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Towards understanding the effects of individual gamification elements on intrinsic motivation and performance

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ABSTRACT

Research on the effectiveness of gamification has proliferated over the last few years, but the underlying motivational mechanisms have only recently become object of empirical research. It has been suggested that when perceived as informational, gamification elements, such as points, levels and leaderboards, may afford feelings of competence and hence enhance intrinsic motivation and promote performance gains. We conducted a 2 × 4 online experiment that systematically examined how points, leaderboards and levels, as well as participants' goal causality orientation influence intrinsic motivation, competence and performance (tag quantity and quality) in an image annotation task. Compared to a control condition, game elements did not significantly affect competence or intrinsic motivation, irrespective of participants' causality orientation. However, participants' performance did not mirror their intrinsic motivation, as points, and especially levels and leaderboard led to a significantly higher amount of tags generated compared to the control group. These findings suggest that in this particular study context, points, levels and leaderboards functioned as extrinsic incentives, effective only for promoting performance quantity.

1. Introduction

Digital games have become increasingly popular over the last few years (ESA, 2015) and empirical research in psychology has further lent evidence for their motivational appeal (e.g., Peng, Lin, Pfeiffer, & Winn, 2012; Przybylski, Rigby, & Ryan, 2010). Industry professionals have taken notice of this trend and have attempted to apply games' motivational potential to various non-gaming contexts to foster user engagement. This practice is nowadays best known under the moniker "gamification", commonly defined as *the use of game design elements in non-game contexts* (Deterding, Dixon, Khaled, & Nacke, 2011), and has become a heavily debated subject in its own right (Deterding, 2012; Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015).

Most prominently, gamification has been commonly associated with points, levels and leaderboards (Hamari et al., 2014; Seaborn & Fels, 2015). While several studies have shown that the implementation of game elements may promote user behavior in various contexts (refer to Hamari et al., 2014; Seaborn & Fels, 2015; for an overview), some have cautioned against the over-reliance on such elements, as they may diminish users' intrinsic interest and hence lead them to stop engaging with the application or service altogether (Deterding, 2011; Koivisto & Hamari, 2014; Seaborn & Fels, 2015). In fact, previous research in psychology provides ample evidence that certain forms of rewards, feedback, and other external events can have detrimental effects on intrinsic motivation (for an overview see Deci, Koestner, & Ryan, 1999), and a recent study suggests that the same may hold true for gamification under certain circumstances (Hanus & Fox, 2015). On the other hand, it has been argued that – provided a non-controlling setting, – the well-thought out implementation of game elements may indeed improve intrinsic motivation by satisfying users' innate psychological needs for autonomy, competence and relatedness (Deterding, 2014; Francisco-Aparicio, Gutiérrez-Vela, Isla-Montes, & Sanchez, 2013; Pe-Than, Goh, & Lee, 2014; Peng et al., 2012).

Deterding (2011, 2012) suggested that in order to gain a better understanding of the psychological mechanisms underlying gamification, the effects of *individual* game design elements on user motivation should be studied, referring to the concept of *motivational affordance*, that is, *the properties of an object that determine whether and how it […] supports one's motivational needs* (Zhang

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(2008), pp. 145). While efforts have since been undertaken to link game design elements to the satisfaction of motivational needs (Francisco-Aparicio et al., 2013; Pe-Than et al., 2014; Peng et al., 2012; Wang, Schneider, & Valacich, 2015), to date only few studies attempted to experimentally investigate the effects of *individual* game elements on motivation and performance (Deterding, 2011; Hamari et al., 2014; Seaborn & Fels, 2015).

Yet, this issue is highly relevant to gamification research. Firstly, the majority of currently available gamification literature focuses predominantly on studying the effectiveness of game design elements in promoting certain behavioral outcomes (Hamari et al., 2014; Seaborn & Fels, 2015), largely ignoring the underlying psychological mechanisms that may actually account for these effects (Antin & Churchill, 2011; Deterding, 2014), (but refer to Hanus & Fox, 2015; Lieberoth, 2015; Mekler, Brühlmann, Opwis, & Tuch, 2013b; for notable exceptions). Secondly, game elements, such as points, levels and leaderboards have been and continue to be applied to a broad spectrum of non-game contexts with varying degrees of success (Hamari et al., 2014; Seaborn & Fels, 2015). But most empirical gamification studies investigate the impact of multiple game elements, making it difficult to pinpoint how and to what extent these game elements contribute to user motivation and behavior (Hamari et al., 2014; Seaborn & Fels, 2015). Moreover, most pattern-based approaches to gamification, such as the one described by Francisco-Aparicio et al. (2013), offer little guidance in deciding whether points, levels or leaderboards are suitable for a given context, or how they should be implemented (Deterding, 2015). Studying the effects of individual game elements on both behavioral outcomes and users' intrinsic motivation thus contributes to gamification research by providing a more nuanced understanding of how particular game elements function in a given context, and may potentially benefit designers, as it allows for more informed decisions on how and under what circumstances game elements, such as points, levels or leaderboards, should or should not be implemented (Seaborn & Fels, 2015).

Based on self-determination theory (SDT), one of the most established theoretical frameworks within gamification and game motivation research (Deterding, 2015; Seaborn & Fels, 2015), the present paper aims to address the aforementioned research gaps by systematically assessing the impact of individual game design elements on both user motivation and behavior. Specifically, this study examines how points, leaderboards, and levels, – three of the most commonly employed game elements (Hamari et al., 2014; Seaborn & Fels, 2015), – affect need satisfaction, intrinsic motivation and performance in an image annotation task. Moreover, because apart from situational factors, individual differences may also account for the differing effects of gamification (Hamari et al., 2014), we additionally examine whether users' causality orientation further determines the effects of gamification.

2. Theoretical background

2.1. Intrinsic motivation, cognitive evaluation and causality orientation

Self-determination theory (SDT) differentiates two forms of motivation (Ryan & Deci, 2000) – (but refer to Vansteenkiste, Niemiec, & Soenens, 2010; for a more nuanced differentiation of varying types of extrinsic motivation): *Extrinsic motivation* is defined as doing something due to a separable outcome, such as pressure or “extrinsic rewards” in the form of money or verbal feedback (e.g., praise) (Deci et al., 1999), whereas *intrinsic motivation* denotes the pursuit of an activity, because it is inherently interesting or enjoyable. A recent literature review by Seaborn and Fels (2015) identified intrinsic and extrinsic motivation as some the most frequently discussed, yet rarely empirically studied constructs in gamification research. It is important to note that both extrinsic and intrinsic motivation promote performance gains (see Cerasoli, Nicklin, & Ford, 2014; for an overview), but only the latter has been associated with improved psychological well-being, enhanced creativity and learning outcomes (Ryan & Deci, 2000), as well as increases in the extent and quality of effort that people put into a given task (Cerasoli et al., 2014).

While certain extrinsic rewards have been found to reduce intrinsic motivation in various domains (Deci et al., 1999; Ryan & Deci, 2000), external rewards must not invariably undermine people's intrinsic motivation (Cerasoli et al., 2014; Deci et al., 1999). According to cognitive evaluation theory – a subtheory of SDT (Ryan & Deci, 2000; Vansteenkiste et al., 2010), – the effects of extrinsic rewards on intrinsic motivation are mediated by a person's perception of these events as informational or controlling (Deci et al., 1999; Ryan & Deci, 2000), which in turn determines how these events influence the innate psychological needs for competence and autonomy (see Fig. 1). *Competence* signifies the perceived extent of one's own actions as the cause of desired consequences in one's environment (Ryan & Deci, 2000) and thrives when met with direct and positive (i.e., *informational*) feedback. However, feelings of competence will not increase intrinsic motivation unless they are accompanied by a sense of *autonomy*, that is, people must experience their behavior as self-determined rather than *controlled* by some outside source. If perceived as controlling, even positive feedback may thwart people's inherent need for autonomy and hence, decrease intrinsic motivation (Deci et al., 1999), whereas feedback that is perceived as both non-controlling and informational, supports people's need for competence and subsequently boosts their intrinsic motivation.

Finally, according to causality orientation theory (Deci & Ryan, 1985), another subtheory of SDT (Vansteenkiste et al., 2010), people differ in the extent to which they experience their actions as self-determined, which further influences whether they perceive feedback as informational or controlling (see Fig. 1). Hence, a person's causality orientation acts as a moderator of the effects of feedback on need satisfaction. Autonomy oriented individuals are more likely to act according to their own interests and values and interpret external events as informational rather than controlling (Deci & Ryan, 1985; Vansteenkiste et al., 2010), therefore experiencing more competence need satisfaction. Control oriented people, in contrast, are more likely to act due to external demands and perceive external events as pressuring and therefore experience less feelings of autonomy.

2.2. Need satisfaction and game design elements

The intrinsically motivating nature of digital games has been attributed to their potential to satisfy the psychological needs for autonomy, competence and relatedness (Przybylski et al., 2010). Satisfaction of those needs has also been found to be positively associated with the enjoyment of human computation games (Pe-Than et al., 2014). Additionally, Peng et al. (2012) compared different versions of an exergame, designed with a variety of autonomy-supportive (i.e., avatar customization) and competence-supportive game features (i.e., dynamic difficulty adjustment, various performance indicators). As posited by cognitive evaluation theory (Ryan & Deci, 2000), they found that need satisfaction mediated the effects of the game elements on participants' enjoyment (as measured by the Intrinsic Motivation Inventory; Ryan, Mims, and Koestner (1983)), motivation for future play and game recommendation. However, since their study combined several game elements in each experimental condition, Peng et al. (2012) acknowledge that it is not possible to assess which and to what

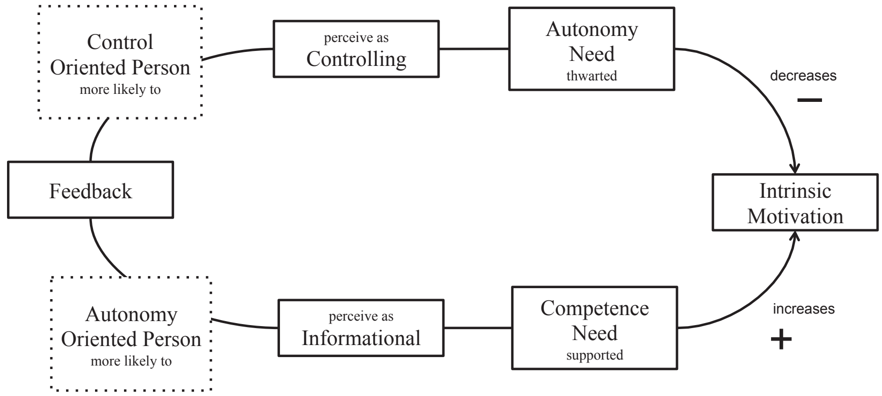

Fig. 1. Feedback may be perceived as controlling or informational, thereby affecting need satisfaction and intrinsic motivation in different ways. A person's causality orientation may further moderate how feedback affects need satisfaction and intrinsic motivation.
Figure adapted from Deterding, 2012.

degree each game element accounted for the increases in need satisfaction and intrinsic motivation. As this allows only for limited carry-over to gamification and since several psychological mechanisms may underly the same game element (Antin & Shaw, 2012), Deterding (2011) stressed the need for studying how *individual* game elements influence need satisfaction in various non-game contexts.

Points, levels and leaderboards, in particular, have become the poster children of gamification (Hamari et al., 2014; Seaborn & Fels, 2015), due to their apparent connection to digital games (Zagal, Mateas, Fernández-Vara, Hochhalter, & Lichti, 2005) and due to them being readily applicable to various non-game contexts. Zagal et al. (2005) categorize them as *goal metrics*, as all three are used to keep track of and provide feedback on player performance in games. According to Przybylski et al. (2010), they function as *positive*, *informational* performance feedback and thus form an important part of digital games' motivational appeal, since they afford opportunities for players to satisfy their need for competence.

Correspondingly, Francisco-Aparicio et al. (2013) list points, levels and leaderboards as a means to promote competence need satisfaction in gamified services – provided they are presented in a non-controlling manner and a voluntary setting, – but their framework still awaits empirical validation. Similarly, Jung, Schneider, and Valacich (2010) found that providing feedback (i.e., points) and clear goals (i.e., levels and leaderboards) in an idea generation task yielded significant performance gains, compared to the control group, and theorized that these results were due to the game elements satisfying people's intrinsic need for competence. Drawing upon causality orientation theory, Wang, Schneider, and Valacich (2012) further found that users performed best when provided with a challenging, but attainable performance target (i.e., levels) instead of a moderate one. But while these studies claim that this may be due to performance targets promoting competence need satisfaction, it is not clear whether this was actually the case, as they did not measure feelings of competence. In fact, their conclusions actually contradict those posited by causality orientation theory, as control oriented participants outperformed autonomy oriented participants. Finally, Wang et al. (2015) also examined the effects of informational versus controlling performance feedback on competence need satisfaction. Whilst participants reported feeling less competent in the challenging condition when provided with controlling feedback, no significant differences between informational and controlling feedback for moderately challenging performance targets were found.

However, it should be noted that all of the aforementioned studies took place in form of a group collaboration setting with up to 50 students present on site per session, and it could be argued that even the informational feedback employed by Wang et al. (2015) was worded in a manner that could have been perceived as controlling by some ("You have contributed X ideas. On average, people with the same goal have contributed Y ideas by this time."). Unfortunately, since neither Jung et al. (2010) nor Wang et al. (2012, 2015) actually measured intrinsic motivation, the effects on intrinsic motivation and how these in turn relate to performance remain unclear.

2.3. Aim of study

As showcased by the literature review above, and further supported by previous systematic reviews of current gamification research (Hamari et al., 2014; Seaborn & Fels, 2015), few studies attempted to investigate the effects of *individual* game design elements on the interplay between users' need satisfaction, intrinsic motivation and behavior. While it has been suggested that points, levels and leaderboards could enhance feelings of competence, and therefore boost intrinsic motivation and performance (Francisco-Aparicio et al., 2013; Jung et al., 2010; Przybylski et al., 2010) – provided they are encountered in a non-controlling, voluntary situation, – to date, no empirical research has been conducted on the subject.

The present study aims to expand upon existing research by investigating the effects of points, levels and leaderboards on participants' performance and motivation in an image annotation task. This non-game context was deemed suitable for three reasons. First, Von Ahn and Dabbish (2008) consider points, levels and leaderboards essential to increase enjoyment in human computation tasks (e.g., image annotation). Secondly, human computation tasks are often engaged in voluntarily, for fun and for pastime (Antin & Shaw, 2012). Thus, the threat of contextual factors acting as confounding influence (e.g., school being a potentially controlling setting (Hanus & Fox, 2015)) is minimized. Thirdly, user performance can readily be measured through the quantity and quality of generated tags.

Points, levels and leaderboards are commonly implemented in digital games to provide players with performance feedback (Przybylski et al., 2010; Zagal et al., 2005) and previous gamification research has demonstrated their effectiveness for promoting certain behaviors, since they form a clear connection between user actions and their performance (Cechanowicz, Gutwin, Brownell, & Goodfellow, 2013; Denny, 2013; Hamari, 2013; Wang et al., 2012). Moreover, in contrast to points, levels/leaderboards set clear performance targets for users to aspire to, which have been associated with further performance gains (Jung et al., 2010). Hence, we formulate the following hypotheses:

H1a. *Points, levels and leaderboards significantly increase the number of tags generated in the image annotation task, compared to the plain condition.*

H1b. *Levels and leaderboards significantly increase the number of tags generated in the image annotation task, compared to the points condition.*

As previous studies on the effects of feedback on performance quality yielded mixed results (Cerasoli et al., 2014; Jung et al., 2010), no hypotheses concerning tag quality were formed.

Given the assumption that points, levels and leaderboards may afford competence need satisfaction in non-game contexts (Francisco-Aparicio et al., 2013). The effect should be more pronounced for levels and leaderboards, since they provide more performance feedback than points only (Jung et al., 2010). Lastly, need satisfaction has been found to mediate the effects of game elements on intrinsic motivation (Peng et al., 2012), hence we posit that:

H2a. *Points, levels and leaderboards significantly increase competence need satisfaction, compared to the plain condition.*

H2b. *Levels and leaderboards significantly increase competence need satisfaction, compared to the points condition.*

H3a. *Points, levels and leaderboards significantly increase intrinsic motivation, compared to the plain condition.*

H3b. *Levels and leaderboards significantly increase intrinsic motivation, compared to the points condition.*

H4. *The effect of points, levels and leaderboards on intrinsic motivation predicted in H3a and H3b is mediated by competence need satisfaction.*

Finally, it has been suggested that causality orientation may moderate the effects of feedback on user performance (Wang et al., 2012) and that autonomy oriented individuals tend to perceive feedback as more informational than control oriented individuals (Deci & Ryan, 1985; Vansteenkiste et al., 2010), therefore experiencing more competence need satisfaction. Hence, we expect that:

H5. *Autonomy oriented study participants generate significantly more tags than control oriented participants, when in the points, level and leaderboard conditions.*

H6. *Autonomy oriented study participants report significantly more competence need satisfaction in the points, level and leaderboard conditions, compared to control oriented participants.*

H7. *Autonomy oriented study participants report significantly more intrinsic motivation in the points, level and leaderboard conditions, compared to control oriented participants.*

3. Method

To test our hypotheses, we conducted a 4×2 between-subject online experiment. The independent variable were three of the most common game elements: points vs. leaderboard vs. levels vs. plain condition without any game elements, as well as participants' causality orientation (autonomy vs. control oriented). The dependent variables were user performance (amount of tags and tag quality), intrinsic motivation and satisfaction of autonomy and competence needs.

3.1. Materials

3.1.1. Image tagging platform

The image annotation task consisted of 15 abstract paintings that were taken from Machajdik and Hanbury (2010)'s study on affective image classification. In order to control for social factors, a single player image tagging platform was designed. An image was presented for 5 s, before flipping over and revealing the input area, where participants could enter their tags. It has to be noted that we did not aim to create the most efficient or effective image annotation platform, but rather focused on developing a system that would allow us to systematically study various game design elements in a controlled manner. In a previous study employing the same platform (Mekler, Brühlmann, Opwis, & Tuch, 2013a), participants rated the image annotation task as rather intrinsically motivating (mean intrinsic motivation = 4.72 on a 7-point Likert scale).

In the *plain* condition, no game design elements were present and the right-hand side of the screen was left blank.

In the *points* condition, participants earned 100 points for each tag they entered. The current score was displayed in the upper right corner of the screen (see Fig. 2 and Fig. 3). Points had no further meaning, other than depicting how many tags a participant had generated. After completing all 15 images, participants were presented with their final score.

In the *leaderboard* condition, participants could compare their current score to four fictitious participants in a leaderboard on the right-hand side of the screen (see Fig. 2). Participants were deliberately left unaware of the fact that fictional participants occupied the leaderboard. This static leaderboard was implemented so that all participants had the same chance to rise in ranks, as the leaderboard posititioning may have had a confounding effect on motivation otherwise (Von Ahn & Dabbish, 2008). To reach the lowest position on the leaderboard, participants had to generate at least ten tags. For each subsequent position, participants had to generate a specific number of tags: 30 tags for 3rd position, 60 tags for 2nd position, and 100 tags for top rank. Put differently, the four competing players had a score of 1000, 3000, 6000, and 10,000 respectively. These step sizes were chosen to allow participants to reach a reasonably high position on the leaderboard, but it was expected to be still reasonably challenging for participants to come up with more than 100 tags.

In the *levels* condition, participants were presented with a vertical progress bar labeled with "next level" and the corresponding points necessary to reach the indicated level (see Fig. 3). Progression to the next level mirrored the leaderboard condition, albeit without the option for (seemingly) social comparison. Whenever participants reached a score of 1000, 3000, 6000 and finally 10,000, they would gain another level symbolized by an asterisk.

3.1.2. Measurements

Performance was measured by tracking the amount of tags generated per participant. In order to assess *tag quality*, the dataset was cleaned up using Open Refine (www.openrefine.org) to remove typos and spelling mistakes. All nonsensical tags and articles (e.g., the) were discarded from subsequent analyses. Two independent evaluators rated how well the remaining tags fit the images, following the instructions used in the study. They were asked to rate the images from 1 to 3 (1 = tag does not represent the emotional content of the image, 3 = tag reflects the emotional content of the image). The inter-rater reliability was found to be Kappa = .825. A Kappa value of .8 and higher is considered *almost perfect*. Based on the ratings of the two evaluators mean tag quality scores were calculated for each study participant.

Intrinsic motivation ($\alpha = .95$) and satisfaction of the need for *competence* ($\alpha = .86$) were assessed with the Intrinsic Motivation Inventory (IMI; Ryan et al. (1983)) All IMI items were rated on a 7-point Likert scale, ranging from 1 (not at all true) to 7 (very true). Since previous research found that game elements may impair

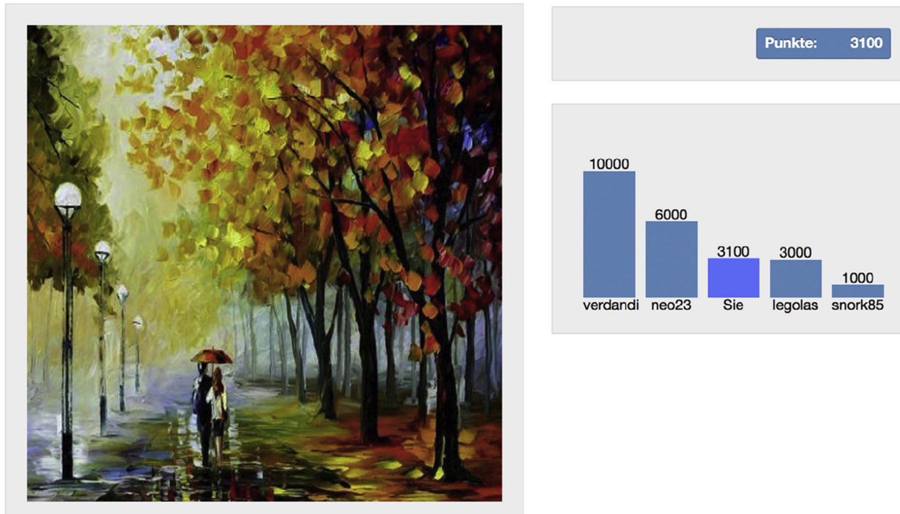

Fig. 2. Screenshot of the tagging platform with points and leaderboard.

intrinsic motivation (Hanus & Fox, 2015), we also included measures of *autonomy* need satisfaction ($\alpha = .68$), in order to find out whether these game elements are invariably perceived as controlling.

Lastly, *general causality orientation* was measured with the 12-vignette General Causality Orientations Scale (GCOS; Deci and Ryan (1985)), which has previously also been used by Wang et al. (2012). The complete GCOS questionnaire can be downloaded from http://www.selfdeterminationtheory.org/general-causality-orientations-scale/. Each vignette describes an incident and lists two ways of responding to it, whereupon participants state how likely it is that they would respond in such a way (7-point Likert scale, 1 = very unlikely, 7 = very likely). For instance:

You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

a) *Will I make more at this position?*
b) *I wonder if the new work will be interesting.*

Answer *a)* depicts the control-oriented response, whereas *b)* illustrates the autonomy-oriented response to the event. As previously described by Wang et al. (2012), each participant's causality orientation was identified by standardizing their total score on the two scales (autonomy vs. control orientation). Participants were then classified as autonomy-oriented when the *z* value of the autonomy scale was higher than the *z* value of the control scale and vice versa.

3.2. Participants

Participants were recruited by e-mail from the university's own database, where people may sign up, if they wish to participate in studies. A total of 273 participants (84 male, 178 female, 11 not specified; mean age 32.80 years (SD = 12.21), range 17–68 years) completed the online study. Five $50 gift coupons for an online consumer electronics retailer were raffled among all participants. The raffle was deliberately chosen as incentive, because it was assumed that it would not distort the experimental effects of game elements on intrinsic motivation, due to being a form of unexpected, task-noncontingent reward. In their meta-analysis, Deci et al. (1999) found that task-noncontingent rewards do not affect

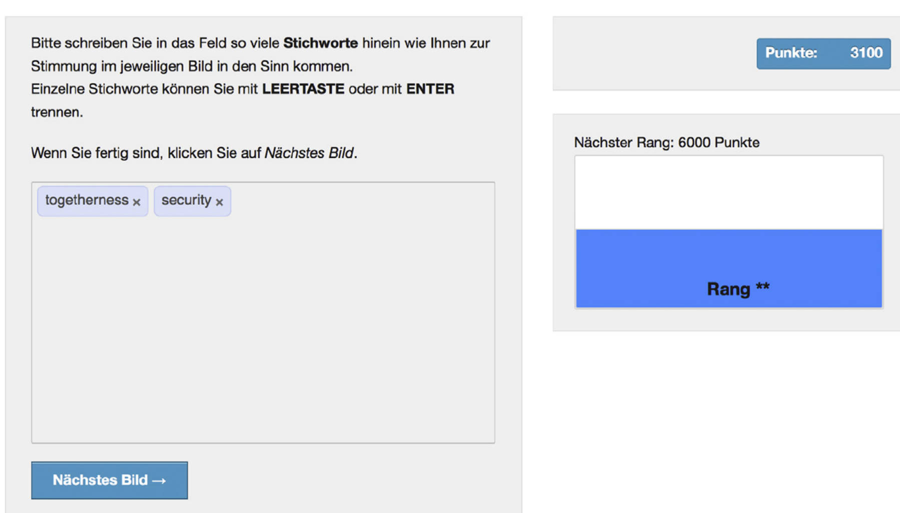

Fig. 3. Screenshot of the input area with points and levels.

intrinsic motivation, as these rewards do not require doing or completing the task and hence are not perceived as controlling. Concerning causality orientation, 130 participants were identified as autonomy oriented, whereas 143 participants were control oriented. Participants of both causality orientations were equally distributed among experimental conditions (see Table 1). Similarly, men and women were evenly distributed among the different experimental conditions and causality orientations.

3.3. Procedure

Upon clicking the invitation link to the study, participants were randomly assigned to one of the four experimental conditions. Following a brief demographic questionnaire, they were then introduced to the image annotation task and informed that their tags would help improve affective image categorization. In order to isolate the effect of game elements on intrinsic motivation, special care was taken to ensure that the study description did not contain any wording that might be perceived as controlling, such as "you must" and "you should" (Ryan et al., 1983). A test trial consisting of three images, which was the same for every condition with no game elements displayed, preceded the actual experiment.

Before starting the actual experiment, participants' attention was drawn towards the game elements, except for the control condition. Again, because the focus of this experiment was to examine the effects of points, levels and leaderboards and not the task context per se, we made sure that task instructions were worded as non-controlling as possible, in order to avoid detrimental effects on intrinsic motivation (Deci et al., 1999). In the points and level conditions, participants were informed that their score and level would help them estimate their contribution to the study. In the leaderboard condition, participants were told that they had the option to compare themselves to other participants.

Images were presented in random order. After completing the image annotation task, participants in the game element conditions were presented their final score, level or position on the leaderboard. Additionally, participants in the leaderboard condition had the option to enter a nickname on the leaderboard. Afterwards, all participants filled in the IMI (Ryan et al., 1983) and the GCOS (Deci & Ryan, 1985) and had the option to comment on the study. Overall, participants took on average around 22 min to complete the study.

4. Results

In order to investigate the effects of points, levels and leaderboard and goal causality orientation on user performance, intrinsic motivation and need satisfaction, analyses of variance (ANOVA) were calculated, unless otherwise noted. To assure homogeneity of variance, data were square-root transformed. For all statistical tests an alpha level of .05 was used. Before any further analysis was conducted, we controlled the data for age and gender effects, but did not find any significant differences. Overall, tag quantity was negatively correlated with tag quality (see Table 2), as well as slightly positively correlated with intrinsic motivation and competence need satisfaction. Intrinsic motivation was positively correlated with both autonomy and competence need satisfaction. An overview of our hypotheses can be found in Table 4.

4.1. Tag quantity

Firstly, while no significant game elements × causality orientation interaction was found, results yielded a significant main effect of game elements on the amount of tags generated. As illustrated in Fig. 4 and supporting H1a, participants in the game element conditions generated significantly more tags than participants in the control condition ($F(3, 265) = 10.09$, $p < .001$, $\eta_p^2 = .103$). Confirming H1b, planned contrasts showed that participants in the points condition significantly outperformed participants in the control condition ($t(141) = 2.613$, $p = .01$, $d = .44$), and were in turn significantly outperformed by participants in the leaderboard ($t(138) = 2.299$, $p = .023$, $d = .39$) and level conditions ($t(138) = 2.032$, $p = .044$, $d = .35$). Performance did not differ between the leaderboard and levels conditions. Additionally, a significant main effect of causality orientation on tag quantity was found ($F(1, 265) = 5.31$, $p = .022$, $\eta_p^2 = .02$). Autonomy oriented participants generated on average more tags than control oriented participants (see Table 1 for descriptive statistics), partially supporting H5.

4.2. Tag quality

No significant interaction or main effects for game elements and causality orientation on tag quality were found. As depicted in Fig. 5 participants in the game element conditions did not generate tags of significantly higher quality ($F(3, 265) = .727$, $p = .537$, $\eta_p^2 = .008$). Neither a significant main effect for causality orientation on tag quality ($F(1, 265) = 1.188$, $p = .277$, $\eta_p^2 = .004$) nor a significant interaction between conditions and causality orientation were observed ($F(3, 265) = .049$, $p = .986$, $\eta_p^2 = .001$). Mean tag quality did not differ significantly between the different game element conditions, nor did it depend on participants' motivational orientation. Overall, mean tag quality was rather low (see Table 1).

As reported earlier, tag quality was significantly negatively correlated with tag quantity. To see if game elements predicted the quality of tags when controlling for tag quantity, a multiple linear regression was conducted. Therefore, the four conditions were dummy-coded into three variables and included in the model. Tag quantity predicted tag quality significantly, but game elements and

Table 1
Descriptive statistics for all experimental conditions.

Condition	CO[b]	N	TagQuantity		TagQuality		Autonomy		Competence		IM[a]	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Plain	Autonomy	37	56.76	17.103	1.45	.252	5.42	1.08	3.81	1.16	5.07	1.41
	Control	31	51.29	21.704	1.43	.206	5.46	.886	3.97	1.14	4.55	1.53
Points	Autonomy	34	66.50	31.111	1.41	.207	5.39	1.27	3.87	1.34	4.83	1.82
	Control	41	62.61	24.461	1.37	.248	4.99	.906	3.77	.954	4.28	1.37
Leaderboard	Autonomy	29	81.97	32.109	1.45	.194	5.21	.891	4.07	1.19	4.94	1.63
	Control	36	70.53	28.360	1.40	.244	5.38	1.26	4.04	1.18	4.62	1.58
Levels	Autonomy	30	75.93	22.770	1.45	.225	5.40	.838	3.94	1.03	5.01	1.59
	Control	35	70.71	29.577	1.43	.206	5.34	.801	3.79	.890	4.70	1.30

[a] IM = Intrinsic Motivation.
[b] CO = Causality orientation.

Table 2
Pearson's Correlation for dependent variables over all conditions.

	Tag quality	Autonomy	Competence	Intrinsic Motivation
Tag Quantity	−.38**	.01	.18**	.14*
Tag Quality		−.02	−.10	−.05
Autonomy			.31**	.44**
Competence				.41**

* Significant at p < .05. ** Significant at p < .01.

the interaction of game elements × tag quantity did not (see Table 3).

4.3. Intrinsic motivation & need satisfaction

Against our expectations, neither a significant main effect of game elements (p = .702) nor a significant game elements × causality orientation interaction (p = .927) on intrinsic motivation emerged. In contrast to H3a and H3b, participants were motivated to similar degrees, regardless of whether they received feedback in form of points, leaderboard, levels, or none at all. Because of the lack of significant differences, it was not possible to assess competence need satisfaction as mediating the effects of the game elements on intrinsic motivation. Still, there was a significant main effect of causality orientation on intrinsic motivation ($F(7, 265) = 6.903$, $p = .009$, $\eta_p^2 = .03$). Autonomy oriented participants were more intrinsically motivated to engage in the image annotation task than control oriented participants, irrespective of the experimental condition. Lastly, no significant interaction or main effects on either autonomy (p = .273 - .585) or competence (p = .656 - .861) need satisfaction were found. H2a, H2b and H6 could thus not be confirmed.

5. Discussion

Our motivation for the present study was to systematically assess whether points, leaderboards and levels increase performance, competence need satisfaction and intrinsic motivation in an image annotation task, while taking participants' general causality orientation into account. In line with previous research on the potential of game elements to promote user behavior (e.g., Cechanowicz et al., 2013; Denny, 2013; Hamari, 2013; Von Ahn & Dabbish, 2008), points, and especially levels and the leaderboard prompted participants to generate significantly more tags, although tag quality remained unaffected. Against our expectations, the different conditions did not differ concerning intrinsic motivation, or competence need satisfaction, nor did participants' causality orientation influence the effects of game elements on performance, need satisfaction or intrinsic motivation. As postulated by Deci and Ryan (1985), autonomy oriented participants reported more intrinsic motivation than control oriented individuals, and produced also significantly more tags. In line with SDT, intrinsic motivation was positively correlated with autonomy and competence need satisfaction, and slightly positively correlated with tag quantity.

Table 3
Summary of multiple linear regression analysis for tag quality (N = 273) with $R^2 = 0.17$, $F(7,265) = 7.866$, $p < .001$. The four experimental conditions were dummy-coded into three dichotomous variables.

Variable	B	SE(B)	β	t	Sig. (p)
(Constant)	1.978	.135		14.637	<.001
Tag quantity	−.075	.02	−.540	−4.044	<.001
Condition points	−.164	.18	−.327	−.887	.376
Condition levels	−.045	.19	−.085	−.240	.810
Condition leaderboard	−.161	.20	−.307	−.824	.411
Tag quantity × condition points	.020	.02	.327	.841	.401
Tag quantity × condition levels	.014	.02	.240	.614	.540
Tag quantity × condition leaderboard	.029	.02	.475	1.176	.241

Note: Tag quantity was square-root transformed for analysis.

Table 4
Overview of hypotheses and results.

Hypothesis	Confirmed?
H1a: *Points, levels and leaderboards significantly increase the number of tags generated in the image annotation task, compared to the plain condition.*	Yes
H1b: *Levels and leaderboards significantly increase the number of tags generated in the image annotation task, compared to the points condition.*	Yes
H2: *Points, levels and leaderboards significantly increase competence need satisfaction, compared to the plain condition.*	No
H3: *Points, levels and leaderboards significantly increase intrinsic motivation, compared to the plain condition.*	No
H4: *The effect of points, levels and leaderboards on intrinsic motivation is mediated by competence need satisfaction.*	No
H5: *Autonomy oriented study participants generate significantly more tags than control oriented participants, when in the points, level and leaderboard conditions.*	Partially
H6: *Autonomy oriented study participants report significantly more competence need satisfaction in the points, level and leaderboard conditions, compared to control oriented participants.*	No
H7: *Autonomy oriented study participants report significantly more intrinsic motivation in the points, level and leaderboard conditions, compared to control oriented participants.*	Partially

5.1. Game elements and performance gains

Zagal et al. (2005) categorize points, levels and leaderboards as different types of goal metrics, as they usually represent and sometimes even define player success. By communicating how many tags have been generated, points likely also formed a clearer connection between participants' effort and their performance in the image annotation task (Jung et al., 2010; Von Ahn & Dabbish, 2008), which may have led to increased tag quantity compared to the plain condition. Seeing how Jung et al. (2010) found that users' performance increased when given a clear goal as opposed to users who were simply asked "to do their best", even if the latter were aware of their performance (i.e., points), it seems plausible that levels and leaderboard further reinforced tagging performance by setting explicit goals for participants to aspire to (Hamari, 2013; Jung et al., 2010; Von Ahn & Dabbish, 2008).

Next, while game elements did not affect tag quality, tag

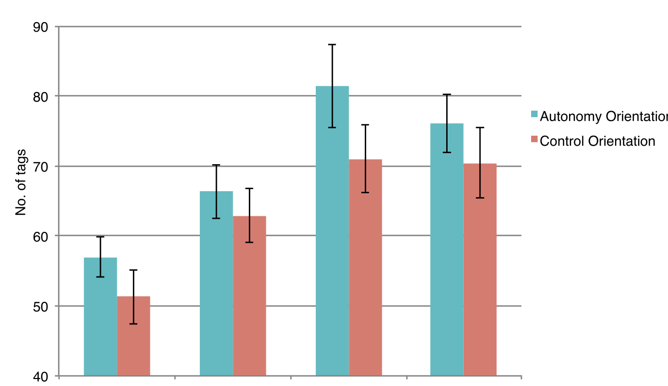

Fig. 4. Average number of user-generated tags per condition. Error bars are indicate standard error of the mean.

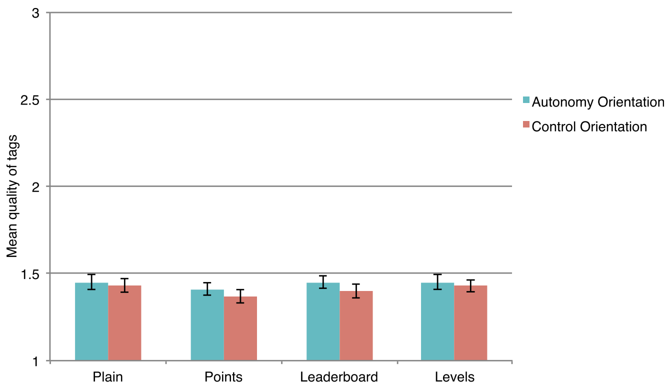

Fig. 5. Average quality rating of user-generated tags per condition. Error bars indicate standard error of the mean.

quantity was a significant negative predictor of tag quality in all experimental conditions. While, the present study does not allow for establishing a causal relationship between increased tag quantity and decreased quality, this may indicate that participants motivated to generate many tags, might have disregarded tag quality in favor of tag quantity. Notably, this also means that participants in the gamified conditions generated more tags than participants in the plain condition, but at a comparable quality. Overall, it could be argued that they performed *better* than participants who were not presented with any game elements, further hinting at the potential effectiveness of gamification to promote certain behaviors. However, these findings should only be applied with caution since game elements might only work short-term due to novelty effects (Hamari et al., 2014; Koivisto & Hamari, 2014).

Further, while tag quantity was slightly positively correlated with intrinsic motivation, participants' reported intrinsic motivation did not reflect their performance. Interestingly, a recent meta-analysis by Cerasoli et al. (2014) found that intrinsic motivation only moderately predicted performance quantity in a variety of domains, whereas extrinsic incentives were found to be strong positive predictors. While in the present study game elements did not *decrease* intrinsic motivation, the fact that they improved tag quantity without increasing intrinsic motivation or competence need satisfaction, suggests that in this particular study context, points, levels and leaderboards may have functioned as (effective) extrinsic incentives. Note that extrinsic incentives need not invariably be perceived as controlling and subsequently undermine intrinsic motivation (Cerasoli et al., 2014; Deci et al., 1999). And although game elements led to overall performance gains, recall that only intrinsic motivation is associated with increases in the extent and quality of effort that people put into a given task (Cerasoli et al., 2014), a fact that is possibly reflected in the lack of improvements in terms of tag quality.

5.2. *Lack of effects on competence need satisfaction and intrinsic motivation*

None of the game elements significantly affected intrinsic motivation or need satisfaction, nor was this further moderated by participants' causality orientation. Against our assumptions, game elements were apparently not perceived as particularly informational (Deci et al., 1999) and did not lead to more feelings of competence or intrinsic motivation compared to the plain condition. Contrary to previous claims on the need-supportive potential of game elements in non-game contexts (e.g., Francisco-Aparicio et al., 2013; Jung et al., 2010), this suggests that points, levels and leaderboards do not readily afford competence need satisfaction, even when encountered in a non-controlling setting. In the following, we discuss several reasons that might account for this finding:

Firstly, the game elements might not have offered enough meaningful, informational feedback to help participants judge their performance (Deci et al., 1999). Points informed participants about how many tags they generated, and the levels/leaderboard provided performance targets to aim for (Hamari, 2013; Jung et al., 2010; Von Ahn & Dabbish, 2008). Yet the present study featured no explicit indication of how many tags actually constituted a "good" performance and participants could therefore not judge whether they were competent at the image annotation task. Also, Wang et al. (2015) found that low performers experienced significantly less competence. Hence, it is possible that performance – or the mere impression that one is performing poorly, – further moderates the effects of game elements on competence need satisfaction.

Secondly, the motivational appeal of many games lies in their ability to provide players with challenges to master, hence allowing them to experience feelings of competence (Deterding, 2015; Przybylski et al., 2010). The image annotation task, on the other hand, could hardly be considered challenging, as participants were free to create as many tags as they wanted. Even in the plain condition participants generated on average more than 50 tags, which corresponds to reaching the first two performance goals set in the level and leaderboard conditions. According to Wang et al. (2015), moderate performance targets do not motivate people to put much effort into achieving that target goal. In this case, informational feedback does not further encourage people to achieve more challenging targets and is thus less likely to satisfy their need for competence. In short, it seems plausible that points, levels and leaderboards only afford competence need satisfaction for tasks that are actually experienced as challenging.

Thirdly, even in the case of points, levels or the leaderboard providing sufficiently informational feedback, their visual presentation was very understated and lacked "juiciness". In contrast, many digital games provide excessive positive – juicy – feedback in the form of sounds, visuals and animations (Przybylski et al., 2010). According to Juul (2012), *juiciness does not simply communicate information […] but also gives the player an immediate, pleasurable experience […] enhancing the experience of feeling competent, or clever, when playing a game* (pp. 45). While the topic still requires empirical work, it seems plausible that a visually and aurally more impressive presentation of points, levels and leaderboards might have amplified their potential to afford competence need satisfaction and subsequently increase intrinsic motivation.

Fourthly, the present study's findings may not as much be due to the game elements themselves, but rather due to the nature of the task. Participants were only scored for tag quantity, and did not receive any feedback on whether a tag was fitting an image or not. If the image annotation platform would have also rewarded tag quality, participants would not only have received more feedback, but maximizing tag quality could have posed another challenge for people to master. The human computation games by Von Ahn and Dabbish (2008), for example, turn maximizing tag quality into a game mechanic by pairing two players together and having them guess how the *other* player would describe a given image, while avoiding a list of "taboo" tags. While points, levels and leaderboards may further add to the task's enjoyment (Von Ahn & Dabbish, 2008), players may actually mostly enjoy engaging in the guess-work involved, which provides both challenge and team-play thereby affording opportunities for satisfying the needs for competence and relatedness. Points, levels and leaderboards on their own might not be as meaningful or informational without this additional "game mechanic".

Similarly, achievement goal theory differentiates between two types of goals, namely, mastery and performance goals (Rawsthorne & Elliot, 1999). While mastery goals refer to skill development and task mastery, performance goals focus on the demonstration of competence relative to normative standards. A meta-analysis on the effects of performance and mastery goals on intrinsic motivation found that informational feedback only increased intrinsic motivation for mastery goals, whereas performance goals were left unaffected (Rawsthorne & Elliot, 1999). Indeed, the image annotation task used in the present study bears more resemblance to a performance than a mastery goal, as participants simply had to “demonstrate” their competence in tagging paintings, relative to the norm set by levels or the leaderboard.

Finally, while the study was engaged in voluntarily, participants were encouraged to solve human computation “tasks” rather than “games”. Lieberoth (2015) however, could show that explicitly labeling an activity containing game design elements as a “game” may increase people's intrinsic motivation, compared to a control task featuring no such framing or game elements. Indeed, Huotari and Hamari (2012) state that the goal of well-thought out gamification is to provide gameful experiences, and Deterding (2014, 2015) stressed that rather than (re-)structuring objects to look more like games (e.g., superficially applying points, levels and leaderboards to an image annotation task), a non-game context should instead be framed in such a way that people experience it as “game-like”. Participants in the present study likely did not experience the image annotation task as gameful/game-like. Perhaps, intrinsic motivation might have increased, if framing of the image annotation task as a game or game-like activity were facilitated, — even if the task itself remained unchanged. However, it is important to note that this may not hold true for all people under all circumstances, as previous research found that people may be suspicious of encountering games in unexpected settings (e.g., Littleton et al., 1999).

5.3. Limitations and further research

Firstly, it has to be noted that the nature of the image annotation task employed may have influenced the outcome of the studies. In contrast to other image annotation tasks (e.g., Von Ahn & Dabbish, 2008), participants were asked to describe the emotional content, and not the actual content of the paintings, which arguably may have also been shaped by participants' subjective experience of the paintings. Seeing how some of the paintings were more abstract, some participants may have experienced difficulties in coming up with suitable tags. The rather free-form nature of the image annotation task may have made it difficult for participants to know when they performed well, because there was no apparent correct way on how to describe the emotional content of the pictures. In order to further understand the psychological mechanisms underlying gamification and its effects on performance outcomes, it would be necessary to also study tasks with relatively clearly defined quality metrics, which make it easier to assess and provide feedback on performance quality.

Secondly, participants interacted only for a short time with the image annotation platform. However, Hamari et al. (2014) and Koivisto and Hamari (2014) found indications that gamification may only promote user engagement for a short time. For instance, the findings of Hanus and Fox (2015) have shown the importance of studying the long-term effects of gamification, in order to better assess whether and under what circumstances game design elements shape user behavior in the long run. However, our findings are still relevant for non-game contexts in which long-term user engagement and retention may not necessarily be the primary goal, such as increasing participation and performance in crowdsourcing tasks.

Thirdly, only participants self-reported intrinsic motivation was measured. While self-reported and free choice measures of intrinsic motivation yielded comparable results in previous studies (Deci et al., 1999), employing a behavioral free choice measure of intrinsic motivation by letting participants choose whether they want to continue engaging with a given task, may yield additional insights. For instance, Cechanowicz et al. (2013) found that, compared to the plain condition, gamification of a market research survey motivated participants to continue engaging with the survey, even after conclusion of the “mandatory” part of the experiment. Future studies should thus consider combining self-reported and behavioral measures of intrinsic motivation for additional methodological robustness. Also, because participants from the university's database usually engage voluntarily in studies, it is possible that they already had a minimum level of intrinsic motivation from the get-go, which might have affected the results of the present study. More research is required to investigate how users initial motivation to engage in a gamified application affects their subsequent motivation.

Fourthly, while our study covered a wide age spectrum, our sample contained relatively few male participants (84 men vs 178 women). Although we did not find any age or gender differences, demographic factors have been found to affect people's reaction to gamification, especially in the long run (Koivisto & Hamari, 2014).

Finally, the results of the present study are specific to the image annotation context. Hence, our findings should only cautiously be applied to other gamified applications. It still has to be seen whether these results can be replicated for other non-game contexts. Moreover, further research into individual factors, such as people's general causality orientation or varying degrees of competitiveness among users (e.g., Song, Kim, Tenzek, & Lee, 2013), is required, since they may potentially moderate the effects of gamification on user behavior and motivation (Hamari, 2013; Hamari et al., 2014). Similarly, more research is required to further investigate the role of contextual, social and situational aspects, as they at least partially determine the motivational affordance of game design elements (Deterding, 2011, 2014). Lastly, game elements may also support other needs besides competence, such as autonomy and relatedness (Francisco-Aparicio et al., 2013; Pe-Than et al., 2014; Peng et al., 2012). It would thus prove insightful to empirically test whether specific game elements afford the satisfaction of individual needs in a variety of non-game contexts.

6. Conclusion

The present study is one of the first to cover several aspects still underexplored in current gamification research (Hamari et al., 2014; Seaborn & Fels, 2015). Firstly, we attempted to empirically evaluate the impact of gamification on intrinsic motivation and need satisfaction, two of the most frequently appealed to, yet seldom empirically studied constructs in gamification literature (Seaborn & Fels, 2015). We did so by employing a validated, theory-based instrument, the Intrinsic Motivation Inventory, in addition to measures of two different behavioral outcomes, tag quantity and quality. As of now, our study is also one of the first to isolate the effects of individual game elements in a comparative experiment. In the context of the present study this meant that while points, levels and leaderboards increased tag quantity, the lack of effects on intrinsic motivation, need satisfaction or tag quality suggest that they may have actually functioned as extrinsic incentives (Cerasoli et al., 2014). However, seeing how they did not impair intrinsic motivation in contrast to previous findings (Hanus & Fox, 2015), points, levels and leaderbords seem to be an effective means for promoting performance quantity. More empirical research is necessary on why particular game elements act as extrinsic or intrinsic motivators in a given context, and how this in turn shapes user enjoyment and behavior, but we believe our study is a valuable first step in this direction and may serve as a blueprint for future studies.

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