"Switch" up your exercise: An empirical analysis of online user discussion of the Ring Fit Adventure exergame

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Abstract

Exercise games (exergames) gamify the activity of exercising and are a growing trend with a corresponding growing online community and culture. The hugely popular recent Ring Fit Adventure exemplifies this and enables study of player's perceptions of the game and themselves in relation to exergaming and its community. We focus on a subreddit /r/RingFitAdventure. Topics ranging from social influences to design features are discovered. The implications of those topics to a variety of gamification notions are analyzed and discussed. The findings can facilitate and inspire future gamification design and research.

Keywords

exergame, technology, adoption, gamification, gameful experience, wearables, fitness

1. Introduction

The popularity of exergames has grown tremendously in recent years. They have been posited as a means to help individuals attain their exercise goals in gameful ways that make exercise more engaging for them [1, 2, 3]. Popularity of wearables has also grown for reasons such as tracking of one's activities, exercise, vital signs and emotional states [4]. The merger of the two growing trends has yielded novel exergames, and gameful applications at large, that capitalize on strengths of the two trends: gamification [5] and quantification [4].

Convergence of these technologies has brought new design possibilities, utilized in various industries, with little research on how individuals experience these applications or their outcomes. One such application that reached skyrocket popularity in 2020 is the exercise game Ring Fit Adventure (RFA) [1], published on the Nintendo Switch platform on Oct 18, 2019. The game is an exercise game where the player explores levels through movement, battles enemies, and plays minigames, by completing exercise moves using special Ring-Con and Leg Strap accessories provided with the game. The primary game mode is the adventure mode: a role-playing game mode that gamifies sustained and repeated exercise activity in several ways. Players play through worlds with several levels, engaging in turn-based battles that center around the player executing exercise moves with different attack attributes and a defensive ab guard move; the adventure also features boss fights and minigames. Collecting experience points allows the player to level up which increases attack and defence statistics of the player and can give benefits such as new exercise moves to use as attacks; a skill tree is also unlocked later in the game. The player may collect or craft smoothies which give specific boosts. The game also instructs the player about stretching to provide a more holistic experience.

With growing research on movement-based games [6, 7], exergames [8] and playful wearables [9], games such as RFA became an important avenue for researching the commercial applications of the academic knowledge. To our knowledge, the RFA, as an exergame facilitated by alternative controllers (Ring-Con and Leg-Strap), has not been investigated in academia. Thus, this study of understanding player experiences through the lens of an online community is imperative to domains including gamification, exergames, wearables, and quantification. This study outlines player perceptions and experiences of RFA, and how they change over time, through text analysis of RFA communities on Reddit. Such understanding is essential to enhance the design through avoiding pitfalls and erratic negative effects. Furthermore, our observations in relation to larger culture experiences can facilitate creating positive impact to a larger bases.

2. Related work

2.1. Gamified exercise

Gamified exercise and exergames are a genre of software and applications designed to foster exercise [10, 5]. They utilize design patterns such as goal-structuring, challenge

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[1] https://www.nintendo.com/games/detail/ring-fit-adventure-switch/

and social cooperation [1, 2, 11] to invoke a gameful experience that engages and motivate users to exercise [3, 12]. These similar patterns are often employed in gamification at large, that some researchers consider exergames a type of gamified exercise [1, 5], while others consider it a distinct genre of serious games [10]. Regardless of this distinction, the engaging gameful experience, that is a target experience of exergames, is often understood as volunteer engagement with artificial challenges that have known possible outcomes [13], however, the gameful experience is a complex experience with seven dimensions: accomplishment, challenge, competition, guidance, immersion, playfulness and social experiences [12]. The drive to progress and achieve goals, or, accomplishment, is a key aspect driving engagement with gameful design and exergames [2, 14]. Badges, beating monsters or outperforming others on leaderboards are key mechanics thought to contribute to feelings of accomplishment and user engagement [2, 14]. Challenge represents need for goals/achievements whose difficulty drives engagement as individuals put in the effort to prove themselves [2, 3]. A key aspect of gameful experience important to exergames is guidance–feelings of support from the system or other users [12, 13]; many exergames provide guidance by structuring play over levels or quests according to players' fitness level and expected progression. By forming organic communities, players also provide guidance to each other whenever needed [11, 15]. This social interaction, whether through the app, a third party app, likes, comments or discussions, is a key dimension of the gameful experience [12, 13], and plays an essential role in attaining desirable outcomes from exergames [8, 11].

Competition is often considered an engagement fuel as individuals are often motivated by competing against others or their own previous performance [2]. But not all are motivated by competition. Hence, it can become detrimental to user experience, (e.g., spam, cheating, and hyper competitive behavior) play becomes about beating others rather than exercise [2, 16]. Hence, playfulness is considered an aspect of gameful experience, where activities are approached with creativity, spontaneity and exploration [12]. Immersion in exergames is an experience where players are absorbed and focused on their task [12, 13], often attained by storytelling and multisensorial mechanics [14, 17].

Despite being central to exergames the gameful experience has received little research [3, 12, 13]. Research has outlined how various game mechanics and design can foster gameful experience with exergames, but has rarely reflected on the seven dimensions of gameful experience simultaneously, nor is there conclusive understanding of changes in player experiences over time. While some research finds engaging experiences from exergames and general gamification short lived [16], other research finds their intensity to increase with time as players grow familiar with the exergames and become better fit than when initially engaging with them [15, 18].

2.2. Movement-based games and playful wearables

Since the introduction of Wii and Kinect, research on movement-based games has grown immensely, with ample design knowledge published as guidelines, implications or recommendations [6, 7, 19]. Studies examined movement-based games in different settings and aspects, namely, in social settings [19], from körper (material body) and leib (experiencing body) angle [7], from the perspective of the 2nd player [20], regarding understanding of words 'play' and 'game' [21], or overall game design guidelines with specific DOs and DON'Ts [21]. Thus, RFA is in a space where effects of the studies can be investigated in a commercial system and over a wide user base.

RFA also capitalizes on the playful wearables area as it has a wearable controller, the Leg-Strap. Playing Ring Fit, compared to many other games, also facilitates wearing specific types of clothing such as trainers, yoga-pants or smart trackers. Investigating Ring Fit around the culture of playful wearables which are wearables specifically designed for games, other playful contexts situated in daily life or for inducing playful and gameful experiences [9]. Plenty of research games based on wearables were produced such as True Colors [22] or WEARPG [23]. Drawing on these games, recently a Design Framework for Playful Wearables was developed investigating wearables through performative, social and interactive planes [9]. Social aspects were also investigated with a social wearables framework [24].

Studies on movement-based games and playful wearables revealed numerous design patterns, recommendations, implications and opportunities, but reflection of the work on the commercial field has been scarce. In this paper, through topics extracted from user discussions on RFA Reddit channels, we elaborate on how academic knowledge corroborates with RFA and reveal opportunities for design.

3. Method

3.1. Data collection

Reddit, as one of the largest online discussion forums, has attracted attention [25] due to its large amount of discussion, having over 138 thousand active subreddits (focused sub-communities) and over 330 million users. The RFA community also has a strong Reddit presence, thus Reddit taken as the venue to study player perceptions of RFA. A subreddit is where concerted discussions

Group (Num)	Original Flair-tags
Admin (11)	Meta, META, Subreddit-related
Fandom (134)	Fanart/Meme, Fanart/Meme/Humor
Gameplay (558)	Gameplay, Gameplay (anything about playing RFA)
Achievements (232)	Achievement, Monthly Challenge Monthly Challenge!, Monthly challenge! In-Game Achievement
Well-being (474)	Fitness, Health, Weight-loss/Diet
Device (239)	Equipment, Troubleshooting
None, Others (3023)	No tags, Other

Table 1
Flair-tag Groups, their number of threads, and their tags.

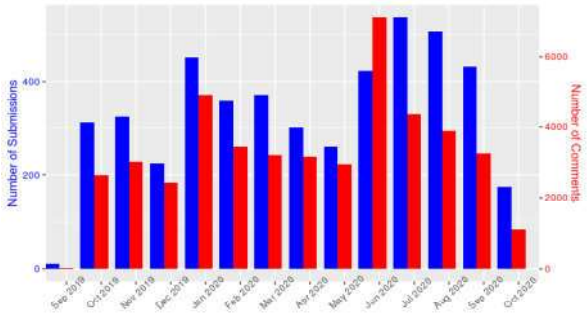

Figure 1: Number of submissions and comments over time

on a particular notion take place; subreddits yield theme-focused discourse and users under a subreddit can be seen as an online community. We focus on the subreddit /r/RingFitAdventure which is directly focused on RFA. Open software pushshift API [2] is used to fetch the threads. Finally, 4681 submissions and 45554 comments (from 2965 and 7754 unique users, respectively) were collected.

Reddit users can optionally specify a "flair-tag" to classify their posts. Tags can be used to filter posts, thus it is expected that flair tags would attract readers of similar interests and further comment under the submission. For simplicity, we categorized the flair-tags in to 7 groups (as shown in Table 1). Flair-tags in each group share a similar notion. We noticed that the submissions with the tag "Other" cover a wide range of content, thus posts without flair-tags were categorized into the same group.

3.2. Text analysis

To analyze the large mass of text data we used topic modeling [26], a text analysis technique of machine learning where each document is modeled as a mixture of latent topics. Topic modeling can identify such latent topics over corpora whose documents contain a variety of topic combinations. This flexible way of representing a document is an essential feature that makes it a better option especially comparing to, for example, hard clustering where each document is assumed to belong to one specific cluster. Each topic is a distribution over words. The probability of the word w occurring in document d is

$$p\ w\ d \qquad p\ k\ d\ p\ w\ d \qquad (1)$$
$$k$$

where $p\ k\ d$ is the probability of the word coming from topic k out of all possible K topics. Such topics are not pre-specified by humans but are automatically learned by fitting the model to the data. Unlike, for example, principal component analysis, topic modeling is inherently designed for count data such as word counts in text documents. Topic modeling has been used in many domains including game studies (e.g. [27]).

We consider each Reddit thread a document; in addition to text of each thread, its flair-tags and submission time were also collected. To leverage this information, we chose a more advanced topic model called Structural Topic Model (STM, [28]). It is used to model and analyze how the topic prevalence is affected by document-level covariates. It models the topic prevalence of a document $p\ k\ d$ with a vector θ_d $p\ \ d\ ,\ldots,p\ K\ d$ and

$$\theta_d \sim LogisticNormal_{K-}\ \ \mathbf{\Gamma}\ \ _d, \mathbf{\Sigma} \qquad (2)$$

where $_d$ is the document-level covariates, $\mathbf{\Sigma}$ is the covariance matrix, and $\mathbf{\Gamma}$ is the coefficient matrix governs the integration between topic prevalence and document-level covariates. Here, we take the flair tag groups and the submission time as document-level covariates.

The only user-specified parameter which needs to be set up when training an STM model is the number of the topics K. To decide it, we assessed the held-out likelihood value as the criterion: to compute it, a subset (here 50%) of the documents is considered unobserved ("held out"), and the models are evaluated by their likelihood on this held-out portion. For each model setting, from K to K , the held-out likelihood is computed 10 times with random initialization, and the final number of topics is chosen as the value where the held-out likelihood plateaus. We then optimize STM with the final K from 10 random initializations, choosing the result with the best semantic coherence [29] as the final model.

4. Result

The volume of the collected data is displayed in Figure 1. The number of submissions reached its peaks in December 2020 and June 2020; the number of comments reached its peaks in December 2020 and May 2020.

[2] https://github.com/pushshift/api

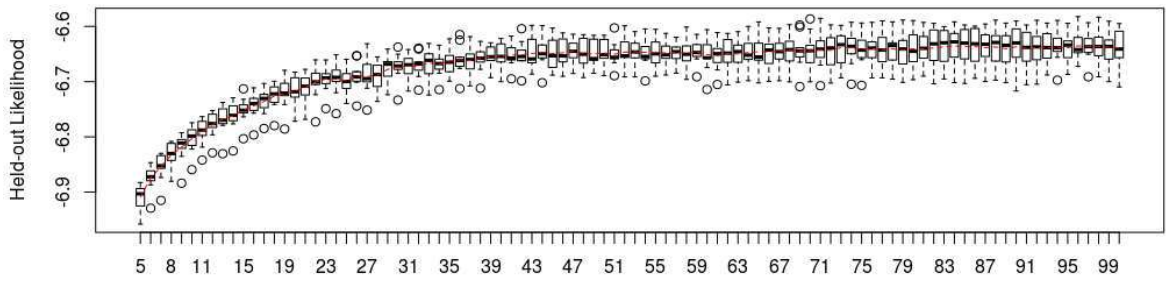

Figure 2: Held-out likelihood over number of topics (horizontal axis). Box-plots show variance: median (bar), 25%-75% quantiles (boxes), 1.5 interquartile range (whiskers), and outliers (circles). The red dot line is the mean value.

4.1. Model selection

Figure 2 shows the model selection process: change of held-out likelihood values over different K. The values clearly plateaued after around 40 topics. For simplicity of the model, we then chose K . We then ran 10 randomly initialized models with this K and picked the one with best semantic coherence as the final model, as described in Section 3.2. To further confirm our model selection, we also built models with 50 and 60 topics. We found that the extracted topics with more topics did not seem to yield more useful information (see supplementary materials). We thus focused on the selected model.

4.2. Extracted topics

Extracted topics are displayed in Table 2. Topics are labeled manually under a common practice which is similar to Thematic analysis [30] but without reading though all the Reddit posts manually. The labelling process was based on examining the semantics of the topic word lists and their example top documents (documents containing highest proportions of the topic). Examining both was crucial, as RFA uses common exercise related words as names for in-game items or in-game moves, thus such words can either refer to the in-game meaning or the real world meaning, "*Smoothies*" as in-game items that provide various effects, exercise moves such as *Overhead Press* and *Warrior Pose*, and *skill* referring to unlockable in-game skills; examining both words lists and top documents helped resolve the meanings of the topics.

Figures 4 and 5 show selected relationships of topic prevalence over flair-tag groups and time respectively. The full list can be found in supplementary materials.

Topic Affinities. To organize analysis of the topics, we manually organized them into taxonomic groups with an affinity diagram, created by the authors of this paper through iterative discussions in an online drafting platform. We thematically grouped the topics based on their similarities; for example, topics "In-store purchase", "online purchase" and "digital purchase" are under "Purchase" group. Figure 3 shows the resulting diagram which yielded 7 major topic groups, each having 1 to 3 subgroups. We analyze the topics and discussion content within each major group and their research implications.

4.3. Social space

This group includes discussion of in-game social features (topic **Social Interaction Features**, 3.01% prevalence), players' social interaction on Reddit (**Social Recognition**, 4.74%; **Social Guidance Appreciation**, 4.68%; **Success Stories / Achievements**, 2.48%; **Discussion of Reddit**, 2.61%; and **Community Challenges and Quests**, 1.25%), and self expression (**Opinion Expression**, 5.84 %; and **User Reviews and Recommendations**, 2.65 %).

Social factors are prominent in RFA, as seen through the prominent emergence of topics such as **Social Recognition** and **Success Stories / Achievements**. Figure 4 shows prominence of the two topics in posts with well-being related flair-tags. Social experiences in RFA manifest not only through commonly observed social behaviors in exergames, such as recognition and social reciprocity [11], but also through provision of social guidance [12] as players sought and provided each other directions both on how to improve their in-game performance as well as exercise in general. On the other hand, while social interaction on Reddit was quite rich, in-game social features came up on only one topic and focused on features such as friend requests or leader boards.

Implications. The prominence of social factors is in line with previous research [2, 11, 15]. However, in RFA players demonstrate very rich patterns of social interaction through Reddit. The observed variety of social behavior gives credence to the observed presence of social interaction for guidance and communal improvement, rather than mere socialization, praise and connections building as seen in previous research [2, 15].

4.4. In-game elements

This group involves conversation on in-game elements from mechanics and strategies (**Fighting Boosts**, 3.18%; **Fight Mechanics**, 1.19%; and **Exercise Mini Games**,

Topic	Pr (%)	Top 10 Words
Opinion Expression	5.84	like think make good way time can say thing actually
Quests	5.14	world level fight complete boss battle beat back quest finish
Social Recognition	4.74	thank get keep good today first start great congrats awesome
Social Guidance Appreciation	4.68 %	try thank work help know find may see give look
Play Schedule	4.63	day time minute play week hour session every start min
Controller Troubleshooting	3.89	con ring joy-con joy use controller issue ringcon right leave
Registering Leg Involved Moves	3.81	squat leg knee plank climber register mountain low exercise move
Fighting Boosts	3.18	skill attack use move damage smoothie enemy exercise level unlock
Custom Mode over Adventure Mode	3.09	mode adventure set exercise custom workout want option play story
Social Interaction Features	3.01	friend add multitask switch mode profile code send play record
Settings	2.94	screen button menu switch change play setting option leave time
User Reviews and Recommendations	2.65	play fun workout fitness get enjoy still work want gym
Discussion of Reddit	2.61	post people video sub see comment please look question subreddit
Availability and Digital Purchasing	2.61	buy sell nintendo price ring switch copy party want amazon
Game Difficulty	2.59	difficulty level start increase rep set high low intensity hard
Success Stories / Achievements	2.48	back work start get month rfa feel keep life week
Personal Capability and Limitation	2.44	exercise good want easy feel keep hard body youll build
Humor	2.41	love sweat beautiful cat shiny look tipp say lol music
In-Game vs. Wearable Calorie Counting	2.29	calorie burn watch use track workout exercise rfa fitness count
Weight Loss	2.25	weight lose diet loss fat calorie eat muscle gain day
Exercise Recovery	2.15	day take rest break sore body muscle workout work feel
Silent/Regular Running Mode	2.14	run jog mode silent place knee jump squat assist course
Appropriateness of Ringfit for Exercise	2.04	weight muscle rfa train cardio exercise good strength body gym
Wearability of the Leg Strap	2.03	strap leg wear short thigh slip pant good put keep
Ab Guard	2.00	feel arm ring core push like move keep back press
Exercise Mini Games	1.97	coin time back try get mini side robot swing right
Broadening Activities	1.91	fit ring box seem use fitness ringfit pretty call probably
Ringfit Elements in Other Games	1.85	game nintendo see dlc wii love new like fit rfa
Stretching and Injuries	1.77	stretch pain back knee exercise injury hurt doctor help joint
In-store Purchasing Ring Fit	1.73	get stock buy target copy store mine gamestop walmart amazon
Poses / Moves	1.69	pose jump side yoga overhead move twist warrior boat exercise
Exercise Moves	1.67	exercise arm shoulder press hip work muscle pull overhead hand
Auxiliary Exercise Equipment	1.46	mat yoga shoe foot floor use play exercise wear barefoot
In-Game Smoothie Recipes	1.45	smoothie title recipe ♀ ♂ show share get make achievement
Planning of Food and Drink	1.25	eat food diet calorie drink good like water meal make
Community Challenge and Quests	1.25	challenge fast score advance time rep slow speed try leg
Fight Mechanics	1.19	guard heart damage breathe smoothie lose take attack hold time
On-line Purchasing	1.07	order ship get fnac stock say good amazon mine cancel
SPAM-marked Posts	1.04	language know account product scam review report japanese watch page
Hearth Rate Measurement	1.04	heart rate time exercise high watch measure get accurate check

Table 2
Extracted 40 topics, ranked by topic prevalence (proportion of all document content represented by the topic)

1.97%), quests or game modes (**Quests**, 5.14%; and **Custom Mode over Adventure Mode**, 3.09%), different game settings (**Settings**, 2.94%; and **Silent / Regular Mode**, 2.14%) to difficulty levels (**Game Difficulty**, 2.59%).

Game mechanics (boosts, characters, narratives, smoothies) were often discussed, but mostly in light of player needs and experiences, arising in playful reinterpretations, meaning-making, and exercise discussion (e.g. "People with larger chest do you play on regular or silent mode? I'm a woman and my chest, like most of my body, is larger than I'm comfortable with..."). Discussions also seek and provide *social guidance*, discussing *challenge*, *accomplishments* and *competition* against oneself and the game (e.g. "Do you always take damage on the abs bit, or am I doing it wrong? Whoever I do the ab hold thingy...").

Implications. In line with previous research, competitive elements around overcoming game challenges [3, 12] or previous personal performance [4, 15] domi-

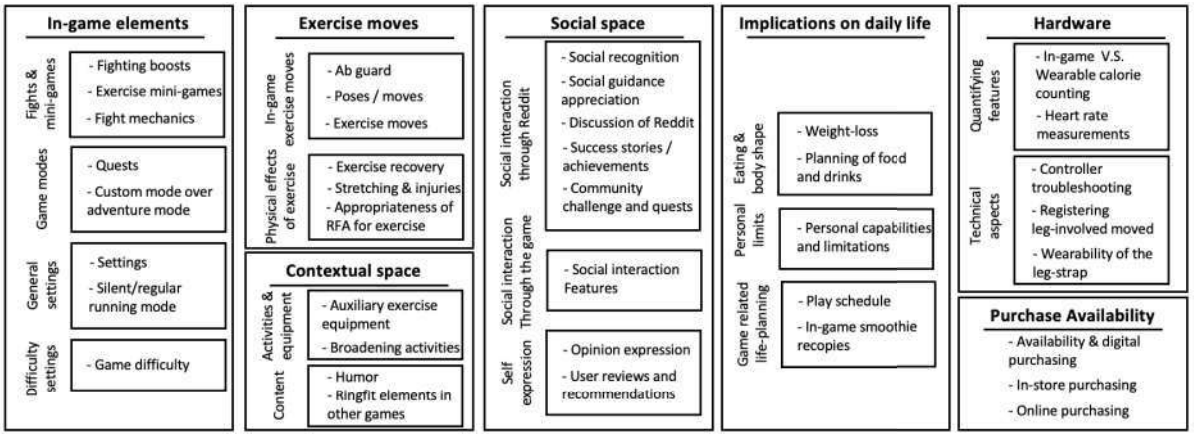

Figure 3: Affinity Diagram: thematic grouping of the found topics. Titles with a dash are topics, boxes are groups/subgroups.

nated much of the discussions. Discussions often centered on exercise moves and fitness the game tries to facilitate, rather than distracting from them, as is often a postulated fear with imposing gamification or an in-game narrative on a non-game activity [16]. Players also engaged in meaning making of the game narrative: adding humor and funny reinterpretation to in-game lines and trying to re-create in-game booster/smoothie recipes in real life. In line with previous research, narrative provided immersion and playfulness allowing players to further engage with exercise and in collective meaning-making [14, 31]. The way game content was discussed highlights that most experiential dimensions [12] of the gameful experience [13], were present and prominent in discussions of RFA, possibly justifying the game's perceived popularity and impact on personal health [3].

A particular discussion with implications for game design was players' preferences for creating custom sets within the main gameplay. While discussions on set quests and humor of the game have a high prevalence suggesting they are important for attracting players, the lack of customization in the narrative mode led to conversations comparing the custom and the narrative modes.

4.5. Exercise moves

The conversation on exercise moves had two main themes. The first theme involves characteristics and details of in-game exercise moves including **Ab Guard** (2.00%), **Exercise Poses / Moves** (1.69%), and **Exercise Moves** (1.67%). Interestingly, discussions about the **Ab Guard** topic are mainly about complaints and confusion on how to perform the move, such as "What am I supposed to be doing with the Ab? ... I'm supposed to feel it in my abs, but I don't ..." or "...how to properly do the ab Guard... should feel it in your abs and not our arms but..." The other theme is about prolonged effects such as **Exercise Recovery** (2.15 %), **Appropriations of Reddit for Exercise** (2.04%), and **Stretching and Injuries** (1.77 %).

Implications. Discussion on prolonged effects can be linked to Calleja's player involvement model [31], all involvement types have a post-game effect: in ludic involvement players keep strategizing about a challenge after a game session; here kineasthetic involvement extends to after-game with effects like injuries or soreness.

4.6. Implications on daily life

This group included three subgroups: 1) Eating and Body Shape (**Weight Loss**, 2.29%; and **Planning of Food and Drink**, 1.25%) which mostly involved players informing each other about weight loss and diets accompanying their RFA routine, 2) Understanding Personal Limits (**Personal Capability and Limitation**, 2.44%) where players tried to understand appropriate difficulty settings, playing frequencies or exercise types to their body shape, condition or training habits, and 3) Game related life-planning (**Play Schedule**, 4.63%; and **In-game Smoothie Recipes**, 1.45%) involving planning the schedule for playing RFA and also other extended activities such as trying out the in-game smoothie recipes in the real life.

Implications. RFA has become integral in players' daily activity and healthy life routine. As seen with phenomena such as "playbour", gaming often becomes as laborious and time consuming as income providing labor [32]. Games having strong impact on daily life is not surprising, but observing it in exergames seems novel.

It has been argued gamifying activities like exercise detracts from them and is not effective in creating engagement with underlying activities after novelty effects [16], but the extent RFA has impacted players' daily life, health, and time scheduling suggests gamification, and exergames in particular, can be designed to yield strong engagement and notable positive impact on daily life.

The prominent discussion on personal limits and balancing the difficulty of the game with one's ability is interesting. In line with research on flow experiences, the balance is essential to positively engage with activities and not be disengaged or overwhelmed [17], as also recommended by movement-based game literature [6]. It is thus important to allow adjusting difficulty and highlight the option to players to ensure positive engagement.

4.7. Hardware

This group includes topics on quantifying features of the Nintendo Switch's Joy-Con controllers (**In-Game vs. Wearable Calorie Counting**, 2.29%; and **Heart Rate Measurement, 1.04%)** while another large portion focused on technical aspects of RFA equipment (**Controller Troubleshooting**, 3.89%; **Registering Leg Involved Moves**, 3.81%; and **Wearability of the Leg Strap**, 2.03%).

Most discussions around hardware were about the quantification feature. Players compared heart rate measurement results and calorie calculation of Joy-Con to values extracted by wearables such as smart watches or trackers. Discussion on technical aspects was mostly about issues and problems players had with RFA equipment, For example, "...I bought the game yesterday and while playing, my left joy-con stopped responding..."

Troubleshooting controllers is not surprising as Joy-Cons had chronic drifting issues where they falsely register moves. However, other discussion is important for wearable design. Players complained about stability of the leg-strap and that its comfort & functionality depends on what is worn under (e.g., "Having trouble with the leg con yesterday to do squats, ..."). The leg-strap washability is also discussed (e.g., "... I can't wash it every time since it would wear the material...").

Implications. The prominence of the quantification feature is in line with previous research, as it is essential to exercise tracking and is often a base for implementation of gamification and exergames [4, 2, 15]. Discussions of stability and washability highlight the importance of wearable appropriateness. Appropriateness with fashion style has been defined a crucial aspect of wearable devices. Washability is also critical when it comes to textile-based electronics [33]. Guidance in [34] can also help identify problems in registering leg moves.

4.8. Contextual space

This group comprises topics related to context of the game: activities and equipment (**Broadening Activities**, 1.91%; and **Auxiliary Exercise Equipment**, 1.46%) and broader content for the game (**Humor**, 2.41%; and **Ringfit Elements in Other Games**, 1.85%). Examples include traveling with RFA (e.g., "...The ring con I just sandwiched between clothes in a luggage. My challenge was finding out where I could actually do the exercise...") or playing other exergames. **Auxiliary Exercise Equipment** captures discussion on choices such as playing with shoes or barefoot, and use of a yoga mat. The topic **Humor** represents humor in discussions and in the game itself. In **Ringfit Elements in Other Games**, RFA is discussed in context of other games, including RFA elements appearing in other games (e.g. "...Thoughts on a character for Smash Uktimate?...I feel like Dragaux could be a good fighter and there's not many huge characters...") and alternate uses for the Ringcon controller.

Implications. Discussions in this group are usually in context of daily life and imagination of players. This shows the strength of RFA's narrative. In-game dialogues can prompt humorous conversation while the game world is perceived deep enough to accommodate elements from, or lend characters to other games. Players were eager to use RingCon in other games or consider external equipment such as yoga mats, trainers or smart watches as part of the game, which corroborates previous work indicating playful utilization of external equipment such as smart watches as game controllers [35].

4.9. Purchase availability

This group contains topics **Availability and Digital Purchase** (2.61 %), **In-store Purchasing Ring Fit** (1.73 %), and **On-line Purchasing** (1.07 %). Each emphasizes a unique aspect related to acquisition of the game. Discussions include faced hassles when obtaining the game (e.g., "Coronavirus concerns mean that the game has been harder...") and information of the availability of the game (e.g. "Left on Walmart! I heard the browser alarm go off and grabbed one in time finally!!!...").

Implications. In Figure 5, prevalence of these topics started to grow after March 2020, which can be linked to global shortage of RFA as reported (e.g., Polygon[3], Forbes[4]) Availability (e.g., purchase from different outlets), different form of purchase, and possibility of digital purchases (e.g., lost a game cartridge) are discussed.

5. Discussion

5.1. Player perceptions

Social Influences. Strong prevalence of social interaction is found in the discussions highlights the importance of social experiences to exergames. It is not facilitated through built in game features but emerges as organic, independent discussion on a separate discussion forum

[3]https://www.polygon.com/2020/3/13/21177214/ring-fit-adventure-sold-out-stock-coronavirus-nintendo-switch

[4]https://www.forbes.com/sites/davidphelan/2020/03/11/coronavirus-causes-nintendo-ring-fit-adventure-to-be-suddenly-super-scarce/

outside of the game: players seek them out through mechanics outside if they are not facilitated in game.

Devices. Controller troubleshooting (i.e. Joy-Con in the leg does not register moves, slips from the leg or is uncomfortable) is frequently discussed. Wearability issues noted and discussed by players (i.e. slipping of the leg-strap might affect accuracy), indicate RFA equipment may benefit from better design directed by wearability guidelines [33]. The way players compared heart rate and calorie measurements to their smart wearables indicate opportunity for developers to integrate external personal smart equipment as part of the game. This supports our previous interpretation on expansion beyond screen in the Implications on the Daily Life theme, and is also supported by previous work on playful wearables [35].

Availability. The need for at-home exercise boosts demand for at-home exergames, as happened with RFA during the COVID-19 pandemic. Although unpredictable, it hugely affected product supply and demand. Exercise habits of many may be permanently altered, enlarging the market for at-home exergames.

Hardware shortages and mishaps with the game cartridge showed that a strategy to only offer a packaged physical game and controller had limits. If the cartridge gets lost, one must buy the whole package. Manufacture issues of hardware components make supply even harder. One could offer a digital download and let third parties produce hardware; but this is risky for assuring optimal player experience due to hardware differences, and can be confusing if players buy the game not understanding they also need the controller. A solution is to make the game a free download that only works with an official controller sold separately. This strategy is used in industries (e.g., Mario Kart Live: Home Circuit[5]).

Beyond RFA. As with most artefacts, RFA users of re-appropriate it for uses outside of the intended; adding equipment such as yoga mats, running shows, body weight etc., to its use outside of what is explicitly recommended by the game. We see playful re-appropriation of the meaning of RFA content by adding humor to it. This supports that RFA yielded a gameful experience with playfulness a key dimension [12]. This may be similar to modding cultures which impose meaning on and re-interpret games they play. Giving a dedicated space for players to exercise modding and re-appropriation could support emergence of a gameful experience and building a personal connection between the players and the game.

5.2. Design opportunities

Customized Gamification. While achievements, rewards or leaderboards are the most frequently used gamification elements[1], altering integral parts of games, such as exergames tailored game mechanics, narrative, in-game items that lead to strategizing, or different game modes which create different context and diversity in exercising seem like critical aspects for engaging players. However, a conflict can appear between the two main purposes, fun and exercising. Discussions indicated players must build custom sets to appropriate exercise moves to their preferences, but the narrative mode of RFAdoes not have such flexibility as in other modes. Thus, in an exergame with a variety of exercises, it is important to conform different physicals needs through allowing players to engage with the core content of the game.

Social Interaction Features. Exergame designers are encouraged to examine social experiences and interaction facilitated by their games and expand on them when possible without limiting or distracting from main gameplay. The observed lack of discussion of in-game social features indicates opportunities to design in-game social interaction features. Based on the players discussions and as presented by work on exergames [19] and playful wearables [9, 35, 24], RFA might be a suitable platform to integrate social game mechanics yielding remote and collocated social interaction. Distinction between parallel (e.g., seeing a mirror and matching game actions with other players) and interdependent play (e.g., sharing an object, interacting with the body of other player through wearables) [19] might be a good source for design of social elements in RFA. Examples can be seeing ghosts of remote players in the game (being aware) for comparison, synchronizing moves with others in mini-game fights for effective attacks, or facilitating collocated bodily engagement by interacting with other players' Joy-Cons (i.e. using the Ring Con as a shared object).

Körper and Leib. Regarding the difficulties of using the equipment, RFA can benefit from the design paradigm on Körper (material body) and Leib (experiencing body) [7], for exercise moves such as Ab Guard and similar moves which require connection and mindfulness of body parts. As suggested by movement-based game literature, reconfiguring such moves in a way which help players to explore the connection between Körper and Leib would help with clarity and playful experience.

Prolonging Effects. Post-game effects of Exercise Moves such as soreness may create means to extend the game beyond the screen by incorporating external equipment such as players' smart watches or trackers, which was suggested as a possible way for using playful wearables [35]. For example, RFA can playfully guide further activities which will effectively help recovering or preventing injuries. In line with the prolonging effects of Exercise Moves, RFA creates other spaces that can extend the gameful experiences beyond screen-time. RFA covers a large space of out-game activities, and time outside of active gameplay time can still be integrated into the game. External smart phone applications, or integrating

[5] https://www.nintendo.co.uk/Games/Nintendo-Switch-download-software/Mario-Kart-Live-Home-Circuit-1832413.html

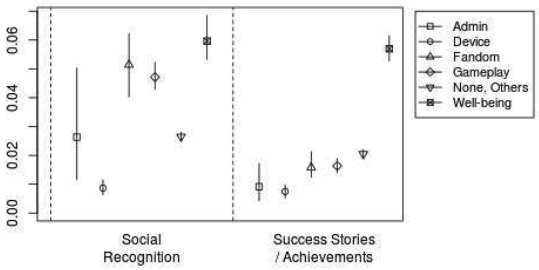

Figure 4: Prevalence of selected topics over flair-tag groups with 95 % confidence interval.

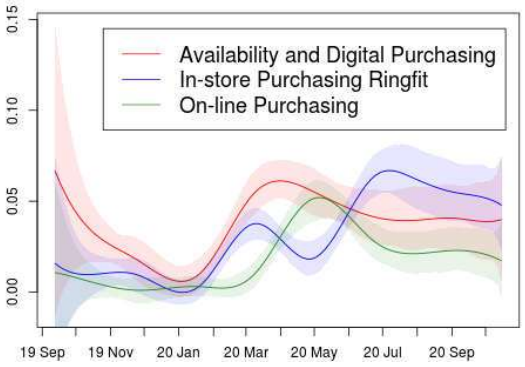

Figure 5: Prevalence of selected topics over time with 95 % confidence interval.

the features of smart wearables with the game might be a way to extend the game world to the daily life of users [35]. For example, daily step count, heart rate, other training or meals as part of game progress might merge the daily life activities with RFA. RFA already has an alarm function which notifies user with a light and vibration but it can be extended even further. Another idea can be a social media integration in which players can upload the photos of smoothies they prepared, yielding in-game rewards.

Immersion. Discussions in the topic group **In-Game Elements** do not make the extent to which the game facilitated immersion clear. While playful discussions of in-game content could indicate immersion, discussion of game difficulty may indicate lack of full immersion that distracts from challenges. This shows the difficulty in balancing game content, engagement and game difficulty and the importance of game experience from gamification rather than additional game mechanics to activities [5, 13]. The comments also show that when the fatigue level induced by exercises does not corroborate with the imaginary world and meaningful play of the game [36], as suggested by Movement-Based Game Guidelines [6], it may detract from the immersion experience.

6. Conclusions, limitations, and opportunities

This work offers an understanding of RFA players from the perspective of discussions in /r/RingFitAdventure. We chose the venue as others (e.g., /r/NintendoSwitch, Nintendo Life Forum), though they may contain relevant discussion, are not online communities focused on RFA.

With a computational text analytic approach, meaningful underlying topics were discovered and analyzed. Our computational topic modeling worked on a level of word occurrences and did not consider order of words in finding topics. Our model took into account covariates, but note that unobserved other covariates (e.g. author information) could also affect results.

The role and functions of social media in gamification and design opportunities based on the discovered themes can be a basis of future research and gamification design. In this work only Reddit data is analyzed; this data source emphasizes English writers. As RFA has been a worldwide popular game, a future direction can be an extensive investigation with other text sources related to RFA.

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