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Planning and positioning mHealth interventions in developing countries

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ABSTRACT

Objective: The objective of this paper is to develop a framework for the planning and positioning of mHealth interventions in developing countries.
Method: The description of the framework uses an illustrative case from Enugu State, Nigeria. Planning and positioning for this case involved a number of interventions including workshops, training sessions, and other attempts to socialise mHealth tools and canvass for local and regional support.
Results: The planning and positioning differentiates between interventions at two levels. First, we differentiate between interventions targeting *traits* and *states*, the latter being situation-specific. Second, we differentiate between *individual* and *social* interventions, the latter being resilient to personnel change. This creates a simple 2×2 matrix to lay out the portfolio of interventions in an mHealth project.
Conclusion: The framework offers support to governments, decision makers, and developers as they design an assemblage of mHealth interventions. This added clarity means the framework also helps to analyse 'as is' structures and behaviours. The framework further provides support for reflecting on projects, as interdependent goals in different quadrants can be assessed against specific interventions.

Introduction

mHealth is the application of wireless mobile technologies to support healthcare delivery [e.g., 1,2]. Existing literature has shown that mHealth can be used in many areas of healthcare services [e.g., 3–5]. Notable examples include improving the quality of data recording and data entry [e.g., 6] and remote tracking of treatment and medication adherence [e.g., 7,8], to mention but a few.

These research streams have helped to highlight the potential of mHealth. Yet mHealth is not simply a matter of building IT; many related activities are required to harmonise goals, inform policy, and justify public investment [9]. This is challenging, as the various supporting interventions may be difficult to scope and may be interdependent on one another, thus difficult to evaluate in terms of quality and effectiveness [e.g., 10]. This study addresses this issue by presenting a framework to help plan, position, and relate supporting interventions. The next section outlines the method used to design the proposed framework. The following section describes the framework, based on a simple 2×2 matrix and a number of illustrative exemplar interventions. The final section presents implications of this framework for health policy and technology.

Methods

The overarching theoretical perspective behind this study is the 2×2 matrix used to build the planning and positioning framework by leveraging the five factor model [e.g., 11] and Hofstede's dimensions [12]. The five factor model (FFM) refers to the five major types of individual personality traits [11,13] that could influence how an individual responds to stressful situations (e.g. the introduction of a new mHealth tool) in their environment. Hofstede's dimensional framework describes five independent dimensions that helps to explain the management structure of a social group (i.e., an establishment, organisation, community, or country) [12]. Put differently, "The collective programming of the mind that distinguishes one group or category of people from another" [14]. The framework was informed by the planning and positioning for an exploratory research initiative in Enugu State, in the South Eastern Region of Nigeria between January 2016 and March 2017 (15 months). This project focused on introducing an ICT-enabled mobile application to assist healthcare delivery for infants and young children under 5 years. The project comprised three phases. Phase one involved a systematic literature

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Table 1
Stakeholders involved in mHealth tool delivery process - adapted from.

Stakeholders	Stakeholders as used in this study
Patients	These are represented by the *Parents/Guardians (PGs)*, who are individuals that help their children to receive preventative or curative care in the healthcare system. These are the vulnerable individuals whom the mHealth systems are intended to help
Healthcare Workers	These are the *Rural Healthcare Workers (RHCWs)* which are those individuals who are directly responsible for one or more aspects of healthcare delivery.
System Developers	Those individuals directly involved in the design or/and development of an mHealth artefact.
Facilitators	These are those individuals or bodies that expedite or enable the development, implementation and provision of mHealth.

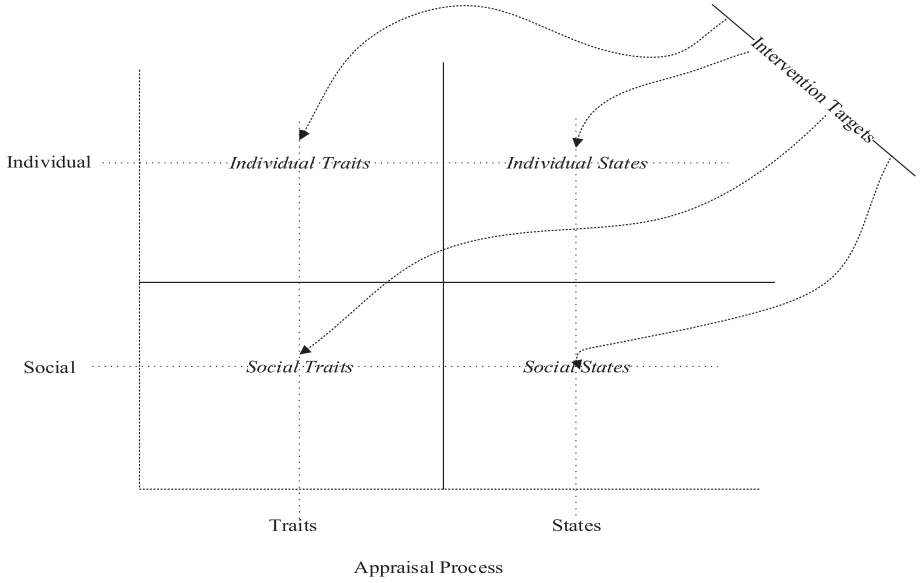

Fig. 1. Framework for planning and positioning interventions.

review to understand how the different stakeholders participate and interact during an mHealth tool implementation process. We identified four main stakeholders (Table 1), i.e., Patients (represented by the Parents/Guardians of the under-fives), rural Healthcare Workers (RCHWs), Facilitators, and System Developers [15]. Phase two was conducted with thirty-two stakeholders to understand the social and material factors that influence the assimilation of mHealth technologies by the different stakeholders. Phase three involved the same stakeholders, our focus was to understand the factors that influence the different stakeholders' primary appraisal of mHealth technologies in rural contexts. These studies encompassed specific workshops, which included training and knowledge exchange sessions supported by practical sessions working with a prototype of the mHealth tool. These working sessions included face-to-face meetings canvassing for financial support from the Facilitators (i.e., the local and regional authorities) to support wider rollout of the mHealth tool. Ethical approval was obtained in both the primary host institution of the researchers and a local university in Nigeria involved with the research initiative.

A planning and positioning framework

The first dimension for differentiating between specific interventions is whether they target *traits* or *states*. This differentiation is key to understanding emotional and behavioural responses to a new IT [e.g., 16,17]. *Traits* refer to those aspects of personality that are comparatively stable over time and situations (environments) [18,19]. Many personality theorists have conceptualised traits as the fundamental qualities, characteristics, or cognitive processes that operate or exist in an individual [19,20]. *States* are defined as being situationally (environmentally) dependent, hence temporary in nature [e.g., 19]. *States* can be internal or external, meaning they may arise because of the mood of the individual and/or the conditions to which they are being subjected at some point in time [18,20].

The second dimension for differentiating between specific interventions is whether the benefits of that intervention are lost if the participating individuals leave the target system, i.e. whether the intervention is at the level of the *individual* or the *social*. At an *individual*-level, desired changes may include everyday activities [19,21], beliefs and attitudes such as hope, optimism, and self-efficacy [20,22], or goals and adjustments [e.g., 20]. At a *social*-level, desired changes may include collective attitudes and beliefs [23], shared processes and culture [24,25], or even shared emotions [26].

Just as designers increasingly understand the need to consider both *traits* and *states*, many organisations recognise the need to balance *individual* and *social* changes when attempting to improve outcomes [e.g., 25,27]. We apply the same logic when attempting to improve a healthcare system, as illustrated in Fig. 1.

Interventions targeting individual traits

Individual traits refer to inherent characteristics of an individual that differentiates him/her from another [19,20]. These characteristics manifest in the personality traits of an individual. They are usually those stable and consistent responses of an individual to adapt to his or her environment [19,20]. These individual personality traits vary in degrees of influence from low to high among different individuals.

First, the *openness-to-experience* trait measures personality characteristics such as broadmindedness, intellect, curiosity, culturedness and intelligence which are positive attributes towards learning experiences [13,21,28]. It is posited individuals who score high

on these attributes tend to be open-minded, inspired, sensible, and intellectual [e.g., 13]. This is important, as individuals with high openness to experience traits are more likely to learn and benefit from training than those with a low score [21,29]. Those with high scores are also likely to be more adaptable to changing circumstances [29,30].

Second, *conscientiousness* is the extent to which an individual is reliable, persevering, hardworking, disciplined, deliberate, and/or achievement oriented [11,28]. Conscientiousness is related to job performance since it measures those attributes which are significant factors for tasks accomplishment [21]. Individuals who display high levels of conscientiousness tend to be responsible, organised, meticulous and high motivation to learn [13,31]. Those with low levels of conscientiousness appear to be untrustworthy, unorganised and irresponsible [13,31,32].

Third, e*xtraversion* refers to an individual's propensity to experience positive emotions [e.g., 33]. These emotions include assertiveness, talkativeness, venturesome-ness and social poise [18,33]. Individuals with high extraversion traits are enthusiastic and joyful because they usually engage in more activities that help in overcoming stressful conditions [18]. This implies individuals that are low in extraversion tend to be introverted, aloof, and resigned [13,32].

Fourth, *agreeableness* describes individuals who are compassionate, trusting, cooperative, and amenable-to-changes [21,33]. Individuals who score high in agreeableness are said to be good-natured and cooperative [13,21]. Hence individuals with high agreeableness are likely to work together in a team to achieve a common goal, while those with low agreeableness tend to be antagonistic and inflexible [13,32].

Fifth, *neuroticism* refers to individuals that have a tendency to experience distressful and nervous emotions easily, such as anger, anxiety, depression, and vulnerability [18,33]. Highly neurotic individuals are prone to mal-adaptive coping strategies, leading to withdrawal or disengagement [33,34]. Individuals with low neuroticism are more likely to bounce back from difficulties, stay in control, and withstand stressful conditions [34].

We targeted *individual traits* in two notable ways (Fig. 2). First, rural healthcare workers (Healthcare Workers) and supervisors (Facilitators) were provided training on basic IT skills and targeted training in the use of our mHealth tool. This helped increase the participants' *openness to experience* and reduce *neuroticism* around the use of IT in healthcare more broadly. Second, local government officials (Facilitators) were made aware of the current issues regarding mHealth as a healthcare delivery support tool. Perceived blind-spots around the use of the mHealth tool were thoroughly explained in an effort to enable a credible foundation for mHealth. This increased *conscientiousness*, not only as it concerns some new mHealth solutions, but for the Enugu State healthcare system more broadly.

Interventions targeting individual states

Individual states occur when situational internal or external conditions cause us to deviate from our typical traits. These states often result from emotional reactions to events in a workplace or environment which trigger atypical behavioural responses [16,33]. For example, an individual's first encounter with new IT may cause them to form a disproportionally favourable/unfavourable perspective [16,33]. This may follow for every subsequent satisfying or unsatisfying interaction with IT [16,33]. The extent of this emotional reaction is moderated by individual dispositions, yet the presence of the influence is nonetheless consistent [16,18,33]. For example, positive moods moderate the relationship between extraversion and achievement [13,18,33], while negative moods moderate the relationship between neuroticism and retirement [13,18,33].

The most important *individual state* we targeted was *neuroticism* (Fig. 2). First, rural healthcare workers and supervisors were required to socialise with mHealth tools in a workshop setting to reduce tool-specific anxiety. This provided individuals with a sense of what it would be like to use the mHealth tool as part of their roles in the community. Second, rural healthcare workers and supervisors were asked to engage in role-playing scenarios to learn from each other while acting in a role as a patient or a healthcare worker and vice-versa. This helped participants imagine how other people might respond to different illness or sickness scenarios, allowing them to begin mentally preparing in a safe environment.

Interventions targeting social traits

Social Traits describe shared values and belief systems that help individuals to cooperate to accomplish one or several goals [e.g., 22]. We apply Hofstede's [e.g., 35,36] framework on cultural dimension to understand social traits. Hofstede's five dimension are explained as follows:

Power-distance describes the extent to which the less powerful in an a social group anticipate and agree that power is distributed equally among members [12,14,37]. It is a measure of *'dependence'* with a given social group [35,37], meaning low power-distance implies less dependency on leaders.

Individualism-collectivism refers to the degree to which individuals are concerned with their own interests relative to the larger social group [14,37]. Individualistic groups tend to encourage individuals to focus on themselves and their immediate family, while collectivistic groups encourage loyalty to shared interests [12,34].

Masculinity-femininity draws on the historic generalization that "men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with the quality of life" [37]. Thus, masculine cultures encourage assertiveness and competition, while feminine cultures encourage cooperation and gentleness [14,37].

Uncertainty-avoidance describes the level to which members of a social group or system accept unknown or uncomfortable situations [14,35,37]. This cultural dimension is related to cultural anxiety, similar to the neuroticism trait, meaning it often manifests as collective nervous energy [14,37].

Long-term-short-term represents the level to which members of a social group or organisation are consciously manoeuvred to accept delayed remunerations or compensations [14,37]. This means traditionally that short-term oriented social groups among others demand quick results for inputted efforts, while, long-term oriented social groups want future dispensed returns on investment [37].

We targeted *social traits* in two ways (Fig. 2). First, we canvased for financial support from the local government authority and Ministry of Health (Facilitators) to make resources (e.g. Electricity, Internet Access, and Data Credits) available for rural healthcare workers. This was done to nurture *collectivism* and *femininity* to encourage a sense of responsibility for vulnerable individuals on the periphery of the healthcare system. Second, we sought to educate individuals from the local government authority and ministry of health regarding the *long-term* benefits of more accurate health data enabled by mHealth tools. This further acted to minimize *uncertainty avoidance* by creating a clear return of investment for new technologies and reasoning out the potential for future projects.

Intervention targeting social states

Just like individuals, groups can take on atypical qualities in specific situations. For example, where power-distance is low, learning a new skill in a traditional instructor/teacher situation is

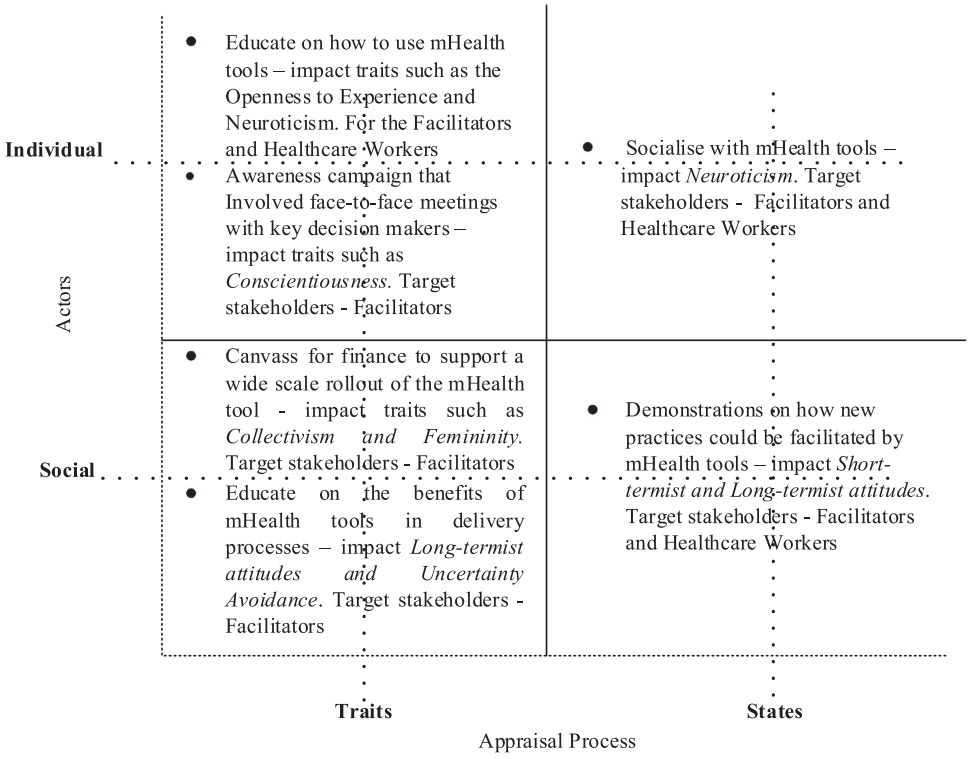

Fig. 2. Illustrates examples of intervention measures focused on key stakeholders.

viewed as impersonal, so creating tensions between otherwise co-operative members and increasing competitiveness [35,37]. Conversely, where power-distance is high, teachers are expected to outline learning processes clearly; failure to do so may feed into collective anxiety and generate increasing *uncertainty-avoidance* [12]. Another example occurs in culturally feminine social groups, wherein teachers typically prefer to praise a weak student in order to encourage him/her, rather than openly praising a good student [37]. However, breaking this norm by extolling excellence might lead to jealousy and increasing individualism [37,38]. These examples show how shared culture can change once a scenario is encountered for which the existing culture is poorly equipped. Thus, the scenarios must be managed to avoid breakdowns that threaten the consistency of the group over time.

The *social states* of interest in the illustrative case concerned tensions between long-term and short-term time orientations (Fig. 2). The culture in Enugu State is largely long-term, with a strong sense of connection to the local history and many individuals committed to improving conditions in the future. Yet the attitudes towards the mHealth tool were short-termist, often concerned with cost and challenges presented by the transition. Hence, demonstrations were made for healthcare managers (Facilitators) to make them aware of the new practices facilitated by mHealth tools. This included the quality of diagnosis and treatment, as well as the ability to reach those living in hard-to-reach areas of rural communities. Additionally, rural healthcare workers were shown how new processes increased adherence and created less paper and more consistent records. This was an obvious contrast to existing paper-based tools that allow users to skip questions and create large piles of partially complete records.

Implications for health policy and technology

This study presents a novel intervention framework for the introduction of mHealth in developing countries. There are a number of limitations to this study. First, in the development of the 2×2 matrix we focused on a single mHealth tool targeted at the assessment of children under 5. There is an opportunity to leverage this framework in light of other types of mHealth tools. Second, the framework was developed using Hofstede's dimensions within the context of a single African country, i.e. Nigeria. Future research in other developing countries could provide governments, decision makers and developers with a more nuanced view of *states/traits* in diverse settings. This would allow for the design of more targeted tailored interventions. Thirdly, healthcare systems are fraught with tensions which are difficult to overcome, these are usually due to deep-set resourcing, political and cultural issues. There is an opportunity for future studies to design and implement new innovative interventions that could be leveraged in the quadrants.

The framework differentiates interventions according to four quadrants. First, some interventions target *individual traits*. These interventions seek to improve individual's abilities, job knowledge, and skills as they relate to an mHealth tool. Second, some interventions target *individual states*. These interventions seek to improve crucial situations that would otherwise drown out desirable individual traits with emotionally-charged destructive reactions to an mHealth tool. Third, some interventions target *social traits*. These interventions seek to improve the culture in which individuals are delivering healthcare using an mHealth tool. Fourth, some interventions target *social states*. These interventions seek to avoid scenarios that create tensions in the healthcare culture and cause social systems to break down around an mHealth tool.

This research makes three important contributions to health policy research. First, the framework provides support for the analysis of the 'as is' of current practice in a target system. Positioning existing interventions using the framework could help governments, decision makers, and programme developers better achieve their goals. For example, we may imagine a scenario where a government is planning a new malaria treatment and have decided that individuals or social groups lack *openness-to-experience* or exhibit *neuroticism*. The framework prompts two important analytical questions (i) are these traits or are they states, i.e. are these

qualities that individuals possess across a range of scenarios or do they arise solely in related healthcare-specific situations? (ii) are there social qualities that also need to be considered, i.e. do elements of local culture (persistent or situational) threaten the effectiveness of a new mHealth tool? This is important, as there may be macro-level issues that limit an individual's willingness to engage with new practices, e.g. excessive *power-distance* or collective *short-termism*. Incomplete diagnosis of the problem can have serious consequences, as demonstrated by previous research, for example, a study by Xue et al., [39]. Xue et al. investigated the reasons behind healthcare providers' resistance to using telemedicine from a threat-control perspective. They concluded that the perceived threat originated from three major cognitive sources: 'reduced autonomy', 'anxiety', and 'cost'. However, it was not clear whether these issues were situational (states) or personality-based (traits). This adds ambiguity to the implications of that study, as it is not clear to what extent the problem precedes the introduction of telemedicine or is symptomatic of it. Hence, it's not clear which part of the new system design should be adjusted.

Second, the framework offers support to governments, decision makers and developers during the planning and positioning of mHealth initiatives. To take the previous hypothetical example, if high *power-distance* has been identified as a problematic social trait, then some intervention(s) need to be designed to address this. Thus, the framework pushes governments, decision makers, and programme developers to design assemblages of interventions more holistically. The benefits of such a holistic approach were also observed in previous research, for example, by Yardley et al. [40]. That study combined a focus on individual-level issues such as acceptability, usability, and satisfaction, with a *social group* modelling process. This included testimonials from successful users, which improved the sense of connectedness and created a clear understanding of shared goals.

Third, the framework provides a way of relating different assessments, both to each other and to project-level goals. Put differently, the framework encourages governments, decision makers, and programme developers to evaluate projects against the collection of individual and social traits and states. Equally importantly, it encourages governments, decision makers, and programme developers to evaluate the impact of each individual intervention according to the corresponding quality and quadrant. Building on the running hypothetical example for a new mHealth-enabled malaria treatment, we may imagine an intervention was designed to increase *long-termism*, e.g. healthcare experts were invited to discuss the long-term gains of new malaria treatment practices, the framework acts as a support tool for governments, decision makers, and programme developers. The framework encourages researchers to evaluate the intervention accordingly by asking 'did it increase *long-termism*?' This is important, as many interventions will have multiple benefits, meaning their success or failure can be somewhat ambiguous. For example, a study by Zakumumpa et al. [41] in Uganda looked at sustaining and expanding antiretroviral treatment scale-up programmes in a resource-limited setting. This particular intervention succeeded in achieving some goals but failed to achieve others. That is, the findings show that at the health facility level, one success measure involved the criteria that reduced the frequency of visits to the clinics based on the clinical assessment of individual patients. This helped to: (1) decongest the clinics; (2) optimise the clinicians' time, and (3) reduce the overall costs of the delivery services by providers [41]. This target was at organisational level and not at the individual level. More importantly, it was unclear which social or individual goals were a priority during the intervention. However, our framework provides guidance in terms of designing and implementing new interventions at the different levels. That is, the framework provides clarity when evaluating such interventions, as project-level priorities can be used to separate social and individual targets. Furthermore, many health information technology assessment interventions are based on assumed benefits, for example, the increased quality of care, improved efficiency and improved cost effectiveness which are not easy to measure [42]. In terms of positioning and planning, this framework could help programme developers identify and focus on achieving specific individual and social (organisational) targets and thereby improve the likelihood of positive outcomes.

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None declared

Ethical approval

Not required

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2019.03.003.

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