation problems [33]. Other research approaches that will be equally critical include establishing clearer boundaries on the scope of applications for UCD within research translation (i.e., identifying types of EBPs and implementation activities for which UCD is most impactful; see [34]); determining whether established reporting standards for implementation strategies (i.e., specifying actors, actions, and timeframes; see [35]) are sufficient for UCD strategies; using novel experimental designs (see [36]) to isolate and evaluate the unique contributions of different UCD strategies to implementation and clinical outcomes (e.g., the impacts of some strategies, such as personas, remain unclear); and

testing causal mechanisms (e.g., increased usability of the EBP vs. increased engagement and investment of users) behind the effects of UCD [37].

In sum, this UCD glossary is part of ongoing efforts to promote the use of health research evidence in practice settings through increased interdisciplinary collaboration. The particular impact of UCD on health services and population health needs to be further tested, and techniques further refined, through considerable expansion of current research and implementation partnerships (see [4,17]). The development of shared language to describe UCD—an ongoing process of which this glossary represents but one important initial step—will make clear the implications of, and connections between, various studies in this much-needed area of interdisciplinary work—while avoiding a “Tower of Babel” due to lack of shared language and understanding [38].

Compliance with ethical standards

Funding: This work was supported by the Marie Wilson Howells Fund, University of Arkansas Department of Psychological Science (PI: Dopp, #1711.01). Authors Munson and Lyon were paid consultants for this grant.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Human Rights: This manuscript does not describe any studies with human participants performed by any of the authors.

Informed Consent: This study does not involve human participants and informed consent was therefore not required.

Welfare of Animals: This manuscript does not describe any studies with animals performed by any of the authors.

References

- Chambers DA, Glasgow RE, Stange KC. The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change. *Implement Sci*. 2013;8:117.
- Chorpita BF, Daleiden EL. Structuring the collaboration of science and service in pursuit of a shared vision. *J Clin Child Adolesc Psychol*. 2014;43(2):323–338.
- Shelton RC, Cooper BR, Stirman SW. The sustainability of evidence-based interventions and practices in public health and health care. *Annu Rev Public Health*. 2018;39:55–76.
- Lyon AR, Koerner K. User-centered design for psychosocial intervention development and implementation. *Clin Psychol (New York)*. 2016;23(2):180–200.
- Lyon AR, Stirman SW, Kerns SE, Bruns EJ. Developing the mental health workforce: review and application of training approaches from multiple disciplines. *Adm Policy Ment Health*. 2011;38(4):238–253.
- Campbell EM, Sittig DF, Ash JS, Guappone KP, Dykstra RH. Types of unintended consequences related to computerized provider order entry. *J Am Med Inform Assoc*. 2006;13(5):547–556.
- Aarons GA, Fettes DL, Hurlburt MS, et al. Collaboration, negotiation, and coalescence for interagency-collaborative teams to scale-up evidence-based practice. *J Clin Child Adolesc Psychol*. 2014;43(6):915–928.
- Proctor E, Silmere H, Raghavan R, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. *Adm Policy Ment Health*. 2011;38(2):65–76.
- Lau A, Barnett M, Stadnick N, et al. Therapist report of adaptations to delivery of evidence-based practices within a system-driven reform of publicly funded children's mental health services. *J Consult Clin Psychol*. 2017;85(7):664–675.
- Moore JE, Bumbarger BK, Cooper BR. Examining adaptations of evidence-based programs in natural contexts. *J Prim Prev*. 2013;34(3):147–161.
- Dopp AR, Parisi KE, Munson SA, & Lyon AR. *Integrating implementation and user-centered design strategies to enhance the impact of health services: Protocol from a concept mapping study*. Manuscript under review.
- Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. *Implement Sci*. 2015;10:21.
- Goodman E, Kuniavsky M, Moed A. *Observing the User Experience: A Practitioner's Guide to User Research*, 2nd ed. Waltham, MA: Morgan Kaufmann; 2012.
- Hanington B, Martin B. *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*. Beverly, MA: Rockport Publishers; 2012.
- Holtzblatt K, Beyer H. *Contextual Design: Design for Life*, 2nd ed. Cambridge, MA: Morgan Kaufmann; 2017.
- IDEO. *The Field Guide to Human-Centered Design*. 2015. Available at <http://www.designkit.org/resources/1>. Accessed November 20, 2018.
- Altman M, Huang TTK, Breland JY. Design thinking in health care. *Prev Chronic Dis*. 2018;15:E117.
- Deirdre MJW, Moran K, Cornelissen V, et al. The development and code-sign of the PATHway intervention: a theory-driven eHealth platform for the self-management of cardiovascular disease. *Transl Behav Med*. 2018;iby017. doi:10.1093/tbm/iby017
- Hekler EB, Klasnja P, Riley WT, et al. Agile science: creating useful products for behavior change in the real world. *Transl Behav Med*. 2016;6(2):317–328.
- Lyon AR, Lewis CC. Designing health information technologies for uptake: development and implementation of measurement feedback systems in mental health service delivery. Introduction to the special section. *Adm Policy Ment Health*. 2016;43(3):344–349.
- Zomerijk LG, Voss CA. Service design for experience-centric services. *J Ser Res*. 2010;13(1):67–82.
- Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med*. 2012;43(3):337–350.
- Greenhalgh T, Wherton J, Papoutsi C, et al. Beyond adoption: a new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *J Med Internet Res*. 2017;19(11):e367.
- Mohr DC, Lyon AR, Lattie EG, Reddy M, Schueller SM. Accelerating digital mental health research from early design and creation to successful implementation and sustainment. *J Med Internet Res*. 2017;19(5):e153.
- Rabin BA, Brownson RC, Haire-Joshu D, Kreuter MW, Weaver NL. A glossary for dissemination and implementation research in health. *J Public Health Manag Pract*. 2008;14(2):117–123.
- Boell SK, Cecez-Kecmanovic D. A hermeneutic approach for conducting literature reviews and literature searches. *Commun Assoc Inform Syst*. 2014;34(1):257–286.
- Waltz TJ, Powell BJ, Matthieu MM, et al. Use of concept mapping to characterize relationships among implementation strategies and assess their feasibility and importance: results from the Expert Recommendations for Implementing Change (ERIC) study. *Implement Sci*. 2015;10:109.
- Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4:50.
- Martinez RG, Lewis CC, Weiner BJ. Instrumentation issues in implementation science. *Implement Sci*. 2014;9:118.
- Darnell D, Dorsey CN, Melvin A, Chi J, Lyon AR, Lewis CC. A content analysis of dissemination and implementation science resource initiatives: what types of resources do they offer to advance the field? *Implement Sci*. 2017;12(1):137.
- Drachota A, Meza RD, Brikho B, et al. Community-academic partnerships: a systematic review of the state of the literature and recommendations for future research. *Milbank Q*. 2016;94(1):163–214.
- Kane M, Trochim WMK. *Concept Mapping for Planning and Evaluation*. Thousand Oaks, CA: Sage; 2007.
- Powell BJ, Beidas RS, Lewis CC, et al. Methods to improve the selection and tailoring of implementation strategies. *J Behav Health Serv Res*. 2017;44(2):177–194.
- Areán PA. *UW ALACRITY Center for Psychosocial Interventions Research*. NIMH grant 1P50MH115837-01; 2018. Available at <https://sharepoint.washington.edu/uwpsychiatry/Research/Pages/ALACRITY-Center.aspx>. Accessed November 20, 2018.
- Leeman J, Birken SA, Powell BJ, Rohweder C, Shea CM. Beyond “implementation strategies”: classifying the full range of strategies used in implementation science and practice. *Implement Sci*. 2017;12(1):125.
- Mazzucca S, Tabak RG, Pilar M, et al. Variation in research designs used to test the effectiveness of dissemination and implementation strategies: a review. *Front Public Health*. 2018;6:32.
- Lewis CC, Stanick C, Lyon A, et al. Proceedings of the fourth biennial conference of the Society for Implementation Research Collaboration (SIRC) 2017: implementation mechanisms: what makes implementation work and why? Part 1. *Implement Sci*. 2018;13:30.
- McKibbin KA, Lokker C, Wilczynski NL, et al. A cross-sectional study of the number and frequency of terms used to refer to knowledge translation in a body of health literature in 2006: a Tower of Babel? *Implement Sci*. 2010;5:16.