

The lack of psychological, behavioural, and adherence theories in designing data-driven conversational agent interfaces

MILO MARSFELDT SKOVFOGED, Aalborg University, Denmark

Patients' non-adherence to regimes in rehabilitation (~50% [4]), medication (~40% [7]), and providing patient-reported outcomes (PRO) (30-70% [29]) has been reported across conditions; e.g. stroke [19], cancer [6], and chronic health conditions [8, 12]. Non-adherence can either be intentional by patients choosing not to follow the recommended action, due to frustration, fear, financial problems, effort, etc. [23], or unintentional by forgetting or misunderstanding the necessary actions [17]. Unintentional non-adherence can be reduced by reminding, educating people about the importance of the task, and simplifying the required tasks [5]. Intentional non-adherence is a complex problem requiring motivating interventions that psychologically target patients' cognition and emotions to change and sustain behaviour [6], e.g. through accountability [21], operant conditioning [11], physical and emotional support [28]. While no single one-size-fits-all intervention strategy has been proven to improve the adherence of all patients, decades of research studies agree that successful attempts to improve patient adherence depend upon patients' knowledge and understanding of the regimen, and external human support from family, friends, caregivers, therapists, etc. [1]. Likewise, many psychological theories concerned with behavioural change and maintenance rely on external human support [16]. Currently, many health sectors collecting PRO data post-discharge utilise phone calls or online consultations as external human support to boost adherence. While this initially boosts adherence (7 days 68%) it declines substantially over time (90 days 52%, one year 25%) [27]. The method with the highest adherence to PRO data is costly in-person consultations in which a person assists the patients. Unfortunately, this is hindered by people's non-adherence to medical appointments. Hence, multiple technology-based intervention approaches, have addressed unintentional non-adherence through e.g. reminding or motivational text message [7, 20, 26] and apps [15], with modest evidence of efficacy [25]. Unfortunately, text messages and traditional button-driven UI apps are a poor substitute for external human support and have limited success in addressing intentional non-adherence. Recent advancements in natural language processing (NLP) have made conversational agents (CA) able to mimic human communication, cognition, and behaviour, thereby creating a closer and even emotional connection between the user and CA [3]. Much research both within and outside the health domain has focused on strengthening the connection between users and the CA by improving its appeal (tone of voice [22], visual appearance/embodiment [9, 18]), human-like behaviour [10], usability [13], personality [14], etc. By leveraging this connection to create a social contract and accountability with the user CAs should improve both intentional and unintentional non-adherence, however, little empirical evidence support this hypothesis [2].

In this position paper, I would like to suggest that while the CA-human connection will be improved as technology matures this will not sufficiently increase adherence. The reason is that CAs still have to overcome the fundamental challenge of adherence, namely incorporating new actions/behaviours into existing habits and routines. However, only 27% of the adherence text/app-based interventions incorporated explicit theoretical behavioural approaches or frameworks into their design [7]. To the best of my knowledge, only a few examples of CAs addressing this exist. One eHealth example is Mohr's supportive accountability framework that draws on organizational psychology, motivation theory, and computer-mediated communication (CMC) [21], which improved treatment adherence from 42% to 70% [30]. Psychology has a substantial body of knowledge focused on how to change users' behaviour, yet, the translation to design

is at large missing. This lack of explicit theoretically informed design is a common tendency within human-centred design, which rarely goes beyond abduction and deduction reasoning for its design decisions [24].

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