Exploring user profiles for healthy gamification

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***Abstract*— Gamification in healthcare is still not widespread. One way to facilitate application of gamification is to understand the user via user profiles. This study introduces an easier way to categorize the user profiles in three groups instead of six (Hexad). Most of the survey's to categorize user groups are done with adolescents or students. This study takes a much more realistic sample of 274 Dutch households. The results show that designing within gamified mechanics based on a user profiles main motivation is an effective strategy for personalization. Based on these findings we propose a new user profiles model with three user profiles for healthcare that are mainly autonomy driven (Blue), competence driven (Red) and purpose driven (Green). Furthermore, the results indicate a more generic path towards including essential elements to create a basic understanding, get users involved, and provide them with content fitting their motivations. Further study is needed to show if the model can be used in various environments. The first test at an energy provider shows positive results.**

Keywords—Gamification, Target groups, E-health

I. Introduction

Gamification is a field of research that has become increasingly popular for its ability to lead to behavior change through a fun environment. A well-known definition of gamification is *"the use of game design elements in non-game contexts"* [1, p. 10]. Another definition of gamification is *"a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation"* [2, p. 19]. The potential of gamification lies in restructuring of tasks by adding game elements and affordances [3]. It is used as mean of supporting user engagement and enhancing positive patterns in service use, such as increasing user activity, social interaction, or quality and productivity of actions [4]. While gamification sounds similar to the concept of serious gaming their core ideas differ. Ritterfeld et al. [5] defined serious gaming as *"any form of interactive computer-based game software for one or multiple players to be used on any platform and that has been developed with the intention to be more than entertainment"*. The main difference is that a serious game is a real (digital) game, while gamification is the adaptation of game design elements in a non-game context without the need of designing a real digital game.

Not many healthcare applications using gamification are studied in a way that we can draw broader insights. Most studies investigating insights of populations, investigate this with surveys about gamification (profile) preferences and motivations based on students and adolescents, which are underrepresented in actual healthcare applications. Our work contributes towards this broader understanding of a general public as we gather insights of motivation and gamification preference from a wide range of users from an energy saving platform. To this end we build on the Hexad player profiles and questionnaire [6], [7] and based on our findings propose simplifications for easy application.

First, we introduce the literature method and results. Then we show the survey method and results in section 3. We perform a general analysis in section 4 indicating possible implications for healthcare as well as possible improvements for similar studies and provide the takeaway and conclusions in sections 5 and 6.

II. Background

A. Method

We did a systematic search for literature split up in two main topics, namely (personalized) gamification, and persuasive technology for healthcare. These two topics in the literature are researched separately, but also taking special notice where they overlap. Other categories related to healthy gamification are left out as we worked towards realizing a gamification implementation which should stimulate specific behavior. This choice was made based on the preferences of an interested company at the start of this project. The literature search is performed in two general digital libraries Scopus and Google Scholar to not exclude certain fields a priori. The terms used were split in two phases, see Tab. I.

TABLE I. Applied search terms for literature search on the two main topics

	(Personalized) Gamification	**Persuasive technology**
First search terms	(personalized) gamification, designing (personalized) gamification	(personalized) Persuasive technology, persuasive technology applied with gamification, design of persuasive technology systems
Later search terms	User types, Gamification User Type Hexad scale	Gamification User Type Hexad scale Healthcare

B. Literature Results

Several user typology models exist in the literature. One of the first models that has put this technique into practice is the Bartle's player type model [8], which identifies four player types (achiever, explorer, socializer and killer) for Multi-User Dungeons (MUDs). A more recent user typology, also applied to personalize gameful systems, is the BrainHex model [9]. During the development of this model previously existing player typologies in the literature as well as neurobiological research were considered. This resulted in the BrainHex model considering seven different player types: achiever, conqueror, daredevil, mastermind, seeker, socializer, and survivor. Although these models have been used to personalize gameful systems their usefulness for gameful

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design is limited, because they are specifically built for game design [6]. Building on this and based on research on human motivation, player type, and practical design experiences Marczewski [10] developed the Gamification User Types Hexad Scale to be able to design for personalized gamification solutions. This framework states that there are six different user types who differ in both their intrinsic and extrinsic motivational factors. It is worth noting that an individual is often not restricted to one user type of the Hexad scale [6] . Although individuals often have the tendency towards one user type, they form a spectrum of user types. Which means that they can —to some degree— also be motivated by and interact with elements fitting other user types. The user types of the Hexad scale can be seen as personifications of people's intrinsic and extrinsic motivations, as defined by the Self-Determination Theory (SDT) [11]. With exception of an addition to the three intrinsic motivational needs out of the SDT, the Hexad framework foregrounded purpose as an extra intrinsic motivational need.

Below, the list of user types by the User Type Hexad Scale are described together with their motivational factors [6, p. 231,232]:
"*Philanthropists are motivated by purpose. They are altruistic and willing to give without expecting a reward.*

Socialisers are motivated by relatedness. They want to interact with others and create social connections.

Achievers are motivated by competence. They seek to progress within a system by completing tasks, or prove themselves by tackling difficult challenges.

Free Spirits are motivated by autonomy, meaning freedom to express themselves and act without external control. They like to create and explore within a system.

Players are motivated by extrinsic rewards. They will do whatever to earn a reward within a system, independently of the type of the activity.

Disruptors are motivated by the triggering of change. They tend to disrupt the system either directly or through others to force negative or positive changes. They like to test the system's boundaries and try to push further."

Based on a sample of Canadian undergraduate students the user types philanthropist, free spirit and achiever are on average the strongest motivations, closely followed by socializer and player, contrarily the disruptor has lower average scores [6]. This suggests that the motivations and with them these user types are most likely to be motivated in gameful systems. Tondello et al. [7] accessed a broader population via email, social networks, a game event, and people from related institutions and found that user types and scores are significantly correlated to both gender and age [7]. However, gender differences were small: less than one point on some of the 28-point subscales. Furthermore, the influence of intrinsic motivations increases with the age and the extrinsic motivations decreases with age [7] .

The Hexad framework was used by Tondello et al. [6] as a base to create a procedure to assess an individual's user type based on personal preferences. A 24-items validated survey, answered on a seven points Likert scale, was proposed to score users' preferences towards the six different user types in the Hexad model [6]. Using a survey to determine individuals' preferences was proven to be more useful than asking individuals directly, because it helps to understand more about user psychology in a gamified context than just the elements that they prefer [6]. Therefore, the survey is mostly helpful in a context where it is important to determine player types of people who are not into games. These people do not have any knowledge on game elements and thus their preferences for player types. Besides the survey, the researchers also presented a list of correlations found between the Hexad user types with game elements. Both outcomes can be used in new research. First, the survey can be used to screen the target audience on their user type preferences. Secondly, adequate game design elements matching the user types can be used to design a gameful application.

Tondello et al. [7] conducted a follow up study using the same 24-items survey to see whether the system can be structurally validated. The follow up study consisted of three large-scale empirical validation studies and revealed that the structural validity is generally acceptable through reliability and factor analysis. These outcomes confirm that the User Type Hexad Scale survey is an appropriate method for personalized gameful design wishing to build on the Hexad user types. The validation led to a reformulation of three questions out of the survey resulting in a new survey still used to determine an individual's user typology.

The User Type Hexad scale consists of six different user types. Each user type is motivated in a different way with associated motivational affordances which can trigger intrinsic or extrinsic motivations. Some of the user types of the Hexad framework are close to each other and slightly overlap, because their motivational factors are related [6], [7]. Achievers and players are both motivated by achievement; however, they differ in focus. Where players are focusing on extrinsic awards, achievers are focusing on competence. Furthermore, Tondello et al. [7] demonstrated a strong correlation between the user types philanthropist and socialiser. Both user types are motivated to play with others, but they differ because a socialiser's interest solely on interaction with others, while philanthropists interact with others to help them. Lastly, free spirits and disruptors are both motivated by autonomy and creativity. While this may be true a free spirit stays within the system without having the desire to change the system and disruptors attempt to go beyond borders trying to change the system. The overlap between motivations of user types and their difference in focus within a motivation is displayed in Fig. 1.

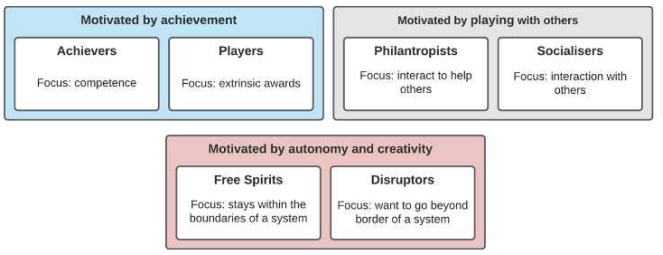


Fig. 1. Overview of player types from the Hexad scale with the overlapping motivations and single focusses.

Since the act of playing a game is generally more considered to be based on intrinsic motivations than extrinsic motivations [4], this section will mostly focus on the intrinsic motivations. Intrinsic motivations are based internal rewards, when we simply enjoy the activity and want to perform its own sake. When an individual's intrinsic motivations are satisfied psychological outcomes will occur. However, it might also be that extrinsic motivations might be of value if the user type

player is largely present. Because of this, we also look at how extrinsic motivations can be triggered by motivational affordances. This section discusses the main motivations of each user type with coupled motivational affordances out of the literature. Tab. II provides an overview of the motivational affordances linked to each specific user type found for each paper from the literature. In Tab. II we also show whether the specific paper had a focus on gamification applied specifically for energy saving purposes. [1] Next to the motivational affordances, the last subsection focusses on literature were the link between the Hexad user types and persuasive technology was researched.

TABLE II. OVERVIEW OF FOUND MOTIVATIONAL AFFORDANCES FOR EACH USER TYPE WITHIN THE LITERATURE

	[12]	[13]	[14]	[15]
Energy focus	Yes	No	No	Yes
Achiever	challenges, feedback, theme, short cycle time and competition	challenges, mystery box, easter eggs, themes, narrative or story, exploratory tasks, learning, unlockable content, levels/progression, meaning purpose, progress feedback, learning, points, lotteries	challenges, certificates, learning new skills, quests, levels or progression, and epic challenges	-
Disruptor	-	mystery box, easter eggs, themes, narrative or story, access, lotteries, boss battles, challenges	innovation platforms, voting mechanisms, development tools, anonymity, anarchic gameplay	Status
Player	-	access, lotteries, boss battles, challenges, social comparison, leaderboards, competition, networks, status, teams, trading	points, rewards or prizes, leaderboards, badges or achievements, virtual economy, and lotteries or games of chance	Rewards, Points, Badges, Leaderboards, Status
Philanthropist	-	levels/progression, meaning purpose, progress, feedback, learning	collection and trading, gifting, knowledge sharing,	Badges, roles
			administrative roles	
Free Spirit	Personal profile and non-fixed structure.	challenges, mystery box, easter eggs, themes, narrative or story, exploratory tasks, learning, and unlockable content	exploratory tasks, nonlinear gameplay, Easter eggs, unlockable content, creativity tools, and customization	Points, Badges, Progression, Status, Levels, Roles
Socialiser	competition, cooperation, chat-based social network.	social comparison, leaderboards, competition, networks, status, teams, trading	guilds or teams, social networks, social comparison, social competition, and social discovery	Points, badges, rewards, roles

TABLE III.

Looking back at the literature we can conclude that the Hexad scale is an often-used method to allow for personalization within gamification design. An important step made in the literature about the Hexad scale is its empirical validation which proves that the survey is effective in determining an individual's user type [7]. For personalizing for an energy saving application two already determined models in the literature seem to be valuable, namely the Hexad scale [6] and the model designed by Gölz and Hahnel [16]. The model of Gölz and Hahnel [16] can be of big importance for designing a gamified energy saving application as it is the only model found describing customer segments within energy saving applications. Striking about personalized gamification performed via the Hexad scale is that user types can be linked to motivational affordances/game mechanics [13]. Which might suggest that this is a good strategy to design personalized gamification. This is supported by the research of Kotsopoulos et al. [15] who were able to link specific motivational affordances to user types within the context of gamification used for energy conservation among employees based on their sample from a technological incubator facility, a university campus, and a technology park. As it is already proven successful for energy conservation, personalization using different motivational affordances for user types should be considered. Furthermore, Wee and Choong [12] showed correlations between the motivational needs of the SDT [17] and motivational affordances in the context of a gamification energy saving campaign. As the user types of the Hexad scale rely on the motivational needs of the SDT, these design elements could be of great importance when designing gamification for energy saving [14].

Finally, we end our literature results based on the combination of search terms as depicted in Tab. I. Only four papers were found relevant. Orji et al. [18] conclude that persuasive gameful systems are effective tools for motivating

[1] As our project started from an energy saving perspective in the context of a dashboard for a green energy provider. Our current focus is however on user profiles in healthcare.

behavior change. The results of their large sample Amazon's Mechanical Turk (AMT)-based responses (n=543) reveal that people's gamification user types play significant roles in the perceived persuasiveness of different strategies. New design guidelines in healthcare information systems are needed for tailoring persuasive gameful systems to each gamification user type. Manzano-Leon et al. [19] show results from secondary school pupils (n=1345) that provide evidence of a valid and reliable six-factor instrument to measure the types of players in the Spanish adolescent population in public health. The two final studies found [20][21], both related to fitness gamification. The studies show the importance of target group identification. Altmeyer et al. [20] had 50 prolific participants and the rest (128) from social media groups via tumblr and Facebook via one of the authors with a wide audience (personal communication). Sienel et al. [21] distributed their survey via email and mainly had participants (almost 75%) in an adolescent age range (18-30).

Taken together this shows that the Hexad model can be used in many contexts and used with various samples that are not health setting-oriented: university students, secondary school pupils, and crowd sourcing platforms and other perhaps more tech savvy locations. In the next section instead, we discuss the results of the translated Hexad scale with a population from a green energy provider.

III. Hexad User Type Survey Method & Results

The 24 questions belonging to the User Type Hexad survey have been analyzed separately. Scores were given for each of the six user types per participant as suggested by Tondello et al. [6]. The scores are based on the four questions belonging to each user type. Each question is answered on a 7-point Likert scale with each answer assigned a score from 1 (strongly disagree) to 7 (strongly agree). After the scores were assigned to each question, the scores of the questions corresponding to each subscale (user type) were added. For better readability, the scores of the subscales are represented by the sum of the items instead of the mean [6], meaning a maximum score of 28 per user type. From these scores the mean and standard deviation were computed as also performed in the research of Tondello et al. [7].

The research plan for both the focus groups and the survey was approved by the ethical committee of our faculty under RP 2020-119. Respondents were recruited using the customer portal of an energy supplier. It was offered to a randomly selected group of customers as a pop up on their start screen and profile. Customers participated voluntarily and did not receive a renumeration, before participation they consented to using their answers and linked demographics for this study.

The user spectrums, and the mean and standard deviation values, were calculated for the whole population and for men and women separately. Although the gender analysis is done, no conclusions are drawn from them, as the gender is based on a customer profile for a typically household based account, thus they only function as information for later research. From the invited customers, a total number of 334 customers have participated in the survey. However, only 274 surveys were completely answered and counted as valid responses. Invalidity was found in two different forms. In total 46 surveys were not completely answered and therefore not considered during the analysis. Another fourteen survey answers were deemed invalid due to a too short response time or due to no variety in answers on the Likert scale at all. During this analysis only the 274 surveys determined as valid were used.

A. Overall scores on Hexad scales

When only looking at the main user type of participants philanthropists are most frequently present, followed by free spirits, and achievers respectively as shown in Fig. 2. Of the total number of participants the main user types are present as follows, 26% are philanthropists, 19% are free spirits, and 13% are achievers. Socialisers (5%), players (9%), and disruptors (3%) are less present within the set. The remaining 26% consists of participants who do not have one main user type, but a set of two or three user types on which they score equally. Fig. 2 shows the occurrences of the different user types in this set of participants in the right diagram . Also in the respondents with two or three equal user types the philanthropists, free spirits and achievers are the most occurring user types.

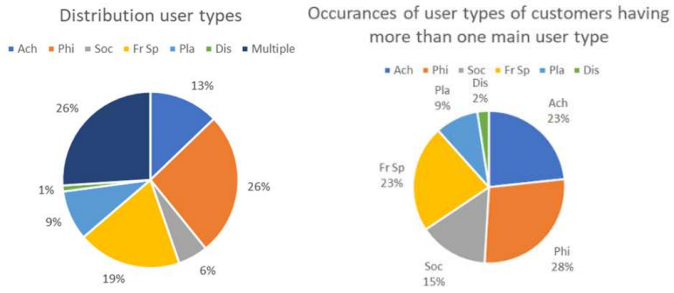


Fig. 2. Distribution of main user types among all participants (left circle diagram) and distribution of user types for customers having more than 1 main user type (right circle diagram)

The results showed within Fig. 2 are supported by the results of the mean and standard deviation computed for each user type as depicted in Tab. III. For better readability, scores are represented as the sum of each user types subtype instead of taking the mean (i.e., the maximum value for each subscale is 28 retrieved from four questions). A visual inspection reveals that philanthropist scores the highest mean, followed by free spirits and achievers. The other types score remarkable lower on the mean. Also remarkable is that the three user types with the highest mean score the lowest standard deviations, suggesting that these are most consistent throughout the whole sample.

TABLE IV. Mean and Standard Deviation of the Calculated Scores for Each of the Six User Type Dimensions from the Hexad Scale

User Type	*Mean score*	*SD*
Philanthropist	23,06	3,51
Socialiser	20,44	4,45
Free Spirit	22,45	3,35
Achiever	22,36	3,67
Disruptor	15,57	5,01
Player	19,77	4,70

TABLE V.

Tab. IV presents the bivariate correlation coefficients and significance levels between each Hexad type and all others. We followed Tondello et al. [55] by using Kendall's τ instead of the more common Pearson's r because of the user scores being non-parametric.

TABLE VI. : BIVARIATE CORRELATION COEFFICIENTS (KENDALL'S T) AND SIGNIFICANCE BETWEEN EACH HEXAD USER TYPE AND ALL OTHERS

User type	Philanthropist	Socialiser	Free Spirit	Achiever	Player
Socialiser	0,313*				
Free Spirit	0,175*	0,112*			
Achiever	0,290*	0,206*	0,339*		
Player	0,126*	0,178*	0,035	0,264*	
Disruptor	0,045	0,046	0,199*	0,092	0,069

*** p < 0.01**

TABLE VII.

B. Overall scores on Hexad scales

As we did not ask for gender specifcally in the survey but had to rely on the customer's profile (76% men and 24% women) gender cannot be determined. However, we still look at the results as if the gender matches the information of the customer profile, which only includes the option women or men.

Fig. 3 shows the distribution of user types per gender, taking men and women into account as explained earlier. A first visual inspection reveals that more large differences between both genders lie within the user types free spirits, socialisers, and achievers. The occurrences of the user types for both men and women having more than one user type were also determined and are shown in Fig. 4. Here the largest differences are seen in the user types disruptor, socialisers, and free spirits.

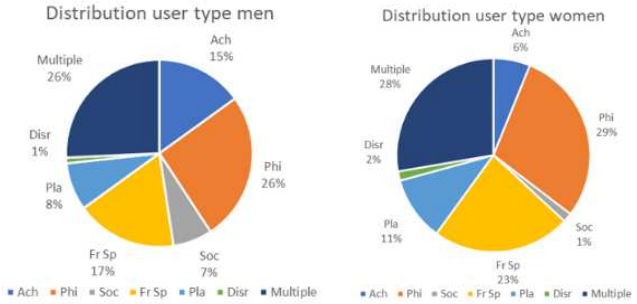


Fig. 3. Distribution of main user types for men (left) and women (right)

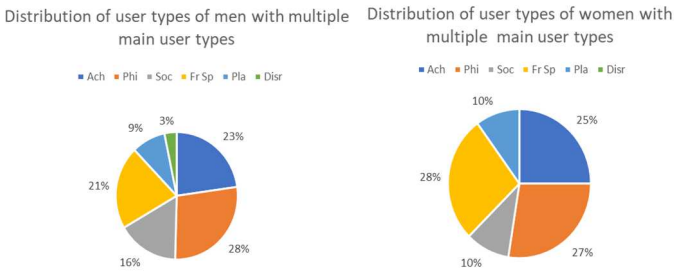


Fig. 4. Distribution of user types for customers having more than one main user type for each gender (left men and right women)

IV. ANALYSIS

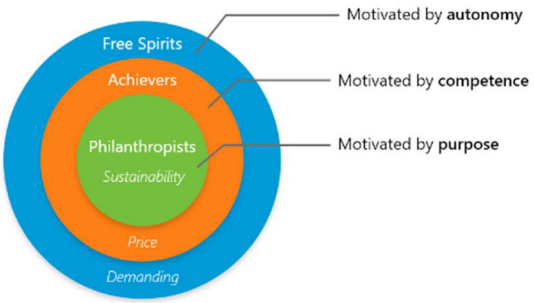
The most occurring main user types identified within the participants of the survey were philanthropists, free spirits, and achievers. As expected, philanthropists and free spirits were found as large groups present as user types. We were more uncertain about what user type to expect as third largest group present in the researched customer base. Results now show that the intrinsic user type achiever is more present among the participants than the extrinsic user type player. These results match with earlier findings from the literature which show that the user types linked to intrinsic motivations are most present [7] . However, we strengthen this body of work using the Hexad scale with a rather different sampling method.

Looking at the overall computed mean and standard deviation for each user type dimension in Tab. III we see that our results are not really different from those earlier reported by Tondello et al. [7]. Within the researched customer base the user type disruptor is almost not present. Earlier performed work also showed the disruptor being the least common user type [7]. That the user type is not prominent within the customer base might be because of a bias within the participants or that this kind of customer simply do not belong to disruptors. Socialisers are also not so present as in other researches [7] . This might be explained by socialisers lying close to philanthropists, which was an already expected correlation and is also proven in Tab. IV. Due to the proven positive significant correlation between philanthropists and socialisers it might be that within the context of a green energy supplier individuals more quickly belong to philanthropists than socialisers as impact on sustainability is an important factor within this context.

We also computed the bivariate correlations between each user type and all others. As in previous work, we found partial overlapping between several user types. On the one hand, some of the observed significant correlations differ from those reported by Tondello et al. [7]. They showed correlations between the disruptor and achiever and the disruptor and player ($p < .01$), but our results do now show these correlations. On the other hand, our correlation results are supporting the findings of [7] which states that the user types from the Hexad scale can be divided into three groups based, as disruptors are only significantly correlated to free spirits, players are significantly most correlated to achievers, and socialisers to philanthropists.

Although gender assumptions have to be made carefully, because the gender is not certain, the results from the survey do not directly match earlier literature findings about gender differences. Literature suggests that women score slightly higher on intrinsic motivations than men, but on the other hand men score slightly higher in disruption on average [7]. When looking at the results and then only at the main user types this does not apply to the participants of this survey as women score both slightly higher on disruption and the extrinsic user type player than men. However, women do score slightly higher, respectively 3 and 6 %, on the intrinsic user types free spirit and philanthropists. On the other hand, men score higher on the intrinsic user types socialisers and

achievers. Although some differences are found conclusions



cannot be drawn with certainty due to uncertainty of the gender of participants. Besides only the main user type is taken into account and we do not look at the overall spectrum of individuals, which could give a different view on the results looking at the differences on gender.

Surveys in healthcare gamification are mainly done with adolescent user groups [18], that do not represent an average and broad sample of the population. The implications of this study for healthcare mean that it might be easier to categorize users in three groups and personalize the gamification mechanics. Tab. V shows this new model. The Blue users are mainly the free spirits together with the small group of disruptors. The Red users are mainly the achievers together with the small group of players. Finally, the Green user profile exists mainly of philanthropist users together with the smaller but still reasonably big user group of socializers.

V. Takeaway

As designing for different user types can be time consuming and costly, especially in a health care setting one might want to use not all the six user types of Hexad but still cover a large portion of their consumers. Based on this rationale also fitting the underlying link to intrinsic motivation, as well as relation to other findings we suggest the opportunity to reduce the Hexad scale to the three primary groups. We refer to this choice a Shortened Hexad Gamification User types: SHEGUT and call other researchers to also make a reduced survey to indicate a clear distinction within a population towards these main groups. The framework is based on the three user types from the Hexad scale studied during this research and is shown in Fig. 5. It can be read as follows the inner circle the philanthropist have one main focus, being sustainable and are only driven by purpose. The second orange circle, the achievers are mainly driven by price and achieving, but their sub motivation is purpose. The outer circle, the free spirits are the most demanding user group who find autonomy most important but can also be driven by achieving and purpose. Each group consists of its own main and sub motivations; however, they can still be motivated by game elements linked to other user types as long as they fit the goal of their main motivation. This framework can help to design a personalized gamified application for energy saving by using different design focusses within elements based on each user type. We strongly argue this might provide a good starting point for gamification in a health setting and call to the SeGAH community to further investigate this.

Fig. 5. Proposed model for Gamification User Profiles

VI. Conclusions

This study shows three conclusions.

Firstly, from the literature study we conclude that there is a big need to understand target groups in Healthcare. Many studies use a six user profiles model (Hexad) and use adolescents or students as a population for their survey's.

The broader survey population delivers the data that for some use cases a three main user profile could be suitable and most of the population has an antecedent user profile. This means we can explore the use of these three user profiles in new healthcare research.

Finally, we derive a new model for personalized health gamification as depicted in Tab. V. The main driver is given for each user profile but also the second driver is important since individuals consist of a spectrum of user types with mostly one main preference. Users will like the other drivers in gamification elements if they support their main drive. Further research is needed to study if a fourth user profile of socializers is needed or that it suffices to share it under the green user profile.

Table V: Gamification User Profiles (GUP)

	Autonomy Driven	Competence Driven	Purpose Driven
Blue	Priority 1	2	3
Red	3	Priority 1	2
Green	3	2	Priority 1

References

[1] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: Defining 'gamification,'" in *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, MindTrek 2011*, 2011, pp. 9–15.

[2] K. Huotari and J. Hamari, "Defining gamification - A service marketing perspective," in *Proceedings of the 16th International Academic MindTrek Conference 2012: "Envisioning Future Media Environments", MindTrek 2012*, 2012, pp. 17–22.

[3] J. Koivisto and J. Hamari, "The rise of motivational information systems: A review of gamification research," *International Journal of Information Management*, vol. 45. Elsevier Ltd, pp. 191–210, Apr-2019.

[4] A. Kankanhalli, M. Taher, H. Cavusoglu, and S. Kim, "Gamification: A New Paradigm for Online User Engagement," *ICIS 2012 Proc.*, Dec. 2012.

[5] U. Ritterfeld, M. Cody, and P. Vorderer, *Serious games: Mechanisms and effects*. Routledge, 2009.

[6] G. F. Tondello, R. R. Wehbe, L. Diamond, M. Busch, A.

Marczewski, and L. E. Nacke, “The gamification user types Hexad scale,” in *CHI PLAY 2016 - Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*, 2016, pp. 229–243.

[7] G. F. Tondello, A. Mora, A. Marczewski, and L. E. Nacke, “Empirical validation of the Gamification User Types Hexad scale in English and Spanish,” *Int. J. Hum. Comput. Stud.*, vol. 127, pp. 95–111, Jul. 2019.

[8] R. Bartle, “Hearts, clubs, diamonds, spades: Players who suit MUDs,” *J. MUD Res.*, vol. 1, no. 1, p. 19, 1996.

[9] L. E. Nacke, C. Bateman, and R. L. Mandryk, “BrainHex: A neurobiological gamer typology survey,” *Entertain. Comput.*, vol. 5, no. 1, pp. 55–62, Jan. 2014.

[10] A. Marczewski, “User Types,” *Even Ninja Monkeys Like to Play Gamification, Game Think. Motiv. Des.*, vol. 1, pp. 65--80, 2015.

[11] R. M. Ryan and E. L. Deci, “Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being,” *Am. Psychol.*, vol. 55, no. 1, pp. 68–78, 2000.

[12] S.-C. Wee and W.-W. Choong, “Gamification: Predicting the effectiveness of variety game design elements to intrinsically motivate users’ energy conservation behaviour,” *J. Environ. Manage.*, vol. 233, pp. 97–106, 2019.

[13] G. F. Tondello, A. Mora, and L. E. Nacke, “Elements of Gameful Design Emerging from User Preferences,” 2017.

[14] A. Marczewski, “Gamification mechanics and elements,” *Even Ninja Monkeys Like to Play Gamification, Game Think. \& Motiv. Des.*, pp. 165--177, 2015.

[15] D. Kotsopoulos, C. Bardaki, S. Lounis, and K. Pramatari, “Employee Profiles and Preferences towards IoT-enabled Gamification for Energy Conservation,” *Int. J. Serious Games*, vol. 5, no. 2, pp. 65–85, 2018.

[16] S. Gölz and U. J. J. Hahnel, “What motivates people to use energy feedback systems? A multiple goal approach to predict long-term usage behaviour in daily life,” *Energy Res. Soc. Sci.*, vol. 21, pp. 155–166, Nov. 2016.

[17] E. L. Deci and R. M. Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior*. Springer US, 1985.

[18] R. Orji, G. F. Tondello, and L. E. Nacke, “Personalizing persuasive strategies in gameful systems to gamification user types,” in *Conference on Human Factors in Computing Systems - Proceedings*, 2018, vol. 2018–April, pp. 1–14.

[19] A. Manzano-león, Camacho-lazarraga, P., Guerrero-puerta, M.A., (...), Trigueros, R., Aguilar-parra, J.M., “Adaptation and validation of the scale of types of users in gamification with the spanish adolescent population”, International Journal of Environmental Research and Public Health, 17(11),4157, pp. 1-10 2020.

[20] M.Altmeyer, Lessel, P., Jantwal, S., (...), Daiber, F., Krüger, A., “Potential and effects of personalizing gameful fitness applications using behavior change intentions and Hexad user types”, User Modeling and User-Adapted Interaction, 31(4), pp. 675-712, 2021.

[21] N. Sienel, Münster, P., Zimmermann, G., “ Player-type-based personalization of gamification in fitness apps”, HEALTHINF 2021 - 14th International Conference on Health Informatics; Part of the 14th International Joint Conference on Biomedical Engineering Systems and Technologies, BIOSTEC 2021 pp. 361-368