Psychology of games

Part 2: Intrinsic motivation, a.k.a. ”But what is the human reward function?”

Aalto University’s Game Analysis course, 2022

Prof. Perttu Hämäläinen

Some of the material contributed by Prof. Elisa Mekler (ITU Copenhagen)

Disclaimer: This content is perpetually work-in-progress, updated every year.

Fill in this questionnaire

- https://urly.fi/2SEL
- We will continue 9:30

Introduction

- Last week: How to optimize reward schedule, presentation, intensity?
- Today: What to reward the players with? What do people desire, feel, need? What is the impact of individual differences between players?

Game design = motivation design

As designers, we want our players to play our games voluntarily, because they want to and feel motivated to do so.

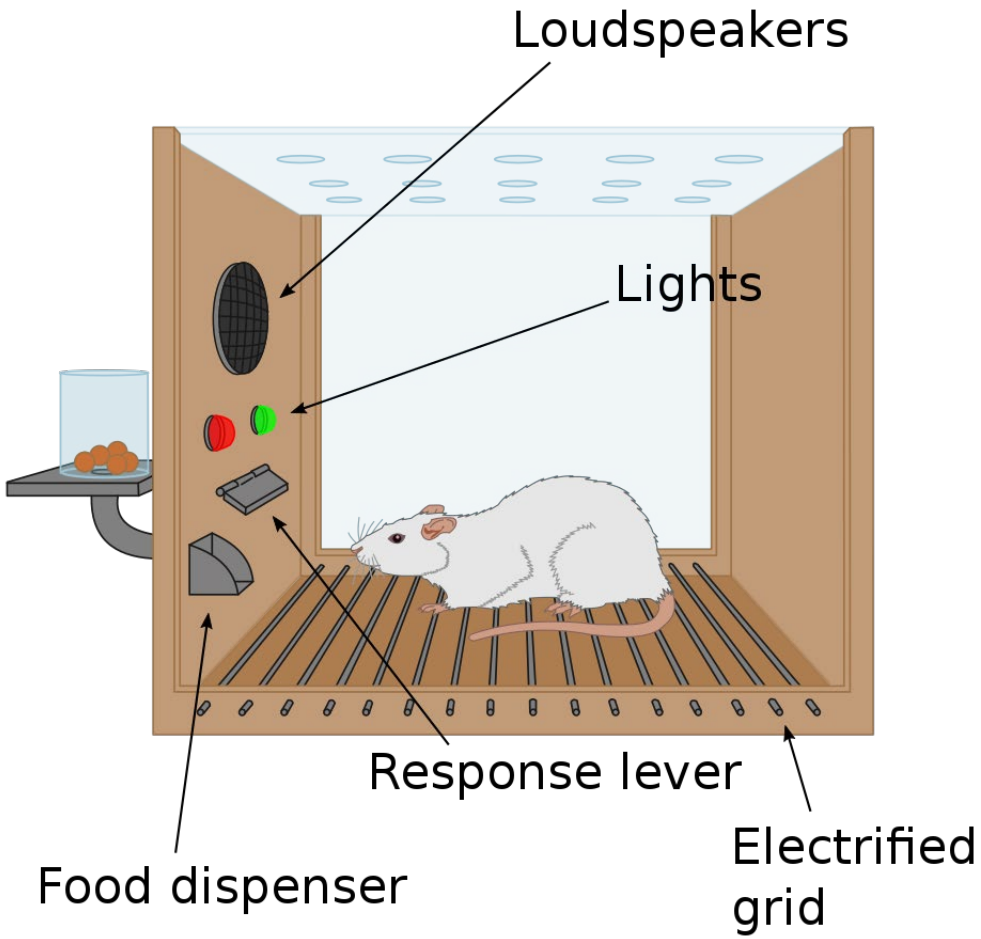
=> Understanding motivation is foundational to game design.

What Is Motivation?

The *energy* to take action, as well as the *direction* in which this energy is then moved

Motivation Research: The Early Days

- Focused on Observable Behavior Only
- No Consideration for Intentions, Experience or Wellbeing



Skinner’s Box – The Game?

Score: 700’000’000’000’000 pts

Earn 100’000’000’000’000 pts

Press the button to earn 100’000’000’000’000 pts

Intrinsic & extrinsic motivation

- Extrinsic motivation: motivation by external elements, such as fame, winning a prize, earning a salary, scoring in an exam.
- Intrinsic motivation: doing something for the sake of it, e.g., practicing something because it is inherently enjoyable and interesting

Intrinsic motivation

”Inherent tendency to seek out novelty and challenges, to extend and exercise one’s capacities, to explore, and to learn.”

”Children, in their healthiest states, are active, inquisitive, curious, and playful, even in the absence of specific rewards.”

”Natural inclination towards assimilation, mastery, spontaneous interest, and exploration that is so essential to cognitive and social development and that represents a principal source of enjoyment and vitality throughout life.”

Intrinsic and extrinsic motivation in games

- Extrinsic motivation: score, leaderboards, achievements...
- Intrinsic motivation: curious exploration, self-expression, empowerment, friendship-supporting social features, also rewards and feedback if properly designed to support the feeling of competence

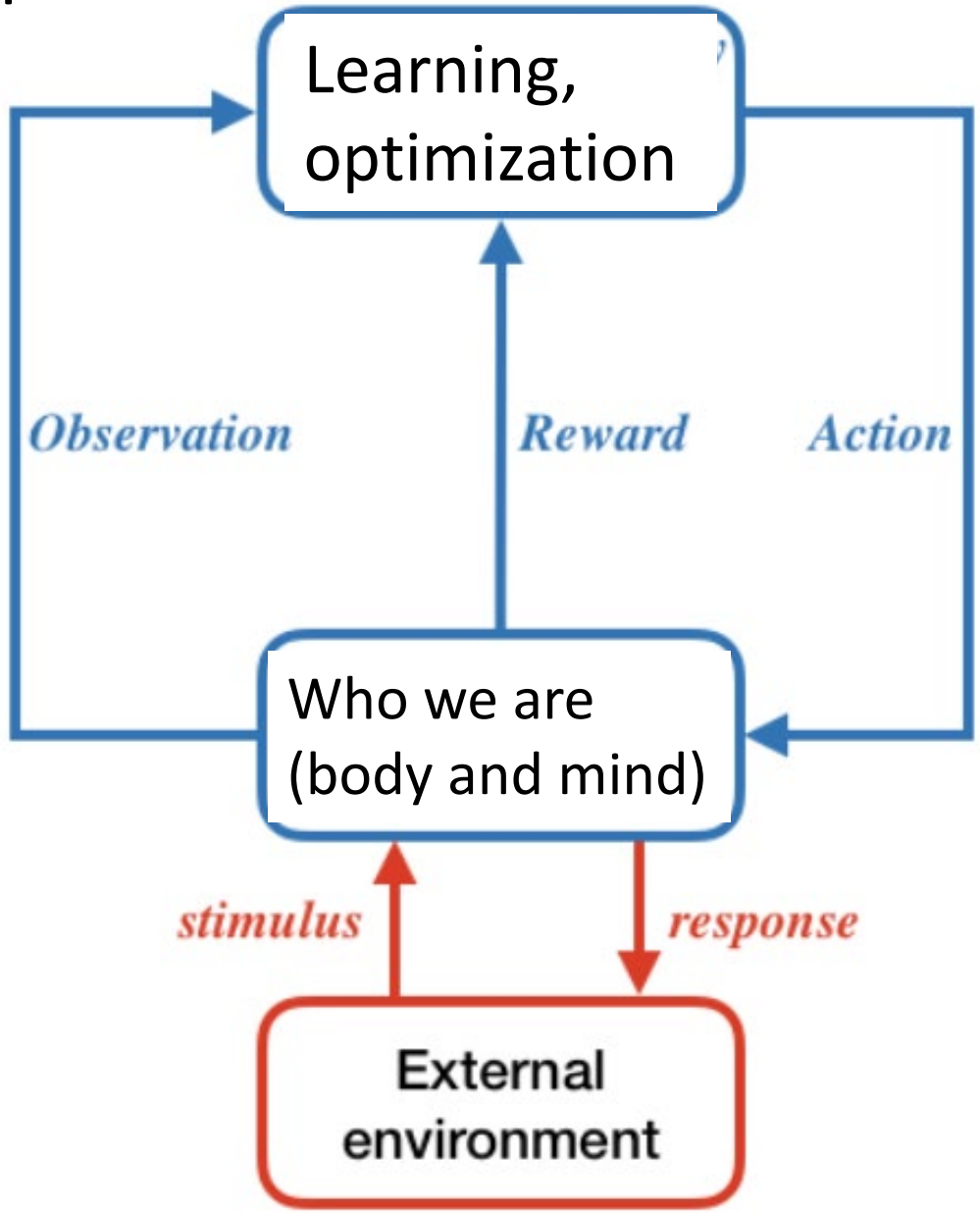
Intrinsic motivation, need satisfaction, and Computational Rationality

- Psychology of intrinsic motivation: Intrinsically motivating experiences facilitate satisfaction of basic psychological needs
  - Games: Satisfaction of basic psychological needs predicts game enjoyment, playing persistence, and improved wellbeing
- Computational Rationality: motivation emerges from rewards

=> To reconcile the two perspectives, one can define a reward function with ”intrinsic rewards” that represent need satisfaction.

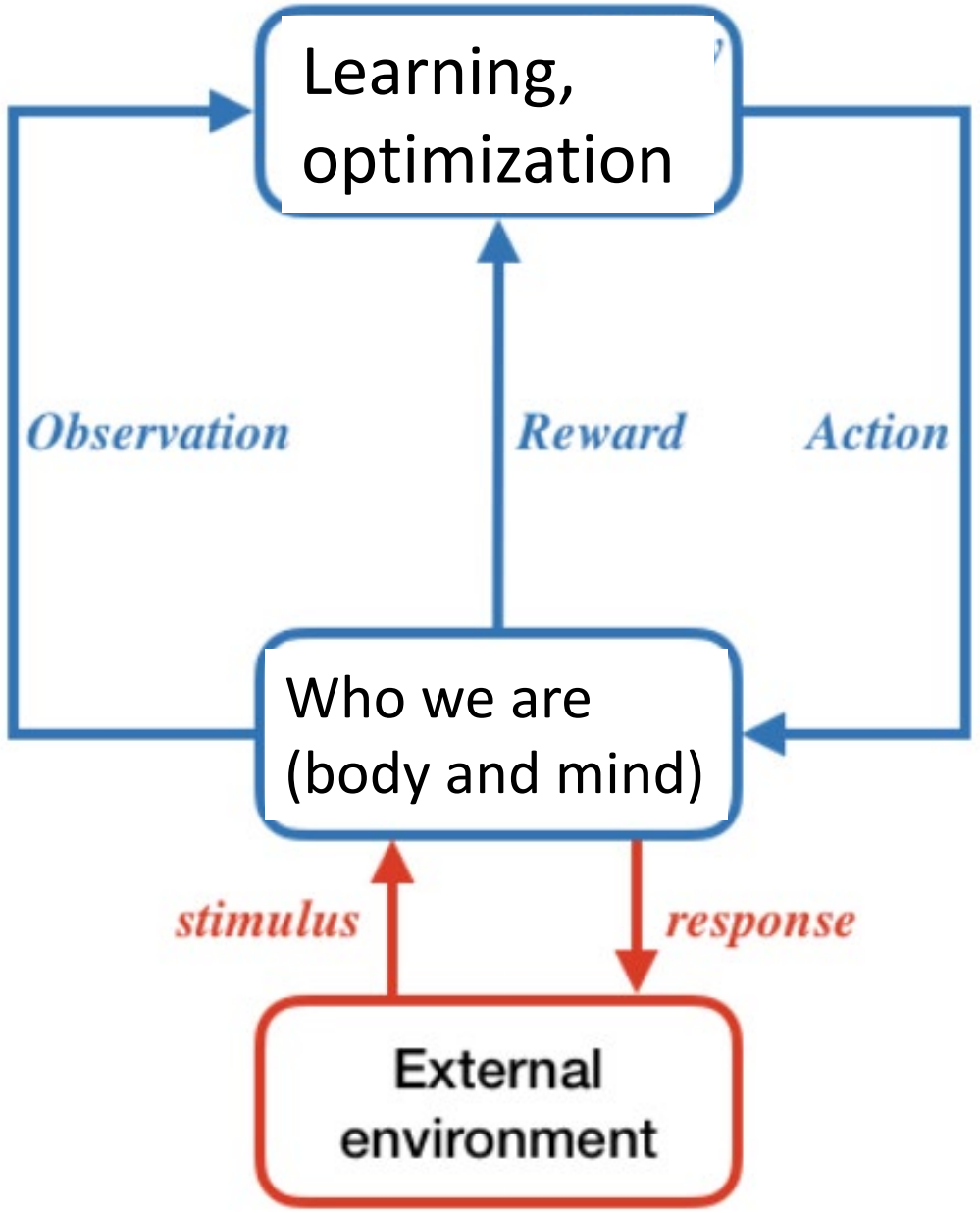
Intrinsic Motivation and Computational Rationality

- Extrinsic motivation = seeking extrinsic rewards
- Intrinsic motivation = seeking intrinsic rewards
- Not just splitting hairs—crucial for implementing intrinsically motivated AI, e.g., for playtesting



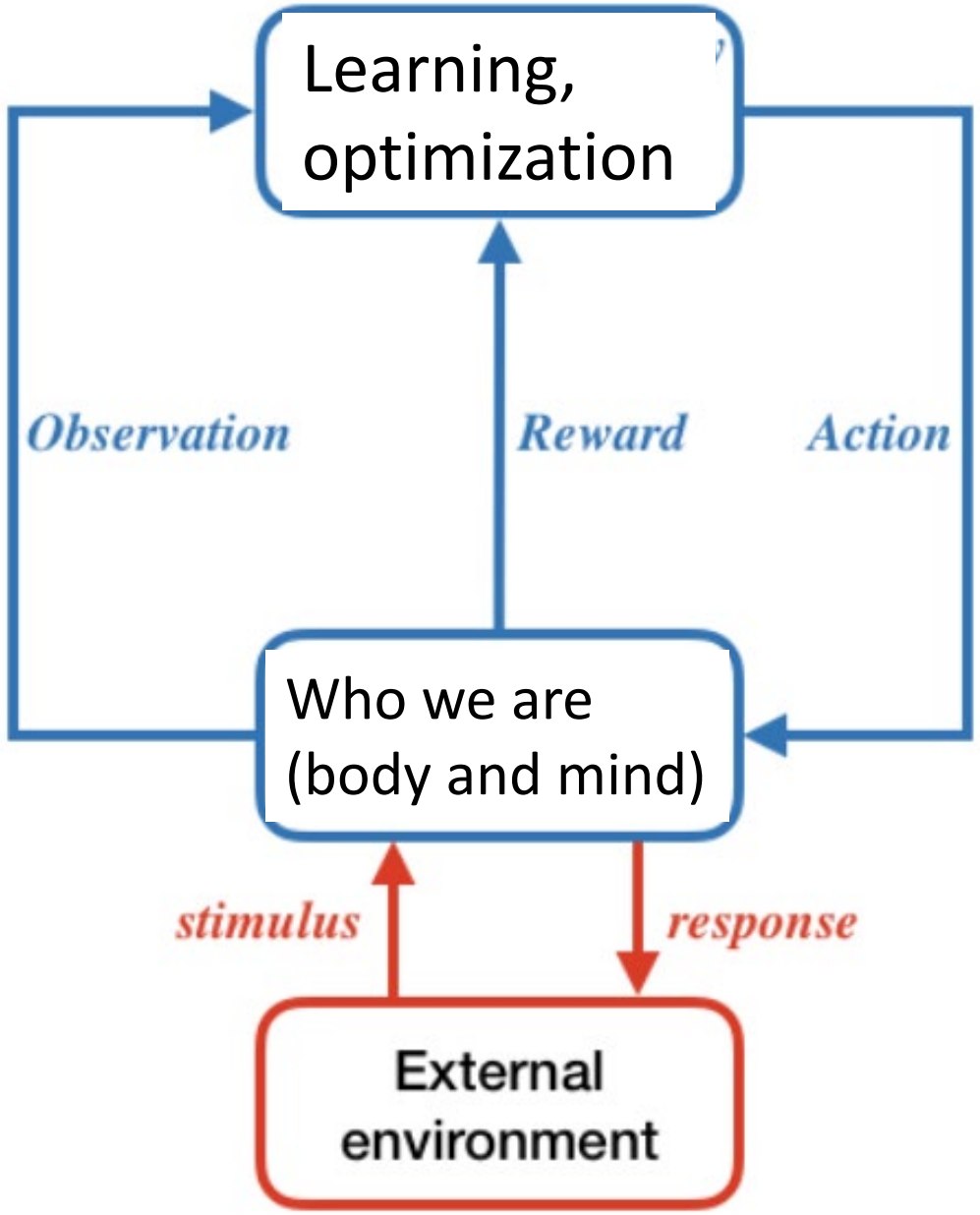
Where do intrinsic rewards come from?

To be an accurate model, intrinsic rewards based on psychological needs must be somehow rational/optimal, from an evolutionary perspective.



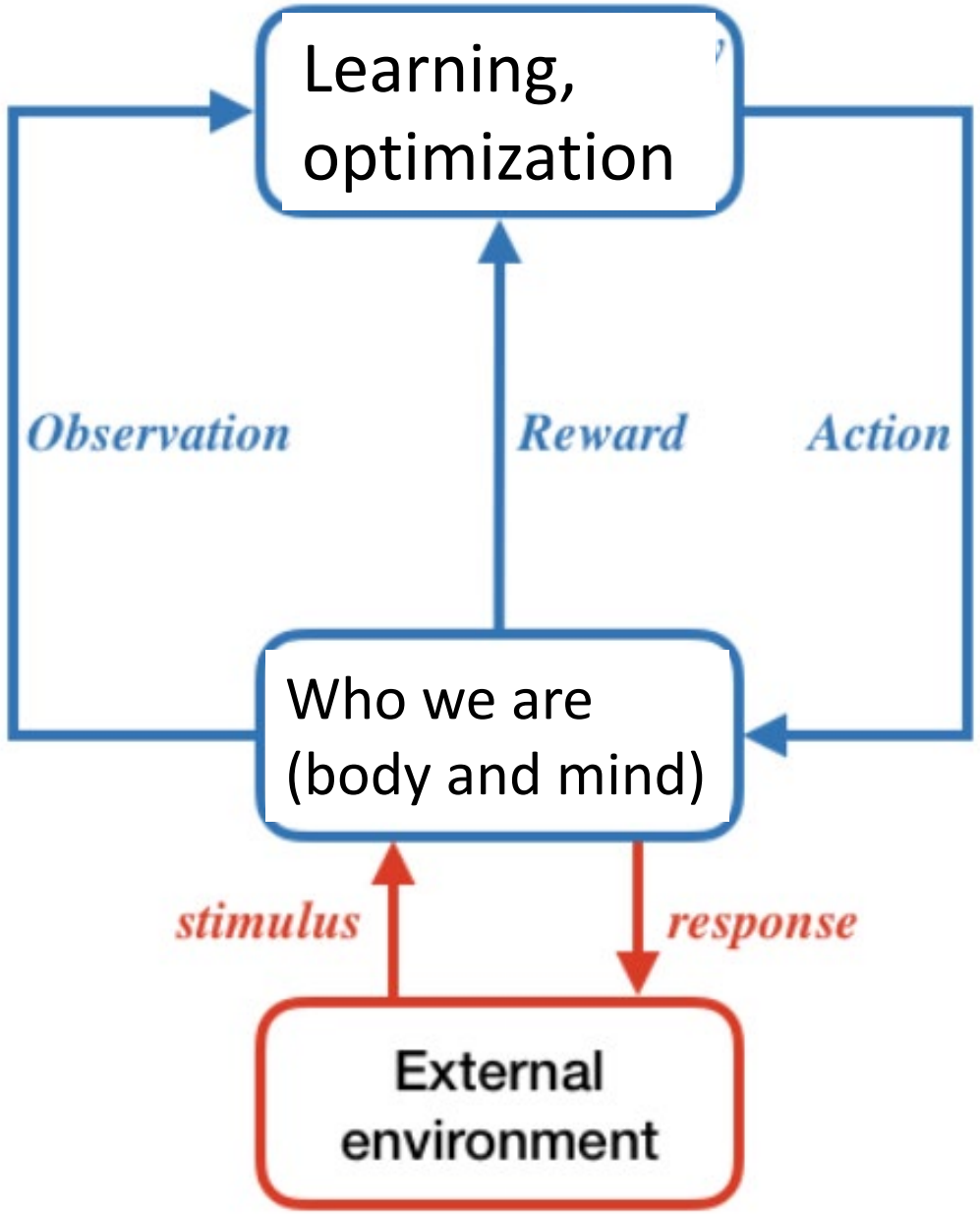
Where do intrinsic rewards come from?

Evolution: We care about survival



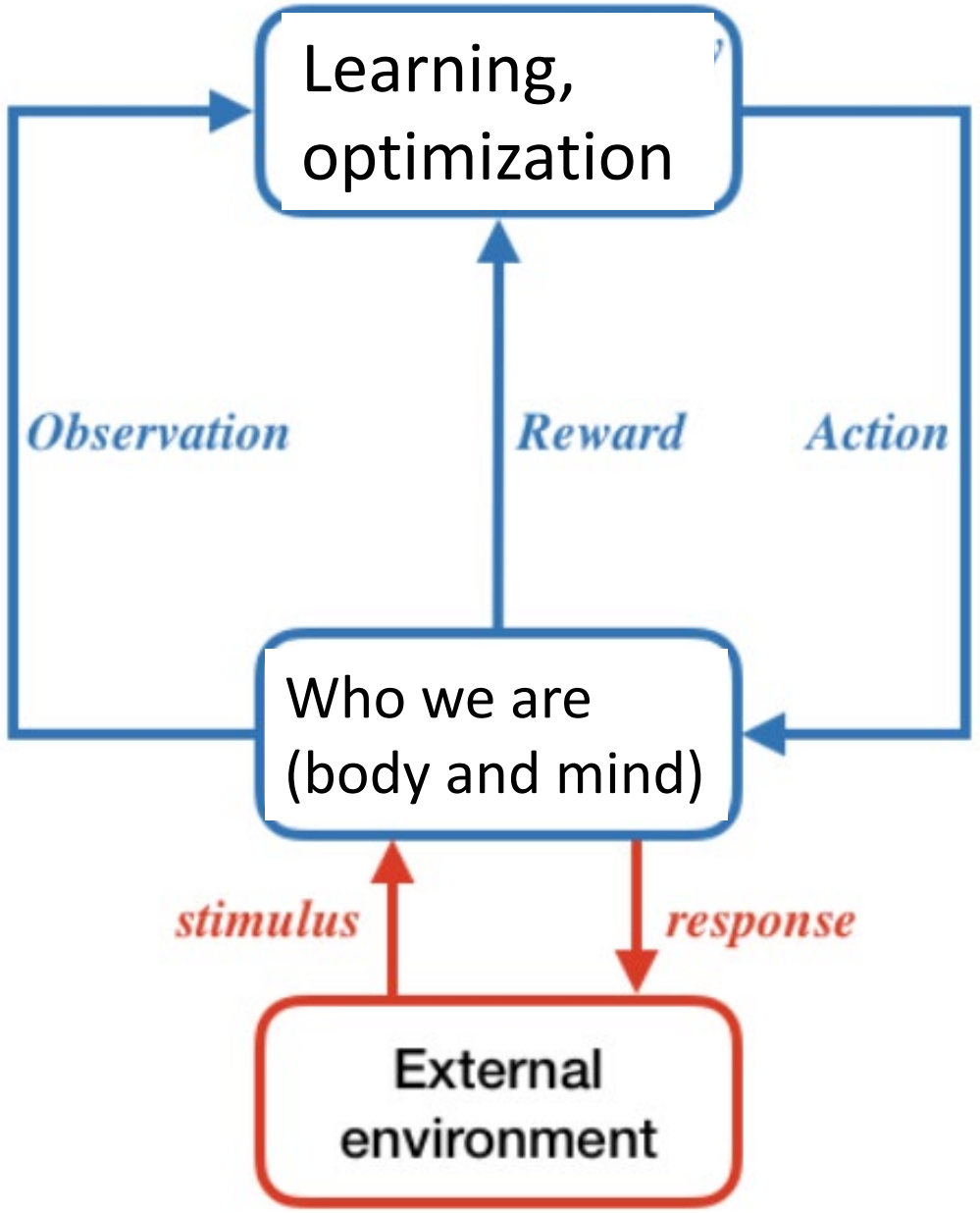
Where do intrinsic rewards come from?

Problem: The world is unpredictable and dangerous => can't simply learn through trial and error.



Where do intrinsic rewards come from?

Solution 1: Things that provide a survival advantage may be intrinsically and innately rewarding/satisfying



Innately rewarding: Calories

- During the most of our evolution, energy has been a scarce resource
- High-calorie foods have provided a survival advantage => we're genetically built to seek them and experience them as rewarding

JOURNAL ARTICLE

Sweet taste preferences are partly genetically determined: identification of a trait locus on chromosome 16

Kaisu Keskitalo, Antti Knaapila, Mikko Kallela, Aarno Palotie, Maija Wessman, Sampo Sammalisto, Leena Peltonen, Hely Tuorila, Markus Perola

The American Journal of Clinical Nutrition, Volume 86, Issue 1, July 2007, Pages 55–63, https://doi.org/10.1093/ajcn/86.1.55
Published: 01 July 2007 **Article history**

ABSTRACT

Background: Humans have an innate preference for sweet taste, but the degree of liking for sweet foods varies individually.

Objective: The proportion of inherited sweet taste preference was studied. A genome-wide linkage analysis was performed to locate the underlying genetic elements in the genome.

Design: A total of 146 subjects (32% men, 68% women) aged 18–78 y from 26 Finnish families evaluated the intensity and pleasantness of 3 suprathreshold solutions of sucrose (3.0%, 7.5%, and 18.75%) and plain water and the intensity of filter paper impregnated with 6-*n*-propylthiouracil (PROP). The subjects also reported the pleasantness and the use frequency of 5 sweet foods (chocolate, candy, ice cream, sweet desserts, and sweet pastry) and completed a food-behavior questionnaire that measured their craving for sweet foods.

Results: Of the chemosensory functions, the pleasantness rating of the strongest (18.75%) sucrose solution and the intensity rating of PROP yielded the highest heritability estimates (41% and 66%, respectively). The pleasantness and the use frequency of sweet foods (both variables calculated as a mean of ratings for 5 food items) and the craving for sweet foods showed significant heritability (40%, 50%, and 31%, respectively). A logarithm of odds score of 3.5 ($P = 0.00003$) was detected for use frequency of sweet foods on chromosome 16p11.2 (marker D16S753).

Conclusions: Sweet taste preferences are partly inherited. Chromosome 16p11.2 may harbor genetic variations that affect the consumption of sweet foods.

Innate aversion (punishment, negative rewards)

Current Biology

Volume 25, Issue 3, 2 February 2015, Pages R120-R129

Review

Aversion and Attraction through Olfaction

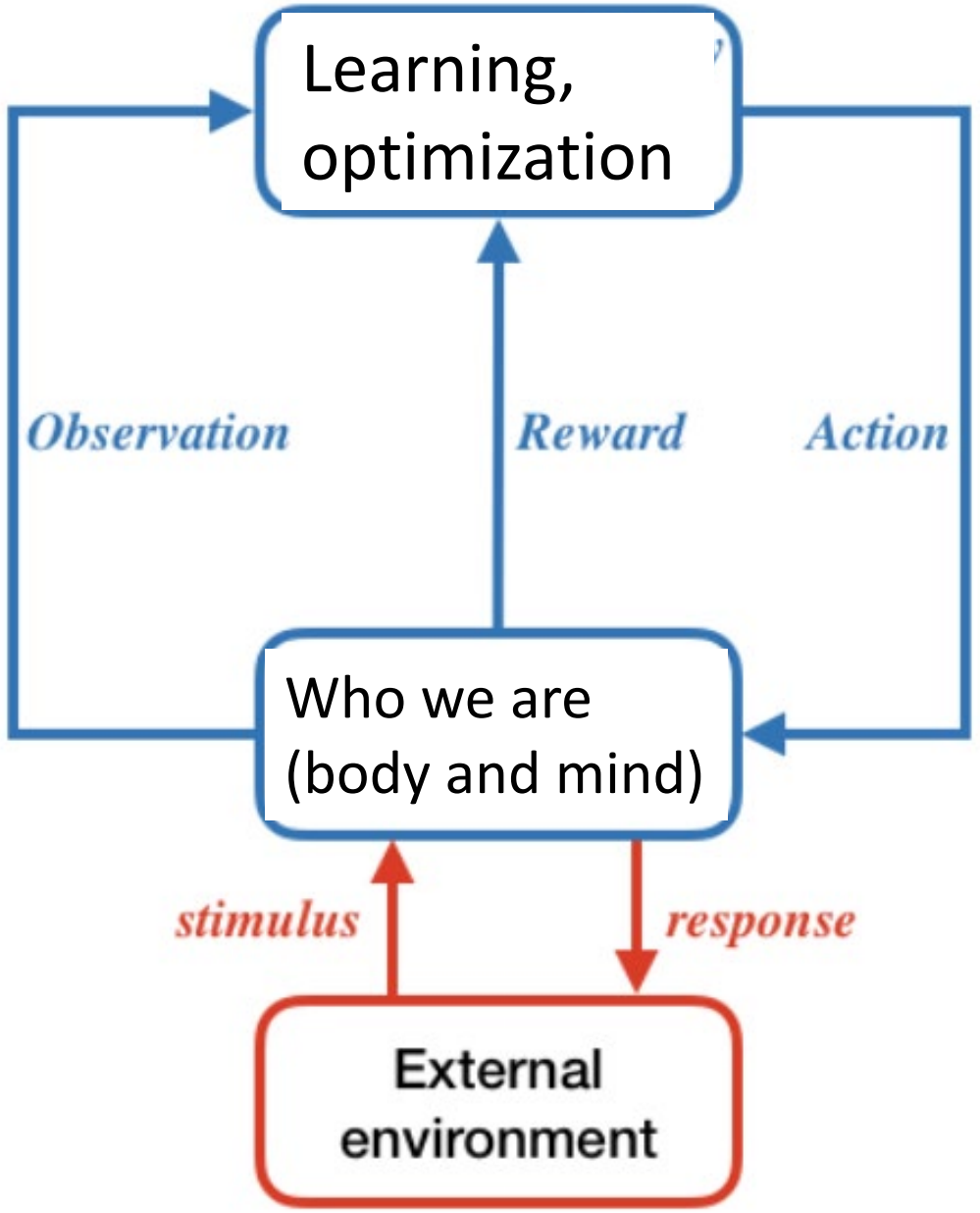
Qian Li, Stephen D. Liberles

https://doi.org/10.1016/j.cub.2014.11.044

Sensory cues that predict reward or punishment are fundamental drivers of animal behavior. For example, attractive odors of palatable food or a potential mate predict reward, while aversive odors of pathogen-laced food or a predator predict punishment. Aversive and attractive odors can be detected by intermingled sensory neurons that express highly related olfactory receptors and display similar central projections. These findings raise basic questions of how innate odor valence is extracted from olfactory circuits, how such circuits are developmentally endowed and modulated by state, and how innate and learned odor responses are related. Here, we review odors, receptors and neural circuits associated with stimulus valence, discussing salient principles derived from studies on nematodes, insects and vertebrates. Understanding the organization of neural circuitry that mediates odor aversion and attraction will provide key insights into how the brain functions.

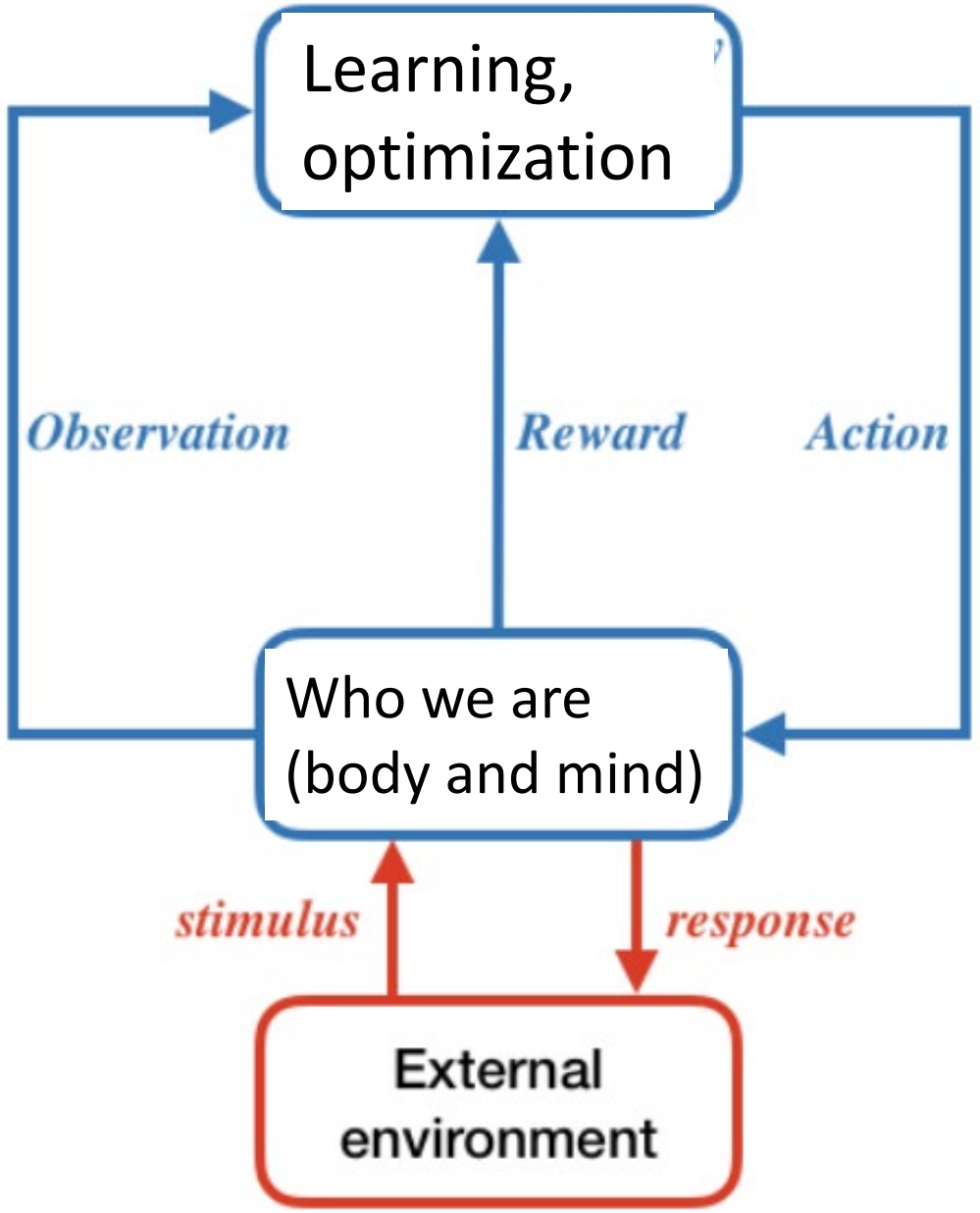
Where do intrinsic rewards come from?

Problem: The world is unpredictable and dangerous => can't simply learn through trial and error.



Where do intrinsic rewards come from?

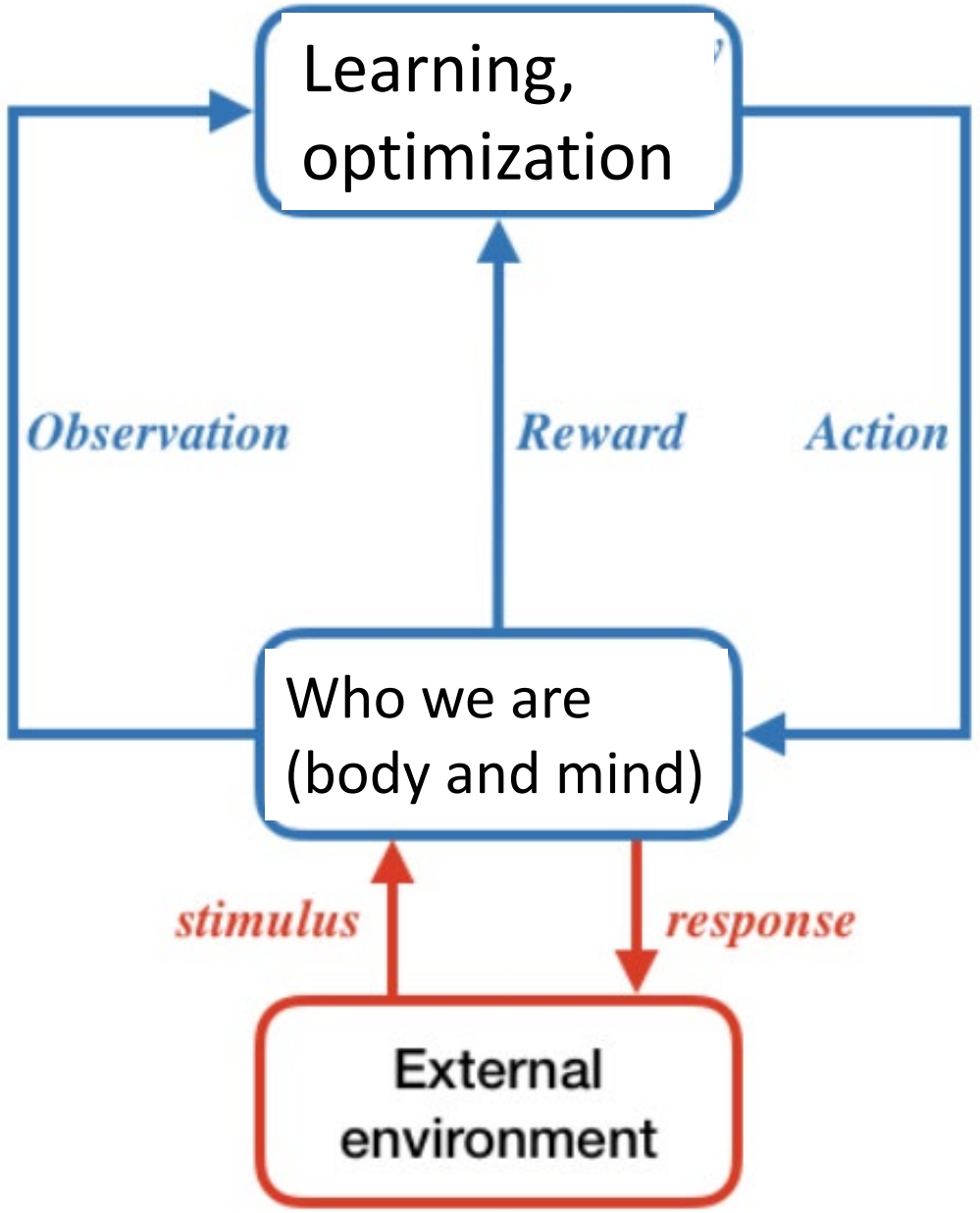
Solution 2: As children, we explore the world to construct a rich mental model that allows us to predict the results of actions without actually trying them out.



https://youtu.be/9FizCJdJDec

Where do intrinsic rewards come from?

What rewards would make such exploration behaviors emerge?



Curiosity Driven Exploration by Self-Supervised Prediction

ICML 2017

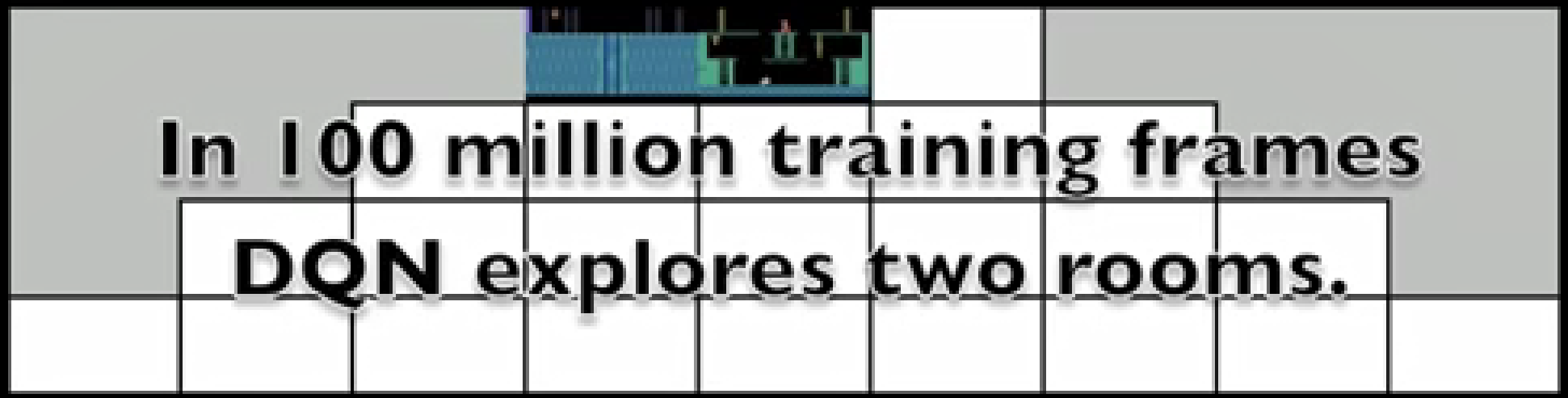
Deepak Pathak, Pulkit Agrawal, Alexei Efros, Trevor Darrell
UC Berkeley

Unifying Count-Based Exploration and Intrinsic Motivation

Bellemare, Srinivasan, Ostrovski,
Schaul, Saxton, Munos

Google DeepMind

June 6, 2016


In 100 million training frames
DQN explores two rooms.

Curious interest

- Silvia: Interest is the ”curious emotion” or state of feeling curious towards something
- Interest elicited through: complexity/novelty, comprehensibility/coping potential

Interest—The Curious Emotion

Paul J. Silvia

University of North Carolina at Greensboro

ABSTRACT—*Despite their interest in why people do what they do, psychologists typically overlook interest itself as a facet of human motivation and emotion. In recent years, however, researchers from diverse areas of psychology have turned their attention to the role of interest in learning, motivation, and development. This article reviews the emerging body of work on the psychology of interest, with an emphasis on what contemporary emotion research has learned about the subject. After considering four central questions—Is interest like other emotions? What functions does interest serve? What makes something interesting? Is interest merely another label for happiness?—the article considers unanswered questions and fruitful applications. Given interest's central role in cultivating knowledge and expertise, psychologists should apply research on interest to practical problems of learning, education, and motivation.*

KEYWORDS—*interest; curiosity; exploration; emotion; learning*

Humans are curious creatures: They devote a lot of effort and brainpower to the things that interest them. How much money would it take to persuade an indifferent person to memorize a team's baseball statistics, compile a four-volume encyclopedia of Danish furniture, learn to play the banjo, or spend a career studying an obscure academic topic? As a source of intrinsic motivation, interest plays a powerful role in the growth of knowledge and expertise (Kashdan, 2004; Sansone & Thoman, 2005). The psychology of interest dates to the 1800s, and it has flourished in the last 10 years. Researchers who study emotion, personality, aesthetics, education, vocations, motivation, and development have taken a new look at what interest is, what it does, and how it works (Silvia, 2006). In this article, I'll review what emotion psychology has learned about interest, the curious emotion.

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IS INTEREST AN EMOTION?

Interest is an eccentric emotion. Many theories don't include interest in their lists of major emotions, and a few theories reject interest as an emotion altogether. Nevertheless, interest has a proud history in emotion psychology. In his landmark book on emotional expression, Charles Darwin (1872/1998) described emotions related to learning, thinking, and exploring. Darwin's terms—*abstracted meditation*, *perplexed reflection*, and *stupefied amazement*—seem quaint to modern readers, but his ideas remain ahead of their time. Many decades later, modern emotion psychology doesn't know much about what I'll call *knowledge emotions*: states such as *interest*, *confusion*, *surprise*, and *awe*.

A good case can be made for viewing interest as an emotion. Modern theories of emotion propose that emotions are defined by a cluster of components. Typical emotional components are physiological changes, facial and vocal expressions, patterns of cognitive appraisal, a subjective feeling, and an adaptive role across the lifespan (Lazarus, 1991). Interest appears to have these components: It has a stable pattern of cognitive appraisals (Silvia, 2005b), a subjective quality (Izard, 1977), and adaptive functions (Sansone & Smith, 2000). Interest's physiological and expressive components, not surprisingly, are associated with orientation, activation, concentration, and approach-oriented action (Libby, Lacey, & Lacey, 1973). Interest lacks the smiling and eye-crinkling expressions of happiness. Instead, interest involves movements of muscles in the forehead and eyes that are typical of attention and concentration (Langsdorf, Izard, Rayias, & Hembree, 1983; Libby et al., 1973; Reeve, 1993). When interested, people often still and tilt the head, which aids in tracking objects and sounds (Reeve, 1993). Interest's vocal expression involves a faster rate of speech and greater range in vocal frequency (Banse & Scherer, 1996). Taken together, interest appears to have the features typical of emotions.

WHAT DOES INTEREST DO?

According to functional approaches to emotion, emotions help people manage fundamental goals (Lazarus, 1991). Interest's function is to motivate learning and exploration. By motivating people to learn for its own sake, interest ensures that people will develop a broad set of knowledge, skills, and experience. The

Abstract

A fundamental tenet of self-determination theory is that the satisfaction of three basic, innate psychological needs for autonomy, competence, and relatedness is necessary for optimal functioning. The aim of this research was to propose novelty as a basic psychological need in self-determination theory and develop a new measure to assess novelty need satisfaction, the Novelty Need Satisfaction Scale (NNSS). Two studies were performed, one at the global lifestyle level (Study 1: general adults, $N = 399$, $M_{age} = 31.30$ years) and the other at a contextual level in physical education (Study 2: first-year post-compulsory secondary school students, $N = 1035$, $M_{age} = 16.20$ years). Participants completed the NNSS alongside measures of psychological needs and regulation styles from self-determination theory and psychological well-being. The six-item NNSS showed adequate psychometric properties and discriminant validity with other psychological needs in both studies. Novelty need satisfaction predicted life satisfaction (Study 1) and intrinsic motivation in physical education (Study 2) independent of the other three psychological needs. Results provide preliminary evidence that need for novelty is a unique candidate need alongside existing needs from self-determination theory, but further confirmatory and experimental research is required.

Keywords: basic psychological needs, motivation, well-being, curiosity

Novelty-variety as a candidate basic psychological need: New evidence across three studies

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Marina Milyavskaya

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This is a pre-print of an article published in *Motivation and Emotion*. The final authenticated version is available online at https://doi.org/10.1007/s11031-019-09807-4

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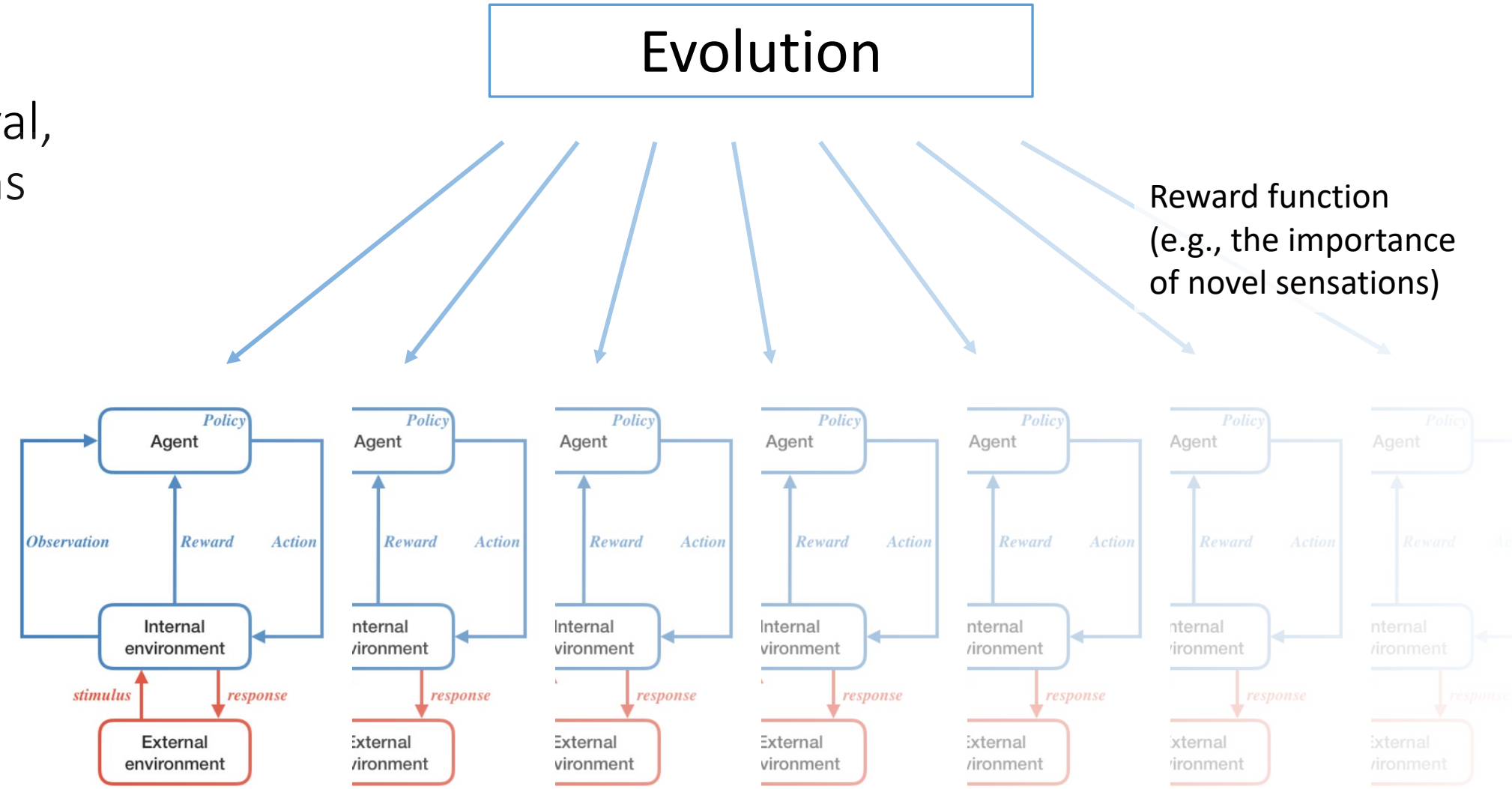
Abstract

This paper investigates the plausibility of novelty-variety as a potential basic psychological need in a series of three studies. Using criteria proposed by Baumeister and Leary (1995) and Ryan and Deci (2017) to establish a motive as a basic human need, we focus on those criteria where evidence is lacking. Specifically, we examine whether novelty-variety is distinct from other needs in Basic Psychological Need Theory (BPNT) proposed by Self-Determination Theory (SDT), whether its absence results in adverse effects and its satisfaction uniquely predicts well-being outcomes, and whether the effects are different across age and personality. In Study 1, participants (N=202) rated novelty-variety and needs from BPNT (competence, autonomy, relatedness) in three domains to assess its independence from these needs and the extent to which novelty-variety uniquely relates to domain-specific well-being. In Study 2 (N=414), the fulfillment of novelty-variety and two BPNT needs (autonomy and relatedness) was experimentally manipulated in work-related vignettes, further showing that unsatisfied novelty-variety is related to lower well-being. Finally, the third study (N=599) accounts for some of the limitations in Study 2 and examines the criteria of universality. Based on the examined criteria, all three studies provide support for further considering novelty-variety as a potential basic psychological need.

Keywords: Psychological needs; novelty; variety; well-being

The big picture: Two nested optimization processes

Evolution:
Optimization of genes for survival, over generations



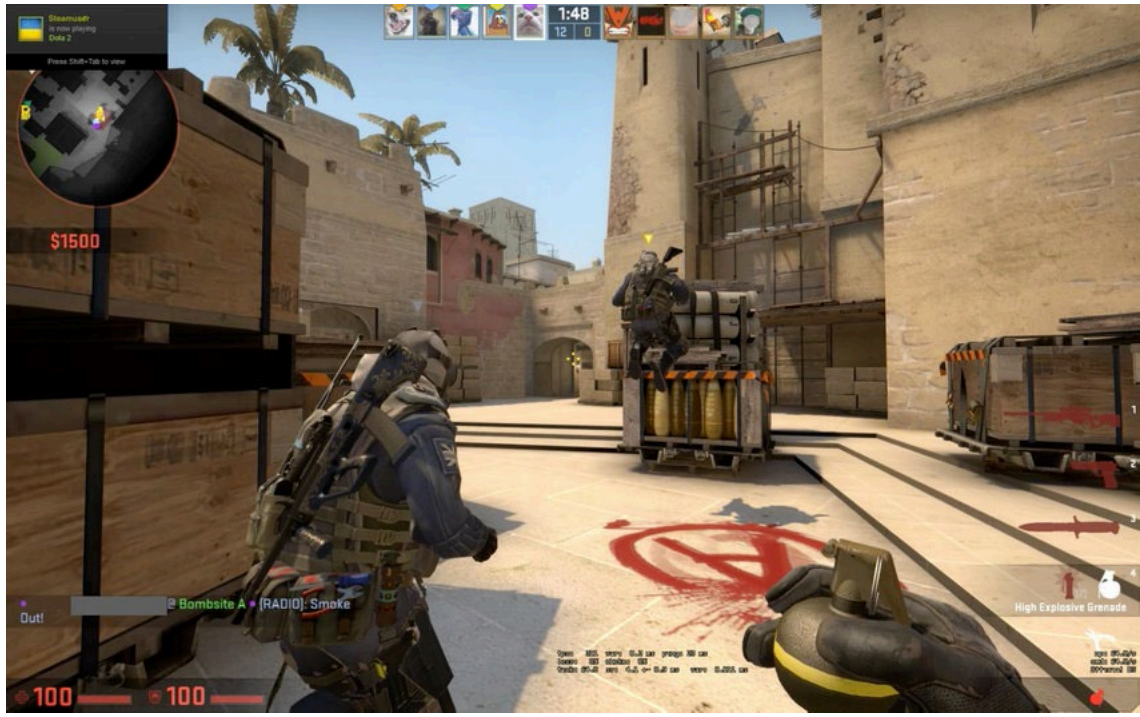
Computational Rationality:
Optimization of behavior during each individual's lifespan

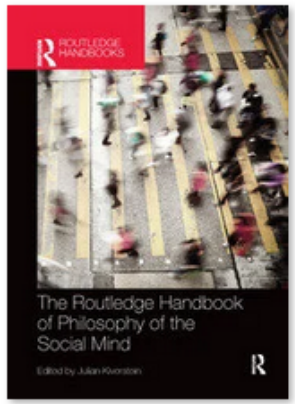
Problem: Complex high-risk environments

- Social context: Parents demonstrate correct behavior and foster and protect children until they are ready to act autonomously
- Evolution optimizes over multiple generations: For the survival of genes, we need to care about the safety of our offspring

Caring beyond one's own kin

- Survival may require collaboration of communities beyond one's immediate family.
- Genetic foundations of politics and moral psychology: Variability in how we treat others differently based on whether we identify them as "in-group" or "out-group"





Chapter

The evolution of tribalism

By ***Edouard Machery***

Book [The Routledge Handbook of Philosophy of the Social Mind]

Edition	1st Edition
First Published	2016
Imprint	Routledge
Pages	14
eBook ISBN	9781315530178

ABSTRACT

Tribalism is a complex psychological phenomenon: It involves emotions – such as disgust and sometimes hatred at the members of outgroups or outrage when their behavior violates ingroup norms – preferences – typically, but not always, a preference for interacting with the members of one's own groups – stereotypes and prejudices – which underlie expectations about ingroup members' interactions with outgroup members - and normative cognition – people often have different norms governing interactions with ingroup and outgroup members. It is also a socially important phenomenon, which fuels between-group conflicts in the contemporary world – from genocides such as the genocide in Rwanda to unrelenting conflicts such as the Israeli-Palestinian conflict – and possibly within-society cultural phenomena such as racism. Improving our understanding of tribalism may give us more tools for dealing with between-group conflicts and within-society cultural phenomena, for example by allowing better training of mediators involved in between-group conflicts.

ARE WE STALLED PART WAY THROUGH A MAJOR EVOLUTIONARY TRANSITION FROM INDIVIDUAL TO GROUP?

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This commentary poses an evolutionary hypothesis about the nature of the human condition: that we are stalled part way through a major evolutionary transition from individuals to groups, a transition that may never be completed but that has already shaped our history, politics, psychology, and social life. The conditions causing the transition to stall include the decreasing congruence of group boundaries with kinship boundaries, growth in group size, increasing interdependence of groups, membership of individuals in several types of groups, divided loyalties of individuals among groups, and the emergence of institutions as novel entities uncoupled from the individuals who temporarily belong to them. Those conditions combine to decrease the ability of cultural group selection to effect genetic change in group-oriented traits.

The theory supporting this hypothesis deals with major transitions (e.g., Maynard Smith and Szathmáry 1995), hierarchical selection (e.g., Price 1970, 1972; Frank 1995, 2003; Rice 2004), conflicts and conflict resolution (e.g., Burt and Trivers 2006), and gene-culture coevolution (e.g., Boyd and Richerson 2005; Richerson and Boyd 2005). The evidence is diverse. It comes from biological anthropology (e.g., Hill and Hurtado 1995), behavioral economics (e.g., Hammerstein 2003; Bowles 2004; Henrich et al. 2004), evolutionary psychology (e.g., Barkow et al. 1992), and history. The research programs it suggests are at least in anthropology, history, and political science.

multicellularity (≈1000 mya), of the full capacity for language (≈0.1 mya), and of writing (≈0.005 mya).

These are their defining characteristics:

- There is a change in the way information is transmitted from one generation to the next: the nature of the replicator changes.
- A new unit of selection—a new interactor—emerges at a higher level.
- For that to happen, conflicts within lower levels and between lower and higher levels must be suppressed or otherwise resolved. Conflicts may be resolved by brute force, by realignment of information transmission into similar pathways so that partners in conflict come to share common stakes, and by the evolution of mutualism from parasitism.
- As the new unit of selection starts to emerge at the higher level, there is a division of labor with specialization of parts. When the reproductive performance of the higher-level unit starts to depend strongly on the degree to which it has become well integrated–when it has recognizable physiology and development–we call it an organism or individual (Buss 1987).

The major transition in which we appear to be stalled is a transition from the individual to the group: if it were com-

Innate social instincts/rewards

- Protecting one's own kin
- Empathy for the needs and experiences of others (e.g., reciprocal altruism)

Reciprocal altruism: 30 years later

Robert Trivers

"Two are better than one; because they have a good reward for their labour. For if they fall, the one will lift up the other: but woe to him that is alone when he falleth; for he hath not another to help him up. Again, if two lie together, then they have heat: but how can one be warm alone? And if one prevails against him, two shall withstand him; and a three-fold cord is not easily broken." (Ecclesiastes 4, 9–12; King James Version).

4.1 Introduction

A little over 30 years ago, I had the good fortune of publishing my first scientific paper on reciprocal altruism, a subject that had not yet been addressed from an evolutionary standpoint. Hamilton's (1964) great work on kinship and altruism made it clear that in humans there existed a major form of altruism that could not be explained by kinship. Its elaboration was responsible for the complex economic systems in which we now live and its regulation could plausibly be explained by a system of interconnected human emotions, including feelings of friendship, gratitude, sympathy, guilt, moralistic aggression, a sense of justice and (I would now add) forgiveness.

I brought no great talents to this enterprise, beyond a willingness to take the evolutionary problem seriously and to model evolutionary logic on easily inferred psychological facts regarding our own behavior (for a description of how the paper was written, see Trivers 2002). The paper was certainly timely. My 600 reprints were quickly exhausted and the evolutionary idea was off and running. There now exists a very large literature on the subject and many subareas have advanced far beyond my original paper.

The purpose of the present paper is to provide a personal review of some major developments since my paper. These include the Prisoner's Dilemma (PD) as a model for reciprocal altruism, other models and third-party observer effects. I concentrate on the human sense of justice and the selective forces likely to have molded it. In the process, I discuss recent empirical work (using economic games) that bears on our sense of fairness and what seems to me the most plausible way to interpret these results. I neglect many important topics, for example, discrimination against cheaters in symbioses (see Sachs et al. 2004).

Intrinsically Motivated General Companion NPCs via Coupled Empowerment Maximisation

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***Abstract*—Non-player characters (NPCs) in games are traditionally hard-coded or dependent on pre-specified goals, and consequently struggle to behave sensibly in ever-changing and possibly unpredictable game worlds. To make them fit for new developments in procedural content generation, we introduce the principle of *Coupled Empowerment Maximisation* as an intrinsic motivation for game NPCs. We focus on the development of a general game companion, designed to support the player in achieving their goals. We evaluate our approach against three intuitive and abstract companion duties. We develop dedicated scenarios for each duty in a dungeon-crawler game testbed, and provide qualitative evidence that the emergent NPC behaviour fulfils these duties. We argue that this generic approach can speed up NPC AI development, improve automatic game evolution and introduce NPCs to full game-generation systems.**

I. Introduction

Dogmeat from *Fallout* or *Ellie* from *The Last of Us* or the pet from *Nethack* – memorable companions are an important part of our gaming experience. But companions can also be a great source of annoyance, especially when their behaviour fails miserably [1]. The vast majority of companions are hard-coded by means of e.g. finite state machines or behaviour trees, and consequently struggle to produce believable or even plausible behaviour in unforeseen contexts ([2], [3]). More advanced companions can adapt their behaviour by means of planning, or by learning a policy via neural networks or traditional reinforcement learning. Nevertheless, they require intense training or pre-specified rewards, which again renders them inflexible especially in sandbox games where players with a large choice of options can change a dynamic world. In the future, the demands on non-player character (NPC) AI in general are likely to increase further [4]. This is particularly in the agent's sensorimotor relationship with the world [8], so changes to the world or the agent's embodiment are reflected in potentially new behaviour. A curious mouse and a curious bird would consequently behave differently, moderated by their embodiment and environment. In this paper, we will work with the intrinsic motivation of *empowerment* [10], a measure of how much an agent is in control of the world it can perceive. We have previously argued [11] that empowerment reflects an agent's drive to maintain its own precarious existence, and allows them to adapt to changes in their embodiment and environment. But while empowerment might be very useful to produce an intrinsically motivated *general NPC*, we have to look specifically into how to turn it into a good *companion*.

Players seem to expect a companion to behave differently than a general NPC. For instance, in a qualitative study on companion behaviour, a player said "I dislike that [the companion] prioritises getting to the exit herself over helping [me] first" [1], stressing the delicate balance between support and independence. McGee and Abraham [12] argue that the NPC must account for the player's goals as part of coordinated decision-making, possibly incorporating uncertainty. To guide our approach, we identify the following three companion duties, which should generalise across a range of game genres:

1) *Player Integrity*: Ensure that the player can continue playing the game. Act against any limiting force.
2) *Support*: Support and do not hinder the player in achieving their goals. Maintain *operational proximity*, i.e. act towards states where you can support the player.
3) *Companion Integrity*: Secure your own existence and ability to act in order to support the player long term.

Nature vs. nurture

- Obviously, genes don't determine everything
- Our behavoir is also affected by family, education, media, community values…

Computational Rationality and Rule-based Behavior

In the CR framework, **moral imperatives and other rules define *constraints*** for utility optimization, limiting the allowed actions.

We can still be modeled as maximizing utility, but subject to constraints such as “thou shall not kill”

A Simple Reward-free Approach to Constrained Reinforcement Learning

Sobhan Miryoosefi, Chi Jin *Proceedings of the 39th International Conference on Machine Learning*, PMLR 162:15666-15698, 2022.

Abstract

In constrained reinforcement learning (RL), a learning agent seeks to not only optimize the overall reward but also satisfy the additional safety, diversity, or budget constraints. Consequently, existing constrained RL solutions require several new algorithmic ingredients that are notably different from standard RL. On the other hand, reward-free RL is independently developed in the unconstrained literature, which learns the transition dynamics without using the reward information, and thus naturally capable of addressing RL with multiple objectives under the common dynamics. This paper bridges reward-free RL and constrained RL. Particularly, we propose a simple meta-algorithm such that given any reward-free RL oracle, the approachability and constrained RL problems can be directly solved with negligible overheads in sample complexity. Utilizing the existing reward-free RL solvers, our framework provides sharp sample complexity results for constrained RL in the tabular MDP setting, matching the best existing results up to a factor of horizon dependence; our framework directly extends to a setting of tabular two-player Markov games, and gives a new result for constrained RL with linear function approximation.

A General Model: Rewards based on psychological and homeostatic needs

$$r = w_{novelty}\, r_{novelty} + w_{food}\, r_{food} + w_{pain}\, r_{pain} + \ldots$$

- The total reward = sum of multiple components, each based on a need
- Including both psychological and homeostatic (physical) needs
- The weights *w* define one's "personality" or "player type"
- The weights are modulated by both genes and environment
- The weights may change dynamically and contextually

Homeostatic needs

- Homeostatic range: allowable upper and lower limits. If a need violates the limits, the organism takes corrective actions
- Energy (blood sugar)
- Body temperature
- Sleep
- Games: relevant to game addiction, not so much to game design
- Modern version: *Allostasis* (anticipating needs and preparing to satisfy them before they arise)

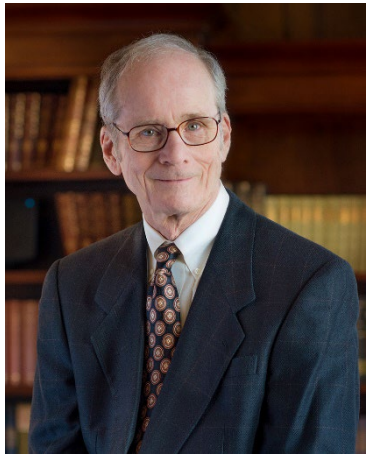
Psychological needs

- Self-determination theory: competence, autonomy, social related ness/connection
- Psychology of curious interest: novelty
- Transformative games: Self-actualization

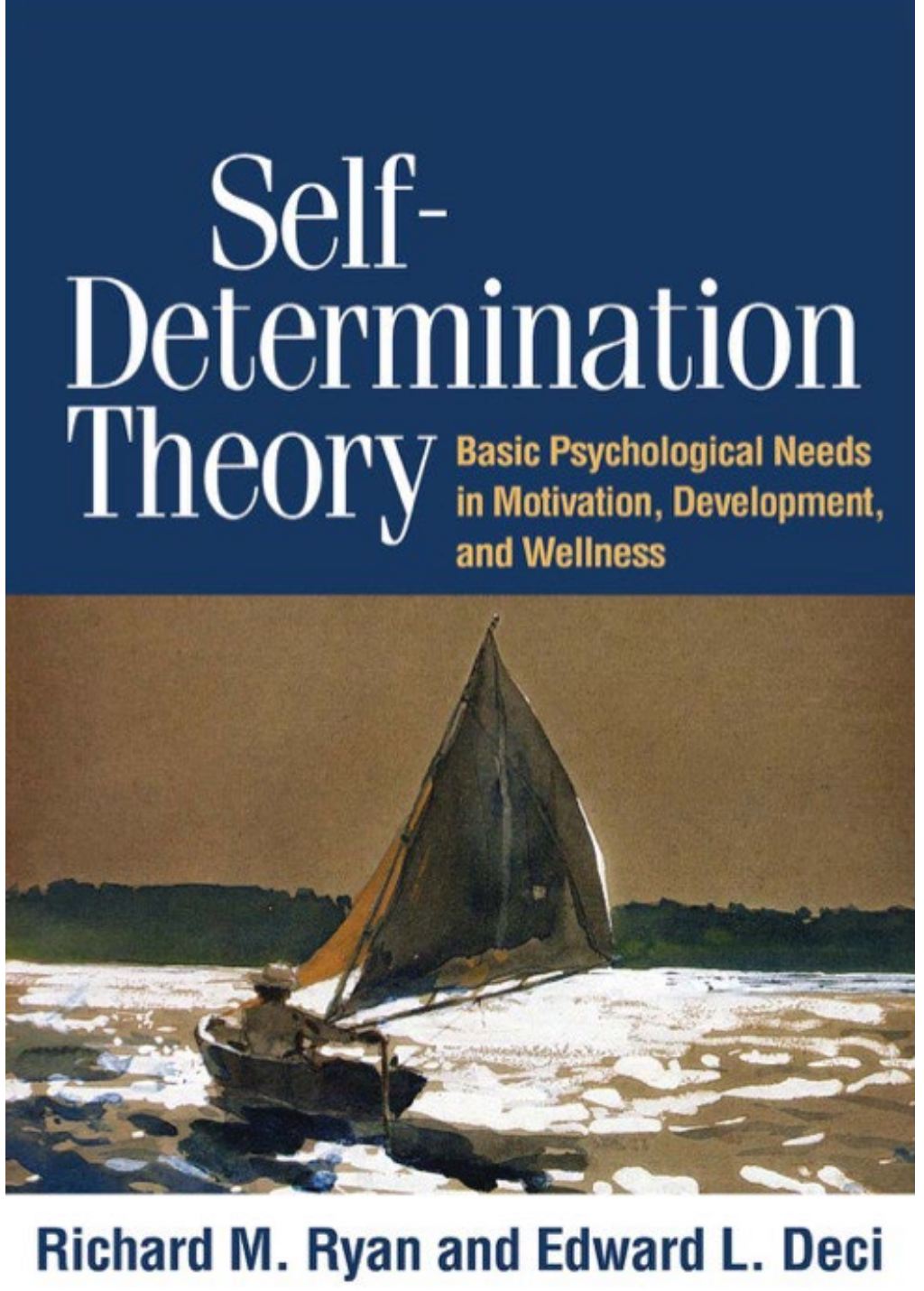
Self-Determination Theory

- A popular psychological theory of motivation
- Intrinsically motivating experiences facilitate satisfaction of basic psychological needs: Competence, autonomy, relatedness

Richard Ryan



Edward Deci



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Increasing Prominence of SDT in the Games Industry

GDC 12

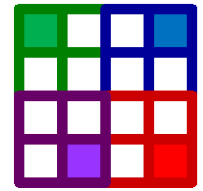
Breaking the Rules of Game Design: when to go against Autonomy, Competence, and Relatedness

Kaitlyn Burnell
Programmer, Naughty Dog (ideas for this talk developed at CCP)

GAME DEVELOPERS CONFERENCE 2012

Engines of Play

Jason VandenBerghe
Creative Director



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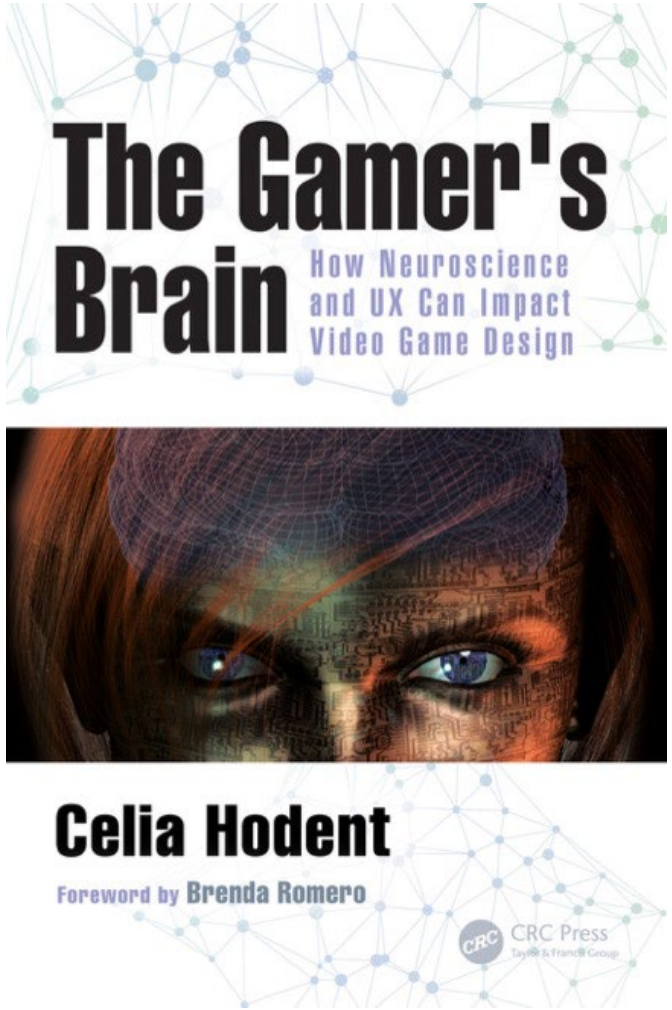
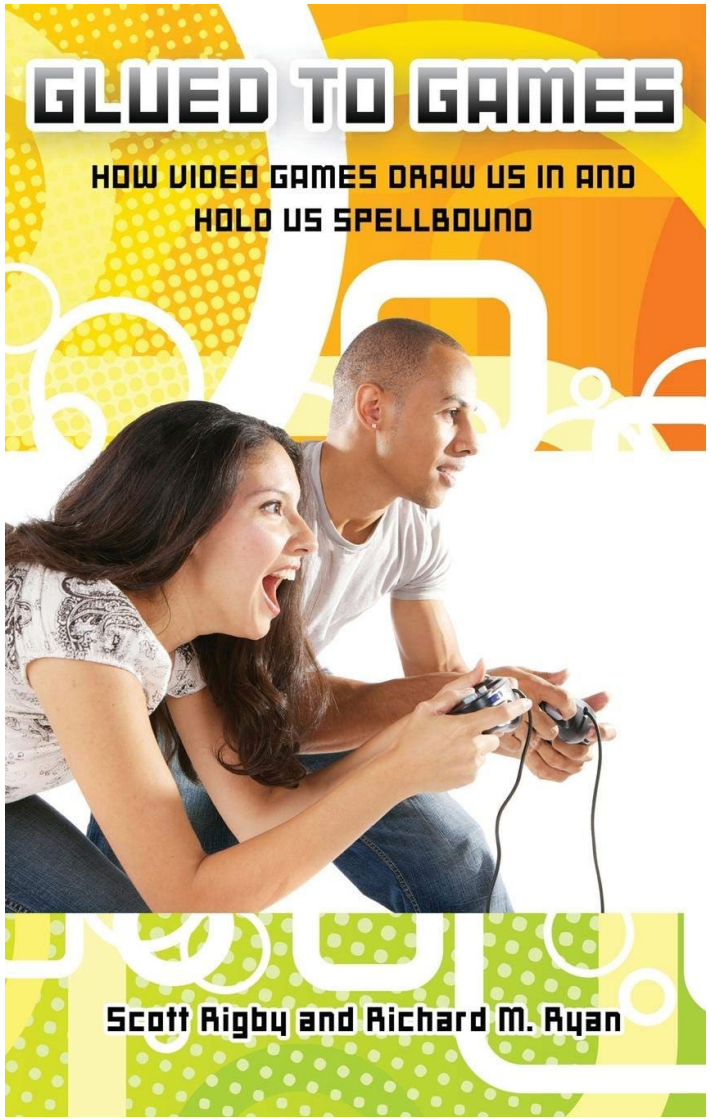
Increasing Prominence of SDT in the Games Industry





What Makes Games Motivating?

Andrew Przybylski

Scott Rigby

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Motiv Emot (2006) 30:347–363
DOI 10.1007/s11031-006-9051-8

ORIGINAL PAPER

The Motivational Pull of Video Games: A Self-Determination Theory Approach

Richard M. Ryan · C. Scott Rigby · Andrew Przybylski

Published online: 29 November 2006

Abstract Four studies apply self-determination theory (SDT; Ryan & Deci, 2000) in investigating motivation for computer game play, and the effects of game play on well-being. Studies 1–3 examine individuals playing 1, 2 and 4 games, respectively and show that perceived in-game autonomy and competence are associated with game enjoyment, preferences, and changes in well-being pre- to post-play. Competence and autonomy perceptions are also related to the intuitive nature of game controls, and the sense of presence or immersion in participants' game play experiences. Study 4 surveys an on-line community with experience in multiplayer games. Results show that SDT's theorized needs for autonomy, competence, and relatedness independently predict enjoyment and future game play. The SDT model is also compared with Yee's (2005) motivation taxonomy of game play motivations. Results are discussed in terms of the relatively unexplored landscape of human motivation within virtual worlds.

Keywords Computer games · Motivation · Self-determination theory

Over the last decade, technology has made possible increasingly sophisticated simulated environments and the ability to use these environments for entertainment, education, and social interaction. The exponential increase in computing power, coupled with the integration of the Internet into mainstream society, has given birth to numerous gaming environments and "virtual worlds," that are increasingly complex, immersive, engaging, and enabling of a wide range of activities, goals, and social behavior.

Of particular relevance to the research we present in this article are those computer environments associated with *gaming*. Participation in video games has become the fastest growing form of human recreation. Attesting to this, annual revenues from video games have surpassed those of Hollywood (Yi, 2004), making them the world's largest entertainment medium. Moreover, participation in gaming is commonplace across a variety of demographic groups, capturing an ever-increasing proportion of both youth and adult leisure time. Whether they take the form of traditional video games, online communities, or "massively multiplayer online" (MMO) adventures, computer games comprise a large and growing share of people's time and energy.

This increased participation in games is not, however, occurring without controversy (Kirsch, 2006). Some scholars have argued that participation in computer games may foster a number of negative effects, including increased tendencies toward violence, lower psychological and physical well-being, lower achievement and productivity, and more impoverished personal and familial relationships (e.g., Anderson & Bushman, 2001; Healy, 1990; Gentile & Anderson, 2003; Setzer & Duckett, 2000). In contrast, other scholars have argued that psychological benefits can be derived from game experiences, including a sense of efficacy and power over one's environment (e.g., Jones, 2002), as well as improvements in learning (Gee, 2003; Johnson, 2005). Given the variety and complexity of computer game activities, it seems evident that games have the potential to yield both psychological harms and benefits to players.

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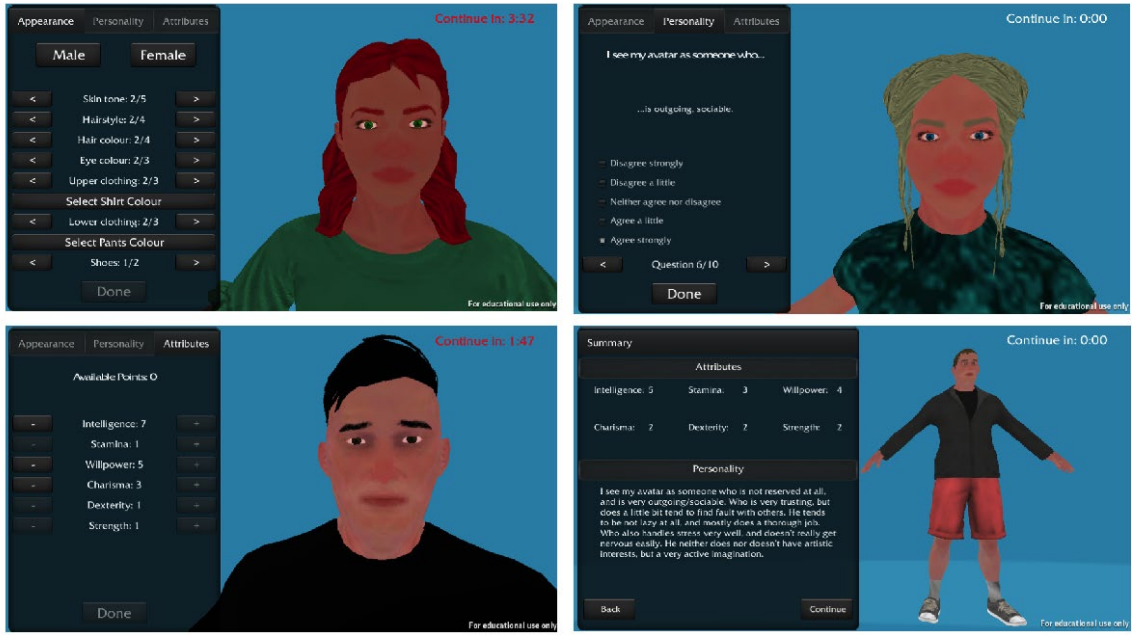
Autonomy

- «I have the choice»: Sense that Actions Are Self-Endorsed and Performed Willingly
- Choice
- Volition

Autonomy

Choice Supports Autonomy



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Fostering Intrinsic Motivation through Avatar Identification in Digital Games

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ABSTRACT
Fostering intrinsic motivation with interactive applications can increase the enjoyment that people experience when using technology, but can also translate into more invested effort. We propose that identifying with an avatar in a game will increase the intrinsic motivation of the player. We analyzed data from 126 participants playing a custom endless runner game and show that similarity identification, embodied identification, and wishful identification increases autonomy, immersion, invested effort, enjoyment, and positive affect. We also show that greater identification translates into motivated behaviour as operationalized by the time that players spent in an unending version of the infinite runner. Important for the design of games for entertainment and serious purposes, we discuss how identification with an avatar can be facilitated to cultivate intrinsic motivation within and beyond games.

Author Keywords
Games; Avatar; Investment; Player Experience; Motivation

ACM Classification Keywords
K.8.0. General: Games

INTRODUCTION
When people are intrinsically motivated to complete a task – that is, they do so based on the inherent satisfaction derived from the action itself [52] – there are many benefits. Broadly speaking, intrinsically motivated people are willing to invest more effort into a task and derive more enjoyment from it [16]. In the case of interactive technology, fostering intrinsic motivation with our applications should translate into more effort invested in the task at hand and more enjoyment as a result of using the application [52]. This increased engagement has implications for both the designers and consumers of interactive technology. For example, consider an educational application designed to help people learn a language; increased effort invested by the user could translate into improvements in language learning. Or consider a citizen science application in which people contribute to finding new proteins that cure diseases such as HIV/AIDS, Cancer, or Alzheimer's [15]; increased enjoyment using the application could translate into more use, and thus a more complete database of proteins.

Because of the potential benefits of increased engagement, creators of interactive technology should ask how they can foster intrinsic motivation through design. One place that designers can look for motivation is digital games. Recent estimates suggest that more money is spent purchasing games ($92b) than music ($18b) and movies ($62b) combined [3]. Four out of five American households own a device that is used to play video games and 115 million Americans play games [1]. Internationally, the global game market is expected to exceed $102 billion by 2017 [2]. Although people sometimes assume that it is highly immersive console and computer games that drive the game industry, 35% of those same revenues are expected to be generated through smart phones and tablets, on which people tend to play games that are more casual in nature. With so much time and money being spent (by choice) on digital games, researchers have questioned what it is about games that make them so motivating to play [52] and how we can translate these motivating features into non-game environments – a process known as gamification [18]. Serious games – games that leverage this ability to motivate behaviour and retain attention in serious contexts – have been effective at encouraging behaviour change and fostering activities that lead to learning [50].

There are various theories that explain why games are engaging [59,10]; the most prevalent arises out of self-determination theory (SDT) [52]. Being self-determined describes a state in which people have their basic psychological needs for perceived competence (i.e., demonstrating mastery over challenges), autonomy (i.e., doing so under their own volition), and relatedness (i.e., doing so while feeling connected to others) satisfied through the activity. Satisfying these needs leads to people who are intrinsically motivated to perform the activity. Designing with need satisfaction in mind is one way that we can design better games [61]; however, this solution works on the level of the game itself – it helps us build a better interactive application. There is also an argument for seeking ways to foster motivation through methods and approaches that apply across a range of applications.

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Volition – Freedom to Play When You Want to, How You Want to

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Contextual Autonomy Support in Video Game Play: A Grounded Theory

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ABSTRACT
Autonomy experience constitutes a core part of the intrinsic motivation of playing games. While research has explored how autonomy is afforded by a game's *design*, little is known about the role of the *social context* of play. Particularly, engaging with serious games or gamified applications is often obligatory, which may thwart autonomy. To tease out contextual factors that affect autonomy, we conducted a qualitative interview study that compared gameplay experience in leisure and work contexts. We found that leisure contexts, particularly solitary play, support autonomy through a time and space shielded from outer demands, the license to (dis)engage with and configure the situation to fit one's spontaneous interests, and a lack of social and material consequence. Thwarted autonomy occurs *both* in leisure and work contexts when players' spontaneous interests mismatch socially demanded gameplay. We discuss implications for entertainment and applied gaming.

Author Keywords
Games; play; video games; motivation; autonomy; context; gamification; self-determination theory.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; K.8.0. Personal Computing: Games.

INTRODUCTION
Over the past decades, serious games, gamified applications, and other forms of applied gaming have tried to harness the motivational pull of game play for non-entertainment purposes across various contexts [3,40]. The underlying logic is simple: games are intentionally designed to afford engaging play activity. Hence, redesigning (presumed) non-engaging activities in contexts like work or learning into a game or infusing them with the 'active' ingredients of game design should make them more engaging as well [10].

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One immediate question regarding this endeavor is whether these various contexts themselves affect the desired motivational pull of gameplay: In the eponymous 1876 novel, Tom Sawyer famously convinced his friends pay him for the privilege of whitewashing Aunt Polly's fence in his stead because he made said chore appear to be something he *wanted* rather than *had* to do, suggesting not just that "Work consists of whatever a body is *obliged* to do, and that Play consists of whatever a body is not obliged to do" [49] – but that this lack of obligation itself is part of what makes play appealing. If that were the case, it would cast a gloomy light on applied gaming that turns voluntary play into obligatory homework or job tasks.

Indeed, play is commonly defined as "voluntary", "free", or "autotelic", it's own goal [1,2,21,32,52], unlike formal schooling, work, and other applied gaming contexts. Several scholars in human-computer interaction (HCI) [8], informatics [31], and game studies [58,59,61,63] hypothesize that mainstream forms of gamification – behavior tracking, quantitative progress feedback, and reward systems – might thwart rather than support the openness, inconsequentiality, and voluntariness characteristic for play. And evidence suggests that forced serious game play results in negative affect and reduced performance [19], and that worker consent moderates whether imposed workplace gamification results in positive or negative affect [29].

Such potential demotivating effects of play contexts and their (lacking) voluntariness are relevant for entertainment game design as well: Journalists and ethnographers of massively multiplayer online role-playing games (MMORPGs) for instance observed that "instrumental play" – play that is work-like in its repetitive tedium and instrumentality, or even performed as obligatory wage labor – is sometimes described by its players as not enjoyable or play at all [11,30,46,51]. Social network games have been repeatedly critiqued for their "dark patterns" [62] that coerce players to play through timers or social pressure, with presumed negative effects on play experience. A recent survey [60] indicates that solitary and multiplayer playing differ in autonomy experience. Yet existing conceptualizations of the voluntariness of play have remained quite muddled and definitional [23]: they merely state *that* play is voluntary *by definition*. They do not provide a systematic theorization of "voluntariness", nor functional explanations *how* this quality comes about.

Relatedness

- **«I have peers I care about»**
- **A sense of belonging with people we care about (and that care for us)**
- **Multiplayer, livestreaming**

Relatedness

Relatedness & Game Characters

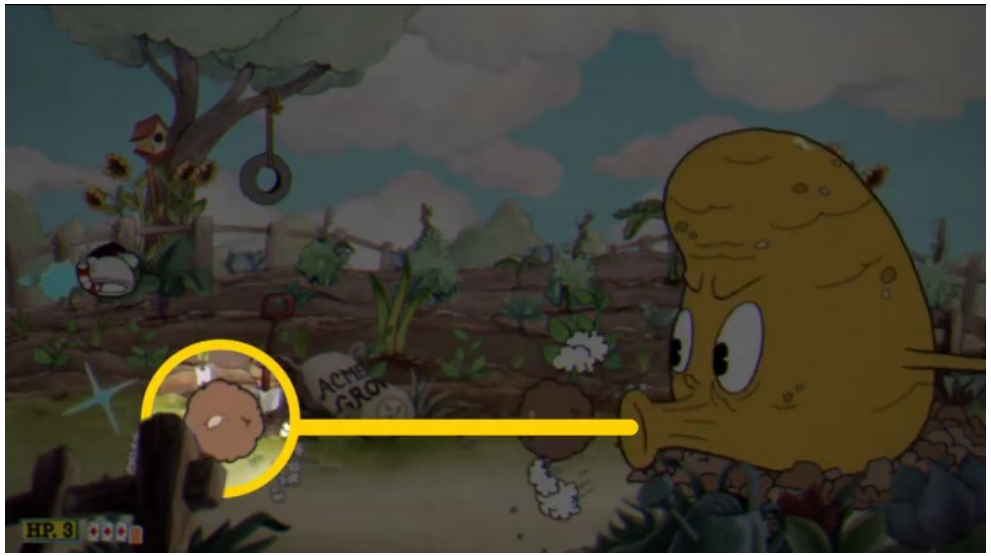
Competence

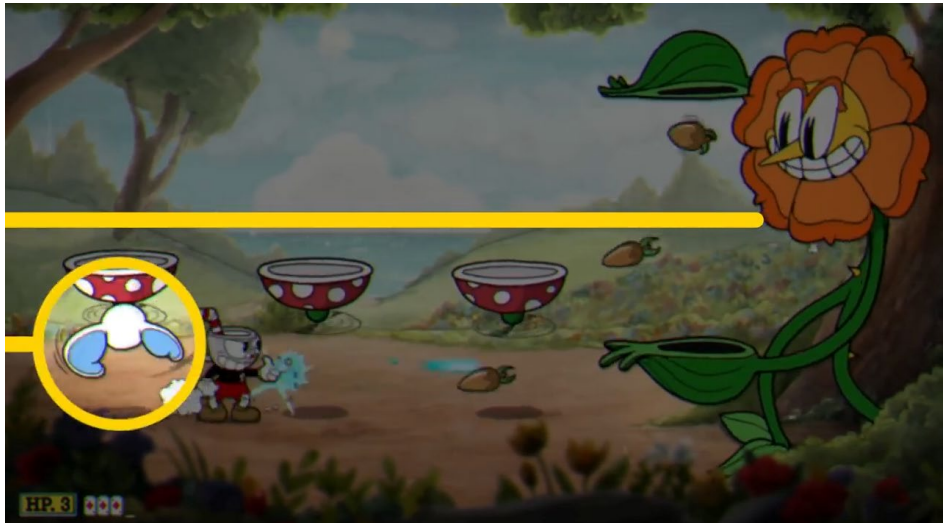
- «I can do it»
- Sense of Effectance and Mastery, Feeling Competent
- Requires **Challenge** and **Feedback** about mastery of the challenge (Rigby & Ryan, 2011)

Well-designed challenge

- **Competence: Fair & suitable for the skills and abilities of your players**
- **Autonomy: Choice of challenges & completion strategies**
- **Relatedness: Co-op challenges (with fellow players or NPC:s)**

Fair Challenge – Possible to memorize, learn and predict





Cuphead

Fair Challenge – Telegraphing

Well-designed feedback

- **Positive**
- **Informational**
- **Juicy**

Positive: Promotes feeling of mastery

Devil May Cry

Informational: Indicates how close we are to mastery

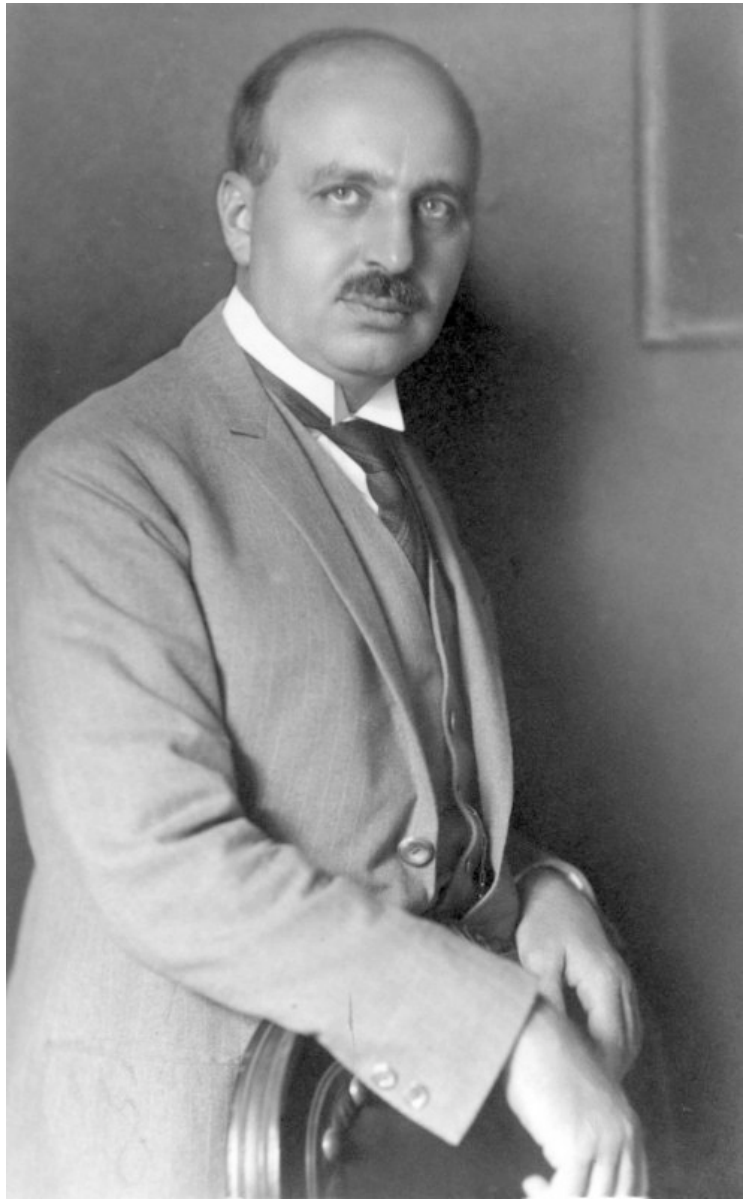
Juicy:

”More is more”

lwglwsss ”**Peggle 23.66 million Shot ! New World Record !”**
https://www.youtube.com/watch?v=QnCZs-TJkJ8

Exploration, curiosity

- Karl Bühler argued that children experience pleasure while playing, because they can observe how their actions impact the environment -> curiosity for the consequences of their actions and for what happens in the environment
- ”Effectance”: Perceptions of causal influence on the game world
- Relevant: Schell’s Lens of Toy



Exploration, curiosity

- Evolutionary perspective: The drive to explore and learn is a survival trait
- The highly successful AI curiosity model by Pathak et al. gives a reward for observing unpredictable results of actions, but only if the agent has control over the results (i.e., the model combines unpredictability & effectance)

Curiosity-driven Exploration by Self-supervised Prediction

Deepak Pathak, Pulkit Agrawal, Alexei A. Efros, and Trevor Darrell

University of California, Berkeley

1. Introduction

Reinforcement learning algorithms aim at learning policies for achieving target tasks by maximizing rewards provided by the environment. However, in many real-world scenarios, rewards extrinsic to the agent are extremely sparse or missing altogether, and it is not possible to construct a shaped reward function. This is a problem as the agent receives reinforcement for updating its policy only if it succeeds in reaching a pre-specified goal state.

Motivation/curiosity [7, 10] have been used both to explain the need to explore the environment and discover goal states, but also, more generally, as a way of learning new skills which might come handy for pursuing rewards in the future. Most formulations of intrinsic reward can be grouped into two broad classes: 1) encourage the agent to explore "novel" states [1, 3, 6] or, 2) encourage the agent to perform actions that reduce the error/uncertainty in the agent's ability to predict the consequence of its own actions (i.e. the agent's knowledge about the environment) [2, 5, 8, 9, 11].

This work belongs to the broad category of methods that generate an intrinsic reward signal based on how hard it is for the agent to predict the consequences of its own actions, *i.e.* predict the next state given the current state and the executed action. However, we manage to escape most pitfalls of previous prediction approaches with the following key insight: we only predict those changes in the environment that could possibly be due to the actions of our agent or affect the agent, and ignore the rest. That is, instead of making predictions in the raw sensory space (e.g. pixels), we transform the sensory input into a feature space where only the information relevant to the action performed by the agent is represented. We learn this feature space using self-supervision – training a neural network on a proxy inverse dynamics task of predicting the agent's action given its current and next states. Since the neural network is only required to predict the action, it has no incentive to represent within its feature embedding space the factors of variation in the environment that do not affect the agent itself.

(a) learn to explore in Level-1 (b) explore faster in Level-2

Figure 1: Discovering how to play *Super Mario Bros* **without rewards**. (a) Using only curiosity-driven exploration, the agent makes significant progress in Level-1. (b) The gained knowledge helps the agent explore subsequent levels much faster than when starting from scratch. Watch the video at http://pathak22.github.io/noreward-rl/

state, given the feature representation of the current state and the action. We provide the prediction error of the forward dynamics model to the agent as an intrinsic reward to encourage its curiosity.

2. Curiosity-driven Exploration

Our agent is composed of two subsystems – a reward generator that outputs a curiosity-driven intrinsic reward signal and a policy that outputs a sequence of actions to maximize that reward signal. Let the intrinsic curiosity reward generated by the agent at time t be r_t^i and the extrinsic reward be r_t^e. The policy sub-system is trained to maximize the sum of these two rewards $r_t = r_t^i + r_t^e$. We represent the policy $\pi(s_t; \theta_P)$ by a deep neural network with parameters θ_P. Given the agent is in state s_t, it executes the action $a_t \sim \pi(s_t; \theta_P)$ sampled from the policy. θ_P is optimized to maximize the expected sum of rewards,

$$\max_{\theta_P} \mathbb{E}_{\pi(s_t;\theta_P)}[\Sigma_t r_t] \quad (1)$$

Our Intrinsinc Curiosity Module (ICM) can potentially be used with a range of policy learning methods; in the experiments here, we use asynchronous advantage actor critic policy gradient (A3C) [4]) for learning a policy. Instead of

Curiosity and interest

- Silvia: Interest is the ”curious emotion” or state of feeling curious towards something
- Interest elicited through: complexity/novelty, comprehensibility/coping potential
- Novelty also considered a basic psychological need

Interest—The Curious Emotion

Paul J. Silvia

University of North Carolina at Greensboro

ABSTRACT—*Despite their interest in why people do what they do, psychologists typically overlook interest itself as a facet of human motivation and emotion. In recent years, however, researchers from diverse areas of psychology have turned their attention to the role of interest in learning, motivation, and development. This article reviews the emerging body of work on the psychology of interest, with an emphasis on what contemporary emotion research has learned about the subject. After considering four central questions—Is interest like other emotions? What functions does interest serve? What makes something interesting? Is interest merely another label for happiness?—the article considers unanswered questions and fruitful applications. Given interest's central role in cultivating knowledge and expertise, psychologists should apply research on interest to practical problems of learning, education, and motivation.*

KEYWORDS—*interest; curiosity; exploration; emotion; learning*

Humans are curious creatures: They devote a lot of effort and brainpower to the things that interest them. How much money would it take to persuade an indifferent person to memorize a team's baseball statistics, compile a four-volume encyclopedia of Danish furniture, learn to play the banjo, or spend a career studying an obscure academic topic? As a source of intrinsic motivation, interest plays a powerful role in the growth of knowledge and expertise (Kashdan, 2004; Sansone & Thoman, 2005). The psychology of interest dates to the 1800s, and it has flourished in the last 10 years. Researchers who study emotion, personality, aesthetics, education, vocations, motivation, and development have taken a new look at what interest is, what it does, and how it works (Silvia, 2006). In this article, I'll review what emotion psychology has learned about interest, the curious emotion.

Address correspondence to Paul J. Silvia, Department of Psychology, P.O. Box 26170, University of North Carolina at Greensboro, Greensboro, NC, 27402-6170; e-mail: p_silvia@uncg.edu.

IS INTEREST AN EMOTION?

Interest is an eccentric emotion. Many theories don't include interest in their lists of major emotions, and a few theories reject interest as an emotion altogether. Nevertheless, interest has a proud history in emotion psychology. In his landmark book on emotional expression, Charles Darwin (1872/1998) described emotions related to learning, thinking, and exploring. Darwin's terms—*abstracted meditation*, *perplexed reflection*, and *stupefied amazement*—seem quaint to modern readers, but his ideas remain ahead of their time. Many decades later, modern emotion psychology doesn't know much about what I'll call *knowledge emotions*: states such as *interest*, *confusion*, *surprise*, and *awe*.

A good case can be made for viewing interest as an emotion. Modern theories of emotion propose that emotions are defined by a cluster of components. Typical emotional components are physiological changes, facial and vocal expressions, patterns of cognitive appraisal, a subjective feeling, and an adaptive role across the lifespan (Lazarus, 1991). Interest appears to have these components: It has a stable pattern of cognitive appraisals (Silvia, 2005b), a subjective quality (Izard, 1977), and adaptive functions (Sansone & Smith, 2000). Interest's physiological and expressive components, not surprisingly, are associated with orientation, activation, concentration, and approach-oriented action (Libby, Lacey, & Lacey, 1973). Interest lacks the smiling and eye-crinkling expressions of happiness. Instead, interest involves movements of muscles in the forehead and eyes that are typical of attention and concentration (Langsdorf, Izard, Rayias, & Hembree, 1983; Libby et al., 1973; Reeve, 1993). When interested, people often still and tilt the head, which aids in tracking objects and sounds (Reeve, 1993). Interest's vocal expression involves a faster rate of speech and greater range in vocal frequency (Banse & Scherer, 1996). Taken together, interest appears to have the features typical of emotions.

WHAT DOES INTEREST DO?

According to functional approaches to emotion, emotions help people manage fundamental goals (Lazarus, 1991). Interest's function is to motivate learning and exploration. By motivating people to learn for its own sake, interest ensures that people will develop a broad set of knowledge, skills, and experience. The

Self-actualization

- Relevant to transformative game experiences
- Maslow: Fulfilling the need of self-actualization is associated with:
  - Increased acceptance of self and of others
  - Deeper and more profound interpersonal relationships
  - Enhanced appreciation of life and newfound perspectives on it
  - Loss of self or transcendence of it

Author Jaakko Väkevä

Title of thesis Transformative game experiences: an autoethnography

Programme Master's Programme in Information Networks

Thesis supervisor Dr. Elisa Mekler

Thesis advisor Dr. Elisa Mekler

Date 15.07.2022 Number of pages vii + 116 **Language** English

Abstract

Art is often hailed for its capacity to produce deeply profound experiences that can transform us as persons and alter our perspectives on life. This thesis sets out to explore, in the form of an autoethnography, how such a transformative power could manifest itself in the evolving digital medium of video games. For the study, I played through five critically acclaimed game titles in an attempt to detect and record transformative experiences by collecting both introspective and retrospective personal data of my game experiences in the form of field notes, reflective journals, and memos; the five games included in the study were *God of War*, *Doki Doki Literature Club!*, *The Stanley Parable*, *Bloodborne*, and *The Beginner's Guide*. I perceived my emotionally profound experiences of *Doki Doki Literature Club!* and *The Beginner's Guide* as transformative; both game experiences greatly widened my understanding of games as a medium, but also provided me with newfound perspectives on topics such as depression and creativity, as well as increased my capacity for empathy and self-understanding. Closer analysis and interpretation of the personal data resulted in identifying four overarching themes distinguishing my transformative game experiences from non-transformative ones; these themes can be characterized as follows: (1) a heightened state "cognitive and emotional involvement", (2) a conception of "playing as myself", (3) an impression of "unconventional game design", and (4) post-play "re-engagement with the game experience". I then examined these themes in a wider context, discussing their relations to existing literature and their possible broader implications regarding transformative game experiences. It seems that several aspects of my personal transformative game experience could potentially correspond to concepts that in the field of empirical aesthetics have been used to model transformative art perception outcomes, but further research is required.

Successful games support many needs

- Competence through character progression, adaptive difficulty, progressive hints, properly tuned difficulty curve
- Autonomy through providing choice and agency, and tools for user-generated content, especially in sandbox games such as Minecraft
- Social relatedness through community features and multiplayer
- Novelty through emergent dynamics, user-generated content, live ops content updates & events...
- Self-actualization through deep interpersonal relationships (fictional or real, e.g., WoW, Life is Strange) and newfound perspectives (e.g., This War of Mine, That Dragon Cancer)

Note: limits of questionnaire studies

- Motivation models are typically based on factor analysis of questionnaire data
- Factor analysis identifies questions whose answers are highly correlated and thus form a ”factor”
- Factor analysis cannot identify factors that are not represented by the questions – thus, a motivation model may miss factors if the researchers did not come up with the correct questions
- Questions typically derived from initial, exploratory interviews or questionnaires => specific to the games and players investigated.

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What Is Satisfying About Satisfying Events? Testing 10 Candidate Psychological Needs

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University of Rochester

Tim Kasser
Knox College

Three studies compared 10 candidate psychological needs in an attempt to determine which are truly most fundamental for humans. Participants described "most satisfying events" within their lives and then rated the salience of each of the 10 candidate needs within these events. Supporting self-determination theory postulates (Ryan & Deci, 2000)—autonomy, competence, and relatedness, were consistently among the top 4 needs, in terms of both their salience and their association with event-related affect. Self-esteem was also important, whereas self-actualization or meaning, physical thriving, popularity or influence, and money–luxury were less important. This basic pattern emerged within three different time frames and within both U.S. and South Korean samples and also within a final study that asked, "What's unsatisfying about unsatisfying events?" Implications for hierarchical theories of needs are discussed.

Most satisfying event. At the beginning of the questionnaire, participants read the following:

> Now, we ask you to consider the past month of your life. Think back to the important occurrences of this period of time. What we want you to do is bring to mind the *single most personally satisfying event* that you experienced during the last month (emphasis in the original). We are being vague about the definition of "satisfying event" on purpose,

Item (responses to "During this event I felt . . .")	Factor 1	2	3	4	5	6	7	8	9
1. Autonomy									
That my choices were based on my true interests and values.	.66								
Free to do things my own way.	.64								
That my choices expressed my "true self."	.72								
2. Competence									
That I was successfully completing difficult tasks and projects.		.86							
That I was taking on and mastering hard challenges.		.82							
Very capable in what I did.		.49							
3. Relatedness									
A sense of contact with people who care for me, and whom I care for.			.80						
Close and connected with other people who are important to me.			.85						
A strong sense of intimacy with the people I spent time with.			.77						
4. Self-actualization–meaning									
That I was "becoming who I really am."				.78					
A sense of deeper purpose in life.				.76					
A deeper understanding of myself and my place in the universe.				.81					
5. Physical thriving									
That I got enough exercise and was in excellent physical condition.					.69				
That my body was getting just what it needed.					.73				
A strong sense of physical well-being.					.66				
6. Pleasure–stimulation									
That I was experiencing new sensations and activities.					.57				
Intense physical pleasure and enjoyment.					.78				
That I had found new sources and types of stimulation for myself.					.61				
7. Money–luxury									
Able to buy most of the things I want.						.77			
That I had nice things and possessions.						.69			
That I got plenty of money.						.81			
8. Security									
That my life was structured and predictable.							.69		
Glad that I have a comfortable set of routines and habits.							.70		
Safe from threats and uncertainties.							.48		
9. Self-esteem									
That I had many positive qualities.								.78	
Quite satisfied with who I am.								.77	
A strong sense of self-respect.								.80	
10. Popularity–influence									
That I was a person whose advice others seek out and follow.									.58
That I strongly influenced others' beliefs and behavior.									.79
That I had strong impact on what other people did.									.82

Table 2

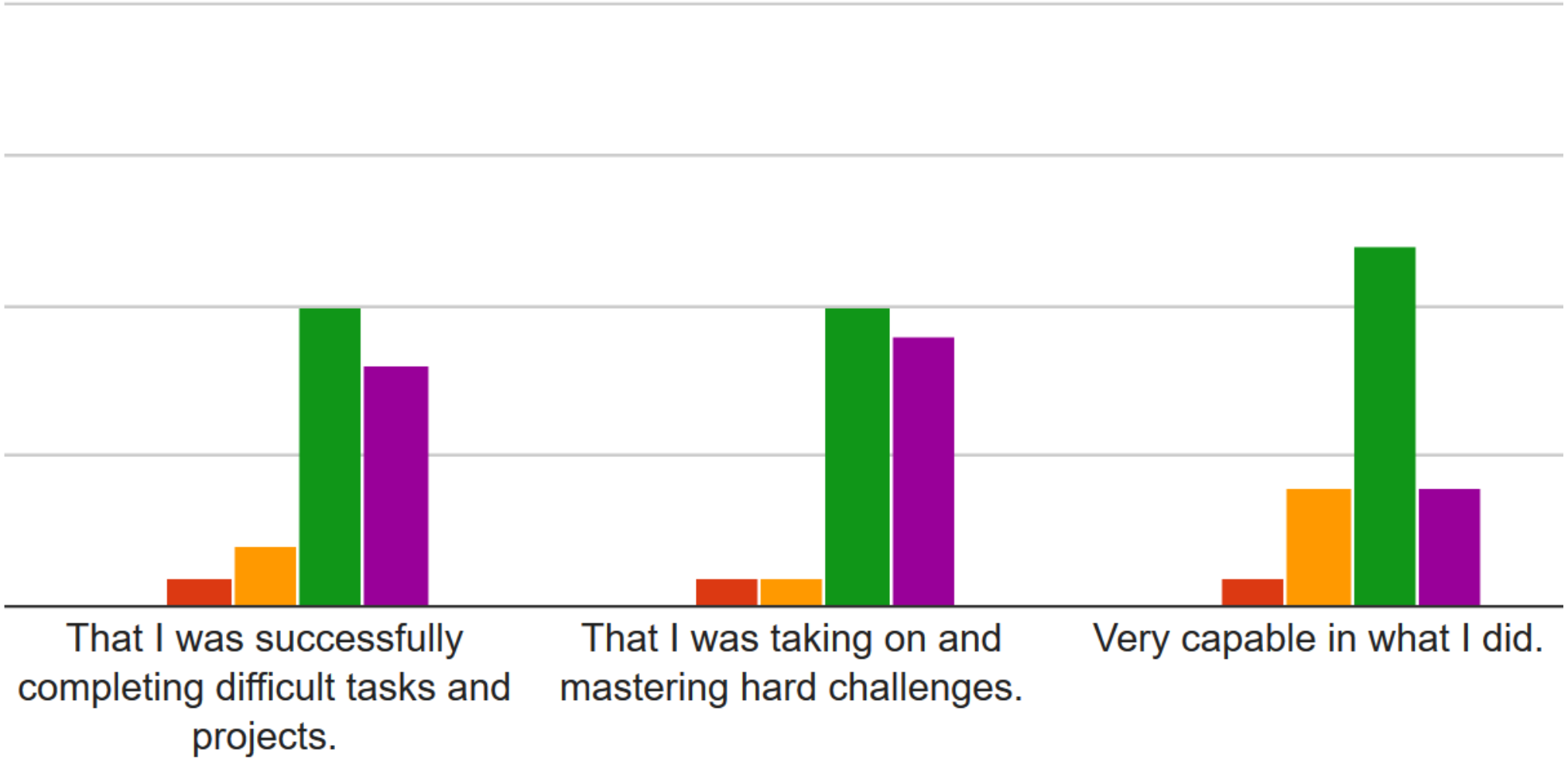
Study 1: Mean Salience of Each Candidate Need Within Participants' Most Satisfying Experiences of the Last Month

Candidate need	*M*	*SD*
Self-esteem	4.08_{a}	0.90
Relatedness	3.99_{a}	1.13
Autonomy	3.98_{a}	0.87
Competence	3.74_{b}	0.98
Pleasure–stimulation	3.53_{c}	1.08
Physical thriving	3.25_{d}	1.13
Self-actualization–meaning	3.23_{d}	1.13
Security	3.03_{e}	0.90
Popularity–influence	2.89_{e}	1.02
Money–luxury	2.37_{f}	1.08

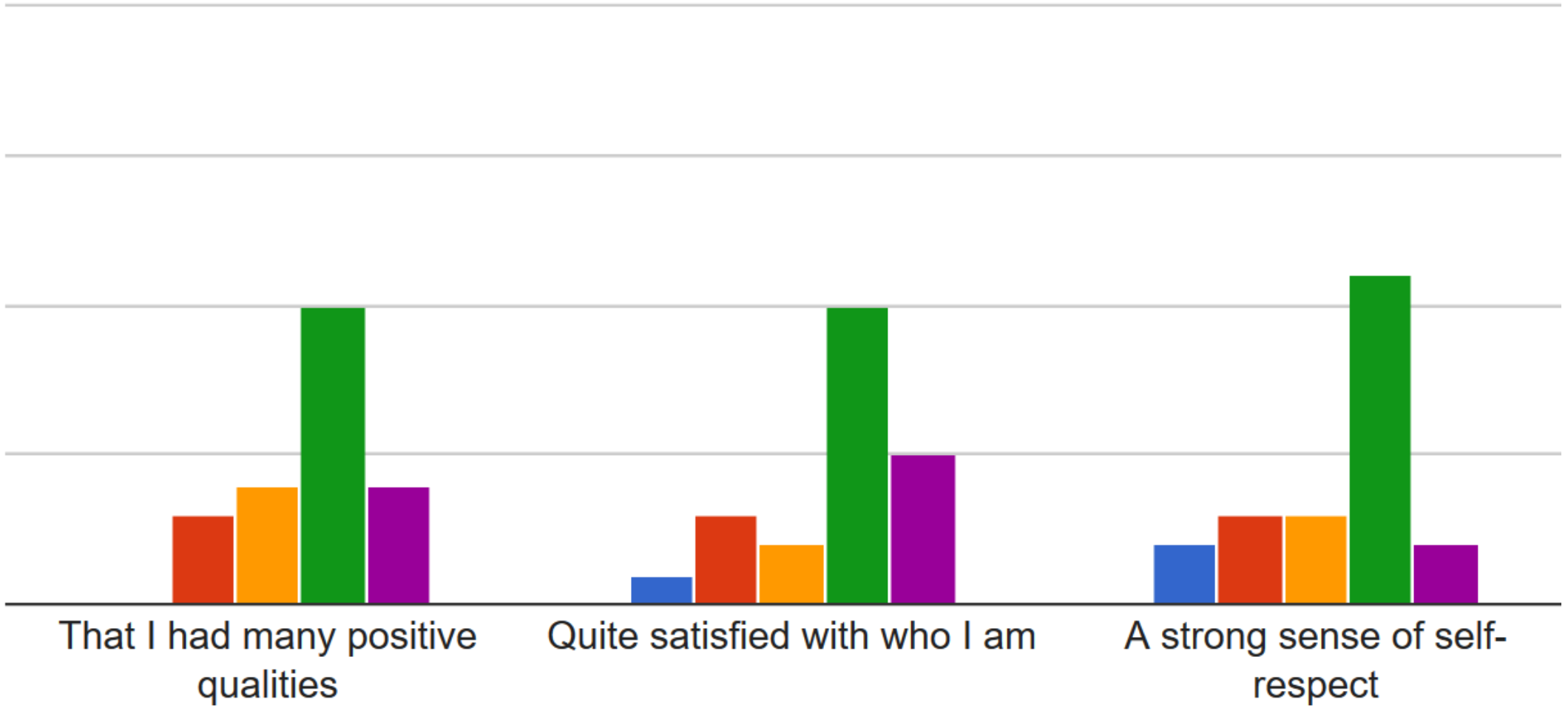
Does it apply to games?

- In 2018, 21 students filled in a version of this questionnaire presented as “Please think of your most favorite game or one of your favorites if you have many. Then rate the following statement. Playing this game, I felt...”

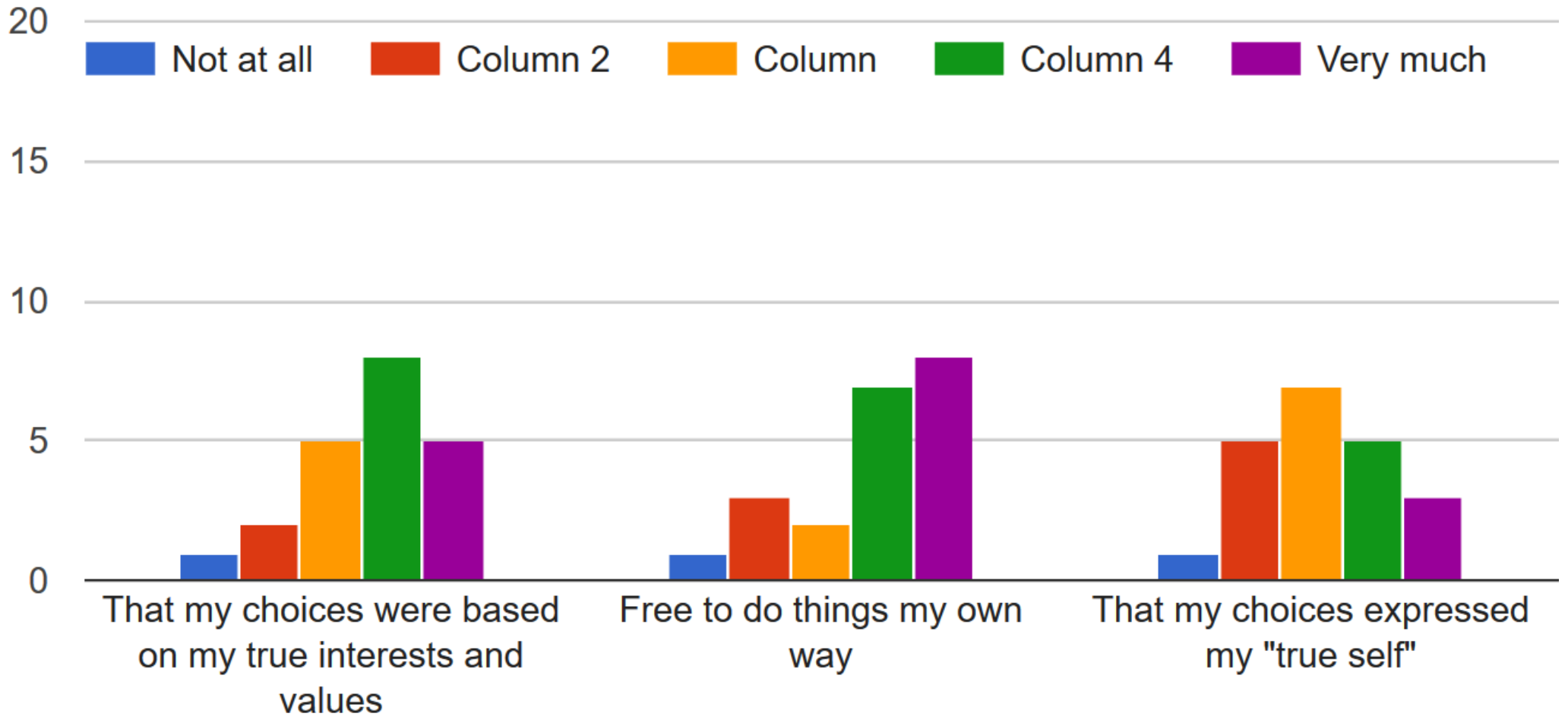
Competence: salient to almost all the favorite games



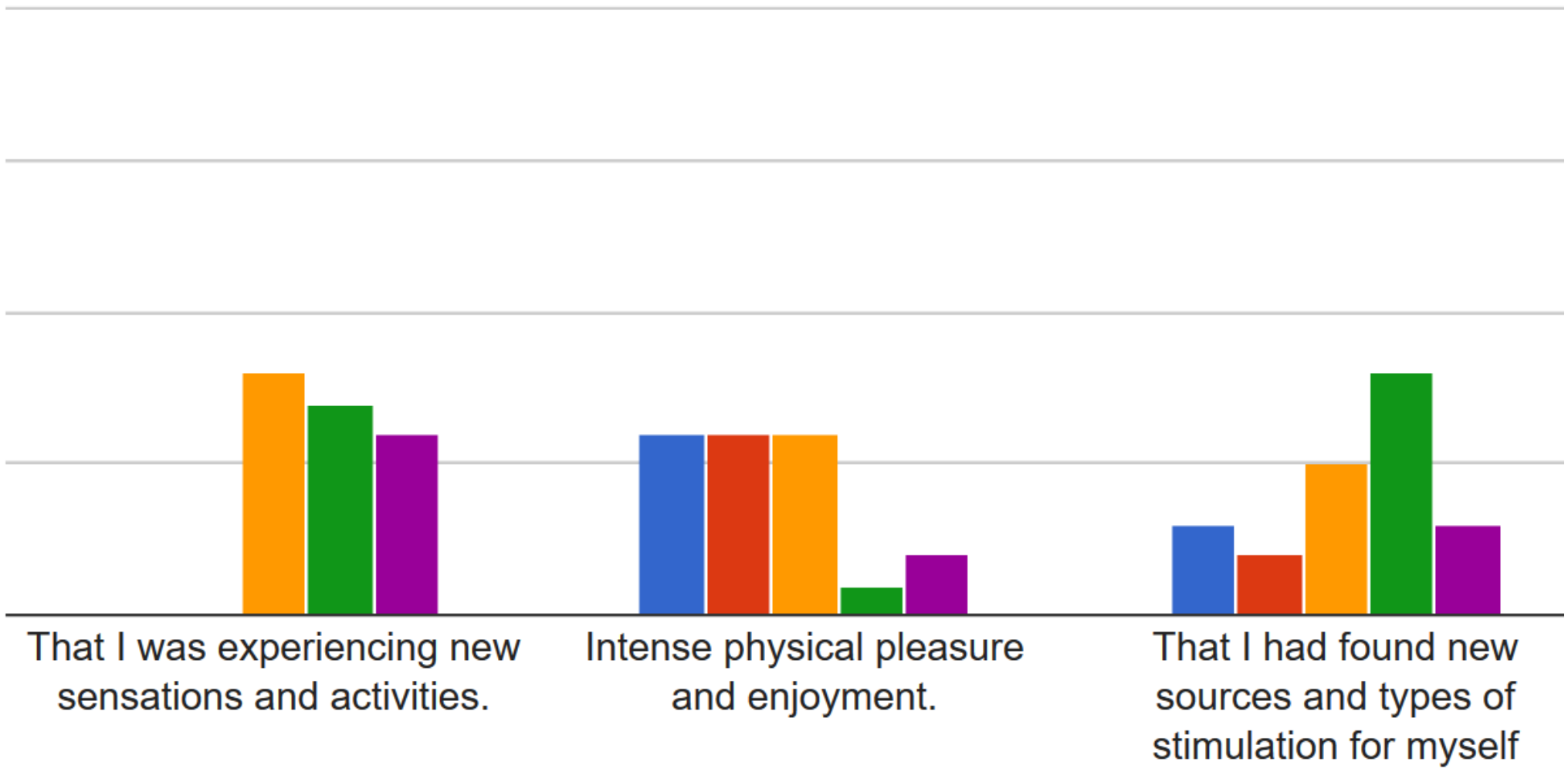
Self-esteem


That I had many positive qualities
Quite satisfied with who I am
A strong sense of self-respect

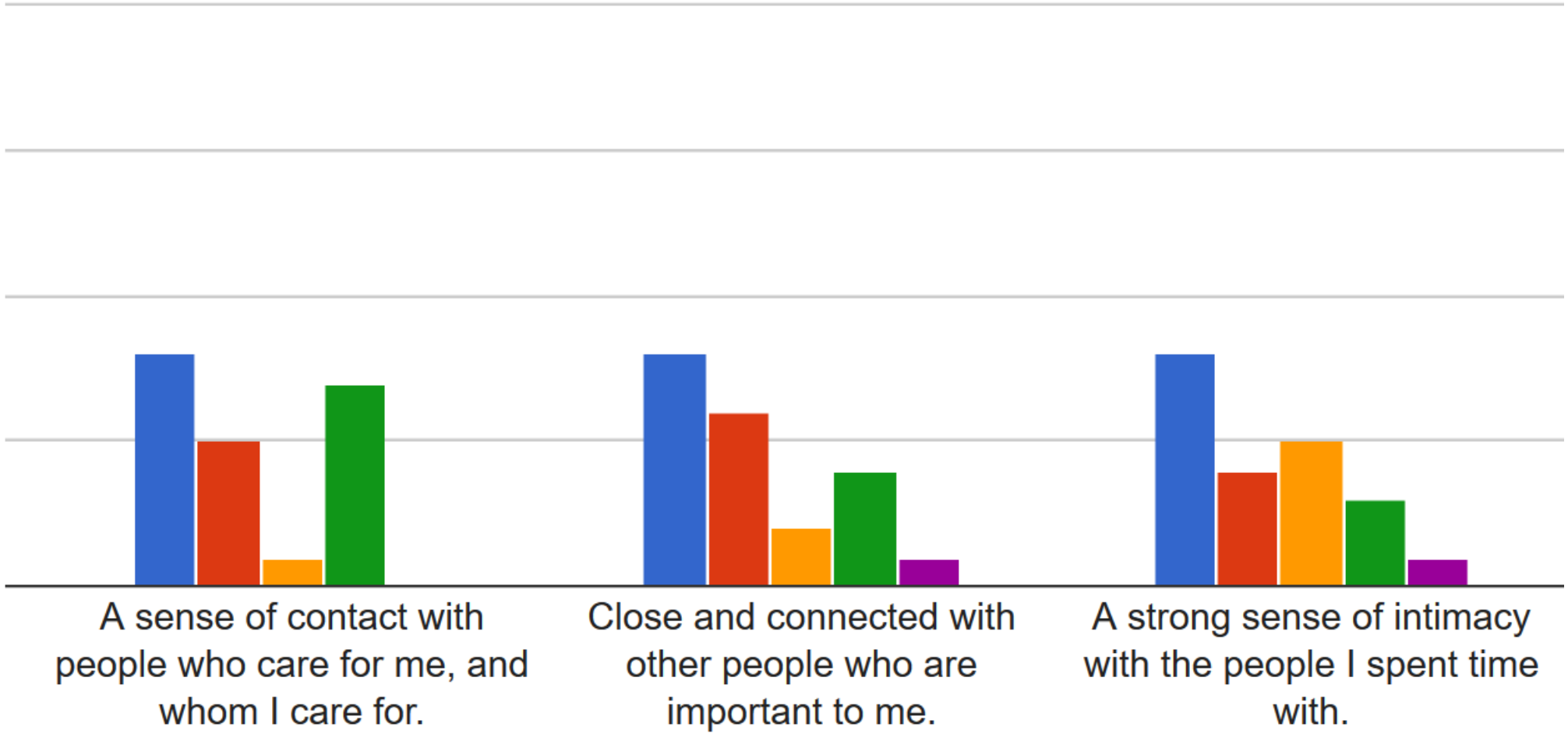
Autonomy


20
15
10
5
0
Not at all
Column 2
Column
Column 4
Very much
That my choices were based on my true interests and values
Free to do things my own way
That my choices expressed my "true self"

Pleasure-stimulation: novel experiences matter (interest, curiosity)



Relatedness: not relevant for every game or every player



This summit aims to bring light and love to a somewhat controversial subject in games; even though romance, love and sex are some of the most natural aspects of human behaviour, it is not portrayed very often, or very well in games. We want to bring artists, developers, sound artists and creatives from inside and outside the industry together to celebrate, discuss and create within these marvelous topics.

http://lyst-summit.org/

TODO: add data from the new version

Sunk cost fallacy revisited

- Which basic psychological need might explain?

Daily rewards revisited

- Daily rewards can be motivating, but may also be perceived as obligations or chores.
- Which basic psychological need might explain?

Daily Quests or Daily Pests? The Benefits and Pitfalls of Engagement Rewards in Games

JULIAN FROMMEL, Utrecht University, Netherlands and University of Saskatchewan, Canada
REGAN L. MANDRYK, University of Saskatchewan, Canada

Many games use engagement rewards as incentives for players to engage, e.g., daily login rewards, repeatable challenges, or seasonal rewards like holiday skins. These rewards may serve players by facilitating enjoyment or motivation; however, they may also be considered differently by skeptical players, e.g., as dark patterns that do not benefit players, and may detract from—or even harm—player experiences. As they are widely prevalent in a variety of games, it is important to understand how such rewards are experienced by players to inform potential pitfalls, such as when they are negative for gaming experience or lead to unhealthy gaming behaviours. 178 participants completed a mixed-methods survey and described such rewards in games they play, the tasks required to acquire them, and their experience qualitatively and with validated scales of motivation regulation and passion orientation. We found that players perceived these rewards as beneficial (e.g., as motivation), as negative (e.g., by promoting fear of missing out), or even as an obligation or chore. Quantitative results further support the dualistic experience of such rewards. We contribute findings and design recommendations that are useful for understanding and designing widely used but potentially detrimental reward mechanics.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; • **Applied computing** → **Computer games**; • **Software and its engineering** → **Interactive games**.

Additional Key Words and Phrases: games, reward, daily, quests, engagement, motivation, passion, lootbox

ACM Reference Format:
Julian Frommel and Regan L. Mandryk. 2022. Daily Quests or Daily Pests? The Benefits and Pitfalls of Engagement Rewards in Games. *Proc. ACM Hum.-Comput. Interact.* 6, CHI PLAY, Article 226 (October 2022), 23 pages. https://doi.org/10.1145/3549489

1 INTRODUCTION

Many current games use *engagement rewards*, i.e., rewards that aim to entice players to engage with the game by providing motivation to login and play. For example, games may use daily login rewards, such as for simply logging into the game client (e.g., *Guild Wars 2* [4]), rewards for generic repeating in-game challenges or quests that are renewed daily, weekly, or monthly (e.g., "Win

Random rewards revisited

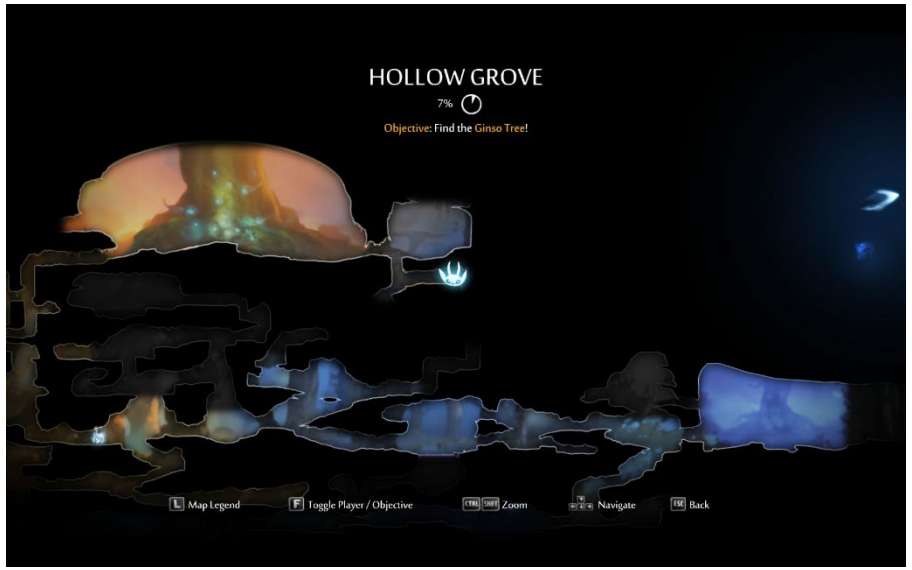
- Which basic psychological need might explain (partially)?

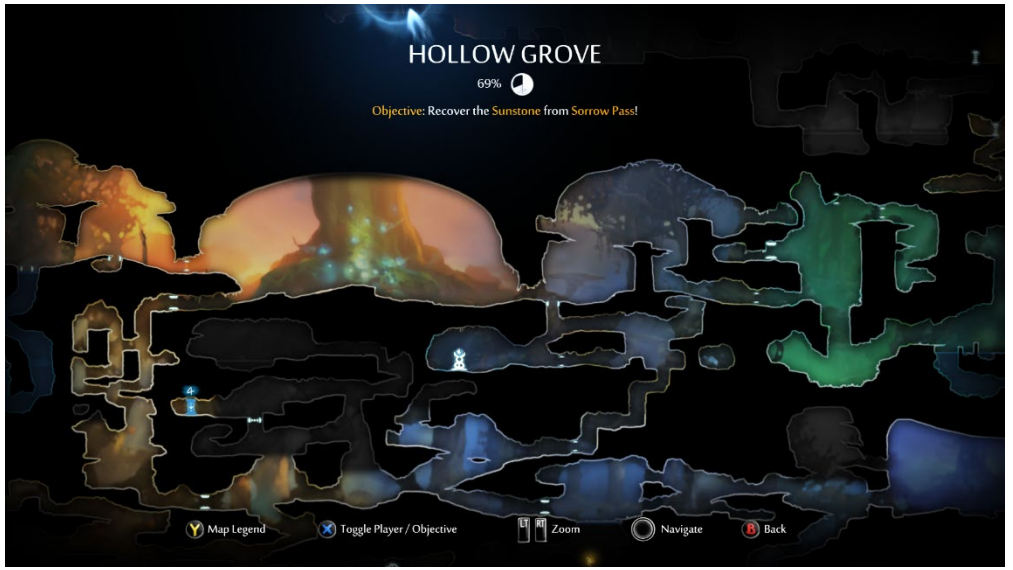
Intrinsic motivation, need satisfaction and rewards

- Question: What are your favorite in-game rewards and what needs / motivation factors do they support?

Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Access:* Unlock new levels, items, gameplay modes that were previously inaccessible
  - Ori and the Blind Forest





Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Facility:* Player becomes more effective and powerful in the game
  - The Legend of Zelda: A Link to the Past

Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Sustenance:* Attenuate negative status events
  - Playerunknown‘s Battlegrounds, Kirby

Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Glory: Don‘t actually influence the game status, „bragging rights»*
  - Leaderboard in Parodius

Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Praise: Praise for the player*
  - Devil May Cry Combo

Rewards Taxonomy (Phillips et al., 2013, 2015)

- *Rewards of Sensory Feedback: aesthetic feedback, which is sensorily pleasing to the plaer*
  - Example: The Legend of Zelda

Reward design outside games: Gamification

- Gamification = applying game design thinking in non-game contexts
- Usually, the goal is to increase motivation
- Often centers around reward design
- Naive gamification only facilitates extrinsic motivation – slap on leaderboards, badges, trophies etc.
- Successful gamification often manages to facilitate intrinsic motivation too

Bottle Bank Arcade

https://www.youtube.com/watch?v=zSiHjMU-MUo

Sight (2012): A utopian or dystopian vision?

https://www.youtube.com/watch?v=H1TRosKxhg0

Dangers of extrinsic motivation

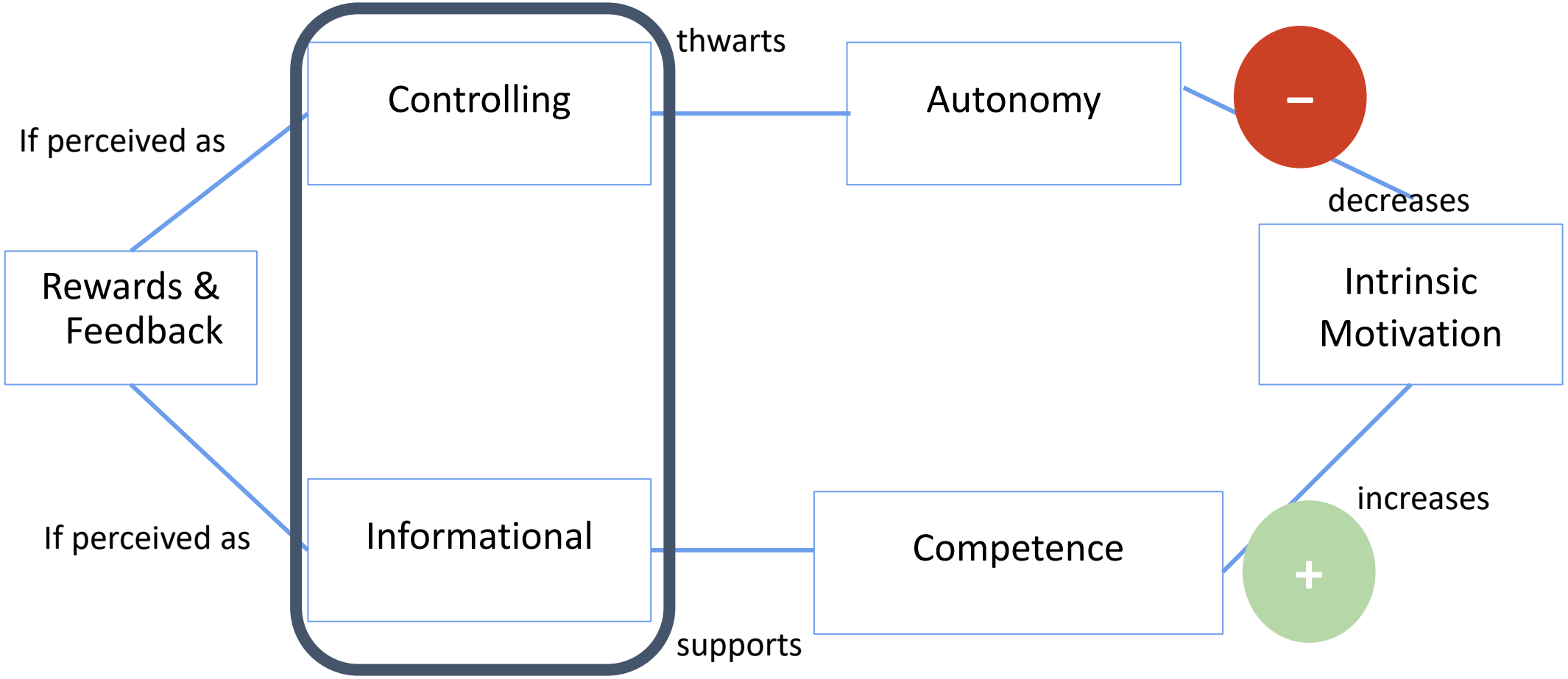
- Intrinsically motivated workers put in a lot of hours and excel because they love what they do
- Adding extrinsic motivation such as organization KPIs can change one's motivational profile towards more extrinsically motivated, and decrease intrinsic motivation
- Extrinsically motivated people are more prone to cheating and backstabbing (e.g., in sports and education)
- Basic rule of gamification: you get what you measure and reward, often at a hidden cost.

You get what you measure: Clickbait

- Traditional good journalism: The header or title summarizes the news
- Journalism optimized based on click analytics: The news is held back.
- One gains clicks, but does one really gain loyal readership, positive effect on society etc.?
- Both AI and humans may optimize/game the system and get the reward in a manner that is detrimental

Do leaderboards support competence?

Cognitive Evaluation Theory



Ryan, Richard M., Valerie Mims, and Richard Koestner. "Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory." *Journal of personality and Social Psychology* 45.4 (1983): 736.

Some other motivation models

The role of story/narrative?

- Some intrinsic motivation papers list fantasy as its own motivator (E.g., Malone 1981)
- Narrative can also support basic psychological needs
- A good story is novel and not too predictable (curiosity/interest), and creates a feeling of connection with the characters (relatedness)
- A simple example: Giving a child the official shirt, ball or cap of a famous athlete can motivate through a form of power fantasy (competence, autonomy)
- Narrative can also be rewarding/motivating through *emotional gratification* (discussed in part 3 of this lecture series)

Malone, Thomas W. "Toward a theory of intrinsically motivating instruction." *Cognitive science* 5.4 (1981): 333-369.

Flow (Csikszentmihalyi)

- Flow is a model of an optimal experience – e.g., total absorption, losing track of time. “A feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment.”
- Flow is experienced in *autotelic* activity (having a purpose in and not apart from itself)
- Origin of flow is in Csikszentmihalyi’s study of athletes and artists
- Autotelic persons: internally driven, with curiosity and sense of purpose.
- Closely related to intrinsic motivation (autotelic ≈ intrinsically motivated)

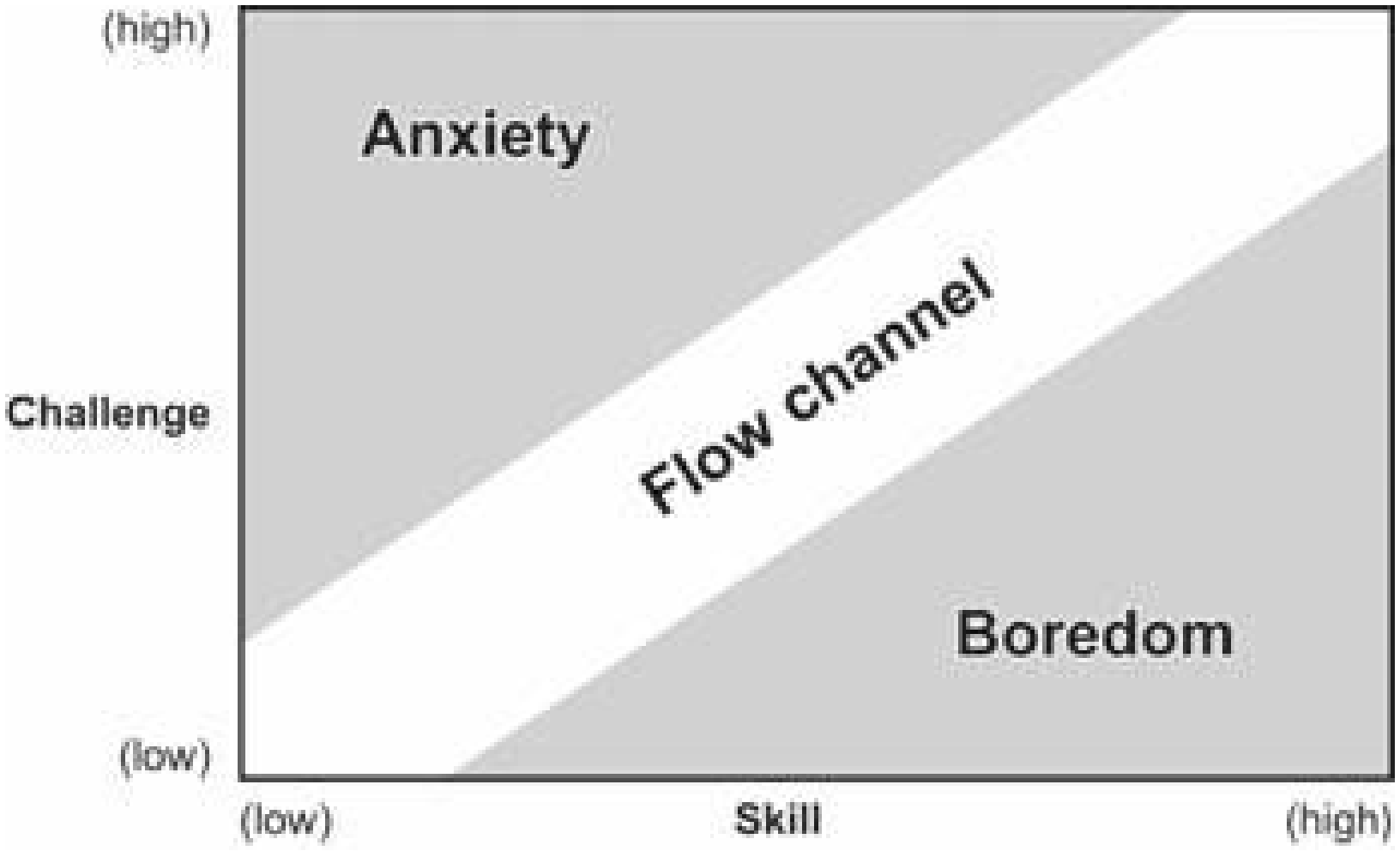
Elements of flow

- Clarity of goals and immediate feedback
- A high level of concentration on a limited field (no distractions)
- Balance between skills and challenge
- The feeling of control
- Effortlessness
- An altered perception of time
- The melting together of action and consciousness
- Autotelic experience

Flow and the dual systems theory

- Effortlessness and feeling of control suggest that flow is something one can experience when practicing a highly automated skill, and System 2 does not need to be engaged
- Burzik describes flow using System 1 terminology:”The activity runs smoothly, guided by an inner logic. All necessary decisions arise spontaneously from the demands of the activity without any deliberate reflection.” (www.flowskills.com)

Skills and challenges – flow channel



Flow and expertise

Jin et al, 2012 study, N = 307, Racing vs. Action vs. Medical Simulation games

- Experienced players reported strongest sense of flow when challenge high
- Mediocre players reported most flow for moderately challenging gameplay
- ***Novices experienced no flow***

➢ Focused on learning controls, instead of challenge

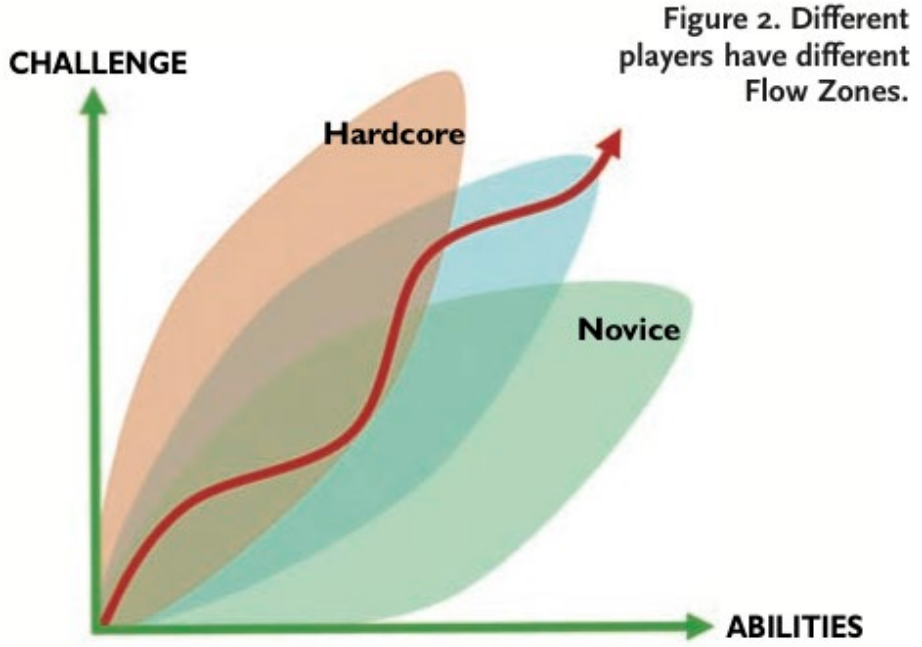
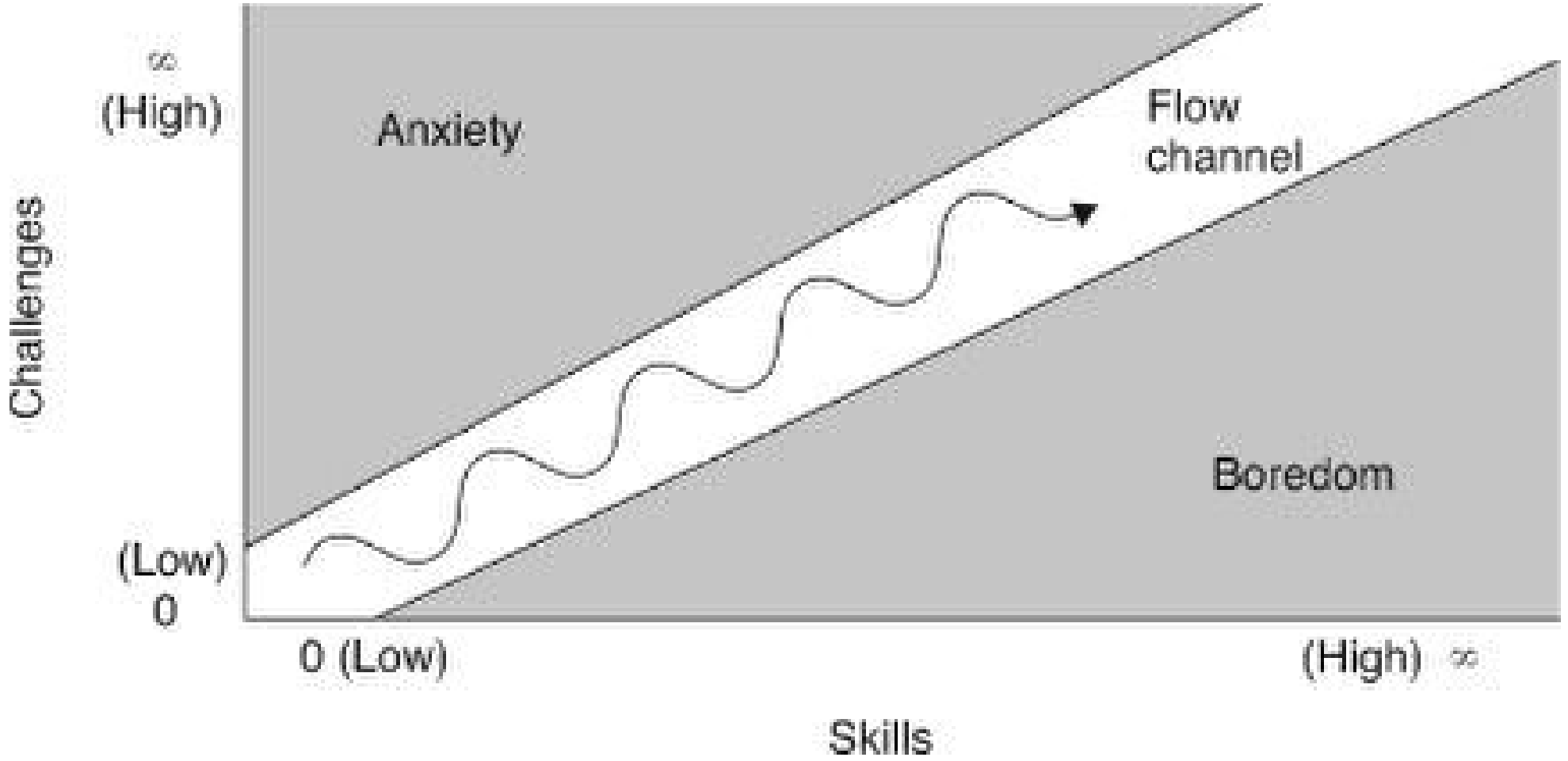


Figure 2. Different players have different Flow Zones.

https://www.jenovachen.com/flowingames/p31-chen.pdf

Flow channel in games, according to Schell



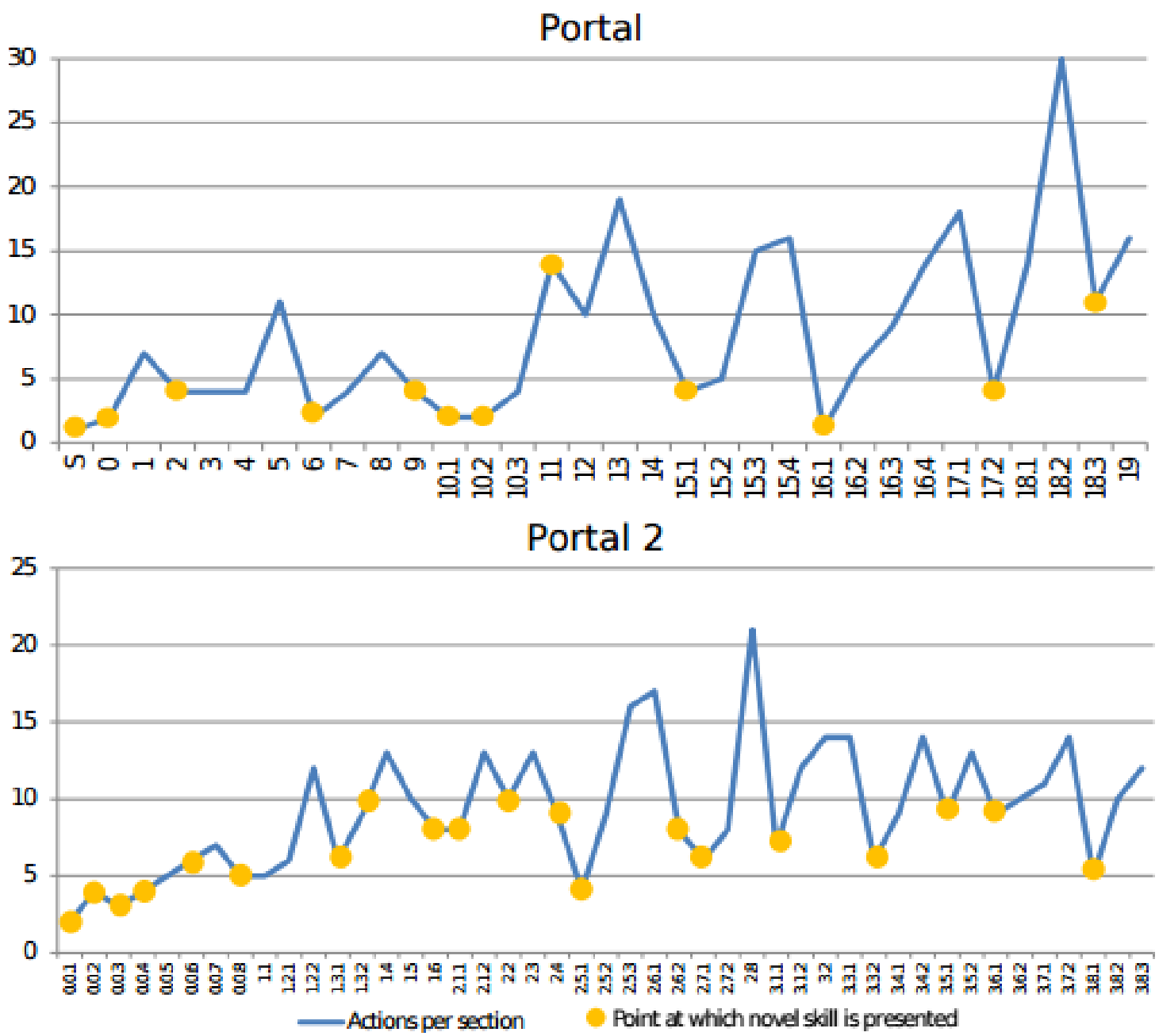


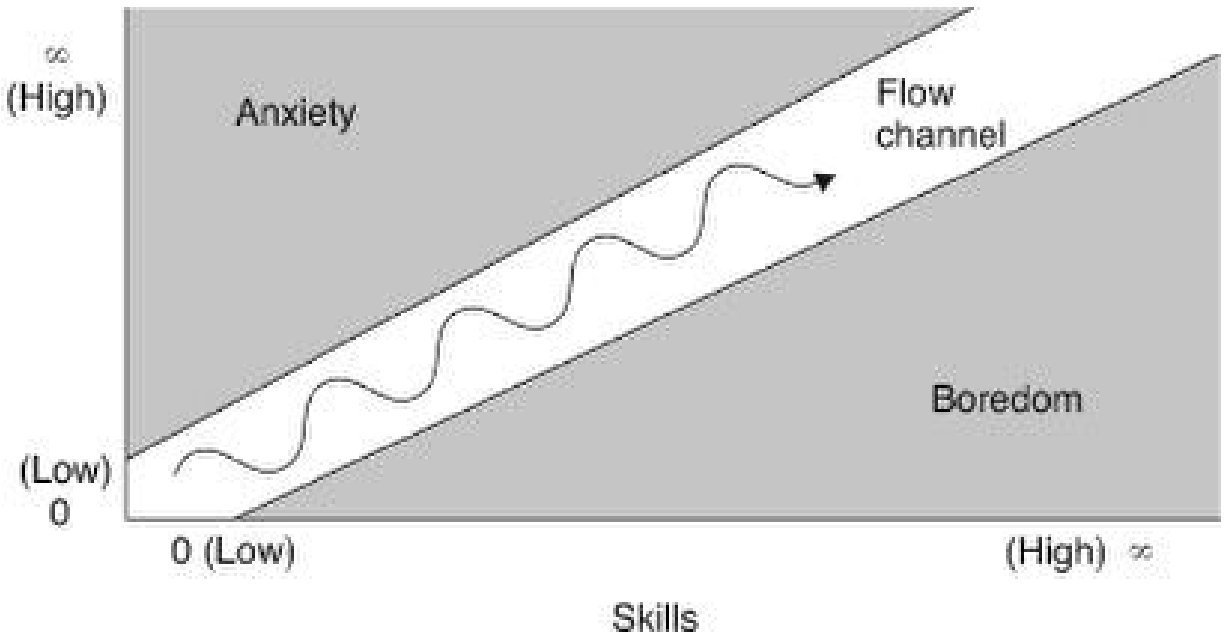
Figure 1. Minimum number of player actions required to solve successive puzzles in Portal (top panel) and Portal 2 (bottom panel).

Flow channel & novelty

- The sawtooth curve of successful games is a logical outcome of attempting to satisfy both
  1. Competence (skills and challenges balance)
  2. Novelty (avoiding too much repetition by gradually introducing new mechanics)

Flow channel & Novelty

Skills & challenges balance only



Also supporting novelty

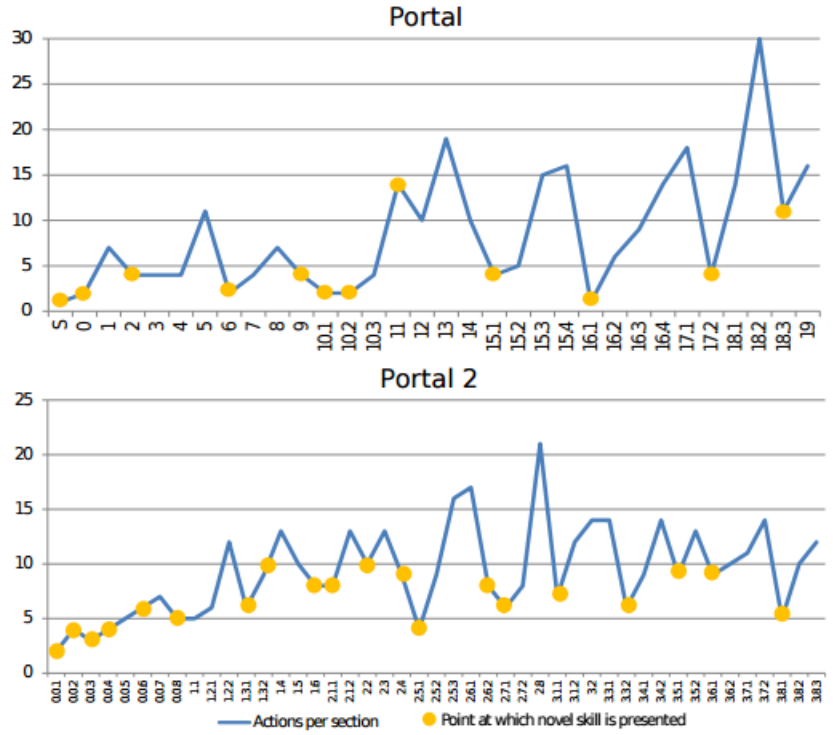
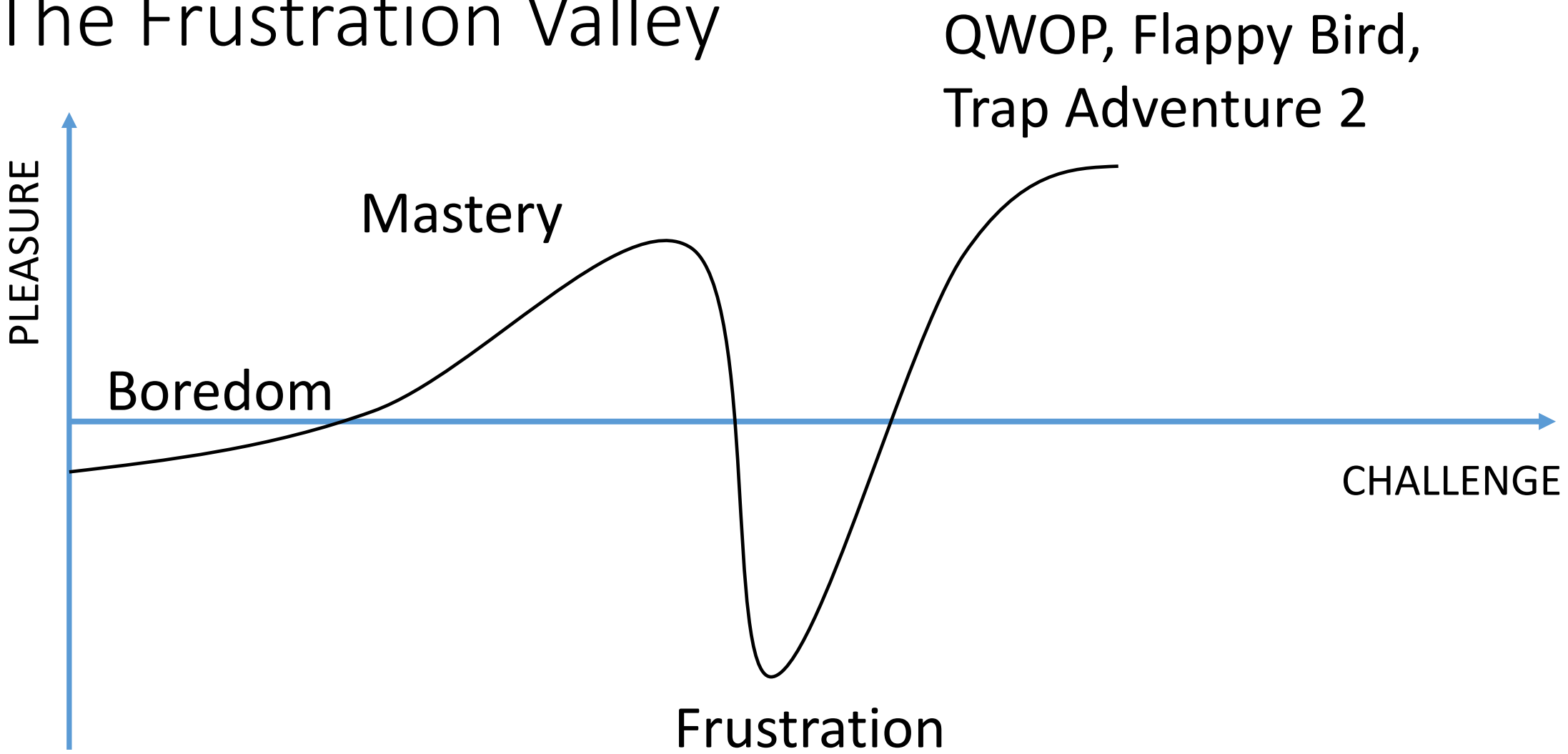


Figure 1. Minimum number of player actions required to solve successive puzzles in Portal (top panel) and Portal 2 (bottor panel).

Exceptions to the rule

- Candy Crush Saga: occasional super difficult levels actually boost virality
- Only works because luck plays a major role in the game (random fluctuation around average difficulty)

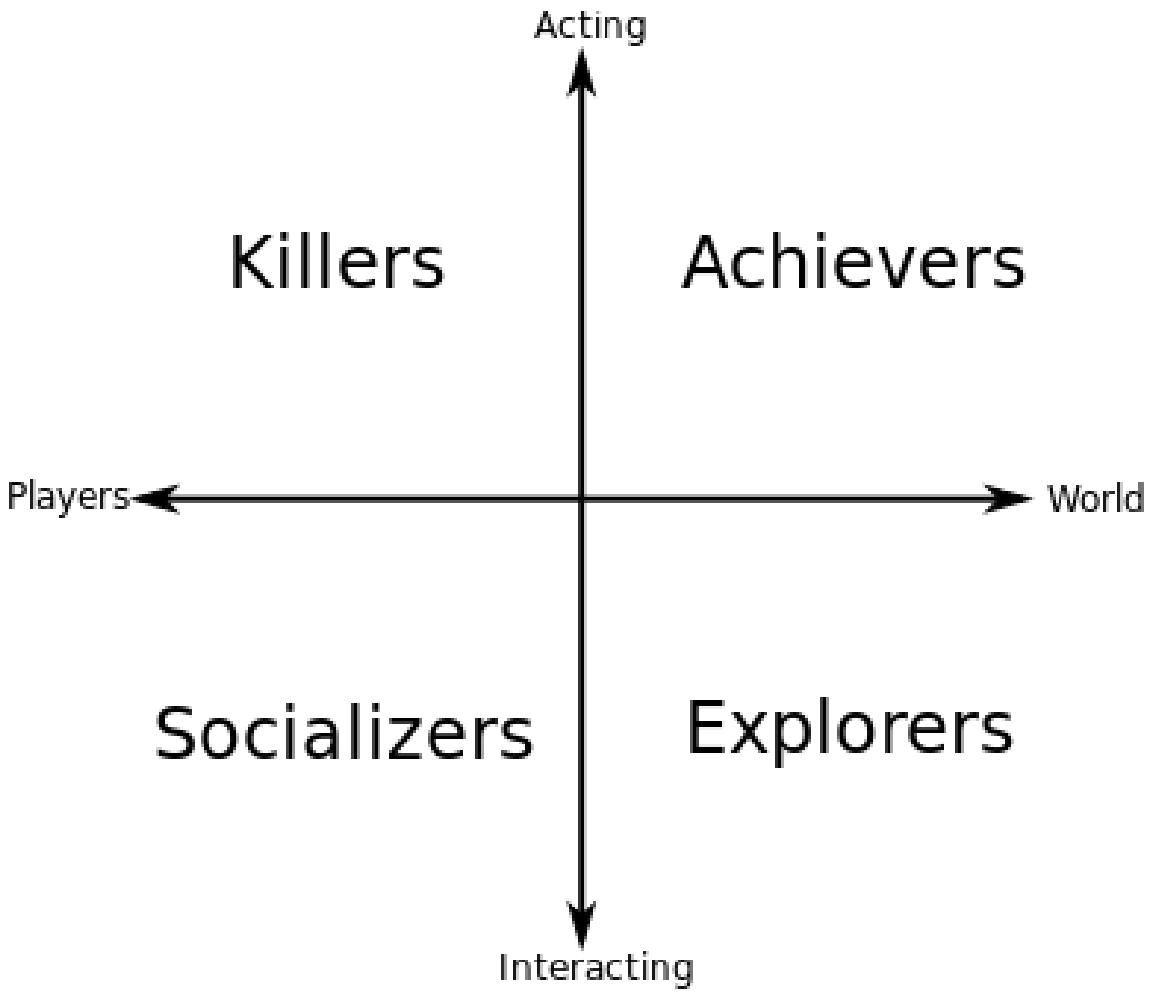
Extending the flow channel theory: The Frustration Valley



Individual differences

- In reality, no single model of motivation applies to all people
- Motivational profile of a player: The relative importance of different motivations and psychological needs
  - Computational rationality: the weights of need-based reward function components
- Player types: Motivational profile stereotypes. Can be useful for discussion, but danger of oversimplifying

Bartle's player types



English

Get Your Gamer Motivation Profile

After filling out a brief survey (5-7 minutes), this profile tool will generate a customized report for you. The report will describe the traits that were measured, and how you compare with other respondents. You will also be given a link to share your results. Based on your motivation profile, our Game Recommender Engine will suggest games you may like. Your responses may be used to refine the algorithms that generate the profile, and aggregate findings may be published in public or commercial reports. More Information.

New to Quantic Foundry?

You will have the option to create an account after taking the survey.

Take The Survey

Already Have An Account?

Please sign in so we can attach your results to your account or to see your existing profile.

Sign In

See what a Gamer Motivation Profile looks like by clicking a user below:

Rodrigo
33 years old
Hardcore Gamer

Caner
29 years old
Hardcore Gamer

Becky
23 years old
Core / Mid-Core Gamer

Exercise: Gamification, intrinsic & extrinsic motivation

1. Pick a physical activity (sport, exercise, cleaning, whatever) that you do not find motivating. Analyze it from the point of view of both intrinsic motivation (competence, autonomy, relatedness, curiosity, self-actualization) and reward&feedback design principles from today and yesterday: informational rather than controlling, juicy, both short & long term rewards, rewards for playing every day, randomness, anticipation. Can you identify any problems related to these?
2. Can you fix the problems by modifying, adding, or removing elements to better support various motivations?

Alternative: If this is too hard in real life, can you think of a digital game that would be interesting for people who hate the activity? A good example: http://whatthegolf.com/ (The golf game for people who hate golf)

Add the results to a shared Google Slides

Exercise: identify your player type

- Take Quantic Foundry's gamer motivation profile test: http://apps.quanticfoundry.com/lab/gamerprofile/

Exercise: learn to understand other player types

- Get into a random breakout room. Discuss games you like and your motivational profiles. Do you like the same games? If not, considering the motivational profiles of someone else, how could you modify your favorite games to make them interesting for them?
- Report your discussions as at least one slide per group. See the template: https://docs.google.com/presentation/d/12K3UvFYBA7t42dljFCmXuMCqRph9FNS-nHu7W-jFiAM/edit?usp=sharing

Recap: Practical implications

- The theories and typologies provide checklists against which you can critique a game.
- Alternatively, one can decide to optimize a game for a specific player type or motivational profile.
- Currently being researched: effective ways to classify a player's type or otherwise gather data that can be used to personalize a game
  - Already works in practice: customized IAP advertising
  - Recommendation systems of Netflix, Tiktok, Amazon etc.

Recap: Psychological needs that every game designer should remember and consider

- Competence
- Autonomy
- Relatedness
- Novelty

Some games also support: Self-actualization (transformative game experiences), physical thriving (exergames)