Mapping Game Preferences Of Older Adults: A Field Study Towards Tailored Gamified Applications

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ABSTRACT

Digital applications are a valuable addition to traditional healthcare. An opportunity in retaining motivation to use these applications lies in gamification. To design a gamified healthcare application for a specific target group, such as the older adult, detailed insight in their game preferences is needed. This insight enables us to tailor gamification to the user to make applications more engaging and usable, which is thought to better facilitate underlying healthcare goals. This raises the need for methods to assess these game preferences. Towards such a method, we deploy a classification for game content based on the five domains of play theory.

In this study, 12 older adults played five off-the-shelf tablet games for one week. Preferences were assessed through a questionnaire, log data and semi-structured interview. The resulting overview of preferences was used to make recommendations for future gamification as well as a refinement of the classification.

Author Keywords

Gamification; older adults; game content classification; game preferences; telemedicine

ACM Classification Keywords

H.1.2. User/Machine Systems: Human Factors; K.8.0 Personal Computing: Games.

INTRODUCTION

Digital healthcare applications – telemedicine, the use of IT solutions that enable medical professionals to remotely provide care to patients in their daily environment [12] – can contribute to the alleviation of the increasing demand for care [2] that is caused by a rapidly changing socioeconomic structure [21]. As there is a high old-age

dependency ratio in Western countries [26], telemedicine applications that enable people to maintain their autonomy and independence by adopting a more active and healthy lifestyle are particularly valuable [31]. An issue to overcome in the use of these applications in practice is a rapidly decreasing adherence that occurs after several weeks of use [25,6], which is possibly caused by loss of interest and a drop in motivation. As such, there is a need for strategies to motivate people to use digital healthcare applications on the long term.

Gamification, the application of game elements to retain motivation in the use of applications outside entertainment, may be such a strategy, as it can increase engagement to an application or make otherwise boring routine of exercises more endurable [14]. Older adults increasingly gain access to digital games through the popularity of tablets, and appreciate tablet use in healthcare setting [22]. Furthermore, the positive effects of gamification in digital healthcare for the older adult are demonstrated [10]. However, the majority of research on gamification in healthcare is focused on a younger population [13] and we are uncertain how to tailor game content for this target group to increase and sustain engagement. Instead of borrowing strategies from practical examples of successful gamification for the older adult, we aim to address the specific preferences for game content the older adult may have, which we can transpose to healthcare applications.

In this study, we gain insight in the preferences for game content of a group of older adults. Working towards a method to assess these preferences, game content should be made explicit more elaborately than current practice by for example game genre classifications [1]. We therefore explore the use of a classification for game content based on the five domains of play theory [27] and assess preferences by means of a questionnaire. As it is vital that the participant can relate to the game content presented in this questionnaire, we aimed to give participants a basic experience with modern (i.e. recently developed, not based on conventional games) video games. Few older adults are acquainted with such games, thereby lacking background to answer questions about their specific preferences. We therefore supplied the participants with a tablet pc and five off-the-shelf games to be played for a week before

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assessing their preferences. Next to an initial understanding of the preferences this target group may have, this study gives us insight in the potential of the classification to assess and visualise game preferences of older adults, which can aid the development of tailored game content essential for creating engaging applications.

BACKGROUND – GAME CONTENT IN FIVE FACTORS

At the origins of the development of a new classification for game content lies the five factor model [15], selected for its preferred use in other studies about game preferences [18,8,24,5] and comprehensiveness, predictive powers, reliability and universality [3,9,16,17]. Following the five factor model, the five domains of play theory semantically translates the original five factors of personality into aspects of gaming motivation [27]. Each of the five domains describes the nature of game content that the player may find satisfying. The domains are continuous variables, which together form a characterisation of the content of a game. Hypothetically, the preferences for these aspects of game content a user may have are in conjunction with personality. The theoretical background of this classification, i.e. the relations between personality and preference for game content were explored by De Vette et al., for adults (including older adults) in general [28], and for the older adult specifically [29]. The latter was done by means of an additional questionnaire on personality that was part of the method of the paper at hand. This analysis has been left out of scope for this article. Even though the

relation between personality and game content for the older adult could not be supported by statistical evidence, we find that the classification for game content itself may be suitable for assessing and expressing game preference. The five domains of play theory provides an essential level of depth and comprehensiveness to describe game content that was not discovered in other existing classifications [30]. This is mainly because in most other classifications, characteristics contain singular instead of continuous classes, or are applicable only to a specific context (such as MMORPGs). This results in a categorisation of users along stereotypes, as is often the case in earlier player type models, or genres, to which the user's favourite games can roughly be assigned to.

In this study, we deploy a classification of game content that is a modified version of the five domains of play theory. According to the original theory, each of the five domains has six underlying facets, which are directly derived from the facets of the five factor model. To enable analysis of the game content that may satisfy a user by means of a questionnaire, now that its original assessment method through personality has been omitted, we further elaborated the model by adding semantics to both ends of each domain (Fig. 1). Also, some facets of the five factor model were considered not relevant or translatable into game content and have therefore been left out of scope for this study.

Figure 1 - Game content in five domains

The domains enable to 'rate' content based on its novelty, challenge, stimulation, harmony and threat. Each of these domains is characterised on both sides of the spectrum with examples of game content. Oversimplified, the domain novelty, for example, distinguishes between game content that is repeating and predictable, and more imaginative and open. Content characteristics for the one end are the presence of clear boundaries, similarity to the real world and routine. On the opposite side, we find game content that can be described as adventurous, fantastical, artistic or aesthetical. The classification can therefore be used to describe the contents of a game, as well as to express the preferences for game content a user may have.

METHODS

Participants were given a tablet with five off-the-shelf modern games, and were asked to freely play their games of choice. They were introduced to the device and each game at an intake session. Before the use time, the participant was asked to complete a questionnaire on demographics. The study concluded with a questionnaire on game preferences and an additional interview to discuss the games' attributes on a higher level.

Participants

Twelve people between the age of 65 and 75 years old, six male and six female, participated. Participants were recruited through a local community centre (Alifa in Enschede, the Netherlands), via an internal request to its older volunteers. Inclusion criteria were to have affinity with smartphone or tablet and to enjoy playing games regardless of experience or playing frequency. Participants were excluded when their cognitive or their physical abilities did not allow them to complete the test protocol (severe visual, auditory or cognitive impairment).

Materials and measures

Participants were provided five games installed on a tablet pc (10" screen), randomly ordered on the home screen. A paper manual was provided for the tablet pc. At the intake session, demographics were measured by means of a paper questionnaire. Game preferences were determined by means of a second paper questionnaire, filled in after the use period of a week, in 84 items. The participant was asked to indicate how much satisfaction was derived from playing each game (1-9 numbered VAS scale), followed by questions resulting in domain specific scores (percentages): how satisfying a series of key features were found to be (1-9 numbered VAS scale) and by scoring on agreement on a set of statements on game preference (1-9 numbered VAS scale) without referring to particular games. Playing time for each game was measured in full minutes through an app tracker application hidden in the background. The participant was informed about this measurement. In case of missing data (cut-off point 3 minutes playing time) the participant would be omitted from the results. Previous gaming experience, experience with the five games from the test and motivating and demotivating aspects of each game were discussed in a concluding semi-structured interview. Thematic content analysis was performed on the interview data. Interviews were transcribed by the authors. The themes are the content characteristics from the five domains (fig. 1). The number of times unique participants mentioned these themes as either motivating or demotivating were counted.

Game selection

An initial selection of five games was made by the authors. All five games are off-the-shelf and generally available, sourced from GooglePlay. They were chosen for strongly representing one extreme of each domain of game content.

	<i>Name</i>	<i>Domain</i>	<i>Description</i>	<i>Recognisability</i>	<i>Suitability</i>	<i>Limitations</i>
#1	Monument Valley	Novelty +	Artistic, optical illusion puzzle adventure, mysterious storyline.	12/12	9/10	Quite logical, clear boundaries. Suits high Harmony.
#2	Osmos	Challenge -	Slow, low effort, playing an organism floating around with the goal of absorbing other organisms in order to grow. Thinking and strategy.	11/12	8/10	Matches low Stimulation.
#3	Diner Dash	Stimulation +	Very fast-paced multitasking game, serving tables in a restaurant.	10/12	7/10	Characteristic of communication and social contact lack.
#4a	Bird Zapper	Harmony -	Electrocuting birds on power lines, making rows.	7/12	5/10	Too much focus on violence, lacking competition, too high Stimulation.
#4b	Worms 3	Harmony -	Strategic, unrealistic war game, competitive, the first to kill all enemy worms wins.	12/12	7/10	Complex, long gameplay.
#5	Dead Runner	Threat +	Creepy atmosphere, high and increasing frustration level, loss of control. Outrunning 'something' in a dark forest.	12/12	8/10	Not representing extreme Threat for ethical reasons and risk of overshadowing other elements.

Table 1 - Overview of selected games

	<i>Novelty</i>	<i>Challenge</i>	<i>Stimul.</i>	<i>Harmony</i>	<i>Threat</i>
Mean	66	55	39	64	40
Std. Error	11	12	9	11	21
Lower bout 95%	59	47	33	57	26
Upper bout 95%	73	63	44	71	53

Table 2 - Descriptives domain scores (scale 0-100, n = 12)

	<i>Average /game</i>	<i>Minutes /game</i>
Monument Valley	77.1	2175
Osmos	43.8	504
Diner Dash	46.9	438
Worms 3	17.7	353
Dead Runner	37.5	244
<i>Average score/user</i>	<i>44.6</i>	<i>-</i>
<i>Total time played</i>	<i>-</i>	<i>3714</i>

Table 3 - Appreciation and playing time per game

For the domains Harmony and Threat, we chose games moderately representing this content as not to strike ethical issues and distort measurements. The choice for five games instead of ten for each participant was made to reduce cross-linking between the domains, minimising the load and possible confusion for the participant at the same time.

The selection of games was discussed in an expert session. The 12 experts were male and female researchers with various academic degrees, in the fields of psychology, computer science, biomedical engineering, human movement sciences, human media interaction, health sciences and game design, in the age of 24 to 60. Their gaming experience ranged from seasoned gamers who play every day to occasional players. The session included a presentation of the underlying theory and classification used, the five games and the rationale for this selection, and a questionnaire. Through this questionnaire, the experts were asked to indicate if they were able to identify the game elements within the selected game as intended (yes/no, please elaborate), to give a mark for suitability of this game to the corresponding five domains trait (score 1 to 10). We set the minimum number of people to properly recognise the game features to 10 out of 12 and the suitability to the model to be rated 7 or higher. Lastly, there was room for remarks on possible limitations, suggestions for alternative games and discussion. An overview is shown in Table 1.

The characteristics of the game 'Bird Zapper' were not sufficiently recognisable for low Harmony, and the domain suitability was rated insufficient. An alternative suggested by the experts, Worms 3, to better suit the domain extreme's characteristics was chosen. All experts agreed this would be a more representative game (re-rated afterwards).

RESULTS

Participant characteristics

Among the participants are 8 regular players of video games (once a week to daily), 3 less frequent players (monthly) and one person indicates to be fanatic in board and card games but hardly ever plays videogames. All participants indicate high computer literacy (self-assigned). Their favourite games include Scrabble, Wordfeud, Bridge and other card games such as Freecell and Solitaire, puzzle games and games via Facebook. Four people play online, eight people play offline. The majority of participants indicated to frequently play board games, all of them mentioning social contact as a main reason.

Domain scores

Table 2 shows the results on game preferences measured by the questionnaire on each of the seven domains. These scores are also visualised in figure 2, using the mean scores and 95% interval.

Appreciation of games and time played

From the questionnaire, we derive the following scores for the appreciation for each game (Table 3). Each value is the average of the score all users gave for the appreciation of the game (highest score Monument Valley, 77.1, lowest score Worms 3, 17.1). The average score given for all games is 44.6. The relation between played time of all games (measured through an app in the background) and game preferences of all users in the population is explored through a graph (Fig. 3). All participants played each game for a sufficient amount of time (3+ minutes) so there are no cases of missing data. Out of a total playing time of 3714 of all users, Monument Valley is played longest (2175 minutes, which is 3 hours on average per person) and Dead Runner shortest (244 minutes).

Interview data

Interview data were categorised into motivating and demotivating aspects of each game (Table 4), as well as usability remarks that are either limiting (-) or enabling (+) gameplay. Between brackets is the number of participants that made the remark. Participants' favourite games are card and word games, three participants indicate to play mostly modern games online. When asked what the most important motivation was to play these games, competition is valued by 9 out of 12 players, 9 out of 12 players indicate to play mostly to enjoy company regardless of which game is played.

DISCUSSION

In this study, we examined the preferences of older adult users regarding game elements, categorised into five domains, after providing them with a frame of reference for expressing their preferences by means of five modern off-the-shelf mobile games. We gained more insight in the preferences of older adults regarding modern game content, often different from the obvious, and in the classifications' weaknesses.

Preferences

We analysed the scores on the different domains of game preferences. From previous study results ($n = 39$, age ≥ 60) [27] we expected that the older user would prefer game elements from the low side of the Novelty domain. This would be in concordance with the games they indicate to play the most, which usually are digital versions of conventional games that they were already familiar with. The score for Novelty from this study however is on the higher side of the spectrum. This is also the case for Challenge. Stimulation, Harmony and Threat are scored to expectations from previous work. Violence is disliked by the majority of participants, as are a depressing surrounding, stress and frustration.

A similar balance is found in the overall appreciation and total playing time per game. Monument Valley, high Novelty, stands out positively; the preference for high Novelty content seems to match the high Novelty game content. Worms, low Harmony, stands out in negative sense; the violence of the game and the disapproval of the elderly may cause the low score on this game. These results must however be viewed in the light of a different amount of time spent for each game for a sense of completion. A discrepancy is found between the time Worms and Dead Runner were played: the score for Worms is lower than for Dead Runner while the latter is played for a shorter amount of time. A playing session on Dead Runner takes seconds to minutes, while a session in Worms may take ten minutes or more to finish. Diner Dash levels take approximately three minutes to finish. Osmos playing time ranges from five minutes, when directly following the objective, to endlessly exploring. In Monument Valley, solving a puzzle may define a feeling of completion, which usually takes a few minutes. The high total playing time of Monument Valley is therefore not explained by a more lengthy playing session.

In the interviews, the (de)motivating elements mentioned for each game are much in line with the opinions of the experts in the process of game selection validation. However, results of this study indicate that we should verify even better if our perspective, that of the designer, aligns

with the way the target group receives the content in order to effectively design suitable content. For example, we see that Osmos, a game that we thought was rather slow, was perceived as unpleasantly fast by some. Similarly, it was beyond expectations that even shooting cartoon worms was considered to be extremely negative and violent. Also, the score of the older adult on Threat is higher than expected, but we should consider that the game selected for high Threat, Dead Runner, is rather mild in our eyes.

Usability

An engaging game requires correspondence with the preferences and abilities of the target group. We find that usability is a threshold in the enjoyment of modern games by older adults. These games are largely inaccessible to this target group, which explains their inability to express their game preferences without presenting a more up-to-date point of reference. The majority of participants remarked in the interviews that games were abandoned when they would become too fast, too much instruction was needed to play, or when working with small visual items or an overload of information at the same time became too fatiguing. According to the participants, the focus of a game should never be on physical agility but on cognitive skills as people feel more challenged in using their brains than their (possibly diminishing) physical skills and reaction speed. Participants remarked that when the game did not involve 'thinking', they were inclined to give up sooner. In addition, they indicated it was necessary for their motivation to always have a clear goal and be able to keep track of their progress. This includes being able to pause and continue at any point in the game. The element of discovery, as part of high Novelty, is appreciated only when the goal is not too abstract, as is the case with Osmos.

Usability is researched and described in several other studies [7,20,11,19], on the topics of interface and interaction design and physical and cognitive challenges of the target group. Contributing to this body of knowledge, we carefully recommend the following based on our study results:

Figure 2 - Game preference, domain scores ($n = 12$), mean and 95% interval

Figure 3 - Playing time (in minutes) and appreciation (in percentages) (mean and std. error)

<i>Game</i>	<i>Motivating characteristics</i>	<i>Demotivating characteristics</i>	<i>Usability remarks</i>
Monument Valley	Thinking [9] Artistic, aesthetics [9] Achieving goals [7] Absence of time pressure [6] Curiosity, discovery [6] Progression [4] Problem-solving [4] Challenge [4] Surprise [4] Variation [2] Humour [1]	No increasing difficulty [1]	Not resuming where stopped (-) [4] Understandable, overview (+) [4] No hints when stuck (-) [4] Easy controls (+) [1]
Osmos	Pleasant tempo [3] Aesthetics [2] Challenge [2] Strategy [1] Thinking [1] Discovery [1] Variation [1]	Unclear goal, discovery [4] Soon boring [4] Little variation [4] Unpleasant tempo (too fast) [4] Insufficient challenge [2] Little progression [2]	Unpredictability in controls (-) [2]
Diner Dash	Fast tempo, thrilling [4] Happy, funny, lively [3] Challenge [5] Mastery, developing skills [3] Focus, reaction speed [1]	Stressful, nervous, hasty [5] Tempo too high [3] Multitasking, chaos [3] Unsuitable theme (childish, too 'cute') [1] Little variation [1] Aggression [1]	Confusing, inconsistent (-) [5] Small elements (-) [3] Cluttered, no overview (-) [1]
Worms 3	Variation [1]	Violence (too much), shooting [7] Aggression, unfriendly [3] Agitation [3] Not aesthetically pleasing [2]	Cluttered, no overview (-) [4] No hints when stuck (-) [3] Small elements (-) [3] Difficult controls (-) [2] Resuming where stopped (+) [1]
Dead Runner	Mastery, developing skills [6] Challenge [3] Aesthetics [2] Relaxing [1] Short attention span [1]	Unsuitable theme: gloomy [7] Little variation: boring [6] Tempo too high [5] Frustration, punishment [6] No thinking involved [4] Too intense [1]	Controls not intuitive (-) [5]

Table 4 - Interview data: motivating and demotivating characteristics of the games played (mentioned by number of participants between brackets, usability remarks positive (+) or negative (-))

- Hints or cheats should be available on request when the player is stuck. Not being able to finish a level or puzzle leads to the user giving up on playing the game, inducing feelings of frustration and incompetence.
- Games should have the function to be stopped and continued at any point in the game. Once the player has the impression that effort is wasted in doing the same thing twice, it is less likely that the game will be picked up again.
- Progression and goals should always be clear to the user. Trial-and-error in general is not an approach many older adults wish to take in games.

Profile comparison and design recommendations

Considering the above, why is Monument Valley the ultimate favourite? We see that the profile of the older adult matches this game's characteristics best on all domains, just as Worms matches worst. Supportive to these findings, in the interviews the characteristics belonging to high Novelty are also mentioned as positively motivating in other games than Monument Valley and even demotivating when absent, for example aesthetics, discovery and fantasy.

We can visualise this (mis)match by translating our estimated profile for both games, supported by the opinions of experts in the validation session, into graphs (Fig. 4, Fig.

5). For Monument Valley the higher Novelty, average Challenge, lower Stimulation, high Harmony and low Threat (filled bars) are closely related to the domain scores from the questionnaire (smaller, transparent bars). For Worms, the low Novelty, higher Challenge and Stimulation, low Harmony and high Threat seem very inappropriate for the target group. In an optimal setting we would have validated these graphs in the expert meeting beforehand.

In addition to the profile of the preferences of the group of older adult users that participated, based on the characteristics as tested in this study, we recommend the following for the selection of games or designing new content for this target group:

- *Novelty* The target group is open to modern games and new experiences, values aesthetics and plenty of variation. Problem solving and intellect are motivating. Restrictions on this domain are that goals must be clear at all times, while discovery is valued.
- *Challenge* Whenever appropriate for the underlying (healthcare) application, we recommend focusing game design on cognitive challenge rather than physical. The actual degree of challenge cannot be generalised for a group and is difficult to measure objectively, but the target group should not be underestimated by presenting

Figure 4 - The profile of Monument Valley (taller bars) against the profile of the older adult (shorter, filled bars)

Figure 5 - The profile of Worms (taller bars) against the profile of the older adult (shorter, filled bars)

them games that are too superficial and easy. Users enjoy achieving goals, progression and development of skills.

- *Stimulation* High intensity and speed are found to be demotivating, in concordance with known usability requirements. Many people find it enjoyable to withdraw and relax with a game on their own, so we cannot be conclusive about the necessity of a social component yet.
- *Harmony* Violence should at all times be absent from games. An overly cute or childish design is often disliked as well.
- *Threat* A much lower tolerance for frustration and negativism should be taken into account. We recommend avoiding game mechanics that present feelings of unfairness or lack of control.

To apply games in telemedicine context, we observe the following from our data. Firstly, we may be able to decide on a strategy in terms of game content tailored to the individual or to a group of users. We regard the older adult user as a fairly uniform target group. Prominent subgroups that differ themselves through clustered game preferences, such as may have been the case for differences in affinity with games or technology, were not found. More data is of course needed as the cohort was small and the participants all experienced with tablets and digital games. However, we expect to find similar results if we expand the number of participants. We may be able to generalise the older adult's previous experience with computer games as well as their current awareness of and access to modern video games. The amount of variation in preferences per domain is limited as well. This would mean that, on the condition that enough variation is offered to suit all users, a single game concept may be able to engage the whole target group. In this lies the risk that the engagement for each user is moderate and never high, while the almost unanimous preference for the game Monument Valley refutes this. Other factors that may be of influence on engagement in a treatment context that deserve much to be explored are social context and the effect of social contact through or around the game. The personalisation of content and user-generated content may be valuable additions.

Classification weaknesses

The findings of this study lead to several refinements of the model domains for future work. We believe it is worthwhile to focus on further developing this classification, but we find that two domains in particular do not allow for precise expression of preferences. Firstly the element of competition, being part of (a low score on) the domain Harmony is overshadowed by violence, placed in the same domain extreme. Participants did not recognise the competitive element in Worms, which was clearly present in our view, possibly from disliking the game so much. In our demographics, we find that most players value competition. Similarly, Diner Dash did not present a suitable frame of reference to the participant on the elements solo versus multiplayer or communication. The

majority of participants indicated to like conventional (board/card)games for social contact. This may be entirely different for digital games, but we missed the means to measure or express this separately from the intensity of gameplay. Lastly, the domain Challenge is too unspecific as Challenge should always be present in the proper ratio to create satisfying gameplay. This is highly individual, making it difficult to objectively measure how challenging a game should be. Each player valued a game that is challenging, which we think is accomplished by adequately meeting the balance between skills and challenge as would be described by the principle of flow [4]. We found the lack of refinement in the domains to express certain aspects, for example (the appreciation of) problem solving and intellect in the domain Novelty. Future work will aim to further refine this model and add more semantics to the domain extremes.

Besides a refinement of the classification itself, we see the need of an extra step in the methods to assess preferences of a target group such as the older adult, whom are less experienced consumers of video games. There is a discrepancy between the view the older and younger population have on the same game content, which may lead to wrong interpretation of the preferences measured by researchers and game developers. In future work, we should therefore seek methods to compensate or make explicit this difference.

Limitations

The sample of participants of this study leads to several limitations when generalising our findings for a greater public. Firstly, an inclusion criterion – to avoid distraction from the rating of game elements by usability issues – was that participants should be able to work with modern technology such as a tablet or smartphone. As such, participants had a high computer literacy level and results may not apply to older adults that have not. Secondly, albeit a repetition, users of this age that are not intrinsically motivated by games already may not be motivated by a game-based application at all. The ratio between men and women and frequent or non-frequent players is well-balanced, and does not seem to influence preferences scores, and evident sub-groups are absent. Most importantly, while the sample size of this study was sufficient for exploratory research we should keep in mind that another sample may lead to a much different profile, and that we therefore cannot extrapolate our findings to the older adult in general. Moreover, few groups are so varied and so rapidly changing as the older generation, where a difference in age non-representative for the physical and cognitive health of people, neither on their skills, openness to and previous experience with games and technology. In a larger cohort, group distribution may need to be taken into account as differentiation between subgroups may be necessary. Lastly, given the small cohort, we chose a number of five games to avoid overload of participants. A follow-up with another selection of five games for each

opposite end of each domain would provide a valuable comparison to the results. Furthermore, in order to give more meaning to the time played with each game, results would benefit from a comparison of time played by younger adults.

CONCLUSION

In search for methods to tailor game design to the preferences of the older adult, thereby effectively engaging them in the long-term use of telemedicine applications, we have investigated and captured the preferences of the older adult regarding game content. These preferences resulted in recommendations for future game design, such as to include novelty over conventional content and to focus on cognitive challenge. This study has led to a better insight in how to address this target group through games and provided a promising starting point towards a method for surveying and mapping preferences of users. Future work will aim to further refine the model and evaluate our findings by putting the method to practice.

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