Human–Computer Interaction

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hhci20

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**To cite this article:** Kyoungwon Seo , Sidney Fels , Mujin Kang , Changho Jung & Hokyoung Ryu (2020): Goldilocks conditions for workplace gamification: how narrative persuasion helps manufacturing workers create self-directed behaviors, Human–Computer Interaction, DOI: 10.1080/07370024.2020.1744145

**To link to this article:** https://doi.org/10.1080/07370024.2020.1744145



Published online: 05 Oct 2020.

HUMAN–COMPUTER INTERACTION
https://doi.org/10.1080/07370024.2020.1744145



# Goldilocks conditions for workplace gamification: how narrative persuasion helps manufacturing workers create self-directed behaviors

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**KEYWORDS** Gamification; visualization; narrative persuasion; flow experience; moral goals; affective utility; self-directed behavior; extrinsic rewards; hedonic adaptation
**ARTICLE HISTORY** Received 2 October 2019; Revised 11 March 2020; Accepted 15 March 2020

## 1. Introduction

> Boredom is … a vital problem for the moralist, since half the sins of mankind are caused by the fear of it. (Bertrand Russell, "The Conquest of Happiness," 1930).
>
> Humans are essentially storytellers. (Walter Fisher, "Human Communication as Narration: Toward a Philosophy of Reason, Value, and Action," 1989).

Research on user experiences has garnered much attention, establishing that "*flow*" is an optimal state where an individual is fully engaged and immersed in what they are cognitively and/or physically doing (Csíkszentmihályi & Csíkszentmihályi, 1992). This is no exception for manufacturing workers' emotions and cognitions, where optimal flow makes them experience physical and psychological well-being (Bloch, 2002; Bryce & Haworth, 2002). This state is also thought to promote higher work performance (Eisenberger et al., 2005), in which manufacturing workers operate at their full capacity and feel like they control their actions (Nakamura & Csíkszentmihályi, 2014). However, keeping them in the flow state is difficult, and thus the crux of flow experience design is to present just-manageable challenges (i.e., neither too easy nor too hard compared to their skill levels; Csíkszentmihályi, 1990). Otherwise, the workers may become bored (Csíkszentmihályi, 1990), which Bertrand Russell noted as one of the moralist's sins.

Indeed, in the automotive assembly line, where both optimal operations management and effective human–machine interaction are intended (Michalos et al., 2010), micro-management designs its unit operations by repetitive activities using the "*optimization*" philosophy. Paradoxically, this makes the manufacturing workers become easily bored (Mann, 2007). A large number of studies contend that work-related boredom creates other negative outcomes, such as low effort and poor performance, job dissatisfaction, absenteeism, high turnover, and moral hazards (e.g., Van Hooff & Van Hooft, 2014), which are related to human resource issues (Csíkszentmihályi, 1996; Fisher, 1993; Mann, 2007; Nakamura & Csíkszentmihályi, 2014).

"Gamification," i.e., applying game design elements for non-game contexts to engage users and to address real-world problems, has long been thought as a potential solution to enhance user experience, increase learning, change behavior, alleviate boredom and so on (Deterding et al., 2011; Hamari et al., 2014). Early gamification studies primarily focused on certain contexts, such as healthcare (refer to Edwards et al., 2016), education (refer to Nah et al., 2014), and business (refer to Burke, 2016; Seo et al., 2018). However, gamification in the manufacturing workplace has garnered little attention. This is partly due to the Taylorism convention in factories (DeWinter et al., 2014) and mainly due to a lack of tenable proofs of gamification effects at the manufacturing site, which is central to our study.

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The paradox of the optimal flow experience (Engeser & Baumann, 2016) also makes gamification harder in reality. For instance, in Disneyland gamification, the real-time productivity of each employee was displayed on the leaderboards, and it became clear that this unexpectedly enforced them to compete with each other and destroyed their collaborative culture (Lopez, 2011). Omnicare, an American pharmacy and healthcare company, introduced a gamified customer relations system to reduce response time, but its employees felt very uncomfortable with covert monitoring of their performance, resulting in a higher turnover rate and accordingly lower customer satisfaction (Liu et al., 2017). Callois (2001) thus claimed gamified systems are too hot when they provide only a hedonic experience, or too cold when they exploit only productive behaviors, which suggests an appropriate gamification strategy needs to set the right balance for both the employers and employees. The focus of this study is to figure out the "Goldilocks" gamification conditions, in particular, for the manufacturing workers at Hyundai Motor Company (HMC).

Recent research sheds light on workplace gamification (Funk et al., 2015; Korn, 2012; Warmelink et al., 2018a), but manufacturing workers are still reluctant to fully adopt the gamified system (Kim, 2018). The reason behind this is previous workplace gamification forced workers to focus exclusively on productivity performance (e.g., accuracy, task completion time) through reward systems (e.g., points, ranks). These pseudo-performance measurements eventually provoke the "give-and-take" feeling in the worker's mindset of what they had acted on (Kohn, 1999; Kramlinger & Huberty, 1990; Nicholson, 2015), so organizational moral problems would follow accordingly (Cable et al., 2013). Janakiraman et al. (1992) maintained, in management studies, that such performance-focused evaluation cannot fully assess the worker's effort level, in the sense that as the workers shift their efforts from a subset of tasks which they consider useful and constructive to a subset that they think "gives" or "returns" the highest benefits of being useful and constructive (i.e., subjectively more valuable; Baker, 1992; Prendergast, 1999). A well-known consequence of this approach is for the worker to be often hooked into off-the-job opportunities when not evaluated or observed (e.g., the Hawthorne effect; Stand, 2000).

In this sense, many gamification studies (Deterding, 2012; Mekler et al., 2017) claimed that intrinsic motivators should be included. However, the conventional gamification approach has simply considered this by providing more enjoyable and exciting gaming experiences, believing that the game-play itself might serve for promoting one's intrinsic motivation to play. Unfortunately, the hedonic adaptation effect (i.e., the tendency for humans to quickly return to a relatively habitual level of happiness despite positive or negative experiences; Diener et al., 2009) thwarts this game-play motivation from lasting longer. Some intrinsic motivators often used in conventional gamification, such as recognition from others or social ranks, also failed to function in the workplace as mentioned in the examples above (i.e., Disneyland, Omnicare).

Indeed, the pre-conditions for intrinsic motivation were already depicted by Bandura's social cognitive theory (1991), which showed that human behaviors are naturally motivated by three subfunctions: i) self-monitoring of one's behavior (i.e., appropriate feedback leads to correct behavior); ii) judgment of one's behavior in relation to personal standards and organizational culture (i.e., personal and organizational morals dictate behavior); and iii) affective reaction (i.e., emotional arousal evokes behavior). More important, he differentiated the three pre-conditions, concluding that the morals would be "stable," the performance factors are "variable," and the affects are "intense." These three pre-conditions separately or at times together serve for human's intrinsic motivators, whereby what is most lacking in previous workplace gamification seems to be a relatively perseverant "*moralist*" approach (Teper et al., 2015). How the three pre-conditions for intrinsic motivation, particularly the moralist approach, would work differently for the operation of one's self-regulative system is the main research question of workplace gamification, which was empirically tested via the HMC factory workers.

However, the moralist pre-condition for workplace gamification is not a state of measurement nor a form of personal performance to achieve. Instead, it is a transportation process (i.e., a feeling of entering a world evoked by the narrative) of developing and expressing personal interests that match

with the organizational core values (or culture) by aligning their work activities to satisfy both the individual's and firm's needs. Nicholson (2015) demonstrated that good narrative(s) of game-play could help workers to easily understand why they played the game and created productive social behaviors at the workplace. In particular, he claimed that the emotional storyline of the game-play would make one more empathetic to the game character's attitudes, beliefs, and preferences (see Figure 1), which could effectively prompt operation of the self-regulative system. The moralist pre-condition, in this sense, resembles flow (Csíkszentmihályi, 1990) as well, because the individuals who are fully transported into the narrative are concentrating on the storyline, and they often lose track of time or fail to notice events occurring around them because of their focused involvement in the world of the narrative (refer to Green et al., 2004).

To the best of our knowledge, narrative workplace gamification lacks solid empirical evidence, and how it can generate positive impacts on manufacturing worker's productivity, emotions, and self-directed behaviors is still open to debate (Galetta, 2013; Guegan et al., 2016). The main focus of this study is thus to compare narrative gamification against other gamifications, in particular, performance-focused gamification. In so doing, in the HMC assembly line, a bolt-tightening (BT) operation, which is the most repetitive and boring, was chosen for the empirical study. With the help of HMC, a similar work environment was set up at a laboratory at Hanyang University. During this study, the same electric fastening tool being used at the HMC factory was applied to measure real-time physical data, which were then converted into a "pseudo-performance" BT gamified system. Three different gamified systems were then considered (i.e., No Gamification vs. Conventional (or non-narrative) Gamification vs. Narrative Gamification). The worker's productivity, emotion, and self-directed behaviors were collected, which are expected to reveal if the moralist approach plays an important part in the exercise of gamification by its strong impacts on the worker's thoughts, affects, motivations, and actions. Our main hypothesis is that successful experiences of goal accomplishment with the moral concept arising from narrative gamification would lead the HMC workers to feel positive emotions, intrinsically motivating them to reengage with the next challenging and creative activity (Locke & Latham, 2002). Of course, this positive feedback loop of "*action – feedback – motivation – reengage*" (Bandura, 1991; Kumar, 2013) might be a way forward as a new factory operations management technique (which considers the worker's behavior and experience; Bendoly et al., 2006; Easton & Rosenzweig, 2012; Warmelink et al., 2018b).

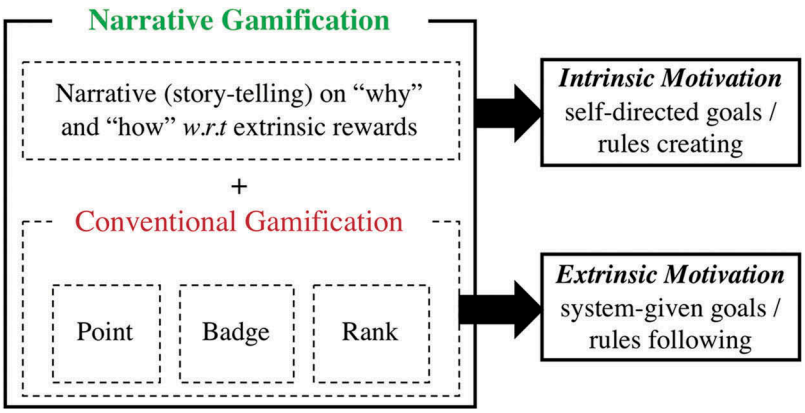


**Figure 1.** A conceptual hypothesis of workplace gamification.

## 2. The goldilocks conditions for workplace gamification

Games can be described as "organized play." According to Prensky (2001), all games possess six key structural elements: rules, goals and objectives, outcomes and feedback, conflict (or competition, challenge), interaction, and narrative. Gee (2007a) thus claimed that games are the best instantiation of "situated learning," by which the context of game-play would be an important instructional source to provide a set of psychological boundaries to explore, think, and physically try things out (Dale, 2014; Kapp, 2012). Because of the nature of game-play, gamification has been applied in many practical domains (e.g., healthcare, education, business), but it is not welcomed in manufacturing factory sites. Roy's (1959) seminal study of machine operators, which examined how workers dealt with the "beast of boredom," was the first study of its kind which documented the potential of game-play to make tedious factory work more engaging by creating gameful experiences. However, providing a sort of enjoyable game-play in a manufacturing context has not been a huge success because its ecological validity has yet to be demonstrated (Mollick & Werbach, 2015), which is central to this study.

It is seen that humans' most enjoyable fun comes from a process of achieving various goals (Gee, 2007a); however, when this process repeats itself and is negatively controlled by the same system feedback, it can become no fun at all. To re-initiate this fun, new activities, tasks, and challenges must be given, but early gamification had leveraged this with people's desires for mastery, competition, achievement, or framing of a situation as game-play (Oprescu et al., 2014). An important note about the positive feedback loop of the "*action – feedback – motivation – re engage*" cycle is thus needed here (Bandura, 1991; Kumar, 2013). Mastering a particular activity asks one to apply significant physical or psychological effort and to repeat the same activity. Hence, mastery paradoxically means short-lived fun, so a key is how to reengage with the tasks that they have already mastered. Gee (2007b) thus claimed that the "deep learning" process is needed to involve them for the reengaging step. Schön's "reflection-in-action" (Schön, 1984) also advocates that mastery means not simply "performance superiority," but also "everyday creativity" that makes one reengage in the habitual activity but in newly–formatted ways (Schuster, 2006). Note that the manufacturing worker's innovation cases in the "Toyota Production System" are prominent examples of such everyday creativity (Alves et al., 2012). That is, mastery means not to memorize the job protocols and standards, but to consciously transport their acquired knowledge for further innovation. This creative level of work practices is then highly associated with human's most enjoyable fun. In response to the criticisms of early gamification, the central tenet of workplace gamification is not for performance enhancement, but to explore what conditions would have certain effects on this positive transportation process through doing and creating, observing consequences, and reflecting on them (Gee, 2007b).

### 2.1. *Making work fun, or making fun of work? Performance monitoring is a myopic gamification*

Traditional factories have sought performance enhancement through optimized human–machine interfacing. This consequently sacrificed the worker's personal values. For instance, an HMC manufacturing worker completes around 300 assembling operations a day and takes around 60 sec per operation. Though this workload does not put cognitive, physical, and temporal stress on the HMC workers, many felt work-related boredom. A more flexible manufacturing operations management technique was then introduced to resolve this boredom. For example, the workers needed to complete different numbers and types of BT operations on the optimized daily/weekly/monthly production schedule. This made the manufacturing workers more carefully and consciously think about the BT job, and partly decreased work-related boredom. However, to some extent, serious quality issues were still present.

Workplace gamification was then introduced by the first author of this article and his colleagues (J. Lee et al., 2016; H. Lee et al., 2016; Roh et al., 2016). Our first consideration was based on the

studies of Korn et al. (2012). For instance, they (Korn et al., 2012) designed the classic game "Tetris" for an assembling task, visualizing the manufacturing process for elderly and impaired workers. Funk et al. (2015) also demonstrated that a gamified system increased the working speed but decreased accuracy (i.e., speed–accuracy trade-off). Korn et al. (2015) furthered his previous work by analyzing which type of visualization (i.e., complex Tetris-type vs. simple bar-type) would be more appropriate, finding that most of the workers preferred the simple bar-type because of its ease of use and the direct perceptual nature. Three additional requirements to adopt Korn et al.'s approach for the HMC contexts were then identified: i) the gaming task and the real-work task are to be cognitively aligned, and the performance on the gaming task needs to enhance the real-work experience (Liu et al., 2017); ii) the extrinsic rewards (e.g., gaming scores) should not attract our HMC worker to shift their attentions from the tasks that they consider useful and constructive to what they think "gives" or "returns" the highest scores of being useful and constructive (Baker, 1992; Prendergast, 1999); and iii) our mastery-level HMC workers need to see the gamified system as a guide to improve their habitual and routine work practices (Mesquida et al., 2016).

The first requirement reflects the central criticism of early gamification. Dale (2014), in his seminal "Making work fun or making fun of work" article, claimed that companies need to design gamified systems that would enhance work cultures rather than exploit their workers. In a similar vein, Wood and De Menezes (1998, 2011) claimed that human resource management by gamification should focus more on how to promote missing human values in the workplace such as "self-esteem" (self-confidence, self-worth, or respect in one's own worthiness or capabilities from others; Judge & Bono, 2001), neither letting the employees make fun of work nor regarding the real work as a meager and unimportant game task. For this, as shown in Figure 2, we developed "gameful real-work experience" (Ferreira et al., 2017; Oprescu et al., 2014), which utilizes engaging and enjoyable "pseudo-performance goals" in real-work contexts, by which reaching the pseudo-performance goals in the game would naturally transport into the real-work experiences. More details of this gamification setting are discussed in Section 3.3.

The second requirement corresponds to an assertion from motivational studies, also briefly discussed in the Introduction section, that discusses how the extrinsic rewards are not sufficient to cognitively and emotionally motivate the HMC manufacturing workers. Many gamifications have employed a variable component that changes along with the worker's (gaming) effort level, though the precise activation mechanism of its motivational direction is dependent on the prevailing situational characteristics (e.g., self-interests, subjective utility, organizational circumstances; Qiao et al., 2017). Easley and Ghosh (2016) thus argued that any gamification should contribute to form worker's self-interested behaviors rather than performance-focused behaviors, thereby avoiding the "motivation crowding effect" (i.e., extrinsic incentives driving out intrinsic motivation; Deci & Ryan, 2010). The empirical evidence (Mekler et al., 2017) also suggested that the extrinsic rewards (e.g.,


**Figure 2.** Electric fastening tool system (left) that, when it pushed on the panel, automatically fastens the bolt and collects real-time torque values (right).

score or points) would eventually cause the worker only to see their game-like task as another performance measure, hampering formation of their own self-directed goals from being turned into intrinsic motivation. In this regard, Hanus and Fox (2015) demonstrated that self-interest in the performance-focused gamification quickly diminished over time. Additionally, in the management science literature, Cable et al. (2013) argued that the crux of employee management is not to find the best capable persons, but to reinvent a harmonizing culture between the individual worker and the organization, so that the individual worker's attitudes, values, and beliefs can be in line with the collective values and culture of an organization. We also agreed with this intrinsic motivational direction for workplace gamification, in the sense that as the HMC manufacturing workers had only seen the extrinsic motivation on their performance, they solely developed marginal productive behaviors by simply relating the extrinsic rewards to be earned with achieving extra incentives rather than creating their own self-interested goals (i.e., self-determination theory; Deci & Ryan, 2012). The intrinsic motivator used in this study is further discussed in Section 2.2.

The third requirement (that mastery-level HMC workers need to see the gamified system as a guide to improve their habitual and routine work practices) is based on the moralist approach, as briefly mentioned in the Introduction, and describes what gamification should achieve in an organizational learning context. In reality, the HMC manufacturing workers do not need any further skill learning because many have more than 20 years of job experience (around 35,000 persons are employed in Korea in 2018, and 50% of them had more than 20 years of job experience). Therefore, the primary interest of gamification at HMC was not to teach new skills, but to tackle their habitual and routine conduct and thinking (e.g., Kim & Ryu, 2014). For instance, Toyota manufacturing workers continuously develop innovative work practices (Alves et al., 2012). Here, we note that Bandura (1991) argued, in developing a moral self, individuals adopt standards of right and wrong that serve as guides and restraints for conduct. In this self-regulatory process, the workers can monitor their behaviors and the conditions under which they occur, judge them in relation to the organization's moral standards, and regulate their actions by the consequences they apply to themselves. However, especially in the absence of a strong internal moral standard, they simply adopt a more pragmatic style (e.g., they are often tempted by off-the-job opportunities, such as watching YouTube on a mobile phone at the workstation; Bandura, 1986), which makes it possible for them to fit their behaviors to the situation they are in. In effect, while performing repetitive jobs, it is therefore very common for the HMC manufacturing worker's individual moral standards to come into conflict with organizational moral standards. It was observed prior to this study that in several informal interviews with the HMC manufacturing workers, they would like to do things that provide them more satisfaction and sense of "self-worth"; however, both the self-evaluative reactions and organizational expectation are opposing influences on their behaviors. Our gamification design needs to trigger this strong internal moral standard to change their habitual conduct, so that their actions in our gameful real-work experiences can be based on whether they believe the action is moral and whether the reward for violating their morals is significant enough (Santrock, 2017). The method to do this in the HMC gamification is detailed in the next section.

### 2.2. *Narrative persuasion of organizational values can promote moral intuitive reactions*

Moral psychologists Haidt (2007) and Greene (2013) argue that the nature and authority of moral values are "fast, automatic, intuitive button-pushing" responses of the affective system, and moral goals quickly provoke one's own self-monitoring process. This means that moral values of a society dictate an individual's attitudes and behaviors, which is also applicable to the workplace context (Moore, 2015; Samnani et al., 2014). Apart from moral justice standards as a human being, in the workplace they involve the judgment of personal behaviors in business interactions and individual interactions in the organizational setting, in relation to the organizational expectations of personal behaviors (Hosmer & Kiewitz, 2005) and the notion of fair play (or moral hazard; Holmström, 1979). Therefore, Lewis (1985) concluded that moral values in the workplace refer to personal

perceptions of rules, criteria, or principles for guiding proper behaviors under every kind of organizational setting.

All of the aforementioned studies agree that the moral values in the organization can be the directive principles guiding individual behavior whenever an individual confronts situations, such as conflicts of interest (personal interest vs. collective interest such as attraction to off-the-job opportunities). Such immoral behaviors can harm individual effectiveness and even compromise the reputation and effectiveness of the organization (Cohen et al., 2014). This indicates the acceptable and moral way of conducting business activities would prevent individuals from making questionable decisions and be positively associated with organizational loyalty (Cohen et al., 2014). Studies also showed that organizational loyalty is highly correlated with the individual's job performance and enjoyment (Mathieu & Zajac, 1990; Turkyilmaz et al., 2011) in the end.

Yet, this is a challenge, and the key is how to craft employees' moral values in relation to organizational core values. According to reasoned action theory (Montano & Kasprzyk, 2015), subjective norms are one of the key determinants of behavioral intention and performance of one's behavior. Ajzen (1991) defined subjective norms as the "perceived pressure to perform or not perform the behavior," and certain beliefs or normative beliefs as to whether or not certain behaviors are acceptable shape one's behavior and intention to perform. This implies that certain or normative beliefs should be taught or newly suggested to provide new perception of organizational core moral values. The central tenets of this study are that the workplace gamification is devoted to this design parameter, and in so doing, such narrative persuasion would serve this purpose.

Scholars in a variety of disciplines have investigated the nature of narrative and our relationship with it (Green et al., 2003). For instance, a wide body of gaming research demonstrated that narrative has significant influences on the players (Jenkins, 2004; Prensky, 2001), whereby they naturally adopt the strategies and rules inserted in the game. Many also agreed with the following contentions: the narrative quickly touches our emotions (Murphy et al., 2013), strongly impacts what we believe (Slater & Rouner, 2002), effectively teaches new behaviors (Hinyard & Kreuter, 2007), and naturally shares our cultural identity (Hammack, 2008). In effect, there is little doubt in the minds of many that narratives can be very persuasive, and their effects are fast, intuitive, and immersive, which means that Bandura's three pre-conditions for intrinsic motivation (1991) are to a greater extent met (i.e., moral standards, performance factors, affective self-reactions).

Another point here is what instructional content or organizational messages should be transported via gamification (Kapp, 2016), although whether one medium or another is better for transportation is open to debate. It is generally believed that games, films, and commercial ads, for example, provide rich visual imagery to viewers, encouraging a greater transportation effect (Burrows & Blanton, 2016; Gerrig & Prentice, 1996). The transported users showed more story-consistent beliefs and opinions than their less transported counterparts (Green & Brock, 2000, 2002), where attitude change would be a natural reservation. Our emphasis in this study is thus on the experiential aspect of attitude changes through narrative gamification.

For this, as shown in Figure 3, we developed a narrative flow that the HMC manufacturing workers are assumed to understand causally and chronically related events played out by themselves in the game (J. Lee et al., 2016; H. Lee et al., 2016; Roh et al., 2016), by which they need to form appropriate moral goals (i.e., "Why should I do this?"). The moral narrative structure we employed in this study is the concept of "global quality control." HMC has critical sales markets worldwide, including in Europe, Russia, China, India, Korea, and USA. Then, its primary narrative was having the HMC manufacturing workers understand that what they are doing in the game can actually reduce global quality problems.

Indeed, the narrative persuasion might occur via any influence on beliefs, attitudes, or actions brought about by the narrative message through psychological processes associated with narrative comprehension or engagement. Non-narrative gamifications (i.e., conventional gamification in our empirical setting) would not trigger this process, and they may be less likely to engage emotions or create vivid mental imagery. In effect, an appropriate narrative would present the HMC


**Figure 3.** HMC game images (left: participants select a departure city among HMC's critical sales markets; right: depending on participants' BT performance, different quality issues are displayed).

manufacturing workers with an experience of cognitive, affective, and imagery involvement, which results in i) the narrative gamification being more enjoyable, ii) the narrative gamification effectively changing the job attitude of the repetitive tasks, and iii) the narrative gamification guiding workers to develop new work practices. This article thus contrasts narrative gamification with non-narrative gamification.

Figure 4 shows our research framework of this study. The pseudo-performance goals (e.g., points, badge, rank) in the conventional (non-narrative) gamification would trigger the worker's extrinsic motivation for game-play while they work. In particular they did not exhibit the manufacturing worker's "affective-cognitive-behavioral" tripartite conduct (Warmelink et al., 2018b), as affective reaction due to the pseudo-performance goals quickly disappeared because of hedonic adaptation (Frederick & Loewenstein, 1999; see the upper part of Figure 4). Haidt (2007), Greene (2013), and Railton (2014) all claimed that the nature and authority of moral values are "fast, automatic, intuitive button-pushing" responses of the affective system, and moral values (or moral goals) would guide the manufacturing worker's own self-monitoring, judging their behaviors or actions in relation to organizational values when the narrative in the game delivers or teaches moral values. Hence, we propose in this article that gamification should be about tightly engaging people on the affective level

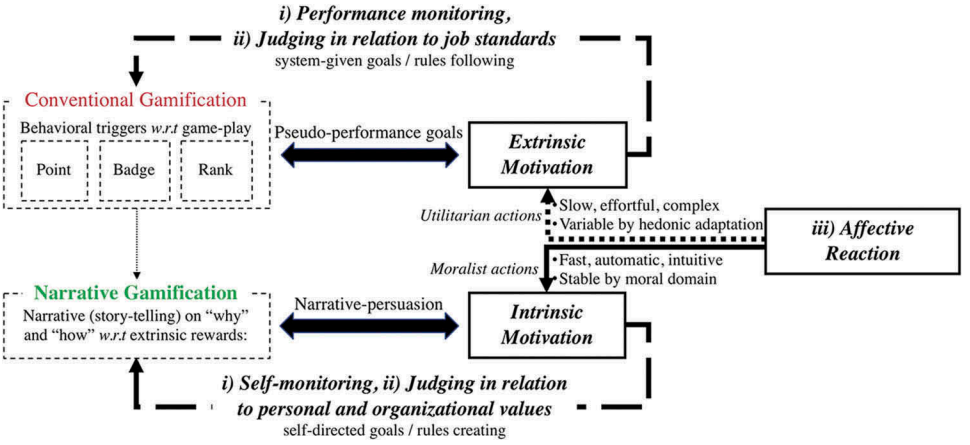


**Figure 4.** The research framework of this study. The effects of both conventional (i.e., non-narrative) and narrative gamification for enhancing motivation are measured in terms of cognitive, physiological, and behavioral correlations, which are based on Pivetti's framework for emotion (Pivetti et al., 2016). Affective reaction triggers and sustains the different types of motivation (Hidi et al., 2004), and moralist actions lead to self-monitoring of their behaviors, judging them in relation to organizational values (Uddin & Gillett, 2002). However, the utilitarian approach to the extrinsic motivation mainly exhibits the extrinsic rewards to be earned from game-play (Hanus & Fox, 2015).

and motivating them to achieve a positive or personally satisfying result or outcome, for which their moral goals can be aligned with the organizational values (see the lower part of Figure 4).

The empirical research design of this article is thus to investigate the effects of the narrative gamification on cognitive, physiological, and behavioral outcomes. For this, we mimicked an HMC factory context at Hanyang University (note this is inevitable because the manufacturing site at HMC cannot be modified for our experimental study), and invited real HMC workers to participate, measuring their cognitive, physiological, and behavioral experience (these are fully explained in Section 3.4). For an effective workplace gamification, three Goldilocks conditions were proposed as shown in Figure 5. Stage Gate 1 refers to gamification needs to provide the right level of effectiveness via Stage Gate 2, where the right amount of intense arousal provokes one's actions, and the narrative persuasion together motivates one's self-directed goals in relation to organizational moral and personal standards at Stage Gate 3. The three hypotheses of this study were then aligned to the Goldilocks conditions as follows:

H1: The worker with narrative gamification is effective not only physically but also psychologically (Stage Gate 1 – Motor behavior).

H1.1: The worker shows a higher work performance (various measures such as the torque value, task completion time, and accuracy).

H1.2: The worker enjoys more flow experience.

H1.3: The worker performs more effective behaviors.

H2: The worker with narrative gamification has the right amounts of affective reactions (Stage Gate 2 – Physiological behavior).

H2.1: The worker has higher physiological arousal (i.e., electrodermal activity).

H2.2: The worker has lower physiological stress (i.e., heart rate).

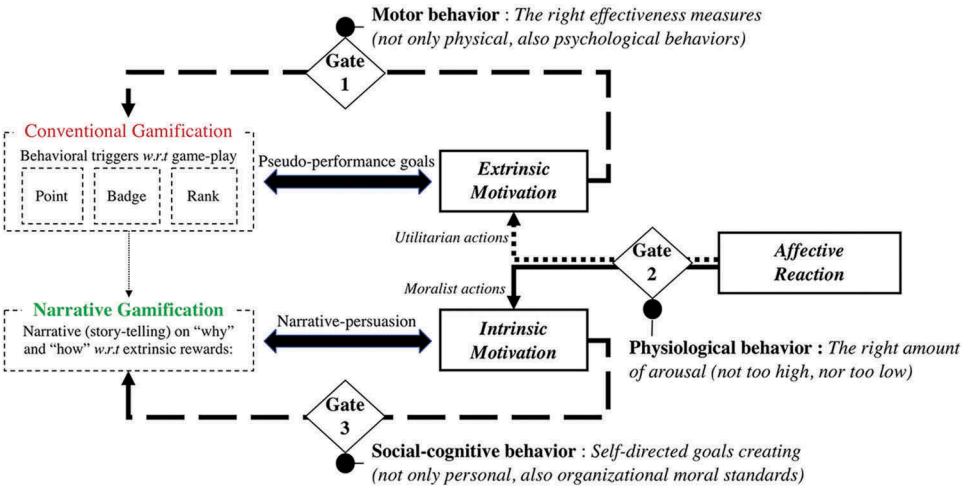


**Figure 5.** The Goldilocks conditions for workplace gamification. Three stage-gates are set to check whether affective–cognitive–behavioral reactions or responses are appropriate at certain decision points.

H3: The worker with narrative gamification creates self-directed goals in relation to personal and organizational values (Stage Gate 3 – Socio-cognitive behavior).

H3.1: The worker feels more self-active and self-worth.

H3.2: The worker develops creative work practices.

## 3. The empirical study with HMC workers

To answer our research questions above, three different gamifications were considered, one of which is currently being used at the factory (i.e., No Gamification), and the other two are newly created for empirical testing (i.e., Conventional Gamification (or non-narrative) and Narrative Gamification). The experimental bolt-tightening (BT) test was conducted for eight hours at Hanyang University laboratory, and the experimental environment for the assembly work was mimicked to be as similar to the HMC factory as possible. While the participants were performing the BT tasks in the experimental environment (see Figure 6 and Section 3.2), we collected their productivity, emotions, and self-directed behavior data for each gamification condition. A retrospective post-interview was conducted to understand how the participants developed their own ways of job performance.

### 3.1. *Participants*

Eighteen male workers from Hyundai Motors Company (HMC) between the ages of 25 and 30 years (mean = 26.2, sd = 0.75) voluntarily participated in the experiment. The motivation for intentionally recruiting male participants in this age group was to reflect the demographic characteristics of the HMC assembly line workers, in particular, the entry-level workers in Korea who were more interested in their working conditions (e.g., they are more concerned about safety, working hours, satisfaction, than salaries or benefits; I. H. Choi et al., 2018). This deliberate selection might create self-selection bias. To reduce the potential self-selection bias, we employed a random recruitment strategy from three different HMC factories (De Vaus & De Vaus, 2013). Only the participants who

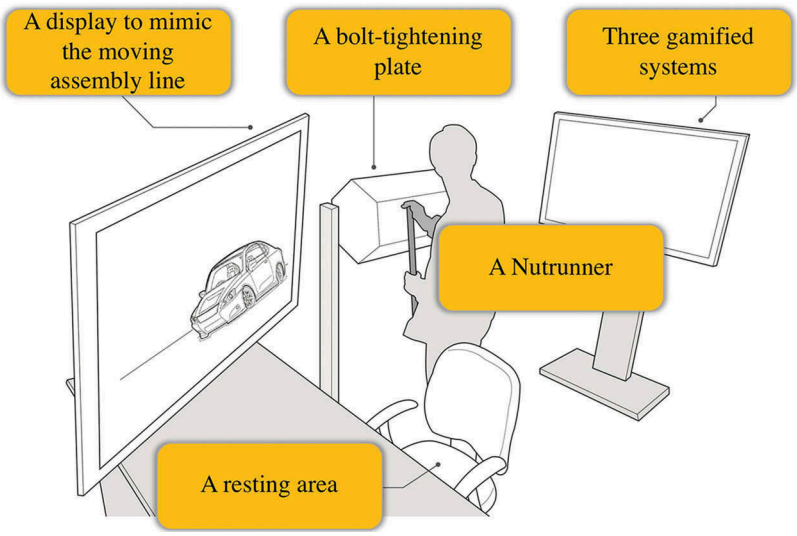


**Figure 6.** The experimental environment.

were able to conduct the BT task for eight hours a day participated in this study and were able to stop the experiment at any time if they felt psychological difficulties, physical difficulties, and/or discomfort. All the participants received a 50 USD voucher, though they were not told about this monetary incentive prior to the experiment. This was intentional for payment not to affect selection (note Ulrich & Grady, 2004 outlined that the monetary incentive should not be too high or too low). All participants were given a written informed consent form to publish their personal data. This study was approved by the Institutional Review Board of Hanyang University according to the Declaration of Helsinki (HYI-17-170-2).

### 3.2. *The bolt-tightening job*

In the HMC assembly line, the BT jobs at a single sub-station run around the eight-hour work schedule per day, including two 30-min breaks and a 60-min meal break. To mimic this, our eight-hour experiment schedule was divided into three slots between the breaks, each of which consisted of 120 BT jobs. During a single BT job, a worker must tighten, within 60 sec, an average of four bolts (between three and five bolts depending on the automotive type) in the moving assembly line with the "Nutrunner" (see Figure 2, i.e., the electric fastening tool for bolt-tightening). One single important job specification with the Nutrunner tool is to apply a specified torque level at greater or equal to 17 Newton-meters (N·m) for each BT, and most of the problems in quality arose from the fact that the workers did not press the tool hard enough at the specific torque level (i.e., 17 N·m). The quality control team at HMC acknowledged that the workers seem to worry that their wrists were twisted by the 360 repetitive BT jobs, but the health and hazard analysis showed that this was not the case.

In effect, to empirically demonstrate how the three gamifications (i.e., No vs. Conventional vs. Narrative Gamification) are different, as shown in Figure 5, the three Goldilocks conditions should be checked via workers' productivity, emotion levels, and self-directed or moral behaviors. Note again that since we were not able to perform this experiment in-situ, we tried to mimic the real-work experiences as much as possible in the experimental setting. Of course, we could not completely simulate some physical conditions, such as the assembly line continuously carrying an automotive frame every 60 seconds and various types of bolts (note that the type of bolts used varies depending on the type of vehicle).

As shown in Figure 6, we instead installed i) a bolt-tightening plate, ii) a display to mimic the moving assembly line (note that the worker must complete the BT job on the assembly line within 60 sec and return to the initial position; we mimicked this real-work experience in the "assembly line" display by showing the moving automotive for 60 sec), iii) a resting area (note that the worker at HMC rests in a designated area at any time after completing a BT job before the 60 sec limit), iv) a Nutrunner (AtlasCopco™), and v) three gamified systems. Both iii) and iv) were exactly the same as the real HMC work environment, but i) and ii) were improvised for our experimental setting. In the case of the three gamified system, "No Gamification" is currently being used at HMC, and the two others (i.e., Conventional Gamification and Narrative Gamification) were newly designed for this experiment.

### 3.3. *Three gamification design concepts: Experimental apparatus*

No Gamification simply displays Pass/Fail for each BT job without any game design elements. As shown in Figure 7, it is now being used at HMC. It shows only the number of bolts to be tightened in a single cycle, i.e., 60 sec. When the torque value of the Nutrunner is lower than the job standard (17 N·m), a negative "beep" sound is displayed as feedback and a "Fail" text is shown on the screen.

Conventional Gamification was inspired by Korn's study (Korn, 2012; Korn et al., 2015), having several box-type bars that match the bolts to be fastened within 60 sec (e.g., if the worker needs to tighten the four bolts, the four box-type status bars appear; see Figure 8). If the worker perfectly

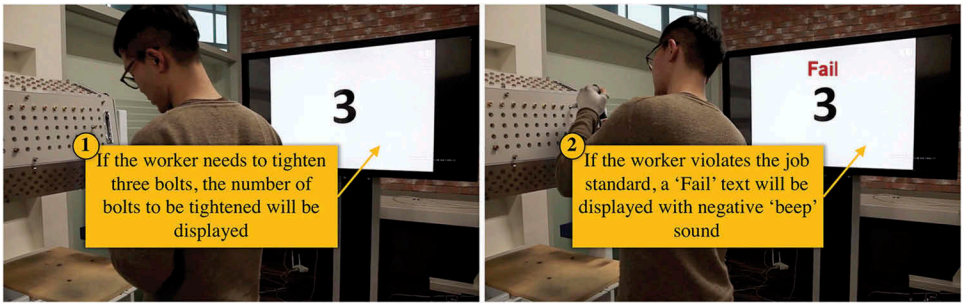


**Figure 7.** No Gamification environment.

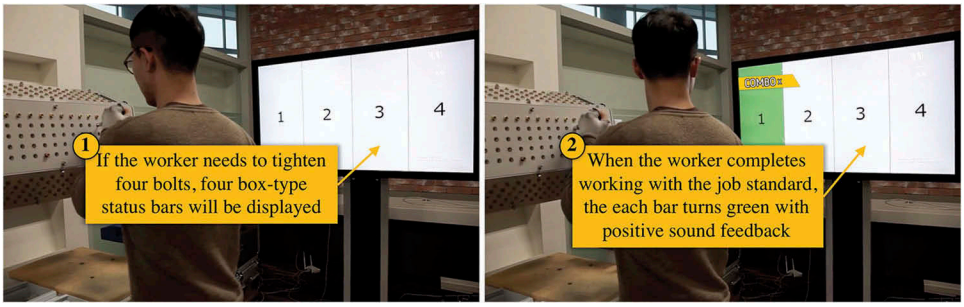


**Figure 8.** Conventional Gamification environment.

completes the BT jobs, each status bar turns green with positive sound feedback. Otherwise, it turns red with a negative "beep" sound. The more green bars the worker gets through the BT jobs, the more points he gets. These points provide immediate feedback, indicating how well the worker is performing the BT jobs (Werbach & Hunter, 2012). Further, the higher the point total, and the higher the rank, and thus the more special of badges a worker obtains. These badges have no narrative meaning, but provide an additional reward for the successfully completing the BT jobs (e.g., when the worker reaches 70, 80, and 90% accuracy, the appropriate badge is shown; Werbach & Hunter, 2012). A leaderboard is presented at the end of the work to display who performed best. This is intended to encourage workers to compare their performance with their peers' (Werbach & Hunter, 2012). In the experimental setting, however, all participants played alone, so they were ranked based on the past records from other participants. This setting was deliberate to examine how the extrinsic rewards, such as point, badge, and leaderboard, would affect participants' productivity, emotions, and behaviors compared to No Gamification.

As shown in Figure 9, Narrative Gamification focuses on providing a narrative structure that might prompt the HMC workers to be intrinsically motivated to understand how and why their activities should be differently perceived than they did previously (Clark & Rossiter, 2008). Narrative flow and the characters that lead the flow are thus two game design elements employed in this condition. The narrative flow contextualizes real-work experiences with intrinsic motivators without extrinsic points and/or ranks that the Conventional Gamification focuses on (Kapp, 2012). The narrative flow we employed in this study was the concept of quality control. HMC has critical sales markets worldwide, including in Europe, Russia, China, India, Korea, and USA (World rank #3 in 2017, accessed from Organization Internationale des Constructeurs d'Automobiles). Hence, the primary narrative structure in here was for the workers to understand that what they are doing in the game can actually reduce global quality problems. The voices of the customer (VOC), reviews, and news articles were used to create a more realistic narrative flow. For instance, if the worker

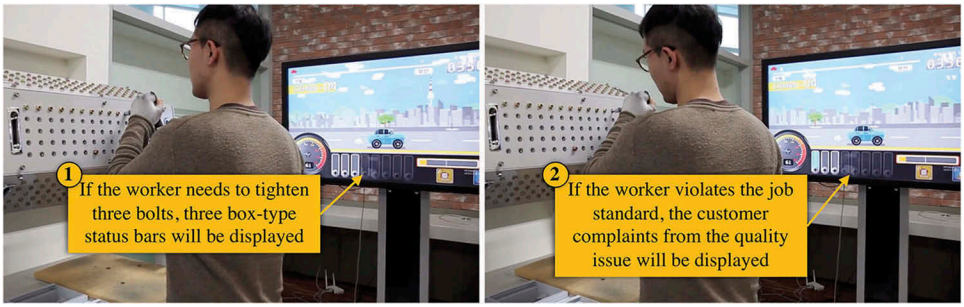


**Figure 9.** Narrative Gamification environment.

perfectly completes the BT jobs, the gamification provides a narrative based on the actual positive evaluation of the HMC car (e.g., the VOC like "*Comfortable, quiet, smooth ride and great gas mileage! Love the look of the body. Have owned one before. It's nice to be driving one again*," the magazine article headlines like "*Hyundai Review: Car of the Year? It's That Good*," or the newspaper headlines like "*Hyundai Car Sales Increased 174% in the States*"). Otherwise, the customer's complaints about HMC car quality is presented (e.g., "*One of the most unreliable cars on the road. Constant clutch, gearbox, wheel bearing, axle problems and outrageous prices for parts*").

The characters leading the narrative flow are essential for narrative persuasion (Green & Brock, 2000, 2002) and are crucial for a highly immersive to the narrative structure. Good characters make players quickly empathize with the real-world contexts, so they can easily absorb the strategies and tactics to play the games to get to know the real-world contexts (Busselle & Bilandzic, 2009). In the narrative literature (Currie, 2009; Keen, 2011), the characters with human-like traits have been found to be more efficient at delivering narrative messages to the game-player. Therefore, in our Narrative Gamification, we deliberately anthropomorphized the HMC car that the worker was currently assembling in the production line. Depending on how well the worker performed the BT jobs, the HMC car character speeds up or breaks down. Figure 10 (left) shows the car character running at a high speed if the worker did perfect BT jobs. Otherwise, the car character was in need of repair as shown in Figure 10 (right).

Indeed, we hypothesized that the narrative in the game could develop internal motives, placing the workers (if sufficiently empathized) into such situations. Note that in the narrative design concept, no extrinsic motivators (e.g., points, badges, and leaderboards in the Conventional Gamification condition) were employed, but the worker was covertly given an understanding of "how" their BT behavior would improve the potential customer's satisfaction and "why" such productive behavior is honored to align with the core values of HMC. This was intentional to see if the Narrative Gamification would prompt the HMC workers to understand the consequences of

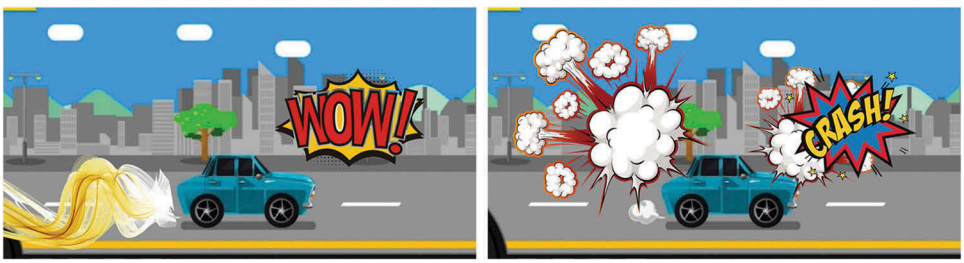


**Figure 10.** A fast-running car character when BT jobs are performed well (left) and a temporarily broken car when BT jobs are performed incorrectly (right).

their own actions for the narrative and as a result trigger intrinsic motivation. In effect, central to these experimental treatments is to demonstrate if the "action – feedback – motivation – reengage" loop through Narrative Gamification would differ from the other gamification schemes (i.e., No and Conventional Gamification).

### 3.4. *Measurements*

While the HMC manufacturing workers were performing the BT jobs in the experimental setting, various data (i.e., work performance, flow experience, physiological arousal and stress, and video recording) were collected. The actual work performance was measured by the torque values logged from the Nutrunner (AtlasCopco™). Additionally, the task completion time and accuracy (pass/fail) were collected from the log data.

The ESM (experience sampling method) was employed to assess the worker's psychological work perception and flow experience throughout the experiment (Csíkszentmihályi & Larson, 2014). It is an on-site survey method that the manufacturing workers use to rate their perceived experiences at different times. The primary advantage of ESM is to capture perceived experiences over time, providing an opportunity to investigate changes in experience through consciousness (Csíkszentmihályi & Larson, 2014; Hektner et al., 2007) without interrupting the worker's natural BT jobs. In our study, every 20 min when the worker was moving to the rest area (or waiting for the next BT job), an ESM was administered using four questions chosen from Csíkszentmihályi's full list (Hektner et al., 2007): i) perceived challenge, ii) perceived skill, iii) perceived activeness, and iv) perceived worthiness. They were asked on a tablet, and the response data were also logged. The first two questions were to assess flow experience, and the last two questions were used to assess work perception. Within each gamified system, the worker completed seven ESM questionnaires (time at 0 min, 20 min, 40 min, 60 min, 80 min, 100 min, and 120 min).

The real-time EDA (electrodermal activity) and HR (heart rates) data were collected to assess the worker's physiological reactions. Kivikangas (2006) demonstrated that EDA was high in the physiological arousal state and low when the task is tedious and too easy (i.e., boredom or apathy). We noted that a higher EDA would be an indicator of a higher level of challenge, flow state, and/or excitement (Mandryk et al., 2006). Most interesting is the study of Appel and Richter (2010), which claims high arousal is associated with high affective reactions to the narrative. Additionally, HR was recorded, showing that a higher HR indicates a feeling of tension and frustration, and a lower HR reflects a positive effect, flow-state, and a feeling of competence and immersion (Drachen et al., 2010). For our study, each worker participant wore an EmpaticaE3 wristband (Empatica Inc., USA) on his non-dominant hand to measure both EDA and HR signals. A 5 min rest period was given before the experiment. The physiological signals (i.e., EDA and HR) were interpreted by grouping a period of 20 min (Peifer, 2012). To reduce individual differences in EDA and HR signals, each participant's EDA and HR signals were $z$-score normalized. In particular, EDA was pre-processed with a low-pass filter of 1 Hz and the data were then sampled to 5 Hz for further analysis (Boucsein, 2012). A Continuous Decomposition Analysis (CDA) was then implemented using "LEDALAB" v3.4.4 (www.ledalab.de) running on MATLAB to retrieve the tonic skin conductance level (SCL; Dawson et al., 2017).

The most interesting socio-cognitive behavioral outcomes were how differently our workers had carried out their BT jobs in the three different gamifications. In so doing, two video cameras (GoPro) captured the whole work behaviors (note the fact that personal data would be collected and used was communicated). All video records were first synchronized by Adobe Premiere Pro CS 6 (USA) and then uploaded to the Observer XT (Noldus Information Technology, Netherlands) for the behavioral coding analysis. Both the behavior coding analysis and tri-gram analysis (Li et al., 2017) were employed to reveal different socio-cognitive behaviors depending on the gamifications, changing their frames of thinking, e.g., effort, intention, moral, and motivation.

### 3.5. *Procedure*

To mimic the real automotive assembly line, each participant carried out a total of eight hours of BT jobs. The participants were performed the BT jobs for two hours at each gamified system, respectively (i.e., within-subjects design), and had two break-times in between the three conditions. Note that we used a within-subjects design to counterbalance individual variability. To avoid any carry-over effects, the order of three gamified systems was counterbalanced. As the participants arrived, they were told about the experimental procedure and the informed consent form was administered. They then were given a brief training session (10 min) to get used to the BT job at the laboratory and were told their behaviors should be similar to what they do at the real assembly line. No experimenter was present during the experiment. During each session, ESM, EDA, HR, and the torque value were automatically administered and collected. After completing all three conditions, a semi-structured reflective interview was conducted.

## 4. Results

### 4.1. *The worker with the Narrative Gamification is effective not only physically but also psychologically*

The first observation was how our HMC workers managed the three gamified systems differently and what gamification really improved their work performance (H1.1), provided a flow experience (H1.2), and eventually created effective work behaviors (H1.3). These establish the first Goldilocks condition as depicted in Figure 5 (Section 2.2).

Table 1 shows the performance data in the three gamifications, roughly outlining the superiority of Narrative Gamification. A one-way ANOVA showed that there were significant differences in the torque value ($F(2, 51) = 5.30$, $p < .01$) and accuracy ($F(2, 51) = 39.64$, $p < .01$). The subsequent post-hoc tests revealed that the torque value was significantly higher in both Narrative Gamification (17.44 ± 0.12 N.m) and Conventional Gamification (17.33 ± 0.22 N.m), which were not statistically different from each other, compared to No Gamification (16.70 ± 1.25 N.m). In terms of accuracy, Narrative Gamification (97.76 ± 1.55%) was much higher than both Conventional (83.62 ± 5.12%) and No Gamification (80.76 ± 4.49%). However, there was no statistical difference in terms of completion time ($F(2, 51) = 0.666$, n.s.), probably due to the BT job cycle time (i.e., 60 sec time limit per each BT job). These work performance data partially validated H1.1 that our HMC workers with both Conventional and Narrative Gamification had completed their BT jobs better than no gamification.

For higher psychological involvement in the repetitive BT jobs, the perception of challenges by the three gamifications should be probed (Deterding et al., 2011; Hamari et al., 2014). Otherwise, our HMC workers would easily neglect the feedback from the gamifications, so the positive feedback control loop of "action – feedback – motivation – reengage" (Bandura, 1991; Kumar, 2013) would eventually collapse.

To examine this, as shown in Table 2, the ratios of the four-channel states (i.e., flow, anxiety, boredom, apathy) at each time interval were tallied. Note that if the HMC workers rated both the perceived challenge level and perceived skill level greater than 3 on the 5-point Likert scale in ESM,

**Table 1.** Torque value, completion time, and accuracy in each gamification (mean ± sd).

| Work performance | No Gamification | Conventional Gamification | Narrative Gamification | $p^a$ | $p^b$ | $p^c$ |
|---|---|---|---|---|---|---|
| Torque value (N.m) | 16.70 ± 1.25 | 17.33 ± 0.22 | 17.44 ± 0.12 | <0.01 | <0.01 | 0.895 |
| Completion time (sec) | 32.44 ± 1.60 | 33.32 ± 1.41 | 34.68 ± 1.33 | 0.518 | - | - |
| Accuracy (%) | 80.76 ± 4.49 | 83.62 ± 5.12 | 97.76 ± 1.55 | <0.01 | <0.01 | <0.01 |

[a]ANOVA, no gamification vs. conventional gamification vs. narrative gamification.
[b]Post-hoc analysis, no gamification vs. narrative gamification.
[c]Post-hoc analysis, conventional gamification vs. narrative gamification.

**Table 2.** Four-channel states of flow (adapted from M. Csíkszentmihályi & Larson, 2014).

| Flow experience | No Gamification | Conventional Gamification | Narrative Gamification |
|---|---|---|---|
| Flow (%) | 4.76 | 9.52 | *13.50*[a] |
| Anxiety (%) | 24.60 | 28.57 | *44.44*[a] |
| Boredom (%) | 32.54 | *42.86*[a] | 24.60 |
| Apathy (%) | *38.10*[a] | 19.05 | 17.46 |

[a]The most representative four-channel state in each gamification.

they were assessed as in the flow state (this four-channel measurement model has been used in several studies; e.g., Csíkszentmihályi & Larson, 2014). Boredom was characterized by high perceived skills (greater than 3) and low perceived challenges (less than 3), while anxiety was the other way around. The state "apathy" was where both the perceived challenge level and perceived skill level were rated as lower than 3. Table 2 clearly shows that No Gamification indeed made the HMC workers experience apathy, and Conventional Gamification made them most bored where their challenge–skill levels seemed to not be aligned. To be fair, both flow and anxiety were the highest in Narrative Gamification, indicating that more conscious work performance was being proposed by Narrative Gamification (Hektner et al., 2007). Results from a Chi-square test confirmed this interpretation ($\chi 2$ (6) = 33.431, $p < .01$). The effects of this conscious work behavior (i.e., awareness and arousal; Bayne et al., 2016) are further discussed in the next section.

The previous two analyses verified that Narrative gamification seemed to de-motivate the off-the-job attitude of our HMC workers, enforcing a more effective "action – feedback – motivation – re engage" cycle. However, these might arise from the nature of the Narrative Gamification design. As shown in Figure 9 (Section 3.3), Narrative Gamification did have more vivid visual information to process, such as a message about the global quality issues, by which our HMC workers might be more attentive to what they had done in the past and would do next. Hence, a more detailed behavioral analysis of the "action – feedback – motivation – reengage" cycle is needed to confirm H1.3. The video records of their work behaviors were coded and tallied as shown in Table 3.

A coding scheme of the working behaviors by the HMC workers was developed by the two independent researchers (who did not participate in this study, and their inter-rater reliability was Kappa = 0.81). A total of four major work behavioral items were detected, "Looking at the assembly line display" (i.e., motivation – reengagement for the next jobs), "Looking at the gamification display" (i.e., feedback of the past action), "Using a mobile phone" (i.e., de-motivated or increasing subject utility), and "Doing the bolt-tightening job" (i.e., action taken). As confirmed in the completion time in Table 1, the last work behavioral item was not of interest, however. How the first three behavioral items are differently generated is helpful for suggesting what gamifications best support the effective "action – feedback – motivation – reengage" cycle.

Note that since each HMC worker created a different number of behavioral items, the percentage of time spent on a specific work behavior was calculated instead. The one-way ANOVA for the average percent of time spent on a particular behavioral item in each gamification showed statistically significant differences in the three behavioral items, i.e., looking at the assembly line display ($F(2, 51) = 16.1$, $p < .01$), looking at the gamification display ($F(2, 51) = 347.1$, $p < .01$), and using mobile phones ($F(2, 51) = 455.9$, $p < .01$). The subsequent Tukey post-hoc tests revealed that, in Narrative Gamification, the workers looked at the assembly display more (6.85 ± 4.00%) compared to Conventional Gamification (2.59 ± 1.11%, $p < .01$) and No Gamification (3.04 ± 1.06%, $p < .01$). Additionally, they looked at the gamification display more (32.56 ± 5.54%) compared to Conventional Gamification (11.60 ± 0.85%, $p < .01$) and No Gamification (4.88 ± 1.02%, $p < .01$). Most interesting was the participants with Narrative Gamification were least likely to use their own mobile phones (2.94 ± 2.90%), compared to both No Gamification (55.82 ± 5.57%, $p < .01$) and Conventional Gamification (25.81 ± 6.63%, $p < .001$). These results confirmed H1.3 by showing that the HMC worker developed more effective work behaviors and less counter-productive behaviors with Narrative Gamification. How this effective "action – feedback – motivation – reengage" cycle

**Table 3.** Coding schemes of working behaviors and their average percent of time spent in each gamification.

| Work behaviors | | The average percent of time spent (%) | | |
|---|---|---|---|---|
| Categories | Purpose(s) | No Gamification | Conventional Gamification | Narrative Gamification |
| Looking at the assembly line display | • To look at the job schedule at present & future events<br>• To guess how long he can rest until the next job arrives | 3.04 ± 1.06 | 2.59 ± 1.11 | 6.85 ± 4.00 |
| Looking at the gamification display | • To get task-level feedback (Pass/Fail)<br>• To get job-level feedback (Torque value – Green/Red)<br>• To get narrative feedback (Quality controls information) | 4.88 ± 1.02 | 11.60 ± 0.85 | 32.56 ± 5.54 |
| Using mobile phones[a] | • To remove boredom<br>• To connect with others | 55.82 ± 5.57 | 25.81 ± 6.63 | 2.94 ± 2.90 |
| Doing the BT job | • To look at (and hold up) the tool<br>• To move the tool<br>• To look at (and hold up) the bolts<br>• To move the bolts<br>• To look at the places where the bolts are put<br>• To fasten the bolt in the places | 30.02 ± 5.63 | 51.18 ± 5.89 | 49.82 ± 4.10 |
| Miscellaneous | • Stay idle (no engagement) | 6.24 ± 3.50 | 8.82 ± 4.10 | 7.84 ± 4.17 |

[a]Note that we did not prohibit any mobile phone use.

for Narrative Gamification, in particular, provides socio-cognitive behavioral changes, which will be discussed in Section 4.3.

In summary, the work performance, flow analysis, and effective behavior analysis consistently supported H1 (H1.1, H1.2 and H1.3), showing that our HMC workers with Narrative Gamification completed repetitive BT jobs while being highly attentive. Research on emotions and their relationship with cognition has received much attention in recent years (e.g., Dolcos et al., 2011; Pessoa, 2008; Phelps, 2006) and is evident in the increasing popularity of the term "emotion–cognition interactions" in the literature. The effects of Narrative Gamification on emotion thus should be further examined to establish what triggers such effective behavioral outcomes.

### 4.2. *Narrative Gamification regulates emotion–cognition interactions: The Yerkes–Dodson law*

In Section 4.1, the work performance, ESM, and behavioral data confirmed that our HMC workers had been more engaged with Narrative Gamification. Such gamification seemed to help our workers understand the work context, which triggered them to more consciously perform boring and repetitive BT jobs. The emotion–cognition interaction paradigm might account for what happens in these behavioral changes (Dolcos et al., 2011).

The Yerkes–Dodson law (Yerkes & Dodson, 1908) is an empirical relationship between arousal and performance, dictating that work performance increases along with physiological arousal, but only up to a certain point. Here, arousal is important in regulating consciousness, attention, alertness, and human-information processing because it motivates certain behaviors, such as intentions to act, think, and the fight-or-flight response (Pfaff, 2006). In particular, according to the Yerkes–Dodson law, tasks demanding persistence such as our BT jobs would be performed better

with a higher level of arousal to increase motivation (Brehm & Self, 1989), if and only if the effect of task difficulty (i.e., physiological stress) does not deteriorate this positive relationship. This means that with the right amount of affective reactions from gamification, our HMC workers have better work performance both physically and psychologically. The hypotheses, arousal (H2.1) and stress (H2.2), were thus examined to see if the three gamifications would have different arousal levels and stress levels (i.e., task difficulty). This indicates fairly well which gamification would be effective in keeping the workers in the "action – feedback – motivation – reengage" cycle. The Yerkes–Dodson Law was also applied to interpret these affective reactions.

Figure 11 (left) shows the EDA data in the three gamification approaches while the HMC workers performed the BT jobs. In general, in high arousal circumstances, EDA is higher (Kivikangas, 2006; Mandryk et al., 2006). The EDA of the narrative condition seemed to significantly increase around an hour later after the BT jobs had started, though the other two conditions were relatively monotonic. This can be interpreted using the Yerkes–Dodson law, indicating why our workers engaging with Narrative Gamification had a higher work performance via attentive cognitive process, as discussed in Section 4.1.

This interpretation should also be checked in conjunction with physiological stress (i.e., the effect of task difficulty) because the work performance would decrease due to the negative effects of stress at a certain point by the Yerkes–Dodson law. Figure 11 (right) shows that Narrative Gamification stays mostly at the lowest stress level, which means it is at a manageable stress level compared to their skill level. However, Conventional Gamification was the highest, which implies the stress given by it might negatively interfere with their affective reactions and attentive cognitive process. Figure 12 plots the accuracy data and EDA on the original Yerkes–Dodson graph for a simple task (Yerkes & Dodson, 1908), which indicates that Narrative Gamification can more effectively manage emotion–cognition interactions than the other two gamified systems (ibid. "strong emotionality can enhance cognitive performance under simple learning conditions, such as when learning involves focused attention on a restricted range of cues").

A two-way repeated measures ANOVA was conducted, finding a statistically significant interaction effect between gamification and the time on arousal ($F(12, 204) = 4.826$, $p < .01$). Simple main effects analysis showed that the arousal significantly increased over time only in Narrative Gamification compared to both Conventional Gamification ($p = .021$) and No Gamification ($p = .005$), which showed no differences between each other ($p = .527$). This supported H.2.1, which states that a higher arousal triggered by Narrative Gamification ensures the highest cognitive performance up to a certain point. In a similar vein, a two-way repeated measures ANOVA found a significant interaction effect between gamification and time of average HR, i.e., physiological stress ($F(12, 204) = 2.869$, $p = .001$). Following simple effects analysis revealed that Conventional Gamification presented a significant level of stress compared to Narrative Gamification ($p < .01$) and No Gamification ($p = .018$). To be fair, these outcomes might arise from the two known facts that i) the Conventional Gamification condition, when extrinsic stimuli are too significant, provides

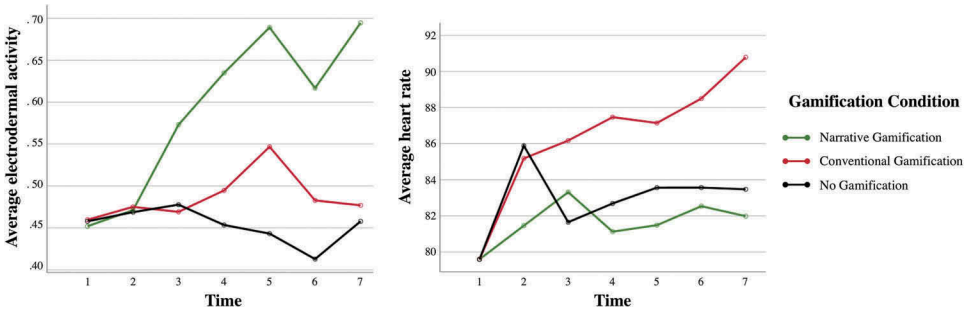


**Figure 11.** Changes in subjects' electrodermal activity (left) and average heart rate (right).

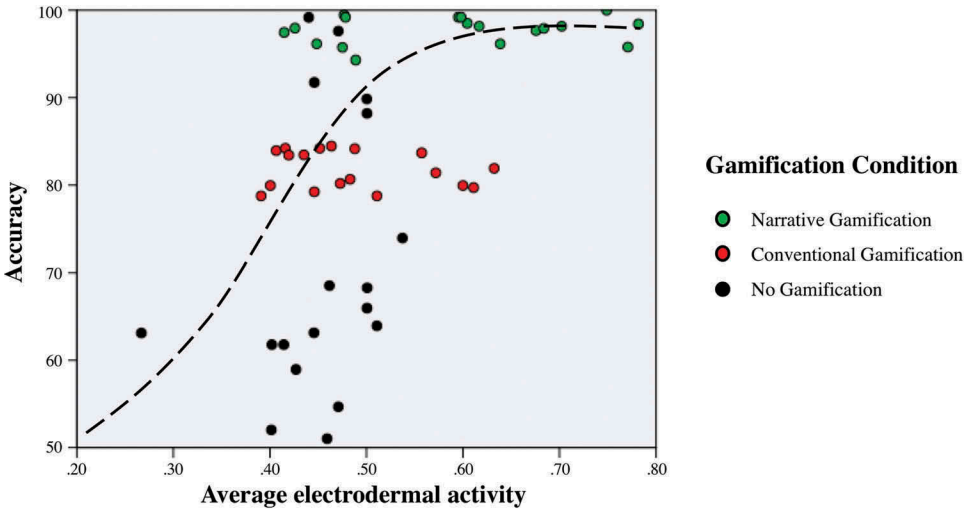


**Figure 12.** The Yerkes–Dodson graph on the accuracy data (performance) and EDA data (arousal).

too much attentive feedback for the worker to concentrate, thus resulting in a higher stress level (Weinstein & Ryan, 2011); and ii) the arrival of strong emotionality (in the case of Narrative Gamification) rapidly shifts one from a cognitive mode to an intuitive mode (Rusou et al., 2013), which underlies the "fast, automatic, honest, moral" responses of morality. The former has been the primary issue of the negative effects of gamification (i.e., Disneyland, Omnicare). More interesting in this study is determining what behavioral changes would be made by the positive attitudes of appropriate affective levels witnessed in Narrative Gamification, which will be further analyzed in the next section.

### 4.3. *Narrative Gamification develops new moral action attitudes*

Our last hypothesis was to test whether Narrative Gamification as considered in this study would provide different morality attitudes, i.e., changes of one's perception of the repetitive BT jobs. We noticed possibilities of work attitude changes based on the performance data discussed in Section 4.1 and affective reaction (Section 4.2), but the resultant behavioral outcomes should confirm this contention.

In so doing, first we note how the HMC manufacturing workers have different perceptions across the three gamifications in terms of self-worth and self-activeness. Several theories of work motivation (Grant, 2008) support a link between the perception of work and job performance. For instance, self-consistency theory (Gawronski & Strack, 2012) hypothesized that individuals are motivated to behave in a manner consistent with their self-image. Thus, the theory predicts that individuals with high self-worth will perform effectively in order to maintain their positive self-image. Similarly, control theory (Lord & Hanges, 1987) predicted that when workers with an internal locus of control (i.e., self-activeness) are faced with the discrepancies between acceptable standards of performance and actual performance, they tend to increase their efforts to match their actual performance to the standards (Duval et al., 1992). Conversely, people who have low self-worth because of repetitive job performance tend to either lower their standards or completely withdraw from the task when given negative feedback (Sommer & Baumeister, 2002).

Figure 13 shows their perceived activeness and worthiness. The left figure shows the changes of perceived activeness levels in the three gamifications. In short, the perceived activeness in Narrative Gamification stayed at the highest level. This was analyzed by a two-way repeated measures

ANOVA, which revealed that it was significantly different depending on the gamification ($F(2, 34) = 7.485$, $p < .01$). The subsequent post-hoc tests using Bonferroni correction found that the HMC workers felt more active in Narrative Gamification than Conventional Gamification ($p = .010$), though it significantly decreased over time ($F(6, 102) = 24.058$, $p < .001$). Note that Narrative Gamification was never below the neutral value 4.00 ($t(17) = 3.020$, $p < .01$), and Conventional Gamification seems to have negative effects on self-activeness thanks to the overtly controlled nature of the BT jobs (i.e., no locus of control).

Figure 13 (right) shows a similar pattern with the left figure, suggesting more self-worth was involved in completing BT jobs with Narrative Gamification. Again, an interesting point was that Conventional Gamification resulted in the lowest self-worth, which confirms that our workers regarded the extrinsic motivators (scores and ranks) as negative and the narrative persuasion in Narrative Gamification as being more positive (Peng, 2009). A two-way repeated measures ANOVA showed a significant main effect on the gamification type ($F(2, 34) = 9.636$, $p < .01$) and time ($F(6, 102) = 19.130$, $p < .01$). There was no interaction effect between gamification type and time ($F(12, 204) = 1.452$, $p = .145$). The subsequent post-hoc tests using the Bonferroni correction found that the workers felt more self-worth in Narrative Gamification than both Conventional Gamification ($p < .01$) and No Gamification ($p = .010$), which were not statistically different between each other. Additionally, the score statistically did not go below the neutral value of 4.0 for Narrative Gamification ($t(17) = 2.190$, $p < .05$).

Taken together, in Conventional Gamification, where extrinsic motivators dictate one's work attitude, the HMC workers compared one's worth and work behavior against the job standards given by the system, by which their work attitude would not go beyond the performance specified in the gamified system. These cognitive and utilitarian actions were also observed in the affective reactions, as shown in Figure 11. By comparison, it is more likely that, in Narrative Gamification, affective reactions seem to suppress the cognitive and utilitarian evaluation of the repetitive BT jobs, provoking more positive motivation for the HMC workers to develop an internal locus of control. The deliberate adoption of a new perspective on the repetitive BT jobs seems to trigger to a change in their attitudes. The moral persuasion adopted in Narrative Gamification might account for this motivational direction change.

The analyses above suggested that Narrative Gamification seemed to conceive self-directed behaviors through the intimate interacting nature between motivational and cognitive processes (Chiew & Braver, 2011; Dobre, 2013; Pessoa, 2009; Pessoa & Engelmann, 2010), allowing for different evolution of the "action – feedback – motivation – reengage" cycle. Equally important is thus how both Conventional and Narrative Gamification would differ in the "reengage" step. To examine this, a "tri-gram" analysis was applied (Li et al., 2017). Table 4 showed the five most frequent contagious steps that consist of the three consecutive intentional actions (note that the five most frequent tri-grams represents 96% of tri-grams). It is evident that Narrative Gamification made

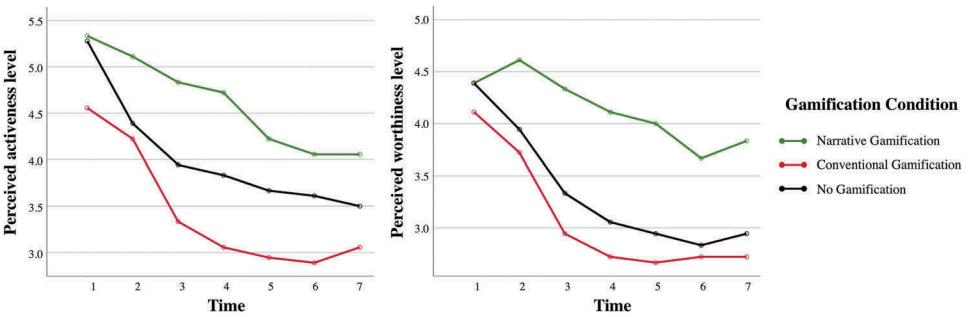


**Figure 13.** Changes in subjects' perceived activeness (left) and worthiness level (right) over time.

**Table 4.** Tri-gram analysis of the video protocols.

| Rank | Conventional Gamification | N | Narrative Gamification | N |
|---|---|---|---|---|
| 1 | Using mobile phones → Doing the BT job → Using mobile phones | 278 | Looking at the assembly line display → Doing the BT job → Looking at the gamification display | 243 |
| 2 | Using mobile phones → Looking at the assembly line display → Doing the BT job | 211 | Looking at the gamification display → Doing the BT job → Looking at the gamification display | 229 |
| 3 | Using mobile phones → Looking at the assembly line display → Using mobile phones | 204 | Looking at the gamification display → Doing the BT job → Looking at the assembly line display | 207 |
| 4 | Looking at the assembly line display → Doing the BT job → Using mobile phones | 181 | Doing the BT job → Looking at the gamification display → Looking at the assembly line display | 195 |
| 5 | Using mobile phones → Doing the BT job → Looking at the assembly line display | 105 | Doing the BT job → Looking at the gamification display → Doing the BT job | 109 |

our workers become more motivated to develop productive behaviors, such as more attention given to feedback from the gamification interface and prospecting the next job (e.g., there were 207 occurrences that just after completing the BT jobs, the worker had checked the assembly line display to figure out the next job to complete). Most interestingly, the most common contagious intentional steps in Narrative Gamification were related to "looking at the assembly line display" (i.e., Ranks 1, 3, and 4), which implies that our HMC workers would like to prepare for the future event (i.e., self-controlling the next BT jobs). By comparison, most obvious is that "Using mobile phones" was the most frequent intentional action in Conventional Gamification (all five most frequent tri-grams have this counter-productive action). In particular, as shown in Ranks 2 and 3, "Using mobile phones → Looking at the assembly line display" was the most common contagious set of actions, which suggests that our HMC workers tended to be heavily engaged in the counter-productive behavior until the assembly line display urgently notified them to complete the BT job on time. Indeed, in our video observations, the workers with Conventional Gamification mostly used their own mobile phones until the last minute. This certainly had a knock-on effect that they did not have sufficient time to re-do (or un-do) a job when errors occurred or to plan and/or prospect the next BT job.

This tri-gram analysis was not amenable to any statistical inferences; instead, to systematically explain the motivational processes that drive different self-directed behaviors, the "Skill–Rule–Knowledge" (SRK) framework by Rasmussen (1983) was applied. It states that when an individual performs a very routine activity, his or her motivational process is almost negligible so that they are heavily automated using procedural memory (skill-level motivation; Graybiel, 2008). In contrast, when the individual faces an unexpected event or a high cognition-demanding task, they have to develop motivations for creativity to move to the top level of one's cognitive ladder (knowledge-level motivation such as "why this happens"; Corazza & Agnoli, 2018). At this level, the learnt rules and routine procedures tend to be blocked and the individuals develop new rules and procedures to cope with the situation.

Figure 14 illustrates the trigrams identified in Table 4 on the SRK framework. The skill-level motivations refer to smooth, automated, and highly integrated patterns of action that take place without "attentional monitoring" (e.g., using mobile phones). Knowledge-level motivation must include any planning behaviors or any conscious analytical processes (Drivalou & Marmaras, 2009). In our observations, this was the case where our HMC workers examined the gamification display to check performance (i.e., evaluation). Last, the rule-level motivation requires recognition of the situation with conscious resources, followed by the retrieval of appropriate rules from pre-stored knowledge. Our analysis regarded seeing the assembly line display to show the next job (i.e., goal formation) before or after BT jobs as rule-level motivation.

In effect, it can be seen that our workers revealed different skill-, rule-, and knowledge-level motivational processes depending on the gamification conditions. The most common motivational process in Narrative Gamification was to look at the gamification display to check performance (i.e., knowledge-level motivation; 66.02%) or look at the assembly line display to prepare for the next job (i.e., rule-level motivation; 33.98%) before or just after BT jobs. In contrast, the most common

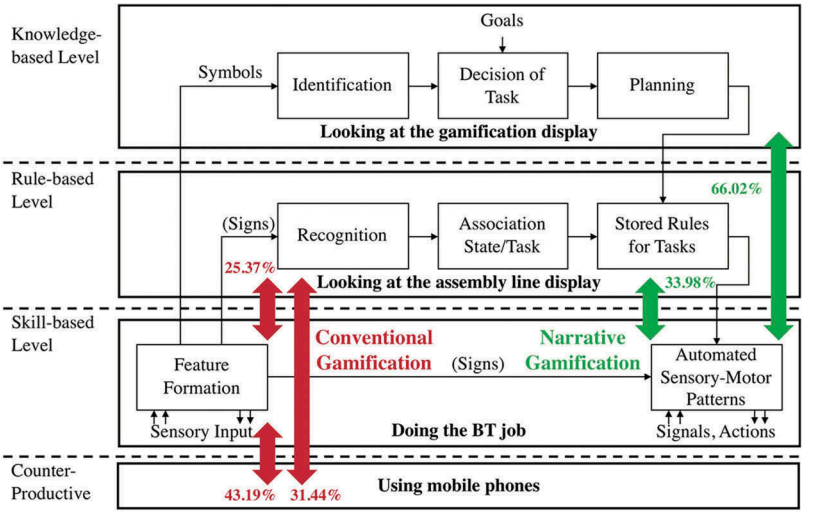


**Figure 14.** The human action cycle model on the tri-gram data.

motivational process in Conventional Gamification was to use mobile phones just before or just after BT jobs (i.e., skill-level motivation; 43.19%). Indeed, it was not as common for our worker participants in Conventional Gamification to look at the assembly line display (only 25.37%) to generate self-directed goals compared to the Narrative Gamification condition. Figure 15 showed that some workers in the Narrative condition tried to create their own goals to perform BT jobs better, such as counting consecutive successful BT jobs by looking at the gamification display (i.e., knowledge-level motivation). In contrast, many workers in Conventional Gamification missed opportunities to correct their action errors because they did not look at the gamification display or prepare for the next jobs to do (see Figure 16).

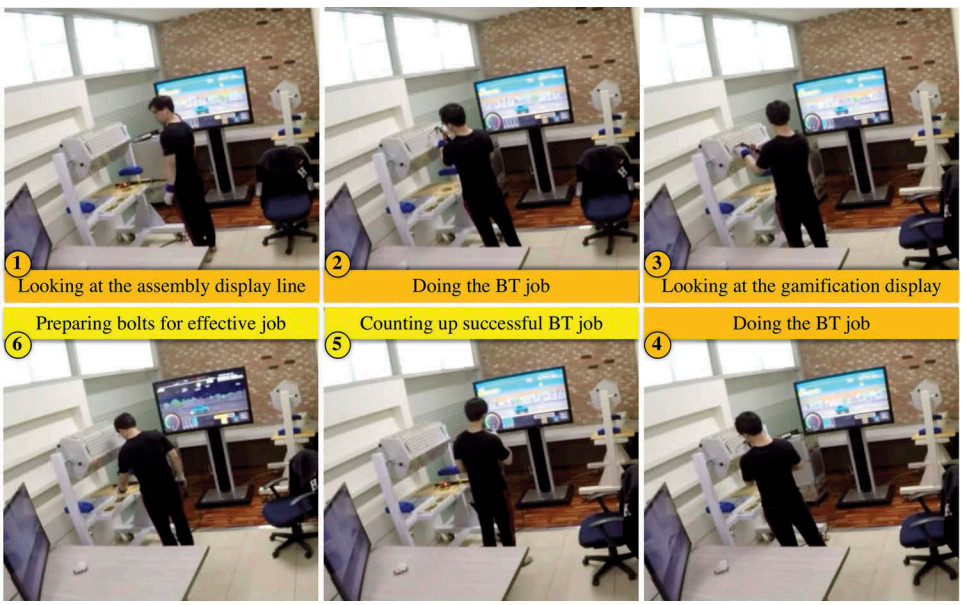


**Figure 15.** Self-directed goal generation (Narrative Gamification).


**Figure 16.** System-given goal following (Conventional Gamification).

## 5. Discussion and conclusions

Scientific management principles, such as division of labor, operation simplification, job standardization, and special training, have greatly improved production process, productivity, and quality (Taylor, 1914, revised Taylor, 2004), for which creative performance has been suppressed in the workplace. Workplace gamification is then to utilize game design elements in the real-work contexts, by which the experiences of playing games are converted into a "gameful real-work experience" for conscious work experiences with less boredom (Ferreira et al., 2017; Oprescu et al., 2014). In practicing gamification design, however, the previous studies focused on office tasks that are more cognitively challenging, which is not applicable to manufacturing workers. In particular, the "motivation crowding effect" (Deci & Ryan, 2010) in Conventional Gamification seems to be an issue to negate its potential benefits, which partially explains why Conventional Gamification with an extrinsic incentive mechanism fails to be widely adopted (Dale, 2014).

In this article, we asked the same question and tried to empirically test if real HMC manufacturing workers could be moved by intangible endogenous factors, such as self-interest, curiosity, care, or abiding by organizational moral values. These intrinsic motivations seemed to sustain their passions, creativity (i.e., new work practices), and sustained efforts (Deci & Ryan, 2010, 2012). How to trigger this positive feedback control loop was the main objective of this study, and we hypothesized that narrative persuasion would serve this purpose.

Indeed, we are not the first to employ narrative (i.e., story-telling) in gamification. Cybulski et al. (2015) contended that a narrative would help the learner to discover the core elements in the game-world that occurred in the past in order to build up more thoughtful, critical, and creative behavior for the future. For active persuasion of beliefs and attitudes, for instance, Depura and Garg (2012) developed an online social game for employees to promote knowledge sharing. However, previous studies did not empirically reveal how social–cognitive behaviors informed by the narrative-embedded gamification would change their frames of attitudinal thinking, e.g., efforts, intention, moral, and motivation, which is the main contributions of this study.

To be fair, Ryan and Deci (2000) claimed that those who are intrinsically motivated would pursue an activity for pure enjoyment (Werbach & Hunter, 2012). Of course, this is not to say that intrinsically motivated behaviors cannot come from extrinsic motivators (e.g., prizes or penalties) used in Conventional Gamification in our experimental setting, nor that extrinsically motivated emotions do not take on enjoyable experiences; however, it is evident that the intrinsic motivators more likely create positive effects and emotions, which might lead to are more self-directed behaviors. In this sense, many studies (e.g., Griggs, 2010) found that if too much extrinsic reinforcement is added, the person may perceive the task as over-justified and quickly turn to negative feelings, thus obfuscating whether their true motivation to participate in the activity is extrinsic or intrinsic (Mekler et al., 2013). For many HMC physical workers, this indicates that intrinsically

motivated activities can generate such feelings as a sense of progress when they see that their work is accomplishing something positive, or personal values when they learn something new or become more aware of the organizational core values (see Figure 12 in Section 4.2). In effect, the central tenet of this study was to determine if proposing more intrinsically related activities through the narrative-embedded gamified system would make the worker more likely to put aside negative emotions while performing repetitive and boring tasks, and whether this would cause the worker to rest often in the optimal flow state (Csíkszentmihályi, 1990); note that these hypotheses have not been empirically tested before.

### 5.1. *Goldilocks conditions for workplace gamification*

Three Goldilocks conditions were then accounted for in workplace gamification as follows: i) "the worker with gamification should be effective not only physically but also psychologically," ii) "the worker with gamification should have the right amount of affective reactions," and iii) "the worker with gamification should have created self-directed goals in relation to personal and organizational values." The Goldilocks principle refers to a worker's preference to attend events that are neither too simple (or boring, which is subjective) nor too complex (or exciting, which is organizational) according to their current representation of the work practices (Goldenhar et al., 2003).

#### 5.1.1. *Psychological and physical well-being: neither too simple nor too complex*

Our findings dictated that a simple utilitarian approach (i.e., higher productivity by extrinsic motivation) for workplace gamification would not be sustainable, because when deciding upon the worker's own optimal actions in the workplace, it is assumed that they would trade off their effort costs against the expected subjective utility. This means that they would like to work aversely, in the sense that tempting off-the-job opportunities may often drive them to reallocate their efforts toward other things (e.g., using a mobile phone at work) to maximize their overall subjective utility.

That said, psychological well-being, which many gamification studies have considered, was accomplished through enjoyment while work-playing, and this "fun" experience would engage the worker to work better or at least avoid a "work-averse" attitude. However, focusing too much on this fun gaming experience was demonstrated to be the wrong approach in these previous studies, thanks to its short-term hedonic adaptation effect (Diener et al., 2009; Frederick & Loewenstein, 1999), as well as the prospective moral hazard that the jobs in the workplace are being made fun of (Dale, 2014). Our experimental results also showed a similar hedonic insensitivity over time, showing that regardless of a gamified or non-gamified scheme, desensitizing physical efforts through gaming experiences or other extrinsic incentives is not the best solution. Instead, as many already adopted in the gamification literature, we advocate for the concept of "flow" (Csíkszentmihályi, 1990), which is the psychological well-being concept describing how people are intrinsically motivated when they feel the tasks are challenging and, at the same time, are able to cope with it. That is, the exogeneous rewards, in the shortterm, are tied to increased productive behaviors, but the endogenous rewards such as the worker's self-interests are, in the longerterm, correlated with their actions (effort level). Though the extrinsic motivators in the Conventional Gamification (i.e., points, badges, and leaderboards) improved physical performance compared to the No Gamification (see Table 1 in Section 4.2), these exogeneous rewards failed to improve the worker's psychological well-being (see Table 2 in Section 4.2). Note that in the Narrative Gamification, no extrinsic motivators were employed, but our workers who were covertly persuaded by the narrative flow and the characters of how and why their activities would be meaningful (i.e., the endogenous rewards) had optimal flow experiences and, as a result, further increases in physical performance. Indeed, the workers with Narrative Gamification had the highest productivity and the highest flow state (see Tables 1 and 2).

Here, the optimal flow reward through appropriate gamification contributes to the worker's behaviors, including their morals and creative performance (Nakamura & Csíkszentmihályi, 2014).

Consider again Table 2 in conjunction with both Tables 3 and 4. We note that the HMC workers with Narrative Gamification differed in their work behaviors, and Table 2 clearly shows that the flow state using Narrative Gamification was dominant. This means, according to flow theory, that the workers' self-interest with regard to repetitive BT jobs was developed differently by the gamification's narrative persuasion, and our workers tend to positively respond to this type of gamification. Our post-interview data re-confirmed that Narrative Gamification was favorable for 16 out of 18 subjects, who were less bored (13/16), more engaged with the job (12/16), and found it more meaningful to do repetitive BT tasks (12/16).

Such psychological well-being is not limited to personal satisfaction, but to helpfully contribute to organizational benefits. Nakamura and Csíkszentmihályi (2014) contended that optimal flow experiences would provide more creative work performance, thanks to its devotion to awareness of work activities. In a similar vein, Prensky (2001) claimed that play-like learning engenders creativity. The empirical evidence suggests that intrinsic motivation causes learners to define the learning tasks as requiring more creativity (other than simply following the goals) to become immersed in them, and to further search for novel ways of carrying them out (Rogstadius et al., 2011). The new work practices promoted by Narrative Gamification in the tri-gram analysis in Section 4.3 are also seen in this way. The creative process is actually a change in process by which old orders and structures are changed in new and innovative ways. As witnessed in the Toyota Production System (TPS; Alves et al., 2012), continued rewards for high creative effort help establish the creative orientation and resilience needed to pursue tedious and repetitive tasks (Eisenberger & Selbst, 1994). However, creativity was lessened by repeated rewards for simple performance (Eisenberger & Selbst, 1994, Experiment 1). In our experimental outcomes, when Conventional Gamification was applied, our HMC workers tended to adjust their work behaviors to the external rewards specified in the gamified system. These utilitarian actions were also interpreted by their low arousal reactions, as shown in Figure 11 (Section 4.2). In contrast, it was more likely that, in Narrative Gamification, their affective reactions seem to increase, whereby deliberate adoption of a new perspective on repetitive BT jobs seems to trigger workers to develop their own locus of control (Kramlinger & Huberty, 1990).

#### 5.1.2. *Emotional arousal: neither too excited nor too bored*

Gamification succeeds when employees do not feel forced to perform system-given goals. In other words, when applying workplace gamification, simply throwing off-the-shelf interface design elements into the workplace and hoping for the best is not be the answer. In this sense, an interesting finding in our empirical study, as depicted in Figure 12 (Section 4.2), was the accuracy data against the arousal data plotted according to the original Yerkes–Dodson law (Yerkes & Dodson, 1908). This re-confirms that strong emotionality can enhance cognitive performance up to a certain point, which means that both adequate task challenges (i.e., cognitive competence) and appropriate affect level serve as interface design parameters.

The emotion–cognition interaction paradigm was first proposed by Damasio and his colleagues (Bechara et al., 2000), suggesting that emotion-related signals are important for our decision-making, because they can actively build up a type of nonspecific "feeling" that might be linked to predicted outcomes in the future. That is, emotion can naturally guide what behaviors or responses bring about the best results for future events, on which both the level of consciousness (i.e., arousal, wakefulness, or vigilance) and the content of consciousness (i.e., awareness of the environment and of the self) are aligned (Tsuchiya & Adolphs, 2007).

Note that our experimental setting focused on arousal level, in spite of the common Valence–Arousal model (Colibazzi et al., 2010). This is because arousal is more important in regulating one's attention, alertness, consciousness, and information processing since it is more likely to motivate certain behaviors such as the fundamental fight-or-flight response (Lindsley, 2018) compared to valence, which works as the subsequent inducer of feelings such as attractiveness and averseness. Considering the intimate interaction paradigm between emotion and cognition, in particular, the influence of arousal is seen as quite functional and prompt. Many claim that arousal provides crucial

information as to whether one is needed to be attentive to the objects, events, and situations (Lindsley, 2018). Many of the hallmark findings in cognitive psychology appear to have this arousal trigger (e.g., anchoring; M. H. Choi et al., 2013), which indicates that an appropriate arousal level is a necessity condition in workplace gamification design.

Our first design guideline in Narrative Gamification, based on the findings concerning the enhancing effect of emotion on attention (e.g., emotional modulation of attention; Bocanegra & Zeelenberg, 2011; Fichtenholtz et al., 2004; Phelps et al., 2006; Schupp et al., 2006), was that narrative persuasion would make our workers more conscious of their work activities compared to Conventional Gamification. This would maintain our HMC workers' focus on the goal-relevant information and thus may enhance their cognitive performance up to a certain point. This Narrative Gamification appeared to provide additional information that allowed the worker to connect what they were doing in the game-world setting with the changes of the real-world through the compassionate and empathetic narrative (Busselle & Bilandzic, 2009; Kapp, 2012; Nera et al., 2018).

Possibly more emotional stimuli tend to capture the HMC workers' attention more easily than non-emotional stimuli in Conventional Gamification, and thus may affect different levels of cognition from the lower level (e.g., perceptual) to the higher level (e.g., executive), as well as cognitive processes or goal-directed behavior (e.g., Table 4 in Section 4.3; Fichtenholtz et al., 2004; Phelps et al., 2006). An additional note on valence (i.e., positive and negative) is also needed here. We acknowledged that although many studies on emotion equivalently considered both valence and arousal, we deliberately paid no attention to valence, partly because it is used to describe the hedonic tone of feelings, and mostly because it is known that repetitive work such as BT jobs at any cost evokes negative valence (i.e., work averseness). Nonetheless, it is known that positive valence could increase one's cognitive flexibility. For instance, fMRI studies (e.g., Wang et al., 2017) using the task-switching paradigm revealed that the switch costs significantly decreased with the positive valence condition and increased with the negative valence condition compared to those with the neutral condition. Agency theory (Shapiro, 2005) in Economics would also explain why valence is to be considered in the workplace. This theory claims that any human performance at work is determined by the contract between a company (in our example, Hyundai Motors Company) and a risk-averse worker to act on its behalf. However, the worker possesses very private information, e.g., his effort and engagement levels that are not costlessly available to HMC. In that case, when bored or losing interest, which may occur when performing repetitive BT jobs, the theory predicts that HMC workers are inevitably tempted to engage less with the BT jobs because their regret (i.e., negativity) consistently increases whenever they otherwise have to do the jobs. This view of valence in emotionality is left for a future study, in conjunction with other work design conditions.

Employing the emotional rather than the cognitive approach often fails to motivate workers, however. For instance, the enhanced significance of emotional stimuli can evidently benefit our cognitive processes (Phelps, 2004), but can also have detrimental effects on worker behavior (e.g., increased distractibility to task-irrelevant emotional stimuli; Dolcos et al., 2008). Additionally, although some of these effects are transient, influencing perceptual and executive processes, others produce long-term effects (Dolcos et al., 2005) that can last for a long time (Rubin, 2005). This is much harder to functionally design, thus it is very contextual. This partially explains why we applied narrative persuasion rather than other emotional design factors (e.g., esthetics). As a result, boredom, a state of low arousal and high dissatisfaction due to an unchallenging and uninteresting work environment, was significantly lessened (see Section 4.2) as a major cause of reduced flow experience (Schaufeli & Salanova, 2014) and increased stress (see Figure 11 in Section 4.2; Van Tilburg & Igou, 2012). Additionally, gamification with low arousal might make physical workers fall into more counter-productive work behavior, such as using mobile phones to cope with their negative emotions while working (refer to Table 4 in Section 4.3; Bruursema et al., 2011; Spector & Fox, 2002; Van der Heijden et al., 2012). Staying between too excited and too bored during workplace gamification is difficult. A moralist approach that quickly evokes affective reactions might hint at how to accomplish this or not.

### 5.1.3. *Moral actions for increasing both personal and organizational values*

As our HMC workers only saw the rewards for a specific behavior, they learned only behaviors that are valuable for their subjective utility (Studer & Knecht, 2016). Hence, it seems that applying extrinsic reward-centered gamification (Conventional Gamification in our case) creates a short-term engagement (Stepanovic & Mettler, 2018; note that all 18 participants for Conventional Gamification responded that they focused on system feedback of the torque values). Again, the positive feedback control loop of "action – feedback – motivation – reengage" (Bandura, 1991; Kumar, 2013) explains why mastered activities are hard to reengage with without an appropriate motivational mechanism. The second design guideline was thus that a moralist approach would have an impact on the worker's own "self-directed goal" attitude and behaviors to reengage with the mastered activities.

Indeed, the pre-conditions for intrinsic motivation are discussed by Bandura's social cognitive theory of morality (see Figure 4 in Section 2.2; Bandura, 1991), which demonstrated that human behavior is naturally triggered by three sub-functions: i) self-monitoring of one's behavior; ii) judgment of their behavior in relation to personal standards and organizational norms; and iii) affective self-reaction. More importantly, he emphasized one's morality by suggesting that personal and organizational standards are more stable than other affective and rational variables. In this regard, Heron and Belford (2019) claimed the largest lack in conventional gamification seems to be a relatively persistent moralist approach.

Moral values of a workplace involve the judgment of personal behaviors in all the business interactions, for instance, the work practices of our HMC workers (Moore, 2015; Samnani et al., 2014). This refers to individual interactions in the organizational setting and includes organizational expectations of personal behaviors (Hosmer & Kiewitz, 2005) and the moral hazard (Holmström, 1979). Therefore, Lewis (1985) concluded that moral values in the workplace are personal perceptions of rules, criteria, or principles for guiding proper behaviors under every kind of organizational setting. Hence, many agree that the moral values related to the organization can be directive principles guiding individual behavior whenever an individual confronts situations such as conflicts of interest (personal interest vs. collective interest, subjective utility vs. social utility, etc.). Such immoral behaviors can harm individual effectiveness and even compromise the reputation and effectiveness of the organization. This indicates the acceptable and moral way of conducting business activities prevent individuals from making questionable decisions and is positively associated with organizational loyalty (Cohen et al., 2014).

However, the moralist design guideline for workplace gamification design is neither solid, a state of measurement (e.g., scores or ranks), nor a form of personal performance to reach (e.g., forcefully teach the work morals by the gamification). Instead, it is a transportation process of developing and expressing personal interests and organizational core values for performing activities or satisfying needs. We employed the underlying foundations from media studies (Appel & Richter, 2010) in designing Narrative Gamification, e.g., Nicholson (2015)'s study. He demonstrated that a rational storyline of game-play makes one empathize with the playing character's attitudes, beliefs, and preferences (see Figure 1 in Section 1), by which it can effectively prompt operation of the self-regulative system. This moralist approach resembles flow (Csíkszentmihályi, 1990), in that the individuals who are highly transported into the narrative are fully concentrating on the storyline, and they often lose track of time or fail to notice events occurring around them because of their focused involvement in the narrative (refer to Green et al., 2004).

In developing a persuasive narrative for our HMC workers, we noted the organizational context that HMC currently faces. The HMC manufacturing workers mostly have more than twenty years of work experience. Their habitual conduct and thinking largely creates serious quality issues, so to simply increase their skill levels is not the best answer. Note that Bandura (1991) argued when developing a moral self, individuals adopt standards of right and wrong that serve as guides and restraints for conduct. In this self-regulatory process, the workers can monitor their behaviors and the conditions under which they occur, judge them in relation to the organizational moral standards, and regulate their actions by the consequences they apply to themselves. Hence, the moral narrative

structure employed in the present study is the concept of "global quality control," whereby HMC has critical sales markets worldwide. Then, its primary narrative was having the HMC manufacturing workers understand that what they are doing in the game can actually reduce global quality problems (see Figure 3 in Section 2.2). The outcomes of our empirical study clearly supported that certain or normative beliefs that were taught or newly suggested by Narrative Gamification provided a new perception of organizational core moral values and, at the same time, personal values (such as flow experiences and self-worth).

Unreported post-interviews in the empirical study are also considered. In the Conventional Gamification condition, all 18 participants responded that while tightening the bolts, they focused on external goals, such as whether each torque value of the BT jobs was good or bad. Otherwise, the participants in the Narrative Gamification stated that during the BT jobs, they developed more specific self-directed goals such as "continuously tighten as many bolts as possible in accordance with the specified torque (16 out of 18)" or "minimize specified torque value variances (2 out of 18)." More interesting was that the narrative persuasion of "global quality control" seemed to work as intrinsic motivation, for instance, one of their frequent responses was "I want to satisfy my customers" (14 out of 18) or "I want to be competent in this task" (4 out of 18), which were not observed in Conventional Gamification.

Taken together, our study confirmed a potential impact of gamification in the workplace, and their behavioral changes would not be expected when only the extrinsic motivation mechanism is applied. Involvement of an intrinsic motivation mechanism is necessary (in our case, a more contextual and organizational agenda was inserted into a narrative). This is so the manufacturing workers are doing something that they find internally rewarding, interesting, positive, and personally satisfying, by which they produce novel ideas and creative solutions (Eisenberger & Shanock, 2003). Determining how to achieve this is thus the key to workplace gamification design.

### 5.2. *Implications for system design*

Our findings suggest three design implications for workplace gamification. First, Human–Computer Interaction (HCI) designers should consider *how to provide the right level of utility at both physically and psychologically* (Stage Gate 1 of the Goldilocks conditions in Figure 5 in Section 2.2). The Conventional Gamification approach guarantees an immediate physical performance increase through extrinsic rewards (e.g., points, badges, and leaderboards), but it eventually makes employees feel compelled or exploited to perform only productive behaviors. This makes the workers feel bored, stressed, and more engaged in counter-productive behavior. This view, that the effects of the reward in the Conventional Gamification eventually reduces perceived self-determination, is well in line with other empirical findings (Deci & Ryan, 2010, 2012).

Second, HCI designers should consider *how to provide the right amount of affective utility* (Stage Gate 2 of the Goldilocks conditions in Figure 5). Of course, this is to some extent well-known in the gamification literature (Drachen et al., 2010; Pe-Than et al., 2014). Our empirical study found that the right amount of affective reactions could help the worker's self-monitoring behavior by an enhancing effect of emotion on attention (see Section 4.2). Our results suggest the important point is to facilitate the right amount of affective utility at the worker's perceived realism level of the narrative. That is, if the narrative is aligned with the individual's perceived realism, their affective reactions make them more conscious of why they need to do those activities. In this regard, the plausibility of the narrative (i.e., as if this narrative can happen the real-world any time soon; Hall, 2003) can make the positive narrative more persuasive (Nera et al., 2018). In particular, this positive transportation process (i.e., a feeling of entering a world evoked by the narrative) would stand out via the two game design elements: *Narrative flow*, and *the characters to lead the flow*. In general, the narrative flow only takes place when real-world experiences are reasonably predicted in performing the game-play. This plausible narrative then encourages the players to naturally adopt the strategies and rules inserted in the game, and this in turn allows the players more conscious of their real-world

activities. In doing so, the characters that lead this narrative flow should be sufficiently empathized by the players (Busselle & Bilandzic, 2009). We proposed, depending on how our HMC workers performed the BT jobs, the car character in the gamification behaved differently to make them more aware of their real-world activities (see Figure 10 in Section 3.3).

Moral behaviors often take place prior to rational or affective behaviors (Greene, 2013; Haidt, 2007). The Conventional Gamification is solely based on negative feedback control loops that tightly balance the system inputs and outputs (refer to Bontchev, 2016). On the contrary, the Narrative Gamification condition seems to trigger a positive feedback control loop that might exacerbate the effects of one's motivational change. In our Human (HMC worker) – Computer (Gamification) interactive systems design, for instance, when the torque value of the HMC worker was lower than the job standards, the Conventional Gamification provided external penalties to control the worker's performance. Instead, the Narrative Gamification did not explicitly control the worker's performance by the system feedback, but fed back in a manner that workers tended to develop new motivational change. Considering again the Bandura's social cognitive theory (1991), human behaviors are naturally motivated by three sub-systems: i) self-monitoring of one's behavior (i.e., appropriate feedback leads to correct behavior); ii) affective reaction (i.e., emotional arousal evokes behavior); and iii) judgment of one's behavior in relation to personal standards and organizational culture (i.e., personal and organizational morals dictate behavior). The Narrative Gamification tends to trigger this strong internal moral standard to change one's habitual conduct other than Conventional Gamification. This suggests the third design implication that *how to create self-directed goals in relation to organization or moral values* (Stage Gate 3 of the Goldilocks conditions in Figure 5). The low-level self-interest (i.e., quickly finishing the day duty jobs) turning to more higher-level moral value (e.g., high quality production) is not easy. In this study, we saw that the Narrative Gamification presented some level of controllable "*positive feedback loop*" against the "*negative feedback loop*" that the Conventional Gamification resorts on. That is, when extrinsic motivators (i.e., points, badges, and leaderboards) were visibly given, the worker's attitude was dictated by the negative feedback loop, so they were easily conceiving their worth against the gaming performance criteria given by the system feedback. This means that their work attitude readily settles in equilibrium by the gamification design elements (i.e., points, badges, and leaderboard; Mekler et al., 2017). By comparison, in Narrative Gamification, the positive feedback loop can result in "*virtuous cycle*" such as increased understanding between the gamification system and the worker leads to more interaction, and therefore, more understanding of what they have to do in the future (Page, 2018). Of course, the positive feedback loop, assumed in the Narrative Gamification, would not be always successful for the worker to build up new challenging goals. However, our empirical study hints that the narrative persuasion can provide an opportunity of "*reflection-in-action* (Schön, 1984)" to allow the workers to connect what they have done in the game-world with what they should have done in the real workplace setting.

### 5.3. *Limitations and future studies*

Gamification has been applied in physical workplaces (Funk et al., 2015; Korn, 2012; Warmelink et al., 2018a), but little is known about how the different gamification approaches and concepts affect the manufacturing worker's productivity, emotions, and self-directed work behaviors. This study assumed and empirically tested whether a moral gamification concept with narrative persuasion could be effective against performance-focused gamification. We were particularly interested in the impacts of the moral gamification approach on self-directed behaviors in the work environment, which provides insight into how manufacturing workers could creatively learn, apply, and transfer their work knowledge via different gamified systems (Eisenberger & Shanock, 2003; Gee, 2007b).

Though our moralist approach in the workplace gamification design is an important contribution to the HCI community, we have to confess that it cannot be quantitatively measured for general validity. This question, raised by an anonymous reviewer of a draft of this article, ask what the baseline of

assessing morality would be. It is well acknowledged that morality is neither a solid state of measurement nor a form of personal performance to reach, therefore, we considered it as the worker's self-regulatory process of developing and expressing personal interests and organizational moral standards for performing their duties (see Section 4.3). For example, the worker's self-control (e.g., preparing the BT jobs in advance) and self-monitoring (e.g., paying attention to feedback) behaviors were interpreted as higher morality; conversely, counter-productive behaviors for less morality (e.g., using mobile phones). A more recent development in moral decision-making (e.g., functional magnetic resonance imaging studies; Garrigan et al., 2016; Jung et al., 2016) might suggest a future research direction, and to address the limitation of this article with respect to measuring the baseline of morality.

Our study cannot cover all gamification design issues. The Narrative Gamification used in this study would work well at repetitive and standardized manual jobs, in particular, whereby people could get easily bored. However, other job descriptions or work contexts (e.g., elderly or impaired workers; Korn, 2012) may benefit more from other gamification approaches. In this regard, many scaled-up usability studies would be necessary, but our three stage-gated Goldilocks conditions for workplace gamification (see Figure 5 in Section 2.2) might be cost-effective for the first conception of any gamification design. Neither of these possibilities has been demonstrated empirically before.

It is of course difficult to generalize from the conditions of a controlled, empirical study to more informal workplace conditions. First, the actual working condition may not fully allow the moral motivation to be formed by the Narrative Gamification, owing to social influence. The laboratory study employed in this empirical study can be seen to avoid this effect, but it is imperative to replicate our findings in a real-work. Second, there are mixed results of the gamification by gender (Koivisto & Hamari, 2014; Pedro et al., 2015), which counterintuitively made us design our empirical study with only males (note also that all the HMC manufacturing workers in Korea are males). Other work contexts or demographical profiles should be considered to interpret the effects of Narrative Gamification. Finally, our experiment mimicked a single working day. How our empirical findings can account for one's longer work patterns is still open to question. However, our empirical data can be taken to suggest that, at the very least, Narrative Gamification enhances self-directed goals and self-efficacy, this accordingly motivates the workers to search and challenge other goals, too (Locke & Latham, 2002). The long-term positive effect of Narrative Gamification might reengage employees in forming a new mindset for authentic professionalism and turn to internal motivation to creatively act (e.g., Jong, 2015). This would be a key place that future gamification research needs to focus on.

## Acknowledgments

We thank the anonymous reviewers of the article for their thoughtful comments and constructive suggestions. Two corresponding authors (Hokyoung Ryu and Changho Jung) contributed equally to this manuscript, and the support of Hyundai Motors Company was also important in developing this research.

## Funding

This research was supported by the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (2018X1A3A1070163) and Basic Science Research Program through the NRF funded by the Ministry of Education (2019R1A6A3A12033722).

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## References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alves, A. C., Dinis-Carvalho, J., & Sousa, R. M. (2012). Lean production as promoter of thinkers to achieve companies' agility. *The Learning Organization*, *19*(3), 219–237. https://doi.org/10.1108/09696471211219930

Appel, M., & Richter, T. (2010). Transportation and need for affect in narrative persuasion: A mediated moderation model. *Media Psychology*, *13*(2), 101–135. https://doi.org/10.1080/15213261003799847

Baker, G. P. (1992). Incentive contracts and performance measurement. *Journal of Political Economy*, *100*(3), 598–614. https://doi.org/10.1086/261831

Bandura, A. (1986). *Social foundations of thought and action*. Prentice-Hall.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, *50*(2), 248–287. https://doi.org/10.1016/0749-5978(91)90022-L

Bayne, T., Hohwy, J., & Owen, A. M. (2016). Are there levels of consciousness? *Trends in Cognitive Sciences*, *20*(6), 405–413. https://doi.org/10.1016/j.tics.2016.03.009

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex*, *10*(3), 295–307. https://doi.org/10.1093/cercor/10.3.295

Bendoly, E., Donohue, K., & Schultz, K. L. (2006). Behavior in operations management: Assessing recent findings and revisiting old assumptions. *Journal of Operations Management*, *24*(6), 737–752. https://doi.org/10.1016/j.jom.2005.10.001

Bloch, C. (2002). Moods and quality of life. *Journal of Happiness Studies*, *3*(2), 101–128. https://doi.org/10.1023/A:1019647818216

Bocanegra, B. R., & Zeelenberg, R. (2011). Emotional cues enhance the attentional effects on spatial and temporal resolution. *Psychonomic Bulletin & Review*, *18*(6), 1071–1076. https://doi.org/10.3758/s13423-011-0156-z

Bontchev, B. (2016). Adaptation in affective video games: A literature review. *Cybernetics and Information Technologies*, *16*(3), 3–34. https://doi.org/10.1515/cait-2016-0032

Boucsein, W. (2012). *Electrodermal activity*. Springer Science & Business Media.

Brehm, J. W., & Self, E. A. (1989). The intensity of motivation. *Annual Review of Psychology*, *40*(1), 109–131. https://doi.org/10.1146/annurev.ps.40.020189.000545

Bruursema, K., Kessler, S. R., & Spector, P. E. (2011). Bored employees misbehaving: The relationship between boredom and counterproductive work behaviour. *Work & Stress*, *25*(2), 93–107. https://doi.org/10.1080/02678373.2011.596670

Bryce, J., & Haworth, J. (2002). Wellbeing and flow in sample of male and female office workers. *Leisure Studies*, *21*(3–4), 249–263. https://doi.org/10.1080/0261436021000030687

Burke, B. (2016). *Gamify: How gamification motivates people to do extraordinary things*. Routledge.

Burrows, C. N., & Blanton, H. (2016). Real-world persuasion from virtual-world campaigns: How transportation into virtual worlds moderates in-game influence. *Communication Research*, *43*(4), 542–570. https://doi.org/10.1177/0093650215619215

Busselle, R., & Bilandzic, H. (2009). Measuring narrative engagement. *Media Psychology*, *12*(4), 321–347. https://doi.org/10.1080/15213260903287259

Cable, D. M., Gino, F., & Staats, B. R. (2013). Reinventing employee onboarding. *MIT Sloan Management Review*, *54*(3), 23. https://sloanreview.mit.edu/article/reinventing-employee-onboarding/

Callois, R. (2001). *Man, play, and games in Champaign*. University of Illinois Press.

Chiew, K. S., & Braver, T. S. (2011). Positive affect versus reward: Emotional and motivational influences on cognitive control. *Frontiers in Psychology*, *2*, 279. https://doi.org/10.3389/fpsyg.2011.00279
Choi, I. H., Yoon, D., Chae, S. A., Song, E., & Kim, Y. M. (2018). *2019 Korean Trends*. Macromill Embrain Co.
Choi, M. H., Min, Y. K., Kim, H. S., Kim, J. H., Yeon, H. W., Choi, J. S., Yi, J. H., Park, J.-Y., Jun, J.-H., Yi, J.-H., Tack, G.-R., Chung, S.-C., & Kim, B. (2013). Effects of three levels of arousal on 3-back working memory task performance. *Cognitive Neuroscience*, *4*(1), 1–6. https://doi.org/10.1080/17588928.2011.634064
Clark, M. C., & Rossiter, M. (2008). Narrative learning in adulthood. *New Directions for Adult and Continuing Education*, *2008*(119), 61–70. https://doi.org/10.1002/ace.v2008:119
Cohen, T. R., Panter, A. T., Turan, N., Morse, L., & Kim, Y. (2014). Moral character in the workplace. *Journal of Personality and Social Psychology*, *107*(5), 943. https://doi.org/10.1037/a0037245
Colibazzi, T., Posner, J., Wang, Z., Gorman, D., Gerber, A., Yu, S., Zhu, H., Kangarlu, A., Duan, Y., Russell, J. A., & Peterson, B. S. (2010). Neural systems subserving valence and arousal during the experience of induced emotions. *Emotion*, *10*(3), 377. https://doi.org/10.1037/a0018484
Corazza, G. E., & Agnoli, S. (2018). The creative process in science and engineering. In T. Lubart (Eds.), *The creative process* (pp. 155–180). Palgrave Macmillan.
Csíkszentmihályi, M. (1990). *Flow: The psychology of optimal performance*. Cambridge University Press.
Csíkszentmihályi, M. (1996). *Creativity: The work and lives of 91 eminent people*. HarperCollins.
Csíkszentmihályi, M., & Csíkszentmihályi, I. S. (Eds.). (1992). *Optimal experience: Psychological studies of flow in consciousness*. Cambridge university press.
Csíkszentmihályi, M., & Larson, R. (2014). Validity and reliability of the experience-sampling method. In M. Csíkszentmihályi (Eds.), *Flow and the foundations of positive psychology* (pp. 35–54). Springer.
Currie, G. (2009). Narrative and the psychology of character. *The Journal of Aesthetics and Art Criticism*, *67*(1), 61–71. https://doi.org/10.1111/jaac.2009.67.issue-1
Cybulski, J. L., Keller, S., Nguyen, L., & Saundage, D. (2015). Creative problem solving in digital space using visual analytics. *Computers in Human Behavior*, *42*, 20–35. https://doi.org/10.1016/j.chb.2013.10.061
Dale, S. (2014). Gamification: Making work fun, or making fun of work? *Business Information Review*, *31*(2), 82–90. https://doi.org/10.1177/0266382114538350
Dawson, M. E., Schell, A. M., & Filion, D. L. (2017). The electrodermal system. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Cambridge handbooks in psychology. Handbook of psychophysiology* (pp. 217–243). Cambridge University Press.
De Vaus, D., & De Vaus, D. (2013). *Surveys in social research*. Routledge.
Deci, E. L., & Ryan, R. M. (2010). Intrinsic motivation. In I. B. Weiner & W. E. Craighead (Eds.), *The Corsini Encyclopedia of Psychology* (pp. 1–2). John Wiley & Sons.
Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (pp. 416–436). Sage.
Depura, K., & Garg, M. (2012, December). Application of online gamification to new hire onboarding. In *Proceedings of the ICSEM 2012 conference on services in emerging markets*. IEEE.
Deterding, S. (2012). Gamification: Designing for motivation. *interactions*, *19*(4), 14–17. https://doi.org/10.1145/2212877
Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: Defining gamification. In *Proceedings of the Mindtreck 2011 conference*. ACM.
DeWinter, J., Kocurek, C. A., & Nichols, R. (2014). Taylorism 2.0: Gamification, scientific management and the capitalist appropriation of play. *Journal of Gaming & Virtual Worlds*, *6*(2), 109–127. https://doi.org/10.1386/jgvw.6.2.109_1
Diener, E., Lucas, R. E., & Scollon, C. N. (2009). Beyond the hedonic treadmill: Revising the adaptation theory of well-being. In E. Diener (Ed.), *The science of well-being* (pp. 103–118). Springer.
Dobre, O. I. (2013). Employee motivation and organizational performance. *Review of Applied Socio-economic Research*, *5*(1), 53-60. https://ideas.repec.org/a/rse/wpaper/v5y2013i1p53-60.html
Dolcos, F., Diaz-Granados, P., Wang, L., & McCarthy, G. (2008). Opposing influences of emotional and non-emotional distracters upon sustained prefrontal cortex activity during a delayed-response working memory task. *Neuropsychologia*, *46*(1), 326–335. https://doi.org/10.1016/j.neuropsychologia.2007.07.010
Dolcos, F., Iordan, A. D., & Dolcos, S. (2011). Neural correlates of emotion–cognition interactions: A review of evidence from brain imaging investigations. *Journal of Cognitive Psychology*, *23*(6), 669–694. https://doi.org/10.1080/20445911.2011.594433
Dolcos, F., LaBar, K. S., & Cabeza, R. (2005). Remembering one year later: Role of the amygdala and the medial temporal lobe memory system in retrieving emotional memories. *Proceedings of the National Academy of Sciences*, *102*(7), 2626–2631. https://doi.org/10.1073/pnas.0409848102
Drachen, A., Nacke, L. E., Yannakakis, G., & Pedersen, A. L. (2010, July). Correlation between heart rate, electrodermal activity and player experience in first-person shooter games. In *Proceedings of the SIGGRAPH 2010 symposium on video games*. ACM.

Drivalou, S., & Marmaras, N. (2009). Supporting skill-, rule-, and knowledge-based behaviour through an ecological interface: An industry-scale application. *International Journal of Industrial Ergonomics*, *39*(6), 947–965. https://doi.org/10.1016/j.ergon.2009.08.012

Duval, T. S., Duval, V. H., & Mulilis, J. P. (1992). Effects of self-focus, discrepancy between self and standard, and outcome expectancy favorability on the tendency to match self to standard or to withdraw. *Journal of Personality and Social Psychology*, *62*(2), 340. https://doi.org/10.1037/0022-3514.62.2.340

Easley, D., & Ghosh, A. (2016). Incentives, gamification, and game theory: An economic approach to badge design. *ACM Transactions on Economics and Computation (TEAC)*, *4*(3), 16. https://doi.org/10.1145/2910575

Easton, G. S., & Rosenzweig, E. D. (2012). The role of experience in six sigma project success: An empirical analysis of improvement projects. *Journal of Operations Management*, *30*(7–8), 481–493. https://doi.org/10.1016/j.jom.2012.08.002

Edwards, E. A., Lumsden, J., Rivas, C., Steed, L., Edwards, L. A., Thiyagarajan, A., Taylor, H., Griffiths, C. J., Munafò, M. R., Taylor, S., Walton, R. T., & Sohanpal, S. (2016). Gamification for health promotion: Systematic review of behaviour change techniques in smartphone apps. *BMJ Open*, *6*(10), e012447. https://doi.org/10.1136/bmjopen-2016-012447

Eisenberger, R., Jones, J. R., Stinglhamber, F., Shanock, L., & Randall, A. T. (2005). Flow experiences at work: For high need achievers alone? *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *26*(7), 755–775. https://doi.org/10.1002/()1099-1379

Eisenberger, R., & Selbst, M. (1994). Does reward increase or decrease creativity? *Journal of Personality and Social Psychology*, *66*(6), 1116. https://doi.org/10.1037/0022-3514.66.6.1116

Eisenberger, R., & Shanock, L. (2003). Rewards, intrinsic motivation, and creativity: A case study of conceptual and methodological isolation. *Creativity Research Journal*, *15*(2–3), 121–130. https://doi.org/10.1080/10400419.2003.9651404

Engeser, S., & Baumann, N. (2016). Fluctuation of flow and affect in everyday life: A second look at the paradox of work. *Journal of Happiness Studies*, *17*(1), 105–124. https://doi.org/10.1007/s10902-014-9586-4

Ferreira, A. T., Araújo, A. M., Fernandes, S., & Miguel, I. C. (2017, April). Gamification in the workplace: A systematic literature review. In *Proceedings of the WorldCIST 2017 conference on information systems and technologies* (pp. 283–292). Springer.

Fichtenholtz, H. M., Dean, H. L., Dillon, D. G., Yamasaki, H., McCarthy, G., & LaBar, K. S. (2004). Emotion–attention network interactions during a visual oddball task. *Cognitive Brain Research*, *20*(1), 67–80. https://doi.org/10.1016/j.cogbrainres.2004.01.006

Fisher, C. D. (1993). Boredom at work: A neglected concept. *Human Relations*, *46*(3), 395–417. https://doi.org/10.1177/001872679304600305

Frederick, S., & Loewenstein, G. (1999). 16 Hedonic adaptation. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 302–329). Russell Sage Foundation.

Funk, M., Bächler, A., Bächler, L., Korn, O., Krieger, C., Heidenreich, T., & Schmidt, A. (2015, July). Comparing projected in-situ feedback at the manual assembly workplace with impaired workers. In *Proceedings of the PETRA 2015 conference on pervasive technologies related to assistive environments*. ACM.

Galetta, G. I. U. S. E. P. P. E. (2013). The gamification: Applications and developments for creativity and education. In *Proceedings of the 2013 conference on creativity and innovation in education*. https://doi.org/10.13140/RG.2.2.24817.68965

Garrigan, B., Adlam, A. L., & Langdon, P. E. (2016). The neural correlates of moral decision-making: A systematic review and meta-analysis of moral evaluations and response decision judgements. *Brain and Cognition*, *108*, 88–97. https://doi.org/10.1016/j.bandc.2016.07.007

Gawronski, B., & Strack, F. (Eds.). (2012). *Cognitive consistency: A fundamental principle in social cognition*. Guilford press.

Gee, J. P. (2007a). *Good video games+ good learning: Collected essays on video games, learning, and literacy* (Vol. 27). Peter Lang.

Gee, J. P. (2007b). Pleasure, learning, video games, and life: The projective stance. In M. Knobel & C. Lankshear (Eds.), *A New Literacies Sampler* (pp. 95–113). Peter Lang.

Gerrig, R. J., & Prentice, D. A. (1996). Notes on audience response. In D. Bordwell & N. Carroll (Eds.), *Post-theory: Reconstructing film studies* (pp. 388–403). University of Wisconsin Press.

Goldenhar, L. M., Hecker, S., Moir, S., & Rosecrance, J. (2003). The "Goldilocks model" of overtime in construction: Not too much, not too little, but just right. *Journal of Safety Research*, *34*(2), 215–226. https://doi.org/10.1016/S0022-4375(03)00010-0

Grant, A. M. (2008). The significance of task significance: Job performance effects, relational mechanisms, and boundary conditions. *Journal of Applied Psychology*, *93*(1), 108. https://doi.org/10.1037/0021-9010.93.1.108

Graybiel, A. M. (2008). Habits, rituals, and the evaluative brain. *Annual Review of Neuroscience*, *31*(1), 359–387. https://doi.org/10.1146/annurev.neuro.29.051605.112851

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, *79*(5), 701. https://doi.org/10.1037/0022–3514.79.5.701

Green, M. C., & Brock, T. C. (2002). In the mind's eye: Transportation-imagery model of narrative persuasion. In M. C. Green, J. J. Strange, & T. C. Brock (Eds.), *Narrative impact: Social and cognitive foundations* (pp. 315–341). Lawrence Erlbaum Associates Publishers.

Green, M. C., Brock, T. C., & Kaufman, G. F. (2004). Understanding media enjoyment: The role of transportation into narrative worlds. *Communication Theory*, *14*(4), 311–327. https://doi.org/10.1111/comt.2004.14.issue-4

Green, M. C., Strange, J. J., & Brock, T. C. (2003). *Narrative impact: Social and cognitive foundations*. Psychology Press.

Greene, J. D. (2013). *Moral tribes: Emotion, reason, and the gap between us and them*. Penguin.

Griggs, R. A. (2010). *Psychology: A concise introduction*. Macmillan.

Guegan, J., Buisine, S., Mantelet, F., Maranzana, N., & Segonds, F. (2016). Avatar-mediated creativity: When embodying inventors makes engineers more creative. *Computers in Human Behavior*, *61*, 165–175. https://doi.org/10.1016/j.chb.2016.03.024

Haidt, J. (2007). The new synthesis in moral psychology. *science*, *316*(5827), 998–1002. https://doi.org/10.1126/science.1137651

Hall, A. (2003). Reading realism: Audiences' evaluations of the reality of media texts. *Journal of Communication*, *53*(4), 624–641. https://doi.org/10.1111/j.1460-2466.2003.tb02914.x

Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?–a literature review of empirical studies on gamification. In *Proceedings of the HICSS 2014 conference on system sciences*. IEEE.

Hammack, P. L. (2008). Narrative and the cultural psychology of identity. *Personality and Social Psychology Review*, *12*(3), 222–247. https://doi.org/10.1177/1088868308316892

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, *80*, 152–161. https://doi.org/10.1016/j.compedu.2014.08.019

Hektner, J. M., Schmidt, J. A., & Csíkszentmihályi, M. (2007). *Experience sampling method: Measuring the quality of everyday life*. Sage.

Heron, M. J., & Belford, P. H. (2019). Do you feel like a hero yet? *Journal of Games Criticism*, *1*(2), 1-22. http://gamescriticism.org/articles/heronbelford-1-2

Hidi, S., Renninger, K. A., & Krapp, A. (2004). Interest, a motivational variable that combines affective and cognitive functioning. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 89–115). Erlbaum.

Hinyard, L. J., & Kreuter, M. W. (2007). Using narrative communication as a tool for health behavior change: A conceptual, theoretical, and empirical overview. *Health Education & Behavior*, *34*(5), 777–792. https://doi.org/10.1177/1090198106291963

Holmström, B. (1979). Moral hazard and observability. *The Bell Journal of Economics*, *10*(1), 74–91. https://doi.org/10.2307/3003320

Hosmer, L. T., & Kiewitz, C. (2005). Organizational justice: A behavioral science concept with critical implications for business ethics and stakeholder theory. *Business Ethics Quarterly*, *15*(1), 67–91. https://doi.org/10.5840/beq20051513

Janakiraman, S. N., Lambert, R. A., & Larcker, D. F. (1992). An empirical investigation of the relative performance evaluation hypothesis. *Journal of Accounting Research*, *30*(1), 53–69. https://doi.org/10.2307/2491091

Jenkins, H. (2004). Game design as narrative. *Computer*, *44*(53), 118–130. https://blogs.bgsu.edu/honors1120/files/2013/08/Jenkins_Narrative_Architecture.pdf

Jong, M. S. (2015). Does online game-based learning work in formal education at school? A case study of VISOLE. *The Curriculum Journal*, *26*(2), 249–267. https://doi.org/10.1080/09585176.2015.1018915

Judge, T. A., & Bono, J. E. (2001). Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. *Journal of Applied Psychology*, *86*(1), 80. https://doi.org/10.1037/0021-9010.86.1.80

Jung, W. H., Prehn, K., Fang, Z., Korczykowski, M., Kable, J. W., Rao, H., & Robertson, D. C. (2016). Moral competence and brain connectivity: A resting-state fMRI study. *Neuroimage*, *141*, 408–415. https://doi.org/10.1016/j.neuroimage.2016.07.045

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. John Wiley & Sons.

Kapp, K. M. (2016). Gamification designs for instruction. In C. M. Reigeluth, B. J. Beatty, & R. D. Myers (Eds.), *Instructional-design theories and models* (Vol. IV, pp. 367–400). Routledge.

Keen, S. (2011). Fast tracks to narrative empathy: Anthropomorphism and dehumanization in graphic narratives. *SubStance*, *40*(1), 135–155. https://doi.org/10.1353/sub.2011.0003

Kim, J., & Ryu, H. (2014). A design thinking rationality framework: Framing and solving design problems in early concept generation. *Human–Computer Interaction*, *29*(5–6), 516–553. https://doi.org/10.1080/07370024.2014.896706

Kim, T. W. (2018). Gamification of labor and the charge of exploitation. *Journal of Business Ethics*, *152*(1), 27–39. https://doi.org/10.1007/s10551-016-3304-6

Kivikangas, J. M. (2006). *Psychophysiology of flow experience: An explorative study*. Unpublished master's thesis, University of Helsinki.
Kohn, A. (1999). *Punished by rewards: The trouble with gold stars, incentive plans, A's, praise, and other bribes*. Houghton Mifflin Harcourt.
Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. *Computers in Human Behavior*, *35*, 179–188. https://doi.org/10.1016/j.chb.2014.03.007
Korn, O. (2012, June). Industrial playgrounds: How gamification helps to enrich work for elderly or impaired persons in production. In *Proceedings of the EICS 2012 symposium on engineering interactive computing systems*. ACM.
Korn, O., Funk, M., & Schmidt, A. (2015, June). Towards a gamification of industrial production: A comparative study in sheltered work environments. In *Proceedings of the EICS 2015 symposium on engineering interactive computing systems*. ACM.
Korn, O., Schmidt, A., & Hörz, T. (2012, June). Assistive systems in production environments: Exploring motion recognition and gamification. In *Proceedings of the PETRA 2012 conference on pervasive technologies related to assistive environments*. ACM.
Kramlinger, T., & Huberty, T. (1990). Behaviorism versus humanism. *Training & Development Journal*, *44*(12), 41–46. https://eric.ed.gov/?id=EJ417739
Kumar, J. (2013, July). Gamification at work: Designing engaging business software. In *International conference of design, user experience, and usability* (pp. 528–537). Springer.
Lee, H., Shin, J., Jung, C., Seo, K., & Ryu, H. B. (2016, January). On the gamification for the automotive manufacturing environment. In *Proceedings of the FISITA 2016 World Automotive Congress*. FISITA.
Lee, J., Kim, J., Seo, K., Roh, S., Jung, C., Lee, H., Shin, J., Choi, G., & Ryu, H. (2016). A case study in an automotive assembly line: Exploring the design framework for manufacturing gamification. In C. Schlick & S. Trzcieliński (Eds.), *Advances in ergonomics of manufacturing: Managing the enterprise of the future* (pp. 305–317). Springer.
Lewis, P. V. (1985). Defining 'business ethics': Like nailing jello to a wall. *Journal of Business Ethics*, *4*(5), 377–383. https://doi.org/10.1007/BF02388590
Li, X., Wang, T., & Wang, H. (2017, March). Exploring n-gram features in clickstream data for MOOC learning achievement prediction. In *Proceedings of the DASFAA 2017 conference on database systems for advanced applications* (pp. 328–339). Springer.
Lindsley, D. B. (2018). Neural mechanisms of arousal, attention, and information processing. In J. Orbach (Ed.), *Neuropsychology After Lashley* (pp. 315–408). Routledge.
Liu, D., Santhanam, R., & Webster, J. (2017). Toward meaningful engagement: A framework for design and research of gamified information systems. *MIS Quarterly*, *41*(4), 1011–1034. https://doi.org/10.25300/MISQ/2017/41.4.01
Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, *57*(9), 705. https://doi.org/10.1037/0003-066X.57.9.705
Lopez, S. (2011). *Disneyland workers answer to "electronic whip"*. Los Angeles Times. Retrieved February 2, 2013, from https://www.latimes.com/health/la-xpm-2011-oct-19-la-me-1019-lopez-disney-20111018-story.html
Lord, R. G., & Hanges, P. J. (1987). A control system model of organizational motivation: Theoretical development and applied implications. *Behavioral Science*, *32*(3), 161–178. https://doi.org/10.1002/()1099-1743
Mandryk, R. L., Inkpen, K. M., & Calvert, T. W. (2006). Using psychophysiological techniques to measure user experience with entertainment technologies. *Behaviour & Information Technology*, *25*(2), 141–158. https://doi.org/10.1080/01449290500331156
Mann, S. (2007). The boredom boom. *The Psychologist*, *20*(2), 90–93. https://psycnet.apa.org/record/2007-03174-004
Mathieu, J. E., & Zajac, D. M. (1990). A review and meta-analysis of the antecedents, correlates, and consequences of organizational commitment. *Psychological Bulletin*, *108*(2), 171. https://doi.org/10.1037/0033-2909.108.2.171
Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013, October). Do points, levels and leaderboards harm intrinsic motivation?: An empirical analysis of common gamification elements. In *Proceedings of the Gamification 2013 Conference on gameful design, research, and applications*. ACM.
Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, *71*, 525–534. https://doi.org/10.1016/j.chb.2015.08.048
Mesquida, A. L., Jovanovic, M., & Mas, A. (2016, September). Process improving by playing: Implementing best practices through business games. In *Proceedings of the EuroSPI 2016 conference on software process improvement*. Springer.
Michalos, G., Makris, S., Papakostas, N., Mourtzis, D., & Chryssolouris, G. (2010). Automotive assembly technologies review: Challenges and outlook for a flexible and adaptive approach. *CIRP Journal of Manufacturing Science and Technology*, *2*(2), 81–91. https://doi.org/10.1016/j.cirpj.2009.12.001
Mollick, E., & Werbach, K. (2015). Gamification and the enterprise. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp. 439–458). MIT Press.
Montano, D. E., & Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior: Theory, research and practice* (pp. 95–124). John Wiley & Sons.

Moore, C. (2015). Moral disengagement. *Current Opinion in Psychology*, *6*, 199–204. https://doi.org/10.1016/j.copsyc.2015.07.018
Murphy, S. T., Frank, L. B., Chatterjee, J. S., & Baezconde-Garbanati, L. (2013). Narrative versus nonnarrative: The role of identification, transportation, and emotion in reducing health disparities. *Journal of Communication*, *63*(1), 116–137. https://doi.org/10.1111/jcom.2013.63.issue-1
Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014, June). Gamification of education: A review of literature. In N. Fiona (Eds.), In *International conference on hci in business* (pp. 401–409). Springer.
Nakamura, J., & Csíkszentmihályi, M. (2014). The concept of flow. In M. Csíkszentmihályi (Ed.), *Flow and the foundations of positive psychology* (pp. 239–263). Springer.
Nera, K., Pantazi, M., & Klein, O. (2018). "These are just Stories, Mulder": Exposure to conspiracist fiction does not produce narrative persuasion. *Frontiers in Psychology*, *9*, 684. https://doi.org/10.3389/fpsyg.2018.00684
Nicholson, S. (2015). A recipe for meaningful gamification. In T. Reiners & L. C. Wood (Eds.), *Gamification in education and business* (pp. 1–20). Springer.
Oprescu, F., Jones, C., & Katsikitis, M. (2014). I PLAY AT WORK—ten principles for transforming work processes through gamification. *Frontiers in Psychology*, *5*, 14. https://doi.org/10.3389/fpsyg.2014.00014
Page, S. E. (2018). *The model thinker: What you need to know to make data work for you*. Hachette UK.
Pedro, L. Z., Lopes, A. M., Prates, B. G., Vassileva, J., & Isotani, S. (2015, April). Does gamification work for boys and girls?: An exploratory study with a virtual learning environment. In *Proceedings of the SAC 2015 symposium on applied computing* (pp. 214–219). ACM.
Peifer, C. (2012). Psychophysiological correlates of flow-experience. In S. Engeser (Ed.), *Advances in flow research* (pp. 139–164). Springer.
Peng, W. (2009). Design and evaluation of a computer game to promote a healthy diet for young adults. *Health Communication*, *24*(2), 115–127. https://doi.org/10.1080/10410230802676490
Pessoa, L. (2008). On the relationship between emotion and cognition. *Nature Reviews Neuroscience*, *9*(2), 148. https://doi.org/10.1038/nrn2317
Pessoa, L. (2009). How do emotion and motivation direct executive control? *Trends in Cognitive Sciences*, *13*(4), 160–166. https://doi.org/10.1016/j.tics.2009.01.006
Pessoa, L., & Engelmann, J. B. (2010). Embedding reward signals into perception and cognition. *Frontiers in Neuroscience*, *4*, 17. https://doi.org/10.3389/fnins.2010.00017
Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2014). Making work fun: Investigating antecedents of perceived enjoyment in human computation games for information sharing. *Computers in Human Behavior*, *39*, 88–99. https://doi.org/10.1016/j.chb.2014.06.023
Pfaff, D. W. (2006). *Brain arousal and information theory: Neural and genetic mechanisms*. Harvard University Press.
Phelps, E. A. (2004). Human emotion and memory: Interactions of the amygdala and hippocampal complex. *Current Opinion in Neurobiology*, *14*(2), 198–202. https://doi.org/10.1016/j.conb.2004.03.015
Phelps, E. A. (2006). Emotion and cognition: Insights from studies of the human amygdala. *Annual Review of Psychology*, *57*(1), 27–53. https://doi.org/10.1146/annurev.psych.56.091103.070234
Phelps, E. A., Ling, S., & Carrasco, M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, *17*(4), 292–299. https://doi.org/10.1111/j.1467-9280.2006.01701.x
Pivetti, M., Camodeca, M., & Rapino, M. (2016). Shame, guilt, and anger: Their cognitive, physiological, and behavioral correlates. *Current Psychology*, *35*(4), 690–699. https://doi.org/10.1007/s12144-015-9339-5
Prendergast, C. (1999). The provision of incentives in firms. *Journal of Economic Literature*, *37*(1), 7–63. https://doi.org/10.1257/jel.37.1.7
Prensky, M. (2001). Fun, play and games: What makes games engaging. *Digital Game-based Learning*, *5*(1), 5–31. http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Game-Based%20Learning-Ch5.pdf
Qiao, D., Lee, S. Y., Whinston, A., & Wei, Q. (2017). Overcoming the crowding-out effect of monetary incentive on pro-social behavior. In *Proceedings of the ICIS 2017 conference on information systems*. AIS.
Railton, P. (2014). The affective dog and its rational tale: Intuition and attunement. *Ethics*, *124*(4), 813–859. https://doi.org/10.1086/675876
Rasmussen, J. (1983). Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models. *IEEE Transactions on Systems, Man, and Cybernetics, SMC-13*(3), 257–266. https://doi.org/10.1109/TSMC.1983.6313160
Rogstadius, J., Kostakos, V., Kittur, A., Smus, B., Laredo, J., & Vukovic, M. (2011, July). An assessment of intrinsic and extrinsic motivation on task performance in crowdsourcing markets. In *Proceedings of the AAAI 2011 conference on weblogs and social media*. AAAI.
Roh, S., Seo, K., Lee, J., Kim, J., Ryu, H. B., Jung, C., Lee, H, & Shin, J. (2016). Goal-based manufacturing gamification: Bolt tightening work redesign in the automotive assembly line. In S. Trzcieliõski (Ed.), *Advances in ergonomics of manufacturing: Managing the enterprise of the future* (pp. 293–304). Springer.
Roy, D. F. (1959). Banana time": Job satisfaction and informal interaction. *Human Organization*, *18*(4), 158. https://doi.org/10.17730/humo.18.4.07j88hr1p4074605

Rubin, D. C. (2005). A basic-systems approach to autobiographical memory. *Current Directions in Psychological Science*, *14*(2), 79–83. https://doi.org/10.1111/j.0963-7214.2005.00339.x
Rusou, Z., Zakay, D., & Usher, M. (2013). Pitting intuitive and analytical thinking against each other: The case of transitivity. *Psychonomic Bulletin & Review*, *20*(3), 608–614. https://doi.org/10.3758/s13423-013-0382-7
Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*(1), 54–67. https://doi.org/10.1006/ceps.1999.1020
Samnani, A. K., Salamon, S. D., & Singh, P. (2014). Negative affect and counterproductive workplace behavior: The moderating role of moral disengagement and gender. *Journal of Business Ethics*, *119*(2), 235–244. https://doi.org/10.1007/s10551-013-1635-0
Santrock, J. W. (2017). *A topical approach to lifespan development* (9th ed.). McGraw-Hill College.
Schaufeli, W. B., & Salanova, M. A. R. I. S. A. (2014). Burnout, boredom and engagement at the workplace. In M. C. W. Peters, J. de Jonge, & T. W. Taris (Eds.), *People at work: An introduction to contemporary work psychology* (pp. 293–320). John Wiley & Sons, Ltd.
Schön, D. A. (1984). *The reflective practitioner: How professionals think in action* (1st ed.). Routledge.
Schupp, H. T., Flaisch, T., Stockburger, J., & Junghöfer, M. (2006). Emotion and attention: Event-related brain potential studies. *Progress in Brain Research*, *156*, 31–51. https://doi.org/10.1016/S0079-6123(06)56002-9
Schuster, M. (2006). The concept of creativity–and everyday creativity. *Psychiatria Hungarica: A Magyar Pszichiatriai Tarsasag Tudomanyos Folyoirata*, *21*(4), 279–287. https://europepmc.org/article/med/17170469
Seo, K., Ryu, H., & Kim, J. (2018). Can serious games assess decision-making biases? Comparing gaming performance, questionnaires, and interviews. *European Journal of Psychological Assessment, 36*(1), 44-55. https://doi.org/10.1027/1015-5759/a000485
Shapiro, S. P. (2005). Agency theory. *Annual Review of Sociology*, *31*(1), 263–284. https://doi.org/10.1146/annurev.soc.31.041304.122159
Slater, M. D., & Rouner, D. (2002). Entertainment—education and elaboration likelihood: Understanding the processing of narrative persuasion. *Communication Theory*, *12*(2), 173–191. https://doi.org/10.1111/j.1468-2885.2002.tb00265.x
Sommer, K. L., & Baumeister, R. F. (2002). Self-evaluation, persistence, and performance following implicit rejection: The role of trait self-esteem. *Personality and Social Psychology Bulletin*, *28*(7), 926–938. https://doi.org/10.1177/01467202028007006
Spector, P. E., & Fox, S. (2002). An emotion-centered model of voluntary work behavior: Some parallels between counterproductive work behavior and organizational citizenship behavior. *Human Resource Management Review*, *12*(2), 269–292. https://doi.org/10.1016/S1053–4822(02)00049-9
Stand, J. (2000). The" Hawthorne effect"-what did the original Hawthorne studies actually show. *Scandinavian Journal of Work, Environment & Health*, *26*(4), 363–367. https://www.jstor.org/stable/40967074
Stepanovic, S., & Mettler, T. (2018, June). Gamification applied for health promotion: Does it really foster long-term engagement? A scoping review. In *Proceedings of the ECIS 2018 conference on information systems*. AIS.
Studer, B., & Knecht, S. (2016). A benefit–cost framework of motivation for a specific activity. In B. Studer & S. Knecht (Eds.), *Progress in brain research* (Vol. 229, pp. 25–47). Elsevier.
Taylor, F. W. (2004). *Scientific management*. Routledge.
Teper, R., Zhong, C. B., & Inzlicht, M. (2015). How emotions shape moral behavior: Some answers (and questions) for the field of moral psychology. *Social and Personality Psychology Compass*, *9*(1), 1–14. https://doi.org/10.1111/spc3.12154
Tsuchiya, N., & Adolphs, R. (2007). Emotion and consciousness. *Trends in Cognitive Sciences*, *11*(4), 158–167. https://doi.org/10.1016/j.tics.2007.01.005
Turkyilmaz, A., Akman, G., Ozkan, C., & Pastuszak, Z. (2011). Empirical study of public sector employee loyalty and satisfaction. *Industrial Management & Data Systems*, *111*(5), 675–696. https://doi.org/10.1108/02635571111137250
Uddin, N., & Gillett, P. R. (2002). The effects of moral reasoning and self-monitoring on CFO intentions to report fraudulently on financial statements. *Journal of Business Ethics*, *40*(1), 15–32. https://doi.org/10.1023/A:1019931524716
Ulrich, C. M., & Grady, C. (2004). Financial incentives and response rates in nursing research. *Nursing Research*, *53*(2), 73–74. https://doi.org/10.1097/00006199-200403000-00001
Van der Heijden, G. A., Schepers, J. J., & Nijssen, E. J. (2012). Understanding workplace boredom among white collar employees: Temporary reactions and individual differences. *European Journal of Work and Organizational Psychology*, *21*(3), 349–375. https://doi.org/10.1080/1359432X.2011.578824
Van Hooff, M. L., & Van Hooft, E. A. (2014). Boredom at work: Proximal and distal consequences of affective work-related boredom. *Journal of Occupational Health Psychology*, *19*(3), 348. https://doi.org/10.1037/a0036821
Van Tilburg, W. A., & Igou, E. R. (2012). On boredom: Lack of challenge and meaning as distinct boredom experiences. *Motivation and Emotion*, *36*(2), 181–194. https://doi.org/10.1007/s11031-011-9234-9
Wang, Y., Chen, J., & Yue, Z. (2017). Positive emotion facilitates cognitive flexibility: An fMRI study. *Frontiers in Psychology*, *8*, 1832. https://doi.org/10.3389/fpsyg.2017.01832

Warmelink, H., Koivisto, J., Mayer, I., Vesa, M., & Hamari, J. (2018a). Gamification of production and logistics operations: Status quo and future directions. *Journal of Business Research*, *106*, 331–340. https://doi.org/10.1016/j.jbusres.2018.09.011

Warmelink, H., Koivisto, J., Mayer, I., Vesa, M., & Hamari, J. (2018b). Gamification of the work floor: A literature review of gamifying production and logistics operations. In *Proceedings of the HICSS 2018 conference on system sciences*. AIS.

Weinstein, N., & Ryan, R. M. (2011). A self-determination theory approach to understanding stress incursion and responses. *Stress and Health*, *27*(1), 4–17. https://doi.org/10.1002/smi.v27.1

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Wood, S., & De Menezes, L. M. (1998). High commitment management in the UK: Evidence from the workplace industrial relations survey, and employers' manpower and skills practices survey. *Human Relations*, *51*(4), 485–515. https://doi.org/10.1177/001872679805100403

Wood, S., & De Menezes, L. M. (2011). High involvement management, high-performance work systems and well-being. *The International Journal of Human Resource Management*, *22*(7), 1586–1610. https://doi.org/10.1080/09585192.2011.561967

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, *18*(5), 459–482. https://doi.org/10.1002/()1550-7149