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BEYOND REWARDS: INTEGRATING SELF-DETERMINATION THEORY AND FLOW THEORY TO ENHANCE PATIENT ADHERENCE IN PHYSIOTHERAPY

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ABSTRACT

Patient adherence to physiotherapy is crucial for achieving successful outcomes, but it is often hindered by the routine nature of traditional rehabilitation exercises. This lack of engagement, along with psychological barriers like low self-efficacy, leads to less effective recovery. Gamification, which is the use of game design principles, has been proposed as a solution, but its success has been inconsistent, often because it emphasizes external rewards too much. This paper argues that for gamification to succeed in a therapeutic setting, its design must be rooted in intrinsic motivation. A framework combining Self-Determination Theory (SDT) and Flow Theory is presented, suggesting that to promote lasting adherence, a system must fulfill patients' basic psychological needs for autonomy, competence, and relatedness while creating a flow state by balancing challenge and skill. This paper outlines the components of this framework and introduces a model for the next generation of gamified systems, shifting from simple rewards to a genuinely motivating therapeutic experience.

Keywords: *Gamification, Patient Adherence, Physiotherapy, Self-Determination Theory, Intrinsic Motivation*

INTRODUCTION

1.1 The Adherence Crisis in Physiotherapy

Healthcare is continuously changing, causing healthcare providers to create innovative tools that actively involve patients in their recovery (Daineko et al., 2023). This is especially crucial in physiotherapy, a field that depends on ongoing patient participation to achieve the best results in their recovery process. Unfortunately, traditional rehabilitation methods often struggle to keep patients engaged. Musculoskeletal disorders are a leading cause of disability worldwide, with physiotherapy being the main non-invasive treatment for recovery. Nevertheless, the success of these protocols heavily relies on one unpredictable factor, which is patient adherence to therapy.

Despite the clear physiological benefits of rehabilitation, non-adherence remains a widespread issue, with rates estimated to be as low as 30% to 50% in home-based exercise programs (Sluijs

et al., 1993; World Health Organization, 2003). This gap is often caused by the boring, repetitive nature of therapeutic exercises and a lack of immediate feedback, which leads to patient disengagement. As a result, even well-designed rehabilitation protocols often produce less than the expected recovery outcomes, not because of a lack of medical effectiveness, but due to behavioral issues, since patients are frequently asked to perform exercises that are dull, repetitive, and uninspiring (Jack et al., 2010). This problem is significant because it is a major factor in poor adherence and, in turn, limited progress in the recovery process. The situation is worsened when patients do not have real-time feedback, making it difficult for them to measure their own improvement and stay motivated.

This challenge is not just logistical; it is also highly psychological because patients often face major barriers, such as low self-efficacy (a belief in one's ability to succeed), fears of movement or re-injury, and difficulty visualizing their own progress (World Health Organization, 2003). This combination of physical demands and psychological obstacles can lead to longer recovery times or incomplete rehabilitation. Gamification, which involves applying game design elements to non-game settings, has become an effective tool to address these specific challenges (van Gaalen et al., 2021).

2. The Inconsistent Efficacy of Current Gamification

Gamification is an innovative therapeutic method that uses the motivational power of games to create engaging and interactive therapy experiences (Faust, 2021). In healthcare, it has been used to make rehabilitation more engaging by transforming the traditional repetitive exercises into goal-driven activities, that include progress tracking and goal-setting, helping patients see their improvements in real-time(Choi et al., 2014). In response to this engagement crisis, gamification has emerged as a promising technological intervention. By integrating mechanics such as points, badges, and leaderboards, developers have tried to motivate patients to complete their therapy sessions without being bored half way through. However, empirical evidence about the long-term effectiveness of gamified health applications is mixed (Hamari et al., 2014). A key limitation of current systems is their reliance on points or extrinsic rewards, which may promote short-term compliance but fail to foster the deep, voluntary engagement needed for long-term rehabilitation.

A review of the literature reveals a significant issue, and research results show mixed effectiveness. Faust (2021) notes that while some studies demonstrate strong potential for boosting motivation and adherence, others report neutral or even negative outcomes, such as reduced exercise compliance or demotivating effects. This paper argues that this inconsistency is not a flaw of the gamification concept itself but rather a failure in how it is applied. A lot of the gamification in healthcare so far can be described as superficial. This approach often involves adding a thin layer of game mechanics, primarily points, badges, and leaderboards (PBLs), to the same boring tasks. This superficial model is flawed because it relies almost exclusively on extrinsic motivation (Deterding et al., 2020). A patient may initially be motivated by earning a badge, but this motivation quickly fades because this approach fails to address the underlying psychological causes of disengagement because it does not build a patient's self-efficacy, it does not give them a sense of control, and it does not make the task itself any less boring. Solving the adherence crisis requires moving beyond extrinsic rewards and designing for deep, intrinsic motivation.

To build a system capable of fostering intrinsic motivation, its design must be grounded in established theories that can explain why people feel motivated. The principles of gamification, which are clear goals, feedback, and progression (Kapp, 2020; Hamari et al., 2024), are a starting point, but they lack a cohesive psychological framework.

This paper argues that for gamified physiotherapy to be truly effective, it must go beyond superficial mechanics and be grounded in established motivational psychology. A unified conceptual framework is proposed that synthesizes two foundational theories which are Self-Determination Theory (SDT) and Flow Theory.

3. Self-Determination Theory as the Psychological Basis of Motivation

Self-Determination Theory (SDT) serves as the foundational theory for this framework, moving the focus of design from external incentives to internal drive. SDT states that for an individual to sustain intrinsic motivation and psychological well-being, three innate psychological needs must be satisfied. These needs are competence, autonomy, and relatedness (Ryan & Deci, 2000).

Figure1: Self Determination Theory

Consequently, a gamified system designed for clinical adherence cannot simply make game mechanics onto existing protocols it must be designed specifically to fulfill these three core needs of the patient, thereby bridging the gap between clinical necessity and patient engagement.

3.1 Designing the Gamified System for Competence

Competence can be understood as the psychological need for mastery, effectiveness, and the belief in one's ability to succeed. This concept is closely connected to Bandura's theory of self-efficacy (Bandura, 1977). Within the context of physiotherapy, one of the most significant psychological barriers is a lack of perceived competence. Patients often question whether their movements are effective because they are uncertain if they are performing them correctly. Existing "lite" gamification strategies frequently fall short in addressing this issue. By rewarding patients with points for simply completing tasks, these approaches provide no meaningful feedback and fail to foster a genuine sense of mastery (Mekler et al., 2017).

The proposed framework emphasizes the importance of designing systems that act as a "virtual coach," with real-time biofeedback at the center. Through the use of sensors, patients can receive immediate and constructive guidance on their form and range of motion. This transforms vague physical effort into clear, measurable data, a method that has been shown to significantly enhance motor learning and patient confidence (Giggins et al., 2013). In addition, progress visualization must move beyond basic logbooks and evolve into what can be described as a "visualization of mastery." This may include growth metaphors, such as a virtual tree that flourishes with consistent

activity, or graphs that illustrate improvements in physical capacity. Such visualizations make therapeutic progress tangible while directly addressing low self-efficacy (Li et al., 2014; Cecilio et al., 2020).

3.2 Designing the Gamified System for Autonomy

Autonomy reflects the fundamental psychological need to experience one's actions as self-directed, personally endorsed, and under individual control (Deci and Ryan, 1985). Conventional rehabilitation protocols are typically prescriptive, often positioning the patient as a passive recipient of instructions. This dynamic undermines the sense of autonomy and has been shown to reduce long-term adherence (Ng et al., 2012). Although certain gamified applications attempt to address this limitation through superficial customization such as allowing patients to select the color of an avatar studies indicate that such minor choices do not foster genuine agency when the core therapeutic activity remains rigid (Nicholson, 2015). For a system to be clinically effective, it must provide meaningful opportunities for choice that empower patients within the therapeutic process. Examples include enabling patients to decide the order of exercises, establish personal daily goals within clinician-defined safety boundaries, or select their preferred virtual environment. Research by Peng et al. (2012) demonstrates that offering players substantive choices within gameplay significantly enhances intrinsic motivation compared to controlled conditions. Similarly, Xu et al. (2023) highlight that embedding autonomy into therapeutic exercises is critical for shifting the patient's role from a passive object of treatment to an active participant in recovery.

3.3 Designing the Gamified System for Relatedness

Relatedness encompasses the universal psychological need to feel connected, supported, and integrated within a community (Ryan and Deci, 2000). This need is often unmet in home-based or traditional rehabilitation, which Jack et al. (2010) describe as a profoundly isolating experience in which patients frequently feel disconnected from professional support. Commercial gamification strategies commonly employ competitive leaderboards to encourage engagement; however, research indicates that such mechanics can be counterproductive in health contexts, as they may reinforce feelings of inadequacy and diminish intrinsic motivation among individuals struggling with recovery (Hanus and Fox, 2015).

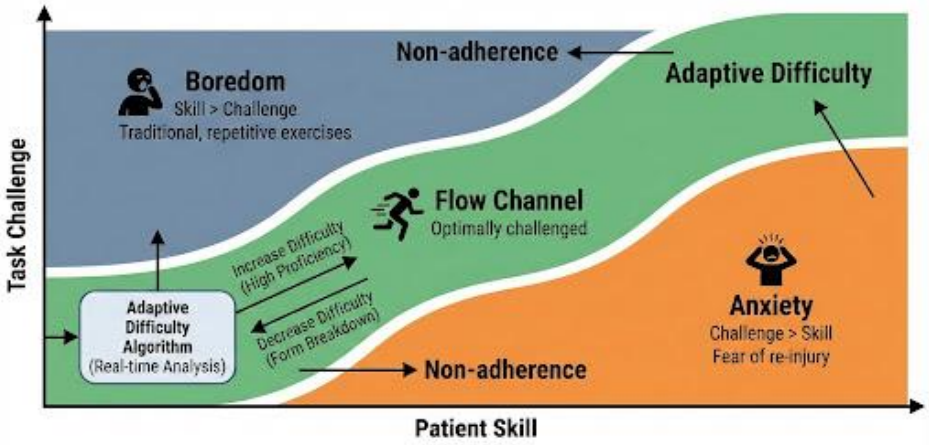
The proposed framework therefore emphasizes social connection rather than competition. The system is designed to serve as a digital bridge that re-establishes the therapeutic alliance, a factor consistently identified as a strong predictor of adherence in physiotherapy (Pinto et al., 2012). Through a remote monitoring dashboard that tracks patient adherence and movement quality, clinicians are able to deliver "high-touch" asynchronous care. This enables the provision of personalized feedback and timely interventions, a feature that Kelders et al. (2012) found to be significantly more effective for adherence than automated system responses alone. In this way, monitoring is recontextualized, shifting from a paradigm of intrusive surveillance to one of supportive clinical oversight.

4. Flow Theory as a Mechanism of Engagement

Self-Determination theory provides the motivational foundation for the proposed framework, while flow theory offers the mechanism for sustaining engagement over time. According to Csikszentmihalyi (1990), flow is defined as a cognitive state of optimal experience characterized by deep absorption, energized focus, and intrinsic enjoyment, during which the individual often loses awareness of time. Importantly, this state depends on a precise balance which is that the perceived challenges of the task must align with the perceived skills of the individual.

When applied to physical rehabilitation, this model highlights the structural limitations of current practices. As illustrated in the figure 2 below, if patient skill surpasses the challenge of the task, the outcome is boredom a state frequently associated with repetitive physiotherapy exercises where patients are capable but uninspired. Conversely, when the challenge exceeds the patient's skill level or physical capacity, the outcome is anxiety. Clinically, this anxiety often manifests as fear of re-injury or physical overwhelm, which can lead to avoidance behaviors. Both boredom and anxiety are precursors to non-adherence (Nakamura and Csikszentmihalyi, 2014).

To counter these extremes and sustain engagement, a therapeutic system must maintain the patient within the "Flow Channel." Static gamification systems often fail to achieve this because their difficulty remains fixed regardless of patient progress. The proposed framework therefore argues for the integration of an adaptive difficulty algorithm (Hunicke, 2005). This algorithm analyzes patient performance in real time. When proficiency is high, for example, sets completed with correct form and consistent velocity, the system dynamically increases difficulty by expanding range of motion targets or repetition counts. Conversely, when sensors detect breakdowns in form or hesitation, the system reduces difficulty to prevent frustration. Through this dynamic calibration, patients remain optimally challenged, thereby fostering a continuous cycle of competence and flow (Zohaib, 2018).



Applying the Flow Model to Physical Rehabilitation: Balancing Skill and Challenge for Engagement
(Adapted from Nakamura & Csikszentmihalyi, 2014; Hunicke, 2005; Zohaib, 2018).

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Figure 2: Illustration of the Flow Theory

5. The Integrated Model which Synthesizes Self-Determination Theory (SDT) and Flow Theory

Though SDT and Flow theory are often referred to as two different psychological theories in literature, in the context of physical rehabilitation, the two theories are mutually reinforcing. A clinically effective system is based on the combination of the technical mechanism of Flow and the psychological gratification of SDT. A cyclical model of engagement has been proposed in which a causal loop of adaptive difficulty algorithm (the engine of flow) is directly serving the psychological need for competence (the engine of SDT). Maintenance of flow channel, requires that a system present a challenge matched to the user's skill (Nakamura & Csikszentmihalyi, 2014). If the system is successful in constantly tuning itself to a patient's capability, it eradicates the anxiety of failure as well as the monotony of boredom. This technical adjustment ensures that the underlying condition is provided, the patient experiences success, thus directly stimulating the need for competence (Ryan & Deci, 2000). On the contrary, a patient who feels competent becomes psychologically competent to take up the next level of challenge, enabling the system to challenge him with higher levels of challenge, advancing along the Flow trajectory.

5.1 Operationalizing the Framework

First, to apply the theory in clinical settings, the next generation of gamified physiotherapy systems must operate on a three-phase loop designed to address specific psychological needs:

Phase 1: The Pre-Activity Phase (Focusing on Autonomy)

Before physical movements start, the system must engage the patient's autonomy. So, instead of showing a directive "Start" interface, the system should offer relevant choices. For instance, the patient may be allowed to choose the order of the exercises, whether the session should focus on "endurance" or "precision", or the virtual environment. As demonstrated in experimental settings by Peng et al (2012), having choice in exergames greatly increases intrinsic motivation and enjoyment when compared to mandatory play conditions.

Phase 2: The Activity Phase (Flow & Competence)

During the exercise, the system's priority is on Flow through real-time responsiveness. Feedback: The biofeedback sensors continuously monitor the quality of performance. If the patient executes the movement without any effort, the system makes a micro-increase in the difficulty ("Superb form, let's add 2 more seconds to the hold"). This in-the-moment, constantly updating calibration ensures that the patient remains in the Flow Channel, while the instant, constructive feedback addresses the need for competence by attesting to the patient's effort (Deterding, 2015).

Phase 3: The Post-Activity Phase (Relatedness Component)

On completion, the system focus is shifted to relatedness. Rather than using a generic 'Level Up' screen or a competitive leaderboard, it would be advantageous to synthesize the data into a progress report that is visible to the clinician. The interface should explicitly include this link (e.g., "Progress sent to Dr. Ezzeh"). This closes the loop on engagement by validating the effort using the therapeutic alliance and not pointless points, thus reinforcing the belief that support is present (Pinto et al., 2012).

6. Conclusion

The crisis of adherence in physiotherapy is not simply a matter of patient discipline, it is fundamentally a matter of design. Conventional rehabilitation approaches often neglect the psychological realities of patients, relying on repetitive tasks that generate boredom or anxiety and ultimately compromise clinical outcomes (Jack et al., 2010). Although gamification has been promoted as a potential solution, its implementation has frequently been superficial, depending on extrinsic rewards such as points and badges that fail to sustain long-term behavioral change (Hamari et al., 2014).

This paper has presented a comprehensive theoretical framework that moves beyond superficial game mechanics. By integrating Self-Determination Theory with Flow Theory, it argues that sustainable adherence can only be achieved when the core psychological needs of patients are addressed. A system that respects autonomy by offering meaningful choice, strengthens competence through adaptive flow, and nurtures relatedness by re-establishing the therapeutic alliance provides a viable path forward. The future of digital rehabilitation lies not in distracting patients from the discomfort of therapy, but in enabling them to discover intrinsic motivation within the recovery process itself.

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