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Gamification of Visual Search in Real World Scenes

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GAMIFICATION OF VISUAL SEARCH IN REAL WORLD SCENES

by

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ABSTRACT

Gamification, or the application of game-like features in non-game contexts, has been growing in popularity over the last five years. Specifically, the successful gamification of applications (such as Waze, Foursquare, and Fitocracy) has begun a spike in gamification of more complex tasks, such as learning to use AutoCAD or Photoshop. However, much is unknown about the psychological mapping of gamification or how it translates to behavioral outcomes. This dissertation aims to compare three distinct styles of gamification (avatars, points and feedback, and leaderboards) onto the three basic psychological needs (autonomy, competence, and relatedness). It will assess behavioral outcomes on a visual search task when gamification styles are used separately, compared against all three styles used in concert. The task chosen is a camouflage visual search task. This task was selected because it is both boring (as indicated by the Flow Short Scale) and difficult (as indicated by previous work). These features make it the ideal task to gamify. Results indicated that only in the full gamification condition was response time significantly faster than in the control condition, or no gamification. However, ANOVA evaluating differences in enjoyment, motivation, and stress indicated differences among the groups, suggesting that gamification may elicit psychological outcomes that may not necessarily manifest into behavioral outcomes. ANCOVA were used to evaluate group differences using relevant survey measures as covariates. These tests indicated differences among groups in all behavioral measures, though these differences were most pronounced in response time measures. Future directions involving gamification based on personality type, as well as suggestions on best practice for gamification in the future are discussed.

This dissertation is dedicated to my younger, yet wiser brother, Russell.

ACKNOWLEDGMENTS

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CHAPTER ONE: INTRODUCTION

The theory of gamification is a marriage of thought from both the learning and motivation domains. Gamification is defined as "the use of video game elements...in non-gaming systems to improve user experience and user engagement in non-game services and applications" (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). It combines what we understand about how individuals are motivated to complete tasks of their own volition (Ryan & Deci, 2000) with the idea that learning outcomes can be mediated or moderated by various interventions (Landers, Bauer, Callan & Armstrong, 2015). While the notion of using game-like elements as a supplement to education has existed in the literature since the 1980s (Dominguez et al., 2013), the label of "gamification" and study of its unique elements and effects is relatively new (Linehan, Kirman, Lawson & Chan, 2011).

Gamification

The blanket term of gamification has been used in a variety of contexts to mean a variety of things. For example, gamification of a system can be created with the sole purpose of increasing engagement among its users (Kapp, 2012). Alternatively, gamification as a means to enhance engagement can be seen as a primary bolstering agent for behavioral change (Zichermann & Cunningham, 2011). While these cases may not be mutually exclusive, the gamification agent chosen to implement within the system should be dependent on the desired outcome of the intervention. If you wish to increase engagement, adding an avatar selection or creating a GUI may increase users' time within the system. However, if you desire behavioral change, the engagement itself must be tailored toward a skill or behavior that you believe will lead to some outcome, such as increased performance. In either case, the use of gamified

elements in instructional design and education is a growing style of intervention, despite a lack of understanding of the effects of various gamification agents. For example, the implementation of leaderboards is growing in popularity among courses (Barata, Gama, Jorge & Goncalves, 2013); points and badges are commonly used in gamification of applied training (Li, Grossman & Fitzmaurice, 2012).

Video games are a very strong example of intrinsic motivation, or motivation to do a task purely driven by enjoyment or satisfaction. Often, people can play video games for hours on end, even when their performance isn't extraordinary, just because the task is personally rewarding (Dominquez et al., 2013). We find video games personally rewarding along several dimensions. For example, video games are thought to connect perception, cognition and emotion with particular actions. This in turn relates visual presentation with an input decided entirely by the user, offering a sense of control within the interaction (Shinkle, 2008).

Using video games to encourage learning for children and young adults has been popular since the 1990s. JumpStart, a series of educational computer games, used engaging storylines, puzzles, and action to encourage students to answer questions directed toward a specific curriculum (for example, JumpStart Math for 2nd graders included fractions and basic geometry). Educational games for children have had their own line of research for some time, finding mixed results as to the efficacy of these games (Linehan, Kirman, Lawson & Chan, 2011). However, it is also pointed out by Linehan et al. that motivation and time-on-task are strong predictors of student learning and achievement, which are both targeted by game based learning (2011). In this literature, the concept of "intrinsic learning" is what makes an educational game successful. If a game requires the participant to learn in order to win, then

intrinsic learning is present, and the educational game is successful at teaching. If it is not required to learn in order to progress, then the game is unsuccessful.

Learning: Operant Conditioning

When answering the question of "why does gamification work," we can look all the way back to operant conditioning for an answer (Antin & Churchill, 2011; Evans, Jennings & Andreen, 2011). Operant conditioning, which involves three component parts (an antecedent, a behavior, and a consequence), is affected by reinforcing or punishing responses. This is called shaping (Skinner, 1953). Reinforcement of responses will increase their frequency, while punishment will decrease them - shaping relies on reinforcement of a behavior without explicitly saying that the behavior is being suggested.

Gamification presents a means to reinforce behaviors; for example, providing a user with a badge for walking three miles will encourage the user to walk, without suggesting that the primary behavior is to exercise. If a reward in-game is presented for pressing a button quickly many times, this skill will be reinforced as an important one, and may affect the learning outcome if speed is a necessary mechanic to achieving the goal. While reinforcement is key to the encouragement of a behavior and its repetition, it is motivation that encourages the user to initially engage in the desired behavior.

Theories of Motivation

Intrinsic motivation and its sister, extrinsic motivation, are the product of decades of research by Deci and Ryan (see Deci & Ryan, 2000 for a review). The division of motivation into two unique sources comes from the idea of locus of causality. A locus of causality refers to

where the source of the motivation is coming from, and can take either an internal (intrinsic) or external (extrinsic) form. This was initially studied in terms of Cognitive Evaluation Theory, or CET (Deci, 1975).

Cognitive Evaluation Theory

CET was used to evaluate how external factors influenced an individual's internal motivation to do something or complete some task. Essentially, Deci discovered that some external reward, such as a raise or a promotion, reduced the internal reward one felt by moving the locus of causality from internal to external. As an example, imagine that you are a photographer. You've recently been hired by a magazine on a pay-per-photo basis. Each week, you must submit 50 photographs to be considered for print, which your employer will review against other photographer's weekly photos to choose which will be printed. The content of your photographs and rate of capture must shift to meet these new, external requirements, as you are rewarded with money if you have the winning photographs. In this case, any internal satisfaction and reward you feel at being a photographer and taking a photograph you are proud of dwindles in the face of the external reward of money and praise by your boss. CET was limited in its scope, however, as it only focused on tasks that have intrinsic value. CET evolved from here, becoming a sub-theory of Self-Determination Theory, or SDT (Deci, 1980).

Self-Determination Theory

SDT posits that extrinsic and intrinsic motivation lie on a continuum branching from one to the other, and are not mutually exclusive. While intrinsic motivation may correspond with higher quality of learning and higher creativity (Ryan & Deci, 2000), both intrinsic and extrinsic

motivation have been found to be effective at motivating individuals to complete tasks (Landers et al., 2015). Despite this, learners who are motivated through intrinsic goals scored higher on tests, were more engaged with the task at hand, and tend to retain learned content longer (Pintrich & DeGroot, 1990; Vansteenkiste, Simons, Lens, Sheldon, and Deci, 2004). Consider the photography example from above. Perhaps when you started as a photographer, you explored different content and stylistic risks, finding that you loved photographing cityscapes and buildings. However, the magazine that hired you focuses on nature, so 80% of the photographs they buy are images of animals and plants. Because of this, the creativity and exploratory nature of your photography is bound by external motivators that limit your scope. Again, the locus of causality is external, and it binds the internal reward you once felt from photography. While this is an extreme example, there are states of motivation where external and internal motivators exist at different degrees.

Intrinsic Motivation vs. Amotivation

Consider a continuum where intrinsic motivation is at the far right end, and amotivation at the far left (Figure 1). Amotivation is a state completely lacking in desire to work at or put effort into a task. It includes feelings such as “my action will have no effect on some outcome”, or “there’s no point in trying”. This is a state of 100% external locus of causality, and a complete absence of competence. Imagine you are in a Calculus class, and the content is very challenging. After failing the first two tests, you know that only a perfect grade on the final test will give you a C in the course, but with the struggle you've felt so far, you cannot find the motivation to study, as you feel there is nothing you can do to get a perfect score. The outcome is unobtainable. This is a state of amotivation.

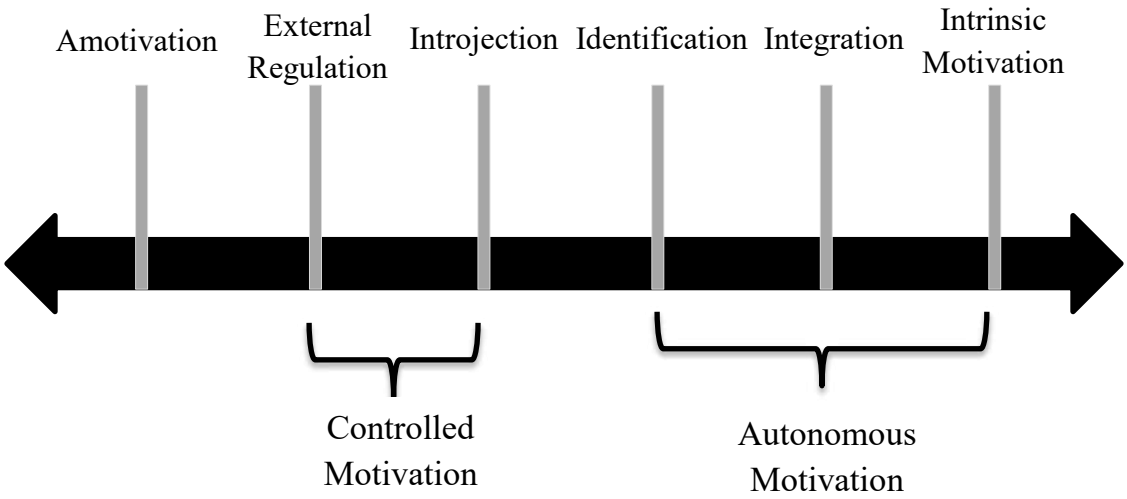


Figure 1. A continuum representing the states between amotivation, or the absence of motivation entirely, and intrinsic motivation, or motivation to act based on merit and enjoyment alone. This continuum is can also be viewed as controlled and autonomous motivation.

Moving to the right, the next state would be external regulation. This state is again characterized by an external locus of causality, but also features the need to achieve the external reward as a slight movement toward motivation. Perhaps you realize that you overlooked an extra credit assignment, and if you complete that, you only need a 90% on your last test to pass Calculus. You need a passing grade, and now that the goal is more attainable, you feel a little more motivated, but you do not want to waste time studying for something almost impossible to achieve.

Following external regulation is introjection, which introduces the interaction of self-esteem. If you don't study for this test, you will let down your study group, who relies on your contributions. You may let yourself down by failing a course. Either way, this state still features

an external locus of causality and a need to achieve an external reward, despite the goals being slightly internalized to permit some self-regulatory behavior.

The next state on the right is identification. Identification involves the knowledge that what you are doing (in this case studying for your Calculus test) will somehow help you achieve your own goals. This shifts the locus of causality from completely external to a blend of external and internal. Perhaps you know that if you fail Calculus, you will be kicked out of your Engineering major, and you have a lifelong passion to be an Engineer. If the course at hand feels like it will teach you necessary skills and knowledge to become an Engineer, the motivation to do well becomes both external (I have to pass to stay in my major) and internal (I want to be an Engineer, and this will help me do it).

The second to last state is integration, a state with a large association to one's internal locus of causality. Integration is characterized by the feeling that you know an external reward is in store, and it holds value to you (staying in your major), but you want to do well because you get satisfaction in what you are doing (Calculus is essential to an Engineer).

The final state is intrinsic motivation, where the external reward, even if it is present, is entirely irrelevant, and the task is enjoyed purely for the internal satisfaction experienced engaging in it. This state has a full internal locus of causality, and can be thought of as wanting to do well in Calculus because Calculus is engaging, interesting, and important for your career. These states can be broken up into larger categories of controlled motivation (external regulation and introjection) and autonomous motivation (identification, integration, and intrinsic motivation). Autonomous motivation states increase flexible thinking, learning, and problem solving (McDaniel, 2011).

Basic Psychological Needs

SDT features three psychological needs that must be satisfied to achieve intrinsic motivation, which are autonomy, competence, and relatedness (see Figure 2). Autonomy, or control over the task or situation, involves the knowledge that you are in charge and making the decisions. Competence refers simply to how comfortable you feel with your knowledge of the current task or situation. Finally, you feel relatedness when you feel a sense of belonging associated with a common goal. These needs can be assessed using the Basic Psychological Needs Scale, or BPNS, which evaluates to what degree each of these three needs are satisfied in your day to day life (Deci et al., 2001).

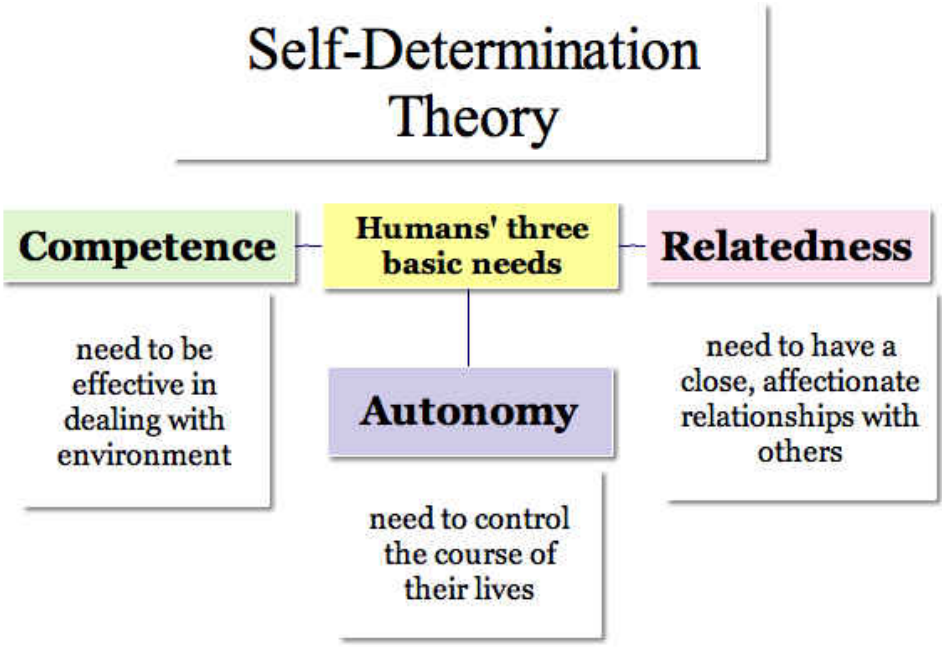


Figure 2. The features of self-determination theory, which are called the "three basic needs". These needs are competence, autonomy, and relatedness. Reprinted from "What is Self Determination Theory" in *Positive Psychology Program,* by N. Tran, 2014. Copyright PPP, 2014.

The relationship between gamification and intrinsic motivation posits that the three basic psychological needs of SDT are also the domains affected by different gamified agents (Aparicio, Vela, Sanchez & Montes, 2012). For example, the use of a leaderboard may raise the user's feeling of relatedness, as it relates their performance to that of others, sharing a common goal. Competence can be achieved using progressive feedback, or feedback that changes based on the user's response. Autonomy can be manipulated using character selection or customization. By introducing gamification into a system that may raise the user's satisfaction of these needs, intrinsic motivation should by default increase as well. For example, satisfaction of competence has been shown to improve task performance (Sheldon & Flak, 2008). However, we do not yet know how these elements work independently in a gamified system (i.e. implementing only autonomy), or if there is additive value to using multiple types of gamified elements.

Applying Gamification

Gamification theory suggests using items like profiles and avatars to affect autonomy, feedback and challenge to affect competence, and groups and chat to affect relatedness (Aparicio et al., 2012). The theory rests on the belief that motivational affordances provided by these changes will affect psychological outcomes, which will in turn affect behavioral outcomes (Figure 3, Hamari, Koivisto & Sarsa, 2014, see also Szalma, 2009). This framework has not only been used in the context of education, but also in a variety of interdisciplinary lines of research, such as commerce, health, organizational systems, sustainable consumption, work, innovation, and data gathering (Hamari, Koivisto & Sarsa, 2014). One of the earliest and most recognizable systems of gamification is credit card rewards (Kim, Shi & Srinivasan, 2001; Landers & Callan, 2012). Credit cards offer points and gift incentives for using your card more often, with the

specificity and amount of the points relying on the brand and precedence of the card itself. While you would use a credit card either way, you become incentivized to use your card more, understanding that if you do, you may receive points, which may eventually lead to a reward of some kind, which may lead you to use that credit card for purchases you would normally make using other mediums. Gamified cell phone applications, such as Foursquare and Waze, grow increasingly common and popular yearly.

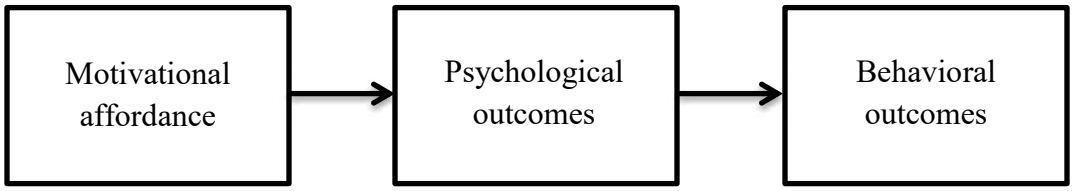


Figure 3. The relationship between motivational affordances, psychological outcomes, and behavioral outcomes in a gamified system. Gamification affects the motivation to use the system, which leads to psychological outcomes (such as increased learning or more attention), which then produces a behavioral outcome (such as a better test score). Adapted from "Does Gamification Work? – A Literature Review of Empirical Studies on gamification", by J. Hamari, J. Koivisto, and H. Sarsa, 2014, in Proceedings of the 47th Hawaii International Conference on System Sciences, Hawaii, USA. Copyright IEEE, 2014.

Gamification of learning has been explored in several applied avenues. Most commonly, it is implemented in education, but recently it has also been adopted in training of complex software, such as learning to use PhotoShop or AutoCAD (Dominguez et al., 2013; Dong et al., 2012; Li, Grossman & Fitzmaurice, 2012). These applied software training programs tend to yield more successful use of the program after completion when compared to a non-gamified alternative training. Qualitatively, participants tend to enjoy the gamified training more, find it less frustrating, and more engaging.

Despite gamification's growing popularity in applied training and education settings, it has only just begun to emerge in more theoretical research. Miranda & Palmer (2014) used what they called "gamelike features" to create intrinsic motivation for a visual capture task. By incorporating reward in the manner of points, and using sound effects to represent beating the top player's score, they were able to bias participant's attention during training toward stimuli that offered them the most reward, capturing attention. Additionally, this paper breaks the two gamification components down into separate experiments, examining their individual effects. This analysis identified that using sound to indicate a new high score and correct answers had an effect on attention capture, but did not bring feelings of intrinsic motivation (measured with survey data). In contrast, using points and no rewarding sound did not create attention capture, but did produce feelings of intrinsic motivation. Together, both effects were achieved, which suggests that the different agents of gamification can operate and affect different components of a task. Because visual tasks generally require both quick and accurate responses in order to have high performance, they lend themselves well to gamification manipulations, such that, various agents of gamification may significantly impact or bias the behaviors that comprise a visual task. Visual search, or the ability to find an item in a visual world filled with distracting items (Wolfe, 1994), is one such visual task. Visual search in its relative ease lends itself to a gamification manipulation, as one requires only quick and accurate responses to perform the task well. Any impacts of gamification would be easily identified by this logic in either measures of accuracy or response time.

Boredom and Visual Search

Visual search performance, especially over longer periods of time, tends to suffer from individuals growing bored or complacent, as is the case for lifeguards and baggage screeners (Dodd & Flowers, 2012; Mackworth, 1948; Page, Bates, Long, Dawes & Tipton, 2011). Boredom is defined as "the aversive experience of wanting, but being unable, to engage in satisfying activity" (Eastwood et al., 2012). Boredom makes us inattentive and inhibits concentration (Schroeter, Oxtoby & Johnson, 2014), leading to more errors on cognitive tasks (Malkovsky, Merrifield, Goldberg & Danckert, 2012). However, objectively rating a task as boring or not is contentious (Schroeter et al., 2014). According to Schroeter et al., a task that may appear "boring" may instead be monotonous, fatiguing, or challenging, which are each distinct entities that can affect task performance in different ways (which can be distinguished using validated scales). But it is boring tasks, they go on to say, that can most directly be improved by gamification. Driving for long distances, for example, is a task that can become boring. Several interventions that "gamify" driving have been implemented recently to try and offset risky driving behaviors that are the product of growing bored (Schroeter et al., 2014). These include Volkswagen's fun theory initiative, which incentivizes people to submit ideas that make car safety more fun. This includes a "speed camera lottery", which uses a speed camera to dole out fines to those speeding, and records the plates of those going the speed limit. From every citation made by that camera and the fines that ensue, those who were going the speed limit are entered into a lottery to win some of the money produced by the fines themselves (Volkswagen, 2009). This idea was such a success, it has now been adopted in Stockholm, Sweden by the Swedish National Society for Road Safety. Other "Fun Theory" projects to gamify safe driving include

the Play Belt, which allows passengers to use in car games and videos only once their seatbelts are buckled, and the Wiki Traffic Light, which is a traffic light that displays a fun fact each time it is on red (Volkswagen, 2009).

While a monotonous or boring task that requires high levels of alertness or attention creates stress on participants (Thackray, 1981), jobs that require prolonged visual search (see above, but also Eckstein, 2011), necessitate training and experience as important factors for better localization and identification of targets (Nodine, Mello-Thoms, Kundel & Weinstein, 2002). This suggests that real world visual search tasks benefit from practice, but that the learning process in and of itself can elicit stress and boredom that can negatively affect performance. For this reason, gamifying a real world visual search task may produce higher performance than in a non-gamified task, as well as provide an effective training method for search-based jobs.

In order to choose a task that is potentially well suited to the benefits afforded by gamification, I examined data collected for a study funded by the Office of Naval Research in my lab on visual search training. This study requires subjects to do eight weeks of training in search for a camouflaged target, varying in difficulty and training style among groups. Subjectively, this task would appear boring, but could also seem monotonous or even fatiguing due to high workload. To try and parse out these outside factors, and understand whether or not the task was boring, I collected data using the Flow Short Scale (FKS) (Rheinberg et al., 2003). The FKS contains two subscales that comprise the measure of flow state, which is thought of as a balance between skill and difficulty in a coherent task that is self-motivated, forcing the subject to lose their sense of time and self-consciousness (Csikszentmihalyi, 1975). These subscales are

referred to as “fluency of performance” and “absorption by the activity”. Together, they comprise flow. FKS also includes a subscale that measures perceived importance of the task at hand, and three stand-alone questions. These questions ask the subjects how easy or hard the task was, how skilled they think they are in the task, and how demanding the task itself is. Engeser & Rheinberg (2008) explain that flow can occur under several different conditions measured within the scale. For example, flow decreases if the demand of a task is too high, but, flow can still occur if the task demands are low, so long as the subject believes the task to be important. But how does this relate to boredom? Traditional flow models depict that if a person is bored, they will be unable to enter flow state (See Figure 4). However, Engester & Rheinberg suggest rather that having high skill and low challenge can still elicit flow, so long as perceived task importance is high (2008), which they found to be the case for students in a statistics course. This suggests that flow can still exist during a boring task. In order for the task to be boring according to the FKS, task demand must be low, and competence or skill in the task must be high. However, if flow scores are high, then perceived importance must also be high. In our camouflage task, this is precisely what we found. Competence scores averaged a 5.38 (SD = 1.04), while task demand averaged at 3.81 (SD = 0.58). Perceived importance of the task was very high, with an average score of 4.62 (SD = 0.88), and flow overall score was high as well with an average of 5.13 (SD = 0.52). This places subjects in the lower right quadrant of balance between skill and challenge, suggesting that they are bored, but the importance of the task moderates the relationship between this state of boredom and the experience of flow (Engester & Rheinberg, 2008). Combined, these data suggest that visual search for camouflaged targets is a boring task, which strengthens the case for using a gamification intervention.

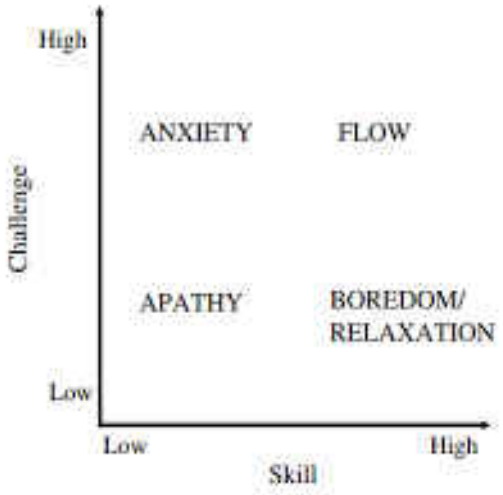


Figure 4. The traditional taxonomy of flow state shows four states in quadrants, with flow only existing when skill and challenge are both high. However, perceived importance moderates this relationship. Reprinted from "The flow experience and its significance for human psychology", in Optimal experience: psychological studies of flow in consciousness (pp. 15 – 35), by M. Csikszentmihalyi. Copyright Cambridge University Press, 1988.

Limitations of Previous Work

In training or learning, the research on gamification is relatively variable in its approaches. Occasionally, researchers choose to implement only one modest gamified element (such as badges), and experience an increase in user engagement and participation in the system (Hamari, 2015). Alternatively, experimenters may incorporate a variety of gamifying elements, such as avatars, leaderboards, badges and optimal challenge on a learning platform, and find mixed results, such that learners participated less in class activity but received better scores in the course (Dominguez, et al., 2013). These gamified elements seem to come from each of the three dimensions of intrinsic motivation in varied amounts. While Miranda & Palmer (2014) made leeway in the direct effects certain styles of gamification may have on performance outcomes, it has not yet been explored whether an element mapping directly onto a feature of intrinsic motivation has a larger impact on the gamification intervention than the other two.

Purpose

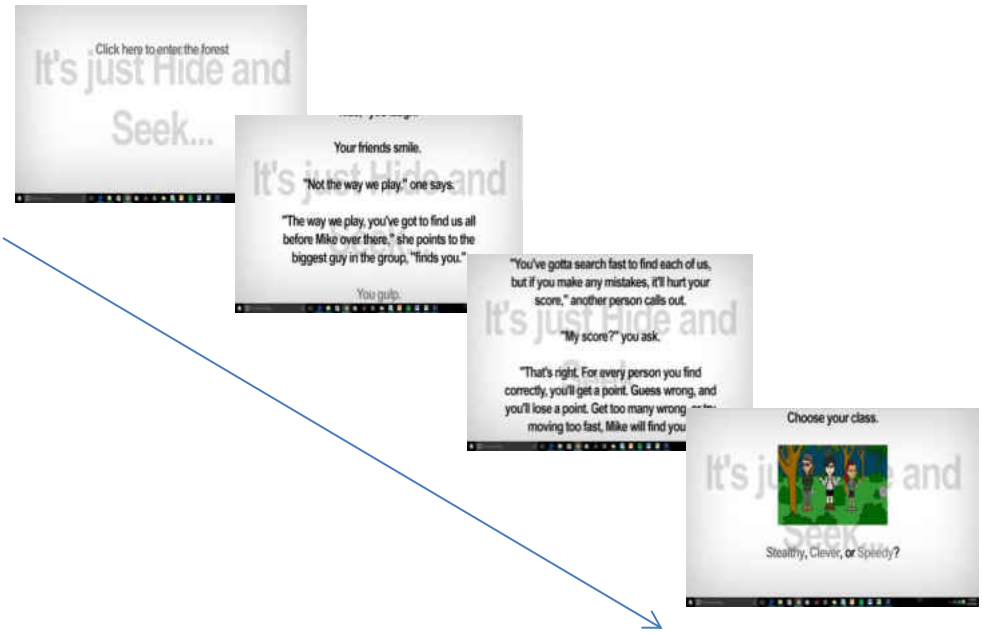
This dissertation aims to explore the use of three different types of gamification, representing each of the three basic psychological needs. I will evaluate performance on a visual search task in each of the three needs conditions, as well as a fully gamified system using all three, and compare performance on a novel task against a non-gamified system. I will collect questionnaire data on basic psychological needs, immersion, enjoyment, intrinsic motivation, situational motivation, and the Big 5 personality traits. The benefit of this research is two-fold: first, I will develop an understanding of how performance is affected by unique types of gamification that map onto basic psychological needs, and second, I will assess how effective gamification is, in general, on a challenging visual search task. While gamification of learning and training systems has seen mixed results in the past, visual search has yet to be explored within this domain. In order to achieve the second goal, I will have subjects perform four blocks of gamified visual search, followed by one transfer block with unique images and no gamification. This will allow me to assess how learning is affected by each type of gamification uniquely, as well as in combination.

Current Studies

The current studies will address the effectiveness of gamification as a tool in a camouflage visual search task, as well as break down the component parts of gamification and analyze each independently. Table 1 depicts the studies and their individual purposes.

Each gamification condition received a narrative in addition to a powerpoint of traditional instructions. This narrative sets the stage for the "game" aspect. The narrative explains that the

subject is playing manhunt with friends, which is similar to hide and seek. It tells the participant they will need to search quickly and accurately in order to earn points, and that if they get too many incorrect answers, “Mike”, who they are competing against, will “find them”. The narrative’s intention is to frame the context for the images (forests) while eliciting a feeling of competition against some opponent, as well as emphasizing the need to be quick, to be smart about their choices, and to not be found themselves. This narrative also transitions into each of the three gamified conditions (autonomy, competence, and relatedness), without explicitly indicating one over the other. The instructions were generated with a program called “Twine” that uses a GUI to write html in order to create a click through story, where depending on the option you choose, a different path can be created (Twine 1.4.2; Klimas, 2009). This feature was used primarily for conditions including avatars (autonomy and full gamification). The instructions are published as an internet link. For added immersion (similar to Miranda & Palmer, 2014), an audio piece called “Myst on the Moor” is played while they read the instructions. For a visual example of the instructions, see Figure 5.



Note: This slide was used only in 1-1 and 2.

Figure 5. An example of the appearance of the narrative.

To gamify the search task, I used three styles of gamification that will map onto each of the three basic psychological needs – those are avatars (autonomy), feedback (competence), and a leaderboard (relatedness). For the first condition, autonomy, the avatars were generated using bitstrips (Bitstrips, Inc., 2015), which creates cartoonish human figures. Skin tones, hair styles, eye shapes, eye color and hair color were all chosen at random. Expressions and attire were chosen to suit the character's class (See Figure 6). In traditional video games, character class lends a benefit to your style of gameplay (e.g., choosing an archer if you prefer ranged play, a warrior if you prefer fighting up close, a mage to use spells, etc.). This approach is reflected in the generation of my own character classes, which include Stealthy, Clever, and Speedy. As the instructions will dictate an emphasis on all three of these as "necessary" features in order to perform the task successfully, I expected the characters to each seem to benefit a different part of

the task. To ensure no avatar or class was favored, a norming study was conducted via Qualtrics on preference of class name and characters.

A. 

B. 

Figure 6. Panel A shows the female avatar options. These were (in order) Stealthy, Clever, and Speedy. Panel B shows the same classes, but for males. These avatars were generated using Bitstrips (www.bitstrips.com).

To address competence, I used feedback. Feedback came in four forms; if the participant indicated the target is present when it is not, they see a red "X". If the participant responds correctly that the target is present, a green box appears around the target. If the participant indicates that the target is absent when it is not, a red box appears around the target. Finally, if a

participant correctly states that the target is absent, they see a green check mark (examples in Figure 7). Participants also earn a point for each correct answer, and lose a point for each incorrect answer.

Figure 7. This shows the four types of feedback included in the competence condition, as well as the full gamification condition. The top line shows feedback for correct and incorrect answers if the target is present, while the bottom line shows feedback (correct and incorrect) if the target is absent. Also, the overall points are displayed in the center of the screen.

Finally, to address relatedness, I used leaderboards. These leaderboards are artificial, so that no matter how well the subject is performing, they believe themselves to be either in first, second, or third place among other subjects. In the full gamification condition, the leaderboard

shows the class of the subject along with the others on the board, and the frequency of the subject's own class on the board will be balanced among blocks (see Figure 8 for an example). Placements were chosen randomly within the top of the leaderboard, but balanced among character classes. Additionally, the characters co-occurring on the leaderboard were also balanced among classes. In Figure 8, the participant's class is Clever in the left panel, and Stealthy in the right. In both instances, characters occur either twice or once (to make up the leaderboard of five). However, each subject sees their own class represented on the board in the majority an equal number of times. This should provide a sense of belonging to a larger group, as well as provide a visual indicator that high task performance is a shared goal among others.

The no gamification group served as a control group, and to ensure that the introductory story has no bearing on task performance, an additional control group, who received no gamification within the task, but did read the story at the beginning, was included.

Figure 8. This image shows leaderboards for both the female and male full gamification conditions. The leaderboard artificially ranks the subject as either first, second, or third.

Table 1. Groups, along with brief descriptions of the planned comparisons, as well as the gamification agent used.

Groups	Planned Comparisons	Gamification Agent
No Gamification	vs. Full Gamification, vs. Autonomy, Competence, and Relatedness, vs. No Gamification, Story	N/A
No Gamification, Story	vs. Full Gamification, vs. No Gamification	Narrative story
Autonomy	vs. Competence, Relatedness, and No Gamification, vs. Competence, Relatedness, and Full Gamification	Avatars, Narrative story
Competence	vs. Autonomy, Relatedness, and No Gamification, vs. Autonomy, Relatedness, and Full Gamification	Points and feedback, Narrative story
Relatedness	vs. Autonomy, Competence, and No Gamification, vs. Autonomy, Competence, and Full Gamification	Leaderboards, Narrative story
Full Gamification	vs. No Gamification, vs. No Gamification, Story, vs. Autonomy, Competence, and Relatedness	Avatars, Points and feedback, Leaderboards, and Narrative Story

For all groups, the visual search task included four experimental blocks and one transfer block with seven possible target sizes, ranging from 100 pixels (very easy) to 60 pixels (very difficult) created from natural images of forest scenes.

Planned comparisons will identify relevant differences in both response time and accuracy between the experimental groups as compared against both one another as well as the control groups. Additionally, comparisons will assess which experimental group showed the

highest performance on the transfer block, similar to the design of Boot, Neider & Kramer (2009).

To better quantify the potential interaction of covariates, survey data will be collected on theoretically relevant factors. ANCOVA will be run on response time for both target present and absent trials, as well as accuracy in target present and absent trials.

Finally, to evaluate gamification's effects on state enjoyment and motivation, ANOVA will be used on multiple survey measures to compare differences between groups.

Hypotheses

1) Performance, as measured by response time and accuracy, will be higher overall in gamified conditions as compared to control groups.
    a. But highest in full gamification when compared to all other groups.
2) Motivation (as measured with the intrinsic motivation inventory and the situational motivation scale) will be higher in gamified groups when compared against control groups.
3) Enjoyment (as measured with the enjoyment scale) will be higher in gamified groups when compared against control groups.
4) Post-task stress scores (as measured by the Dundee state stress questionnaire) will be lower in gamified groups when compared against control groups.
5) When state motivation is used as a covariate, differences between gamified groups and control groups will no longer be significant.

    a. This assumes that the variance is explained specifically by motivation; significant results in this ANCOVA would indicate that motivation is not the only factor causing differences between the groups.

6) Performance will decline in all groups in the transfer block.
    a. But it will decline less in the gamified groups.

CHAPTER TWO: METHODOLOGY

Participants

Overall, 152 subjects were included in analyses (*M* age = 19.6, *SD* = 2.06). This sample included 66 men and 86 women. Subjects were excluded from analyses if they did not complete the study or performed two standard deviations below the mean in accuracy overall, or in accuracy for either target present or target absent trials separately (in order to eliminate those pressing only one button response) – nine such subjects were excluded.

Participants were randomly assigned to one of six groups: no gamification (28 subjects), no gamification, story (20 subjects), autonomy (avatars) (22 subjects), competence (points and feedback) (26 subjects), relatedness (leaderboards) (25 subjects), or full gamification (25 subjects).

Participants were all recruited for credit using the SONA system. All participants were tested for normal or corrected-to-normal vision before being allowed to participate in the study, using Ishihara plates to test for color vision, as well as near and far vision, tested using a Snellen chart. Demographics included age, gender, ethnicity, prior military experience, and video game experience.

Design

This study has a 6 (group) x 2 (target present/absent) x 5 (target size) x 2 (training vs. transfer blocks) repeated measures design. Targets were created for unpublished work funded by

the Office of Naval Research (grant number N000141512243). Stimuli were generated from 30 800 x 600 pixel images of natural, wooded scenes. The images were first divided into an imaginary 5x5 grid, from which the center cell was excluded. Next, the center point of each grid location was used as a center position from which to create circles of five different sizes: 100, 90, 80, 70, and 60 pixels. From here, the camouflaged target was generated using MatLab to create a circular sine wave mask that selected the targeted portion of the image's RGB matrices, scaled to match the size of the desired patch. A binary mask of two alternating sine waves was then generated. We then mapped the target matrices onto the mask, warping the image. Because this distortion changed the perspective, we rotated the image back to the original position, finally replacing the original patch with the distorted target in its original location in the image. Importantly, this image manipulation does not introduce unique color into the targets, but rather produces a distortion that shifts visual information. This process resulted in 3600 unique targets, or 120 per image (Figure 9). For the transfer block, the same process was followed, using 30 unique images of natural scenes.

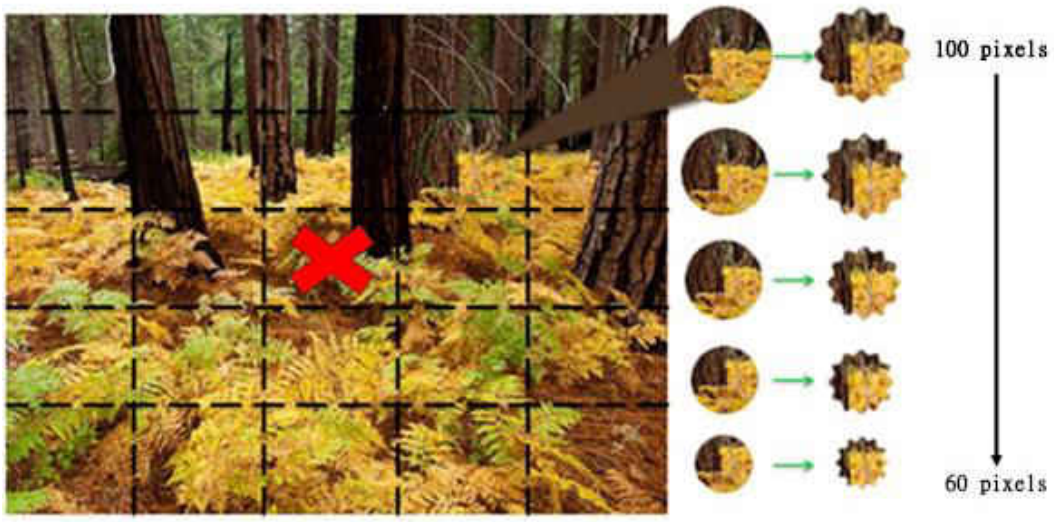


Figure 9. Target creation began with 30 natural images broken into a 5x5 grid. With the center point excluded, this left 24 locations, from which 5 targets were generated each. These targets ranged in size from 100 – 60 pixels.

Participants performed 12 practice trials to become familiar with the experiment. Each of the four experimental blocks, as well as the fifth transfer block contains 48 trials, for a total of 192 experimental trials, and 240 total trials. Trials will be either target present or target absent (50% each), and participants will respond either yes, the target is present, or no, the target is not. The transfer block will contain only target sizes 100, 80, and 60, in order to increase power when assessing transfer. Target size and presence will be counterbalanced and interleaved in the transfer block. Search images and their corresponding targets will be selected randomly in both the experimental and transfer block(s).

Apparatus

All subjects were run on either a Dell Inspiron 570 PC or a Dell Optiplex 9010 using a Dell P190S monitor. The monitor size is 15x12 inches, at a 1280 x 1024 resolution. A chin rest

was kept at a fixed distance of 480 cm. Responses were collected using either a Dell KB212-B or a Dell L100 keyboard. All subjects wore noise cancelling headphones for the duration of the experiment to shield from ambient noise.

Materials

This study used several questionnaires to better understand individual differences and possible predictors of performance in either the gamified or non-gamified groups. These surveys include the Situational Motivation Scale (SIMS) (Guay, Vallerand & Branchard, 2000), the Intrinsic Motivation Inventory (adapted) (IMI) (McAuley, Duncan & Tammen, 1989), the Enjoyment Scale (Lin, Gregor & Ewing, 2008), the Immersive Tendencies Questionnairre (ITQ) (Witmer & Singer, 1998), the Basic Psychological Needs Scale (BPNS) (Deci & Ryan, 2000), the Dundee State Stress Questionnaire (Matthews et al., 1999), and the Ten-Item Personality Inventory (TIPI) (Gosling, Rentfrow & Swann, 2003).

Ten Item Personality Inventory

The TIPI, or ten item personality inventory, evaluates how participants score on each of the big five personality traits. These are openness to new experiences, conscientiousness, emotional stability, agreeableness, and extraversion.

Basic Psychological Needs Scale

The BPNS, or Basic Psychological Needs Scale, evaluates to what degree participants feel that each of their three basic psychological needs are satisfied. The subscales represent the three needs: autonomy, competence, and relatedness.

Enjoyment Scale

The Enjoyment Scale evaluates how much participants enjoyed the task. It has three subscales: positive affect, fulfillment, and engagement.

Intrinsic Motivation Inventory

The adapted IMI (Intrinsic Motivation Inventory) measures to what degree participants felt intrinsically motivated on several subscales. These include competence, interest-enjoyment (strongest relationship with overall intrinsic motivation), effort-importance, and tension-pressure.

Immersive Tendencies Questionnaire

The ITQ (Immersive Tendencies Questionnaire) has four subscales (focus, involvement, emotions, and game). It measures one's trait tendency toward immersion along these four dimensions.

Dundee State Stress Questionnaire

The Dundee State Stress Questionnaire (DSSQ) evaluates factors of stress both pre and post –task. It's three subscales are engagement, distress, and worry.

Situational Motivation Scale

The Situational Motivation Scale, or SIMS measures motivation in a given situation (in this case, after the task). The SIMS subscales are intrinsic motivation, identified regulation, external regulation, and amotivation. Unlike the IMI, the SIMS examines motivation on a continuum of states, rather than specific features of that motivation.

Procedure

Participants all began the experiment by reading and providing verbal consent to the experimenter. From there, screening began. Participants were screened for normal vision using Ishihara plates (for color deficiency) and a Snellen chart (for near and far vision). After visual screening, participants filled out a brief demographic survey, followed by the TIPI, the pre-task form of the DSSQ, and the BPNS.

Following this, participants were seated in front of a computer at a fixed distance and instructed to place their chin in a chin rest. If they belong to the autonomy or full gamification group, they first choose their avatar and class. All gamified groups, as well as the no gamification story condition, then read a narrative about the "game" they will be playing. From there, all groups (gamified and control) read through brief instructions and practice trials to gain familiarity with the experiment. The visual search task begins from here. For the competence and full gamification conditions, participants receive feedback after each trial within the experimental blocks, awarding them a point for a correct response, and taking a point away for an incorrect response.

For all groups, trials begin with a fixation cross, before presentation of the search target. The participants view both the fixation cross and the search target for 1s before automatically beginning the trial. The search display appears until a button press is entered (a 1 indicating the target is present and a 0 indicating the target is absent). It is important to note that the transfer block is treated the same for all groups; there will never be gamification of any type within the transfer block.

After the visual search task is complete, they perform the transfer block of 48 novel images. When that is complete, they fill out the SIMS, the IMS, the ITQ, the post-task form of the DSSQ, and the Enjoyment scale.

CHAPTER THREE: RESULTS

Results are broken into three subsections: planned comparisons of behavioral data, ANOVA of survey data, and ANCOVA of behavioral data, using survey measures as covariates. All analyses were conducted using SPSS. Both response time and accuracy are analyzed separately for target present and target absent trials. Response time analyses were conducted only on correct trials. Those who performed more than two standard deviations above or below the mean in overall accuracy, or for accuracy specifically at target present or absent trials, were removed from all analyses.

Importantly, because average accuracy in the fifth transfer block was at chance on average (50% or less), these data are uninterpretable, and were thus excluded from analyses. Therefore, all analyses reported were conducted on the four experimental blocks.

Planned comparisons evaluating differences in behavioral data

Planned comparisons directly aimed at testing hypothesis 1 were performed. These included: no gamification vs. full gamification (1), no gamification vs. no gamification with story (2), no gamification vs. autonomy, competence and relatedness (3), no gamification with story vs. full gamification (4), and full gamification vs. autonomy, competence, and relatedness (5) (see Table 1 for reference). Comparisons were conducted on both response time and accuracy for target present and absent trials.

Comparisons 2 – 5 were not significant for accuracy or response time in target present or absent trials (all $p > .08$). Planned comparison 1 indicated significant differences between full gamification and no gamification both in reaction time for target present trials, $t(1, 139) = -2.01$,

$p < .05$, and target absent trials, $t(1, 139) = -2.07$, $p < .05$. This difference suggests that in response time overall, full gamification was faster than no gamification. Additionally, this was the only significant difference between groups in all behavioral data and post hoc comparisons, all $p > .07$ (see Figure 10). This suggests that the use of the story may not have played a powerful role in the behavioral data. However, as suggested by Miranda and Palmer (2014), gamification differences may manifest uniquely in survey data. For this reason, ANOVA were conducted on all survey data to compare effects among groups.

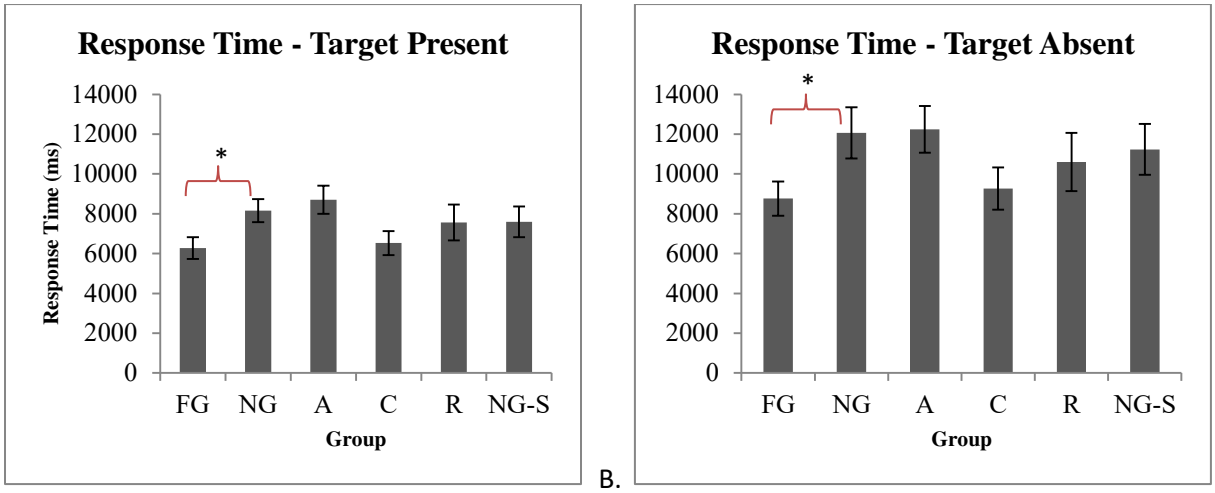


Figure 10. Planned comparisons revealed significant differences in response time between full gamification (FG) and no gamification (NG). These differences existed in both target present (panel A) and target absent data (panel B).

ANOVA of survey data

As a reminder, surveys included the TIPI (ten item personality inventory), BPNS (basic psychological needs scale), ITQ (immersive tendencies questionnaire), DSSQ (Dundee state stress questionnaire), IMI (intrinsic motivation inventory), Enjoyment scale, and SIMS

(situational motivation scale). The former three surveys measure traits, and were not included in the following analyses, while the latter four are state measures, and were used to identify differences between groups. While planned comparisons were conducted for behavioral data, ANOVA were chosen to evaluate group differences in survey data, testing hypotheses 2, 3, and 4. This is because several of the surveys used were selected on an exploratory basis; for example, the enjoyment scale was selected because gamification is expected to, generally, make tasks more enjoyable. However, it is not yet known if this is dependent on the style of gamification chosen, so specific theoretically motivated predictions that would justify the use of planned comparisons could not be made. Post hoc comparisons were used unless otherwise noted.

Dundee State Stress Questionnaire

The DSSQ has three subscales, measuring engagement, distress, and worry, both pre and post -task. Pre-task, post-task, and change scores in each of the DSSQ's three subscales (engagement, distress, and worry) were analyzed in separate one-way ANOVA to compare differences among groups.

Pre-task

Differences were not found in any of the DSSQ's pre-task measures (all $p > .05$).

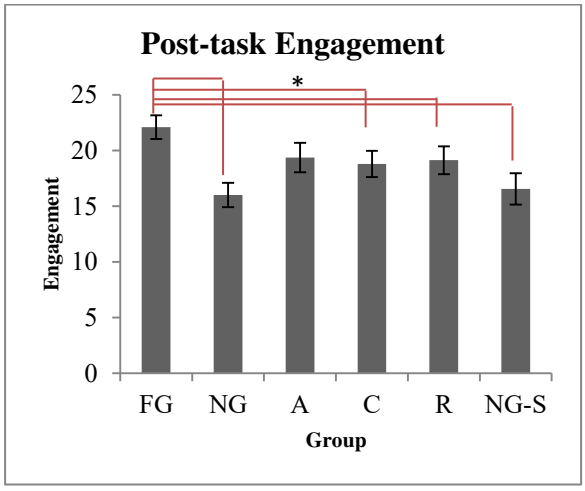
Post-task

Differences were found in both the post score for engagement, $F(5, 132) = 3.14$, $p = .01$, as well as distress, $F(5, 132) = 2.75$, $p < .05$. There were no significant differences in groups for the post worry score ($p > .05$).

Post hoc tests for engagement indicated significant differences between no gamification and full gamification, no gamification, story and full gamification, relatedness and full gamification, and competence and full gamification (all $p < .05$, see Figure 11A). This suggests that post-task engagement was generally greater in full gamification compared to other conditions (save for autonomy).

Post hoc tests for distress indicated significant differences between no gamification, story and relatedness, no gamification, story and competence, no gamification, story and autonomy, and no gamification, story and full gamification (all $p < .05$, see Figure 11B). This indicates that post-task distress was higher in the no gamification, story condition than all other conditions (except for no gamification).

A.



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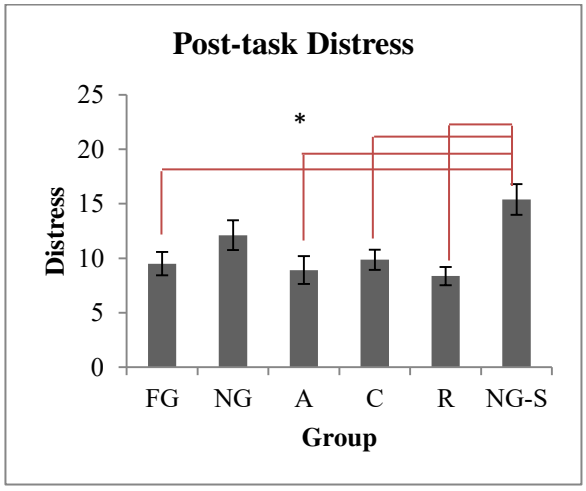


Figure 11. Significant differences were observed in post-task engagement (Panel A) as well as in post-task distress (Panel B). Post hoc differences among groups are denoted by lines. Of important note, the full gamification condition exhibited superior post-task engagement when compared to nearly all groups. In post-task distress, the no gamification story condition presented higher scores than all groups save for no gamification (control).

Difference scores

In order to evaluate the direct change occurring from pre to post -task for each subject's engagement, distress, and worry, difference scores were calculated by subtracting pre scores from post scores, meaning; a positive value indicates an increase in that dimension, while a negative value indicates a decrease in that dimension (i.e. a pre-task worry score of 20 followed by a post-task worry score of 25 would yield a difference score of 5, suggesting that worry increased).

Significant differences were found for differences in both engagement, $F(5, 132) = 3.01$, $p < .05$, and distress, $F(5, 132) = 2.68$, $p < .05$. Again, no significant differences were observed for worry ($p > .05$).

Post hoc comparisons indicate that, for differences in engagement, there were significant differences between no gamification and relatedness, no gamification and full gamification, no gamification, story and full gamification, and autonomy and full gamification (all $p < .05$). Also, the difference between no gamification and competence approached significance, $p = .052$. Overall, this suggests that from pre to post -task, full gamification had the smallest difference in engagement. However, as all difference scores were negative (this means that all groups were less engaged from pre to post -task) full gamification remained closer to 0, or no change. No gamification, on the other hand, had the largest decrease in engagement.

Post hoc comparisons for differences in distress indicate significant differences between no gamification and competence, no gamification, story and relatedness, no gamification, story and competence, no gamification, story and autonomy, and no gamification, story and full

gamification (all $p < .05$). Additionally, the difference between no gamification and relatedness approached significance, $p = .054$. While all groups increased in distress from pre to post -task, the no gamification, story condition increased the most.

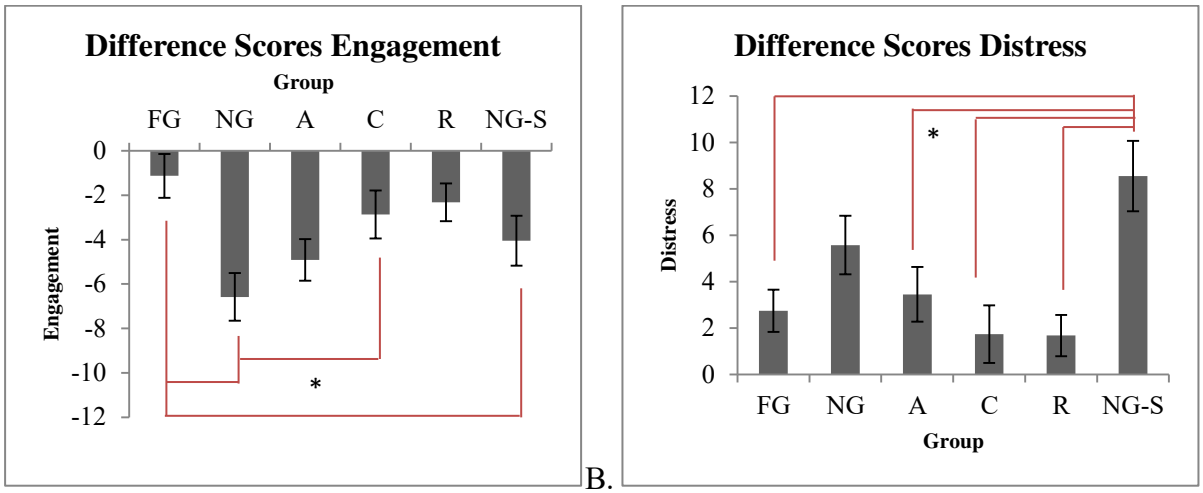


Figure 12. Difference scores for both engagement (Panel A) and distress (Panel B) showed significant differences, with post hoc comparisons identified via red lines. As a reminder, negative values represent a decrease from pre to post task: therefore, all groups decreased in engagement from pre to post task, while all groups increased in distress from pre to post task. Importantly, engagement decreased the least in the full gamification condition, and most in the no gamification condition. Additionally, the control conditions had the highest increases in distress from pre to post –task.

Intrinsic Motivation Inventory

The IMI uses four subscales to measure state motivation, with the subscale "interest/enjoyment" showing a direct relationship to intrinsic motivation. One-way ANOVA were conducted for each subscale of the IMI to investigate possible differences in motivational factors among groups. These subscales include: interest/enjoyment, competence, effort/importance, and tension/pressure.

No differences were observed between groups within the interest/enjoyment, effort/importance, or tension/pressure subscales (all $p > .05$). However, significant differences were observed in the competence subscale, $F(5, 138) = 5.90$, $p < .001$.

Post hoc comparisons for competence indicated differences between no gamification and relatedness, no gamification and competence, no gamification and full gamification, no gamification, story and relatedness, no gamification, story and competence, no gamification, story and autonomy, no gamification, story and full gamification, and autonomy and full gamification (all $p < .05$, see Figure 13). This suggests that full gamification and relatedness had the highest overall scores of competence, while the two control conditions had the lowest scores.

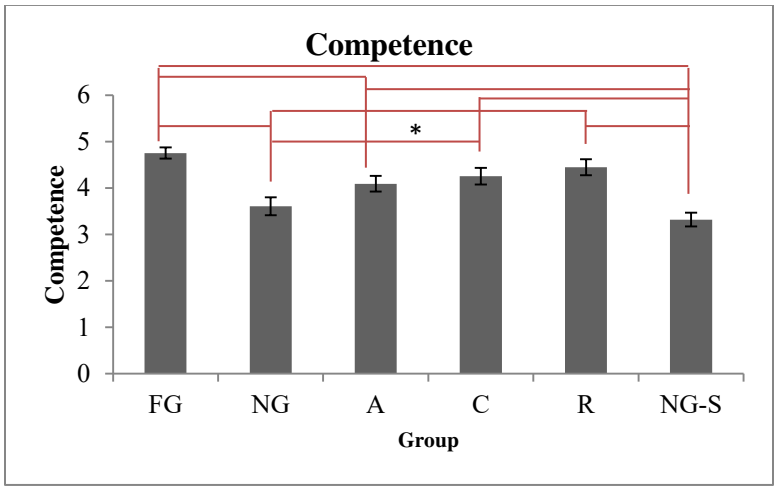


Figure 13. Competence differences (state) among groups indicate an overall low level of competence for the two control groups (NG and NG-S) when compared to other groups. Significant post hoc differences are denoted by red lines. Largely, all experimental groups presented higher competence scores than at least one control group, but none so high as the full gamification condition. This suggests that the full gamification condition felt the most competent about their performance in the task.

Enjoyment Scale

The enjoyment scale measures participants' enjoyment of the task on three subscales. The enjoyment scale's three subscales, engagement, positive affect, and fulfillment, were analyzed in one-way ANOVA to explore possible group differences.

Significant differences were found for both positive affect, $F(5, 138) = 3.27$, $p < .01$, and fulfillment, $F(5, 139) = 3.23$, $p < .01$. No differences were observed in the engagement subscale ($p > .05$).

Post hoc comparisons for positive affect indicated significant differences for no gamification and relatedness, no gamification and competence, no gamification and full gamification, no gamification, story and relatedness, and no gamification, story and full gamification (all $p < .05$, see Figure 14A). These tests indicate that the control conditions had overall lower positive affect when compared to the other groups.

Post hoc comparisons for fulfillment indicated significant differences for no gamification and relatedness, no gamification and full gamification, no gamification, story and relatedness, and no gamification, story and full gamification (all $p < .05$, see Figure 14B). This suggests that the control conditions had overall lower fulfillment than full gamification and relatedness.

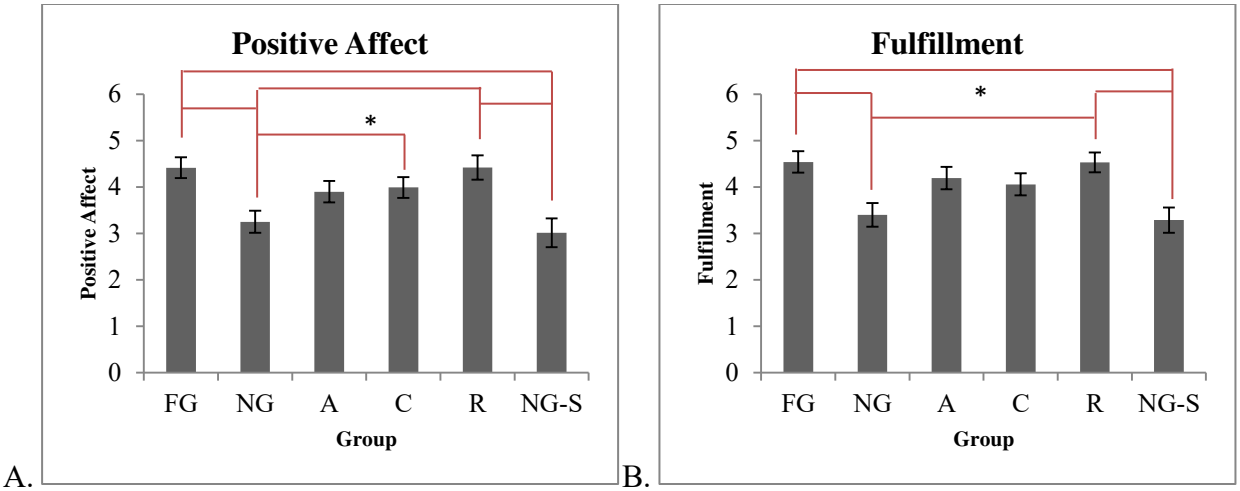


Figure 14. Both positive affect (Panel A) and fulfillment (Panel B) showed significant differences among groups. Post hoc differences are denoted with lines. Overall, the full gamification and relatedness conditions experienced the highest positive affect and fulfillment, especially when compared to the control groups.

Situational Motivation Scale

The SIMS measures motivation in a given situation, in this case, after performing the experimental task. Each of the subscales of the situational motivation scale, which include intrinsic motivation, identified regulation, external regulation, and amotivation, were subjected to one-way ANOVA to detect differences among groups.

No differences were observed for any subscale of the SIMS, all $p > .05$.

Identifying covariates to explain variance in behavioral data

ANCOVA were conducted to explore potential explanation of variance between groups for both response time and accuracy in target present and absent trials, testing hypothesis 5. Importantly, as differences were previously identified using planned comparisons between full gamification and no gamification in response time, if a state motivation covariate creates a non-

significant difference between these groups, it can be assumed that gamification did affect motivation specifically. Alternatively, if a state motivation covariate is used and differences between these groups are still significant, then something other than motivation is contributing to the variance between the groups, and the style of gamification used here may be affecting more than just motivation. All survey subscales were tested as theoretically driven covariates; significant findings are discussed.

Accuracy, target present

There was a significant effect of group on accuracy in target present trials after controlling for the immersive tendency toward play, $F(5, 133) = 2.85$, $p < .05$, *partial* eta = .097 (see Figure 15). Additionally, there was a significant interaction between group and the immersive tendency toward play; $F(5, 133) = 3.60$, $p < .01$, *partial* eta = .119, suggesting that the effect of play scores varied among the groups. However, the correlation between play and accuracy was not significant, $p > .20$. In all other ANCOVA for accuracy, target present trials, there were no significant effects of group, all $p > .05$.

Pairwise comparisons using LSD corrections indicated a significant difference only between the competence and autonomy conditions ($p < .05$). All other comparisons, $p > .05$.

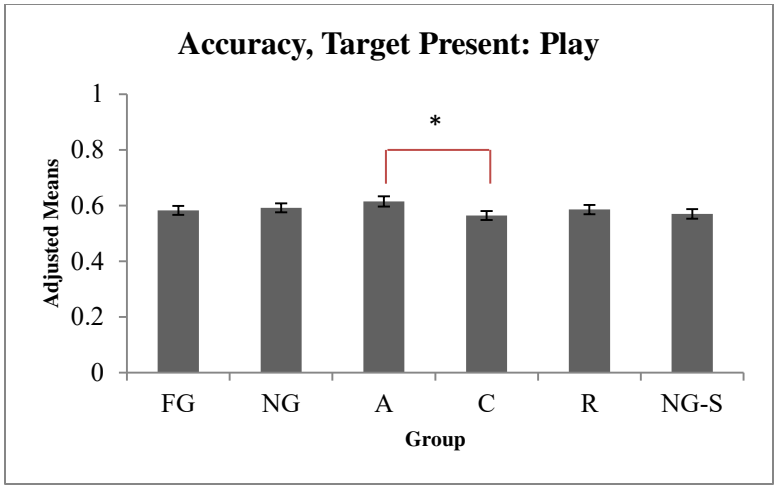


Figure 15. When the immersive tendency toward play was controlled, a significant effect of group emerged for accuracy in target present trials. However, pairwise comparisons indicated a significant difference only between autonomy (*M adjusted* = 62%) and competence (*M adjusted* = 56%).

Accuracy, target absent

There was a significant effect of group on accuracy in target absent trials after controlling for state competence ratings, $F(5, 132) = 2.30$, $p < .05$, *partial* eta = .08 (see Figure 16A), suggesting that state competence contributed significantly to the variance between groups. An interaction between group and state competence ratings approached significance ($p = .056$). The correlation between state competence and accuracy, however, did not approach, $p > .17$.

Pairwise comparisons using LSD corrections revealed no significant differences among groups, all $p > .05$.

Additionally, there was a significant effect of group on accuracy in target absent trials after controlling for tension/pressure, $F(5, 133) = 2.46$, $p < .05$, *partial* eta = .085 (see Figure 16B). An interaction between group and tension/pressure was also found, $F(5, 133) = 2.32$, $p < .05$, *partial* eta = .08, indicating that groups varied significantly from one another regarding the

effect of tension/pressure. The correlation between accuracy and tension/pressure was not significant, $p > .50$. All other ANCOVA for accuracy in target absent trials found no significant effects of group, all $p > .05$.

Pairwise comparisons with LSD corrections indicated no significant differences between groups, all $p > .05$.

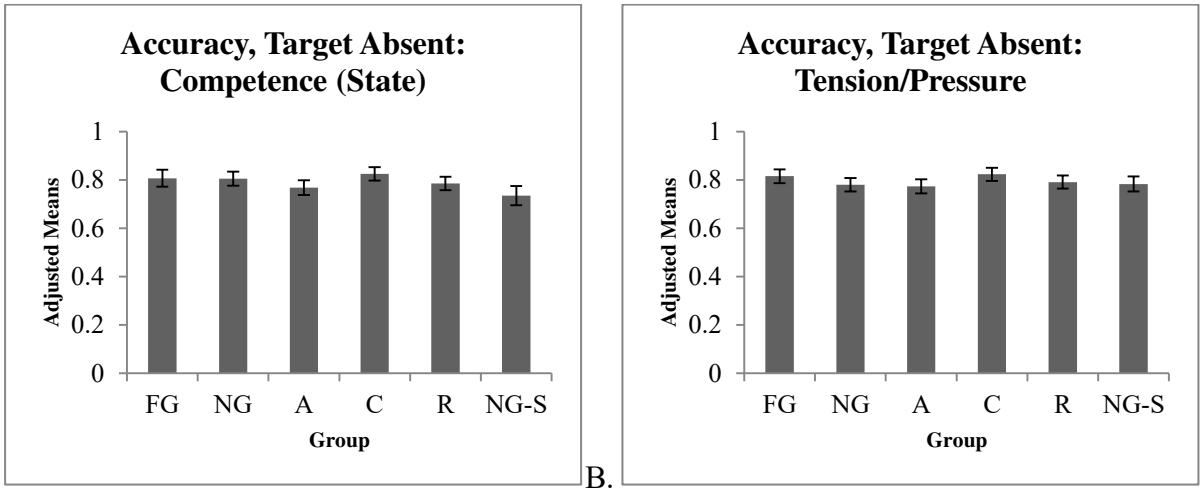


Figure 16. For accuracy data in target absent trials, ANCOVA indicated significant effects of group when controlling for either state competence or tension/pressure. However, pairwise comparisons indicated no significant differences among groups.

Response time, target present

There was a significant effect of group on response time in target present trials after controlling for participants' pre-engagement, $F(5, 126) = 2.41$, $p < .05$, *partial* eta = .087 (see Figure 17A). Additionally, there was a significant interaction between group and pre-engagement; $F(5, 126) = 2.76$, $p < .05$, *partial* eta = .099, suggesting that the effect of pre-engagement scores varied significantly among the groups. The correlation between pre-engagement and response time was marginally significant, $r(136) = .171$, $p = .051$. The

correlation in this case is fairly weak, but positive, suggesting that as a subject's pre-task engagement increased, their response time increased as well.

Pairwise comparisons with LSD corrections indicated significant differences between no gamification and competence, no gamification and full gamification, relatedness and competence, relatedness and full gamification, competence and autonomy, and autonomy and full gamification (all $p < .05$). These differences suggest that full gamification and competence had the fastest response times in target present trials, while autonomy and no gamification had the slowest response times (when pre-engagement scores are controlled for).

There was also a significant effect of group on response time in target present trials after controlling for participants' differences in worry from pre-task to post task, $F(5, 126) = 2.70$, $p < .05$, *partial* eta = .096 (see Figure 17B).

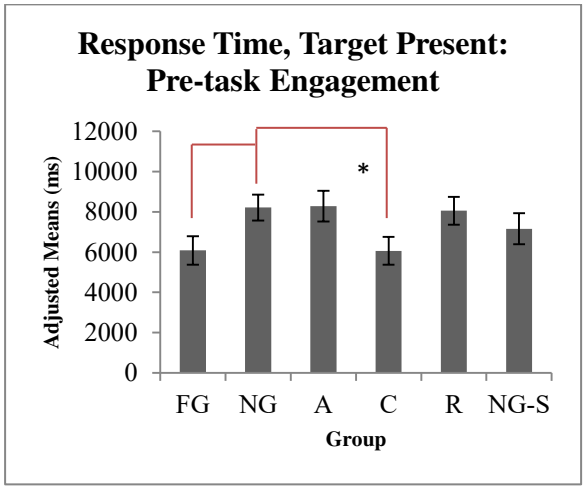
Pairwise comparisons using LSD corrections revealed significant differences between no gamification and competence, competence and autonomy, and autonomy and full gamification (all $p < .05$). These comparisons indicate that autonomy was the slowest condition generally when difference scores in worry are controlled for.

Finally, a significant effect of group was observed on response time in target present trials after controlling for trait focus, $F(5, 132) = 2.52$, $p < .05$, *partial* eta = .087. An interaction between group and focus was also observed, $F(5, 132) = 2.43$, $p < .05$, *partial* eta = .084 (see Figure 17C), suggesting that the effect of focus scores varied among groups. However, no correlation was found between response time and focus, $p > .70$.

Pairwise comparisons with LSD corrections indicated significant differences between no gamification and competence, no gamification and full gamification, competence and autonomy,

and autonomy and full gamification (all $p < .05$). This suggests that, overall, autonomy and no gamification were the slowest conditions when compared to competence and full gamification: the fastest conditions.

A.



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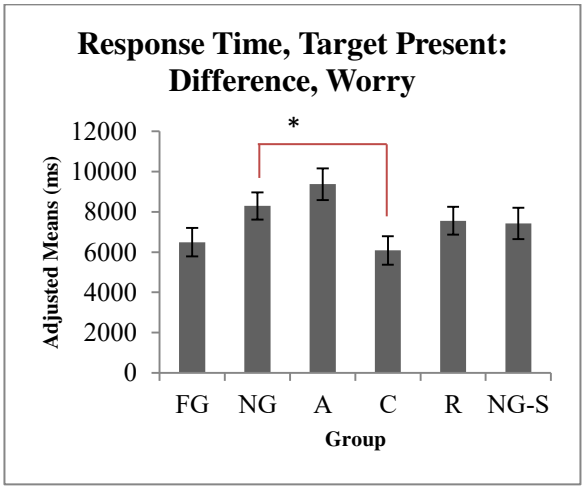


C.

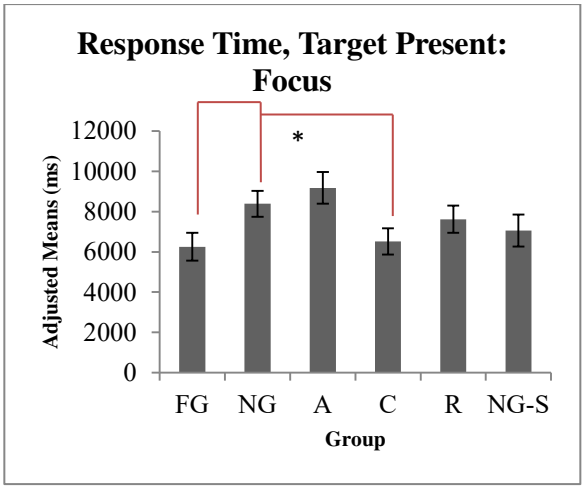


Figure 17. For response time in target present trials, controlling for pre-task engagement, worry difference scores from pre to post task, and trait focus all led to significant effects of group. In panel A, both the full gamification and competence conditions outperform when compared against most groups, including the control group. However, in panel B, competence continues to outperform no gamification, but the difference between full and no gamification is lost. This suggests that this difference may be motivated by difference scores in worry from pre to post –task. Finally, in panel C, the difference between no and full gamification is recovered, and the difference between competence and no gamification holds.

Response time, target absent

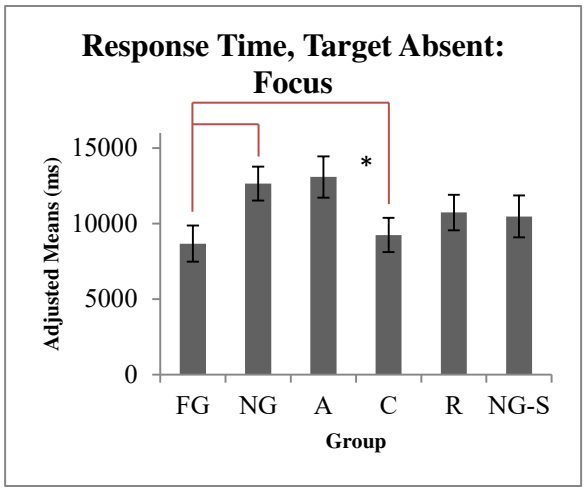
There was a significant effect of group on response time in target absent trials after controlling for trait focus, $F(5, 132) = 2.80$, $p < .05$, *partial* eta = .096 (see Figure 18A). There was an interaction between group and focus, $F(5, 132) = 2.78$, $p < .05$, *partial* eta = .095, again indicating that the effect of focus scores varied significantly among groups. No correlation was identified between response time and focus, $p > .40$.

Pairwise comparisons using LSD corrections suggested significant differences between no gamification and relatedness, no gamification and full gamification, competence and autonomy, and autonomy and full gamification (all $p < .05$). This suggests that, again, autonomy and no gamification are the slowest conditions, while full gamification and competence are the fastest when focus scores are covaried out.

Additionally, there was a significant effect of group on response time in target absent trials after controlling for differences in worry from pre-task to post-task, $F(5, 126) = 2.29$, $p = .05$, *partial* eta = .083 (see Figure 18B).

Pairwise comparisons using LSD corrections indicated significant differences between no gamification and competence, competence and autonomy, and autonomy and full gamification (all $p < .05$). These differences indicate that autonomy and no gamification had the slowest response times, while full gamification and competence had the fastest response times when difference scores in worry were covaried out.

A.



B.

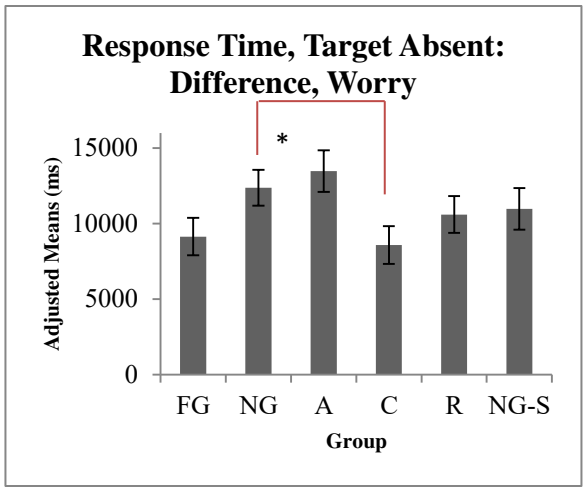


Figure 18. Using the covariates trait focus (Panel A) or the difference from pre task to post task in worry (Panel B), significant group differences were found in response time for target absent trials. Significant pairwise comparisons are represented by red lines. Largely, it appears that full gamification and competence are faster when compared to control in panel A, whereas in panel B, the difference between full and no gamification no longer holds.

CHAPTER FOUR: DISCUSSION

Gamification is growing in popularity as an intervention technique to enhance learning and motivation across domains. Little is still known about the way that gamification can interact with specific tasks. Some have speculated (see again Figure 3) that gamification provides motivational affordances, which then manifest as psychological outcomes, leading to behavioral outcomes (Hamari, Koivisto & Sarsa, 2014; Szalma, 2009), suggesting that motivation is the root of gamification. This dissertation aimed to explore the effects of various styles of gamification, mapped specifically onto the three basic psychological needs: autonomy, competence, and relatedness, on a difficult and traditionally boring visual search task for camouflaged targets. Additionally, a "full" gamification condition, consisting of all three styles, was used to compare potential additive effects. Two control groups were used, one with no gamification, and one with no gamification within the task, but a narrative story read by the participants beforehand. Response time and accuracy data were collected along with multiple survey measures to evaluate gamification's qualitative and quantitative effects.

Planned comparisons revealed significant differences in response time (both target present and target absent) between the full gamification condition and the no gamification (control) condition, which supported the first hypothesis. These findings suggest that, for response time, adding multiple gamified components to the visual search task speeded response times, when compared against the same task with no gamification. However, the semi-gamified tasks did not produce the same benefit. Much like the model proposed by Hamari, Koivisto & Sarsa (2014), motivational affordances seemed to lead to psychological outcomes, which finally manifested in behavioral outcomes. Importantly, these behaviors were only observed when all

three components of self-determination were incorporated, suggesting that, perhaps, in order to experience behavioral outcomes in a task of this nature, autonomy, competence, and relatedness must all be accounted for. Future work investigating task demands may uncover whether this is true for all tasks, or if there is something more unique about this task, rather than it's being both difficult and boring, as stated previously.

The survey data was run through ANOVA that indicated multiple differences between the control group(s) and the experimental groups, largely indicating that the experimental groups, and most particularly, the full gamification condition, were more engaged and less distressed after the task was complete, had higher understanding of the task itself, and enjoyed the task more by expressing higher positive affect toward it as well as more fulfillment. This supported hypotheses 2, 3, and 4. This finding suggests that the Hamari, Koivisto & Sarsa model (2014) may need editing; it may not be the case that motivational affordances always lead to psychological outcomes, which in turn always lead to behavioral outcomes. Rather, it seems more likely given the present data that occasionally, depending on the strength of the motivational signal, the train stops at psychological outcomes. In the semi-gamified conditions, effects were found to indicate group differences. However, these differences did not manifest in behavioral outcomes. Therefore, the weight of the motivational affordance and the role that plays determining whether a behavioral outcome is achieved seems to be in need of further investigation. I propose an alteration to the model, representing what is more of an additive system rather than one of direct relationships (see Figure 19).

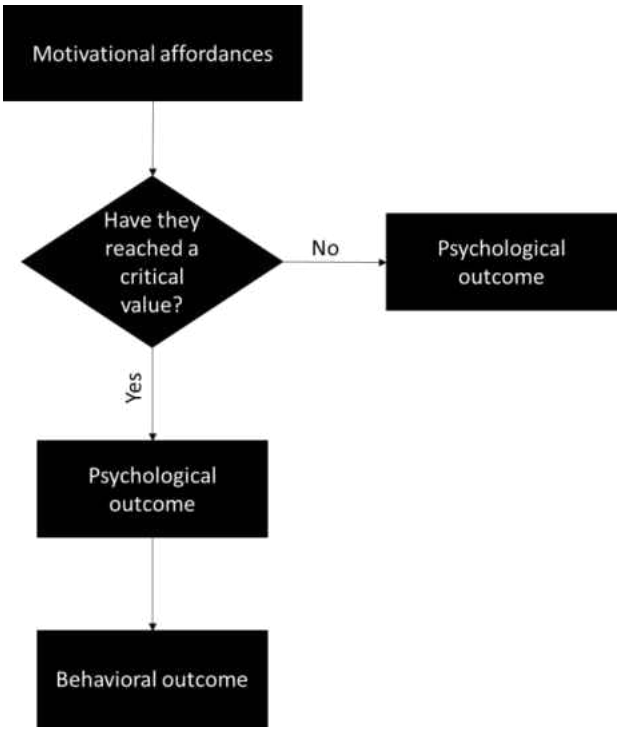


Figure 19. An adaptation of Hamari, Koivisto, & Sarasa's 2014 model. Here, motivational affordances must reach a critical value before psychological outcomes can manifest as behavioral outcomes. Alternatively, if the affordances do not reach this value, only a psychological outcome will be returned.

ANCOVAs were used to explore the possibility that variance in the behavioral data might be explained by the survey measures collected. Overall, covariates were identified for accuracy and response time in both target present and absent trials. While accuracy data were largely uninformative of broader differences, response time data suggested that perhaps the differences between the full gamification condition and the semi-gamified conditions can only emerge when variance is accounted for by additional variables, such as focus, difference in worry from pre to post task, and pre-task engagement. This indicates that hypothesis 5 was not supported. These results reiterate the importance of the revised model; certain gamification conditions can manifest as behavioral differences when psychological factors are covaried. It may be the case, then, that the "critical value" can vary based on many factors. For example, "focus", a covariate

identified for response time, is a trait, rather than a state. This may indicate that, for some, the critical value at which motivational affordances can become both psychological and behavioral outcomes, is lower than for others. Beyond that, participants state of stress and engagement upon arriving to the study also manifested as covariates, meaning that it may not just be traits that determine one's critical value, but overall state before engaging in the gamified task. Future work should consider controlling for these important factors to better understand the relationship between gamification and both psychological and behavioral outcomes.

The results of this study indicate the importance of the gamified factors chosen in a given task. Only in the full gamification condition were results consistently superior to those in the control task, largely suggesting that while the semi-gamified conditions did have differences among them in some measures (which manifested in the ANCOVAs), the whole was in fact greater than the sum of its parts. These results should, however, be taken with a grain of salt; it isn't necessarily the case that using every gamification style one can imagine will yield greater results than using only a select few. It may very well be the case that, just as in the basic psychological needs, it is the satisfaction of autonomy, competence, and relatedness, together, that leads to self-determination. More work should be done to continue mapping gamified features onto psychological factors as well as behavioral outcomes. This would allow for a more stringent means of selection when deciding how to gamify a task.

Additionally, the results of the surveys do provide some indication that gamification may be more or less effective on specific personality types. It may be a worthwhile venture to test specific gamification interventions on various personality types to more effectively assess individual differences. For example, the immersive tendency to focus was a significant covariate

for response time. It may be the case that one's immersive tendencies dictate a good deal of how well gamification may provide a learning benefit.

Though the fifth block of transfer images did not provide information for this study (implying that hypothesis 6 was not supported), it still may be that longer studies with a large training component may yet find benefits of gamification in a transfer condition. It is noted that with a task this short (four blocks, approximately one hour), transfer was not feasible. However, longer tasks may yet investigate this important question: if we take away the gamification, does the learning hold up over time?

One potential explanation of the data, counter to my hypotheses, is simply that the competence condition, using points and feedback, was just as good as the full gamification condition. This suggests that all differences seen between full gamification and no gamification are driven entirely by the inclusion of points and feedback. In response time data for target present trials, the full gamification condition had an RT of ~6276 ms, while the competence condition had ~6526 ms, essentially a 300 ms difference. In TA data, full gamification had RTs of ~8763, while competence had ~9267, or about a 500 ms difference. However, when the difference score for worry was used as a covariate in response time data, both for target present and target absent, the difference between full and no gamification became non-significant, whereas a difference between competence and no gamification was significant. In fact, using those adjusted means, the competence condition is nearly 500 ms faster than full gamification in TP data (FG = 6486, C = 6083), and about 600 ms faster in TA data (FG = 9143, C = 8576). This suggests that it's actually the difference in worry from pre to post –task that seems to differentiate these groups. It may be the case that because the competence condition saw only their score from trial to trial, which was fairly low overall (*M* of accuracy overall for competence

= 69%), they grew more worried about their performance than the full gamification condition, who saw leaderboards and corresponding character classes that suggested that they were doing well, despite their score, and that they had chosen a typically successful character class (via the co-occurrence of avatars on the board). This may have been what drove down their worry, and allowed for the superior response times overall, lending further support to the importance of both the psychological and behavioral impacts of gamification.

This study aimed to evaluate the effects of motivation on a visual search task through the use of gamification. Gamification styles were chosen to target the three basic psychological needs: autonomy, competence, and relatedness, and assess whether they had effects on both behavioral and survey data when used in separately and/or together. While some differences emerged only in psychological data (via surveys), differences between the full gamification condition and the control condition were identified both in psychological and behavioral data. This finding is supported by the use of ANCOVA, allowing behavioral patterns to emerge when survey data are used as covariates. These data overall suggest that visual search tasks of this unique nature do benefit from gamification, as the subjects in the full gamification condition had faster response times. Additionally, subjects in all experimental conditions received some form of cognitive benefit from the gamification, be it enjoyment of the task or motivation while engaging in the task. While in the past, gamification research has largely ignored testing different styles of gamification alongside one another to identify what may work best for their system, this work encourages that procedure to become more commonplace. Additionally, it supports the Miranda & Palmer (2014) idea that gamification can be effective in basic tasks, rather than exclusive to complex systems. Finally, while this study specifically targeted components of motivation as a means to increase performance, past work has often added various gamification

techniques into their task and compared results between gamification and a control group. However, because there is little still known about the psychological manifestations of various types of gamification (i.e. avatars lead to autonomy, etc.), this begs the question: what are we really changing when we introduce gamification into a task?

APPENDIX A: IRB APPROVAL LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Alyssa S. Hess** and Co-PI: **Mark Neider**

Date: **October 24, 2016**

Dear Researcher:

On 10/24/2016 the IRB approved the following human participant research until 10/23/2017 inclusive:

Type of Review:	UCF Initial Review Submission Form Expedited Review
Project Title:	Hide and Seek: Investigating Search
Investigator:	Alyssa S. Hess
IRB Number:	SBE-16-12521
Funding Agency:	
Grant Title:	
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 10/23/2017, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

Sophia F. Dziegielewski
IRB Chair

APPENDIX B: TEN ITEM PERSONALITY INVENTORY

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

1 = Disagree strongly
2 = Disagree moderately
3 = Disagree a little
4 = Neither agree nor disagree
5 = Agree a little
6 = Agree moderately
7 = Agree strongly

I see myself as:

1. _____ Extraverted, enthusiastic.

2. _____ Critical, quarrelsome.

3. _____ Dependable, self-disciplined.

4. _____ Anxious, easily upset.

5. _____ Open to new experiences, complex.

6. _____ Reserved, quiet.

7. _____ Sympathetic, warm.

8. _____ Disorganized, careless.

9. _____ Calm, emotionally stable.

10. _____ Conventional, uncreative.

APPENDIX C: BASIC PSYCHOLOGICAL NEEDS SCALE

Feelings I have

Please read each of the following items carefully, thinking about how it relates to your life, and then indicate how true it is for you. Use the following scale to respond:

1	2	3	4	5	6	7
Not true at all			somewhat true			very true

1. I feel like I am free to decide for myself how to live my life. ___
2. I really like the people I interact with. ___
3. Often, I do not feel very competent. ___
4. I feel pressured in my life. ___
5. People I know tell me I am good at what I do. ___
6. I get along with people I come into contact with. ___
7. I pretty much keep to myself and don't have a lot of social contacts. ___
8. I generally feel free to express my ideas and opinions. ___
9. I consider the people I regularly interact with to be my friends. ___
10. I have been able to learn interesting new skill recently. ___
11. In my daily life, I frequently have to do what I am told. ___
12. People in my life care about me. ___
13. Most days I feel a sense of accomplishment from what I do. ___
14. People I interact with on a daily basis tend to take my feelings into consideration. ___
15. In my life I do not get much of a chance to show how capable I am. ___
16. There are not many people that I am close to. ___
17. I feel like I can pretty much be myself in my daily situations. ___
18. The people I interact with regularly do not seem to like me much. ___
19. I often do not feel very capable. ___
20. There is not much opportunity for me to decide for myself how to do things in my daily life. ___
21. People are generally pretty friendly towards me. ___

APPENDIX D: DUNDEE STATE STRESS QUESTIONNAIRE

DSSQ-3 STATE QUESTIONNAIRE

PRE-TASK QUESTIONNAIRE

Instructions. This questionnaire is concerned with your feelings and thoughts at the moment. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.

Before you start, please provide some general information about yourself.

Age..... (years) Sex. M F (Circle one)

Occupation.....

If student, state your course.....

Date today..... Time of day now.....

For each statement, circle an answer from 0 to 4, so as to indicate how accurately it describes your feelings **AT THE MOMENT**.

Definitely false = 0, Somewhat false = 1,

Neither true nor false = 2, Somewhat true = 3, Definitely true = 4

1.	I feel concerned about the impression I am making.	0	1	2	3	4
2.	I feel relaxed.	0	1	2	3	4
3.	The content of the task will be dull.	0	1	2	3	4
4.	I am thinking about how other people might judge my performance.	0	1	2	3	4

5. I am determined to succeed on the task.	0	1	2	3	4
6. I feel tense.	0	1	2	3	4
7. I am worried about what other people think of me.	0	1	2	3	4
8. I am thinking about how I would feel if I were told how I performed	0	1	2	3	4
9. Generally, I feel in control of things.	0	1	2	3	4
10. I am reflecting about myself.	0	1	2	3	4
11. My attention will be directed towards the task.	0	1	2	3	4
12. I am thinking deeply about myself.	0	1	2	3	4
13. I feel energetic.	0	1	2	3	4
14. I am thinking about things that happened to me in the past	0	1	2	3	4
15. I am thinking about how other people might perform on this task	0	1	2	3	4
16. I am thinking about something that happened earlier today.	0	1	2	3	4
17. I expect that the task will be too difficult for me.	0	1	2	3	4
18. I will find it hard to keep my concentration on the task.	0	1	2	3	4
19. I am thinking about personal concerns and interests.	0	1	2	3	4
20. I feel confident about my performance.	0	1	2	3	4
21. I am examining my motives.	0	1	2	3	4
22. I can handle any difficulties I may encounter	0	1	2	3	4
23. I am thinking about how I have dealt with similar tasks in the past	0	1	2	3	4
24. I am reflecting on my reasons for doing the task	0	1	2	3	4
25. I am motivated to try hard at the task.	0	1	2	3	4
26. I am thinking about things important to me.	0	1	2	3	4
27. I feel uneasy.	0	1	2	3	4
28. I feel tired.	0	1	2	3	4
29. I feel that I cannot deal with the situation effectively.	0	1	2	3	4
30. I feel bored.	0	1	2	3	4

DSSQ-3 STATE QUESTIONNAIRE

POST-TASK QUESTIONNAIRE

Instructions. This questionnaire is concerned with your feelings and thoughts while you were performing the task. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you felt **WHILE PERFORMING THE TASK**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.

For each statement, circle an answer from 0 to 4, so as to indicate how accurately it describes your feelings **WHILE PERFORMING THE TASK**.

Definitely false = 0, Somewhat false = 1,

Neither true nor false = 2, Somewhat true = 3, Definitely true = 4

1.	I felt concerned about the impression I am making.	0	1	2	3	4
2.	I felt relaxed.	0	1	2	3	4
3.	The content of the task was dull.	0	1	2	3	4
4.	I thought about how other people might judge my performance	0	1	2	3	4
5.	I was determined to succeed on the task.	0	1	2	3	4
6.	I felt tense.	0	1	2	3	4
7.	I was worried about what other people think of me.	0	1	2	3	4
8.	I thought about how I would felt if I were told how I performed	0	1	2	3	4
9.	Generally, I felt in control of things.	0	1	2	3	4
10.	I reflected about myself.	0	1	2	3	4
11.	My attention was directed towards the task.	0	1	2	3	4

12. I thought deeply about myself.	0	1	2	3	4
13. I felt energetic.	0	1	2	3	4
14. I thought about things that happened to me in the past	0	1	2	3	4
15. I thought about how other people might perform on this task	0	1	2	3	4
16. I thought about something that happened earlier today.	0	1	2	3	4
17. I found the task was too difficult for me.	0	1	2	3	4
18. I found it hard to keep my concentration on the task.	0	1	2	3	4
19. I thought about personal concerns and interests.	0	1	2	3	4
20. I felt confident about my performance.	0	1	2	3	4
21. I examined my motives.	0	1	2	3	4
22. I felt like I could handle any difficulties I encountered	0	1	2	3	4
23. I thought about how I have dealt with similar tasks in the past	0	1	2	3	4
24. I reflected on my reasons for doing the task	0	1	2	3	4
25. I was motivated to try hard at the task.	0	1	2	3	4
26. I thought about things important to me.	0	1	2	3	4
27. I felt uneasy.	0	1	2	3	4
28. I felt tired.	0	1	2	3	4
29. I felt that I could not deal with the situation effectively.	0	1	2	3	4
30. I felt bored.	0	1	2	3	4

SCORING

Engagement = d5 + d11 + d13 + d25 - d3 - d18 - d28 - d30 + 16.

Distress = d6 + d17 + d27 + d29 - d2 - d9 - d20 - d22 + 16.

Worry = d1+d7+d10 + d12 + d16 + d19 + d21 + d26.

Range of scores. Scores will range from 0-32.

Remaining items are candidate items for an improved worry scale.

APPENDIX E: ENJOYMENT SCALE

Enjoyment Scale (Modified from Lin, Gregor, & Ewing, 2008)

Scale

1 - Strongly Disagree 2 - Disagree 3 - Somewhat Disagree 4 - Neither Agree nor Disagree 5 - Somewhat Agree 6 - Agree 7 - Strongly Agree

Items

While engaging in the task,

1) I was deeply engrossed
2) I was absorbed intently
3) My attention was focused
4) I concentrated fully

While engaging in the task, I felt,

5) Happy
6) Pleased
7) Satisfied
8) Contented

Engaging in the task was,

9) Fulfilling
10) Rewarding
11) Useful
12) Worthwhile

APPENDIX F: INTRINSIC MOTIVATION INVENTORY

Intrinsic Motivation Inventory (McAuley, Duncan & Tammen, 1989) (Adapted)

Scale 1 - (Strongly Disagree) through 6 - (Strongly Agree)

Please answer the following questions in relation to your experience with the task.

These questions relate to the thoughts and feelings you may have experienced. There are no right or wrong answers. Think about how you felt during the task and answer the questions using the rating scale below.

Items

1 - I enjoyed the task very much. (INT-ENJ)
2 - I think I am pretty good at this task. (COMP)
3 - I put a lot of effort into this task. (EFF-IMP)
4 - It was important to me to do well in this task. (EFF-IMP)
5 - I felt tense while engaging in the task. (r) (TEN-PRES)
6 - I tried very hard while engaging in the task. (EFF-IMP)
7 – Engaging in the task was fun. (INT-ENJ)
8 - I would describe this task as very interesting. (INT-ENJ)
9 - I am satisfied with my performance in this task. (COMP)
10 - I felt pressured while engaging in this task. (r) (TEN-PRES)
11 - I was anxious while engaging in this task. (r) (TEN-PRES)
12 - I did not try very hard at engaging in this task. (r) (EFF-IMP)
13 - While engaging in this task, I was thinking about how much I enjoyed it. (INT-ENJ)
14 - After engaging in this task for a little while, I felt pretty competent. (COMP)
15 - I was very relaxed while engaging in this task. (TEN-PRES)
16 - I am pretty skilled at this task. (COMP)
17 - The task did not hold my attention. (r) (INT-ENJ)
18 - I could not engage in this task very well. (r) (COMP)

APPENDIX G: IMMERSIVE TENDENCIES QUESTIONNAIRE

IMMERSIVE TENDENCIES QUESTIONNAIRE
(Witmer & Singer, Version 3.01, September 1996)*
Revised by the UQO Cyberpsychology Lab (2004)

Indicate your preferred answer by marking an "X" in the appropriate box of the seven point scale. Please consider the entire scale when making your responses, as the intermediate levels may apply. For example, if your response is once or twice, the second box from the left should be marked. If your response is many times but not extremely often, then the sixth (or second box from the right) should be marked.

1. Do you easily become deeply involved in movies or tv dramas?

NEVER			OCCASIONALLY			OFTEN

2. Do you ever become so involved in a television program or book that people have problems getting your attention?

NEVER			OCCASIONALLY			OFTEN

3. How mentally alert do you feel at the present time?

NOT ALERT			MODERATELY			FULLY ALERT

4. Do you ever become so involved in a movie that you are not aware of things happening around you?

NEVER			OCCASIONALLY			OFTEN

5. How frequently do you find yourself closely identifying with the characters in a story line?

NEVER			OCCASIONALLY			OFTEN

6. Do you ever become so involved in a video game that it is as if you are inside the game rather than moving a joystick and watching the screen?

NEVER			OCCASIONALLY			OFTEN

7. How physically fit do you feel today?

|_____|_____|_____|_____|_____|_____|_____|
NOT FIT MODERATELY FIT EXTREMELY FIT

8. How good are you at blocking out external distractions when you are involved in something?

|_____|_____|_____|_____|_____|_____|_____|
NOT VERY GOOD SOMEWHAT GOOD VERY GOOD

9. When watching sports, do you ever become so involved in the game that you react as if you were one of the players?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

10. Do you ever become so involved in a daydream that you are not aware of things happening around you?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

11. Do you ever have dreams that are so real that you feel disoriented when you awake?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

12. When playing sports, do you become so involved in the game that you lose track of time?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

13. How well do you concentrate on enjoyable activities?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL MODERATELY WELL VERY WELL

14. How often do you play arcade or video games? (OFTEN should be taken to mean every day or every two days, on average.)

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

15. Have you ever gotten excited during a chase or fight scene on TV or in the movies?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

16. Have you ever gotten scared by something happening on a TV show or in a movie?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

17. Have you ever remained apprehensive or fearful long after watching a scary movie?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

18. Do you ever become so involved in doing something that you lose all track of time?

|_____|_____|_____|_____|_____|_____|_____|
NEVER OCCASIONALLY OFTEN

Questionnaire sur la Propension à l'Immersion (QPI):

Laboratoire de Cyberpsychologie de l'UQO

Validation of the French version developed by the UQO Cyberpsychology Lab :

- 94 French-Canadian participants completed the questionnaire ;
- Cronbach's Alpha = .78.

Scoring :

Total : items 1 à 18

- « Focus » : Items 1 + 2 + 3 + 8 + 13
- « Implication » : Items 4 + 5 + 10 + 12 + 18
- « Émotions » : Items 11 + 15 + 16 + 17
- « jeu » : items 6 + 9 + 14

Norms (French version) :

	Moyenne	Écart type
Total	64.11	13.11
« Focus »	24.81	7.54
« Involvment»	15.33	8.67
« Emotions »	14.25	6.70
« Jeu »	6.56	4.95

APPENDIX H: SITUATIONAL MOTIVATION SCALE

13 Situational Motivation Scale (Guay, Vallerand, & Blanchard, 2000) Scale (adapted)

1 - (Strongly Disagree) through 6 - (Strongly Agree)

Items

Why are you currently engaged in this activity?

1 - Because I think that this activity is interesting
2 - Because I am doing it for my own good
3 - Because I am supposed to do it
4 - There may be good reasons to do this activity, but personally I don't see any
5 - Because I think that this activity is pleasant
6 - Because I think that this activity is good for me
7 - Because it is something that I have to do
8 - I do this activity but I am not sure if it is worth it
9 - Because this activity is fun
10 - By personal decision
11 - Because I don't have any choice
12 - I don't know; I don't see what this activity brings me
13 - Because I feel good when doing this activity
14 - Because I believe that this activity is important for me
15 - Because I feel that I have to do it
16 - I do this activity, but I am not sure it is a good thing to pursue it

Intrinsic Motivation: Items 1, 5, 9, 13 149 Identified Regulation: Items 2, 6, 10, 14 External Regulation: Items 3, 7, 11, 15 Amotivation: Items 4, 8, 12, 16

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