HEC MONTRÉAL

Le rôle des tutoriels de jeux vidéo mobiles : Une approche psychophysiologique explorant la première prise en main

par

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Résumé

Alors que de nombreux rapports prédisent une croissance majeure de l'industrie du jeu vidéo mobile, ce marché fait face à d'importants problèmes de rétention. Ce mémoire s'interroge sur l'importance de la présence des tutoriels, pratique visant à favoriser l'apprentissage des utilisateurs durant leur première exposition. Plus spécifiquement, cette étude s'intéresse aux effets des états psychophysiologiques vécus par des experts et des non-experts, lors de la présence ou de l'absence d'un tutoriel pour un jeu simple. Cette recherche a pour but de répondre à la question de recherche suivante : *est-ce qu'il existe un lien entre l'utilisation de tutoriels, l'expertise, l'état de flow et l'intention de rejouer*. Afin d'y répondre, 40 participants ont pris part à une expérience en laboratoire.

En premier lieu, les résultats suggèrent qu'une absence de tutoriel pour des joueurs inexpérimentés influence négativement leur intention de rejouer et l'émergence d'un état état de flow, défini comme une expérience engageante dans le cadre de ce mémoire. Aucun effet dû à la présence ou à l'absence des tutoriels n'a été relevé pour les joueurs expérimentés. En second lieu, les résultats suggèrent que l'état de flow influence positivement l'intention de rejouer. Les parties prenantes de l'industrie du jeu vidéo peuvent faire usage de ces résultats afin de mieux guider leurs choix liés à l'implantation de tutoriels dans les jeux vidéo. Spécifiquement, nos résultats soutiennent l'incorporation de tutoriels dans les jeux simples (c.-à-d. avec des mécaniques pouvant être découvertes par expérimentation). En somme, nos résultats suggèrent qu'un joueur calme (détendu) a davantage envie de joueur qu'un joueur excité (stressé) lors de la présence d'un tutoriel. En somme, cette étude est d'intérêt pour les chercheurs en expérience utilisateur à savoir qu'elle précise les conditions selon lesquelles l'apprentissage est optimisé en contexte ludique. Finalement, les avenues de recherche émanant de la présente étude ont un fort potentiel d'applicabilité pour de futurs ouvrages scientifiques.

Mots clés : Jeux vidéo, mobile, flow, tutoriel, freemium, intention de rejouer, activité électrodermale et valence émotionnelle.

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Avant-propos

Le mémoire qui suit est présenté sous la forme d’articles, suivant l’accord de la direction du programme de la M.Sc. en gestion de HEC Montréal. Le consentement des coauteurs a été obtenu afin de présenter ces articles dans le contexte de ce mémoire. Qui plus est, l’approbation des coauteurs a été consentie pour chacun des articles inclus dans ce mémoire. Finalement, le Comité d’Éthique en Recherche de HEC a approuvé ce projet de recherche

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En complément, il est important pour moi de mentionner l’apport important que le Tech3Lab a sur la société. Il est un modèle de partenariat réussi entre l’industrie et le milieu académique. Tout en permettant une approche fondamentale, le Tech3Lab facilite la résolution de problématiques importante à l’industrie. Son souci de diffusion de la connaissance est inspirant et mérite également d’être souligné. Bravo !

Un exemple parmi tant d’autres de diffusion de l’innovation fut l’opportunité inouïe que le Tech3Lab m’a offerte en finançant ma participation à la conférence à CHI Play 2016 au Texas. Là-bas, j’ai eu la chance de rencontrer d’autres experts, qui ont eux aussi, par leurs critiques constructives ont contribué grandement à faire avancer ce projet. Thanks to all of you !

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Chapitre 1
Problématique et questions de recherche

Introduction

Le jeu vidéo mobile est dominé, depuis 2011, par un modèle d'affaires profondément différent des autres plateformes s'appelant le *modèle semi-payant (freemium)* (c.-à-d. un jeu gratuit et totalement fonctionnel au téléchargement, mais incluant du contenu haut de gamme achetable) (Valadares, 2011). Bien que le marché mondial du jeu vidéo mobile (i.e., cellulaires et tablettes) bénéficie d'une croissance constante de l'ordre des 20 % annuellement selon NewZoo (2016), il est estimé que pour tous genres confondus 69 % à 77 % des joueurs abandonnent irrémédiablement un jeu à l'intérieur des 24 heures suivant son téléchargement (Appboy, 2016; Emarketer, 2015). Il est donc approprié de mentionner que ce marché fait face à d'importants problèmes de rétention.

Dans la littérature scientifique, il existe très peu d'études traitant du sujet de la première exposition à un jeu vidéo (Andersen et al., 2012; Cheung, Zimmermann, & Nagappan, 2014; Frommel, Fahlbusch, Brich, & Weber, 2017). Cependant, la prise en main d'un système et l'acceptation de nouvelles technologies ont fait l'objet de nombreuses recherches en contexte de productivité (c.-à-d. centré sur la complétion d'une tâche) (voir Venkatesh, Morris, Davis, and Davis (2003) pour une revue exhaustive). Selon Nielsen (1994), l'une des premières interactions susceptibles d'influencer l'expérience d'un usager avec tout système informatique est d'apprendre à utiliser ledit système. Lin and Wang (2006) propose qu'en contexte de commerce mobile, un apprentissage efficace influence positivement les premières capacités d'utilisation et le développement d'habitudes, dont est théoriquement tributaire l'engagement selon le *Technology Acceptance Model (TAM) (Davis, 1989).* Le TAM défini des facteurs susceptibles d'influencer l'intention d'utilisation à court et à long terme d'outils technologiques (Venkatesh et al., 2003). Conséquemment, il est soutenu dans la littérature de l'interaction humain et machine (HCI) que la facilité d'apprendre (*learnability)* est un enjeu important influençant la rétention (Davis, 1989; Grossman, Fitzmaurice, & Attar, 2009; Nielsen, 1994).

En opposition, Pagulayan, Steury, Fulton, and Romero (2003) suggèrent que l'utilisation d'un jeu vidéo est discrétionnaire et qu'alors le besoin d'apprendre à y jouer y serait moindre que pour une application de productivité. Dans un cadre de recherche sur les jeux vidéo, Isbister and Schaffer (2015, p. 38) suggèrent que les aspects de *usefulness* (c.-à-d. le soutien d'un système vers l'accomplissement d'une tâche) et de *usability* (c.-à-d. facilité à apprendre, coûts d'utilisation, efficacité d'usage, etc.) doivent être analysés comme des éléments secondaires tant qu'ils « n'affectent pas les probabilités d'une expérience riche et engageante » [traduction libre].

À notre connaissance, seulement Andersen et al. (2012) explorent le besoin d'apprentissage à travers la présence de tutoriels dans différents contextes de jeu. Leurs résultats concordent en partie avec la conceptualisation de (Isbister & Schaffer, 2015) et (Pagulayan et al., 2003). En effet, les résultats de Andersen et al. (2012, p. 1) suggèrent que les tutoriels incitent à l'engagement qu'envers les jeux complexes, comparés aux jeux caractérisés par des « mécaniques pouvant être découvertes par expérimentation » [traduction libre], soit des jeux simples. Spécifiquement selon Andersen et al. (2012), les tutoriels n'ont aucun effet sur les jeux simples, mais augmenteraient jusqu'à 29 % le temps de jeu pour ceux jugés complexes lorsqu'un tutoriel les présente. Cependant, le niveau d'expertise des participants n'a pas été analysé par Andersen et al. (2012). Il pourrait donc y avoir eu une surreprésentation de certains types de joueurs pour qui la présence de tutoriels est possiblement plus ou moins favorable à l'émergence d'une expérience « riche et engageante » dans certaines conditions de jeu.

La sensation holistique et engageante (c.-à-d. l'état de flow (Csikszentmihalyi, 1975)), qu'un individu peut ressentir lorsque ses motivations internes sont telles qu'il agit en implication totale envers une activité, survient lorsqu'un niveau de défi égal à son expertise lui est proposé. Afin d'obtenir des réponses tenant compte des limites de Andersen et al. (2012), la présente recherche investigue si l'origine du besoin en tutoriel présentée comme étant contextuelle à la complexité du jeu ne serait pas plutôt liée à l'expertise propre aux joueurs. Cet objectif est d'autant plus important, car le marché du jeu vidéo est dorénavant plus vaste et plus varié que jamais, comme en témoigne le nombre imposant de joueuses de 35 ans et plus, dont la quantité surpasse sensiblement le nombre de jeunes hommes de moins de 18 ans (ESA, 2017).

La présente étude explore donc la relation entre la présence ou l'absence des tutoriels, le niveau d'expertise des individus et leur influence commune sur une expérience riche et engageante, qui en théorie devrait avoir un effet sur l'intention de rejouer. Spécifiquement, elle étudie les effets de l'expérience engageante au travers de la théorie du flow et de ses manifestations psychométriques et physiologiques. En effet, cette recherche mesure l'état physiologique des participants, afin d'obtenir des données objectives, continues et non intrusives de leur état durant leur première exposition (Riedl & Léger, 2016), en plus de leur perception par des mesures auto-rapportées à la suite de cette dernière.

1.1 Les concepts mobilisés dans cette étude

Tutoriel et expertise transversale

La présente étude explore le concept d'expertise en contexte de jeu vidéo, spécifiquement comment elle s'acquiert et comment elle se manifeste. Pour se faire, il fallut prendre en compte les évidences de la transversalité de l'expertise en contexte d'interaction humain-machine (c.-à-d. la possible réutilisation des capacités actives et celles qui sont inconscientes acquises d'un autre système). Sur ce point, il existe une vaste littérature entourant les différences entre experts et non-experts comme le démontre le prochain paragraphe.

Vu leur disposition à jouer, Raggad (1997) suggère qu'un expert est plus à même de bien utiliser l'information offerte par un système pour bâtir ses décisions. À l'opposé, Haier et al. (1992); Hill and Schneider. (2006) proposent que sans expérience, un degré élevé de nouveauté est inhérent à tout stimulus et peut impliquer conséquemment une grande incertitude, soit une source de stress, voire d'anxiété. Chez le joueur inexpérimenté, tout cela s'observe par une attention accrue et un traitement conscient des stimuli. Ce n'est qu'au moment d'expositions subséquentes qu'un traitement plus automatique des stimuli pourra avoir lieu. Cette automatisation demande moins de ressources cognitives et produit des performances accrues alors que l'utilisateur est apte à filtrer les informations provenant de son environnement (Haier et al., 1992; Hill & Schneider., 2006).

En somme, bon nombre d'études ont traité des différences existantes parmi ces groupes d'utilisateurs en ce qui a trait à leurs capacités à résoudre des problèmes (Barfield, 1986; Leger, Davis, Cronan, & Perret, 2014), à extraire de l'information stratégiquement (Tabatabai & Shore, 2005), à traiter de l'information (Bateson, Alexander, & Murphy, 1987) et à filtrer des stimuli visuels (Dye, Green, & Bavelier, 2009). De surcroît, Strobach, Frensch, and Schubert (2012) suggèrent que les joueurs experts performent mieux que les joueurs non expérimentés en situation de multitâche (de dualité et en changements rapides de tâches). En somme, l'étude de Strobach et al. (2012) suggère une amélioration significative des capacités de multitâche des joueurs non expérimentés après seulement 15 heures de jeu. Bien que dans son ensemble, une majorité d'études acquiesce de la transversalité de l'expertise, il existe toujours un débat entourant certaines aptitudes cognitives, dont l'orientation spatiale (Sims & Mayer, 2002) et la mémoire à très court terme (Boot, Kramer, Simons, Fabiani, & Gratton, 2008). Malgré tout, la littérature scientifique propose assez d'évidences supportant la transversalité de l'expertise pour justifier son utilisation dans le cadre de cette étude.

En conclusion, les tutoriels visent principalement à offrir les connaissances et compétences à tous les usagers, afin qu'ils puissent surmonter le défi initial d'un système donné. Ceci étant dit, ils révèlent une importance théorique plus importante pour un joueur qui posséderait un niveau d'expertise faible en jeu vidéo que pour un joueur aguerri par des expériences variées. Spécifiquement, un joueur non expérimenté (c.-à-d. un joueur qui joue sporadiquement, qu'à quelques jeux par année et dont les périodes de jeu sont courtes) devrait percevoir le défi initial de tout système comme plus ardu qu'un joueur expérimenté (c.-à-d. un joueur plus dévoué se procurant plusieurs franchises, genres et plateformes.) (Kapalo, Dewar, Rupp, & Szalma, 2015).

L'État de Flow

La relation entre l'expertise et l'appréhension d'un défi est au cœur de la conceptualisation entourant la théorie du flow de Csikszentmihalyi (1975), qui définit le flow comme un état ressenti lorsqu'une personne s'immerge dans une tâche hautement engageante. Cet état holistique et ses composantes utilitaires (perception de contrôle, temps de réponse à une action, compétences actives) et composantes hédoniques (distorsion du temps, téléprésence, éveil) ont fait l'objet de nombreuses études en contexte d'interaction humain-machine (Hoffman & Novak, 2009).

Plusieurs recherches ont démontré un lien étroit entre l'état de flow et des conséquences comportementales positives, dont un plaisir supérieur (Chen, Wigand, & Nilan, 1999; Hsiang Chen, 2006; Pilke, 2004; Webster, Trevino, & Ryan, 1993), une motivation intrinsèque forte envers une activité (Moneta & Csikszentmihalyi, 1999), des intentions d'achats élevées (Bridges & Florsheim, 2008; Sénécal, Gharbi, & Nantel, 2002), mais également une intention de continuer d'utiliser un système (Agarwal & Karahanna, 2000).

Depuis l'illustration originale de l'état psychologique du flow par Csikszentmihalyi (1975), le construit a beaucoup évolué. Hanin (2000) a souligné que l'état de flow possède une composante cognitive, mais également une autre affective et qu'alors mesurer la dimension physiologique en plus de celle qui est psychologique est recommandé. À cet effet, une conceptualisation intégrative a été proposée par Peifer (2012, p. 148) suggérant que le flow est « un état de valence positive (composante affective), provenant d'une activité perçue comme offrant un niveau de défi optimal (composante cognitive), caractérisé par un éveil physiologique adapté (composante physiologique) visant une pleine concentration pour faire face à un environnement et ce qu'il demande » [Traduction libre]. Cette conceptualisation riche du flow est centrale à cette étude qui s'interroge sur l'engagement résultant de l'expertise ou de l'apprentissage (gain en expertise).

1.2 Questions de recherche

Le premier article de ce mémoire a pour but d'explorer l'impact des tutoriels et de l'expertise directement sur l'intention de rejouer et d'achat. Vu un manque important de recherche scientifique sur les bénéfices liés l'utilisation de tutoriels, l'étendue de cette étude est justifiée. C'est dans ce cadre que la première question à laquelle nous avons tenté de répondre dans le premier article était : *est-ce que la présence ou l'absence des* *tutoriels en fonction de l'expertise des joueurs a un effet sur l'intention de rejouer et d'acheter du contenu en jeu ?*

Bâtissant sur les judicieux conseils obtenus lors de la présentation du premier article à CHI Play une importante conférence centrée sur l'interaction entre l'humain et tout système dans un contexte de jeu, le second article est une version bonifiée du premier. Lui aussi explore l'effet des tutoriels et de l'expertise des joueurs, mais est centré particulièrement sur l'état psychophysiologique et l'effet de ce dernier sur l'intention de rejouer. Plus spécifiquement, il recherche si un état de flow, conceptualisé dans la littérature comme contribuant aux motivations intrinsèques d'un individu (Csikszentmihalyi, 1975), peut atténuer le besoin utilitaire d'apprendre à jouer en contexte hédonique. De ce fait, le second article a tenté de répondre à la question suivante : *quel est le lien entre l'utilisation de tutoriels, l'état de flow, l'expertise et l'intention de rejouer dans un contexte de jeu ?*

1.3 Objectif de l'étude et contribution potentielle

L'étude effectuée s'inscrit dans le cadre d'un partenariat industriel dans lequel un développeur de jeu vidéo mobile, Hibernum (Montréal, CA), cherchait à améliorer la rétention de ses nouveaux utilisateurs, soit d'améliorer leur indicateur clé de performance communément appelé le taux d'attrition (churn rate) dans l'industrie. Concrètement, la problématique pour ce partenaire était de retenir ses utilisateurs au-delà de leur première expérience de jeu. À cet effet, il existe très peu de recherches dans la littérature sur lesquels il leur était possible d'appuyer toutes décisions fonctionnelles concernant les premières minutes de jeu, communément appelé la prise en main (onboarding) (Andersen et al., 2012; Petersen, Thomsen, Mirza-Babaei, & Drachen, 2017).

Le but premier de cette étude était de clarifier la contribution des tutoriels dans un contexte de jeu hédonique, cela en tenant compte du niveau d'expertise des joueurs et particulièrement de leur état psychophysiologique durant leur première exposition. Le but secondaire était de sensibiliser la communauté de chercheurs en expérience utilisateur dans le jeu vidéo sur cet enjeu trop peu étudié.

L’atteinte de ces deux objectifs est dépendante à la publication des deux articles inclus dans ce mémoire. Le temps écoulé entre la présentation du premier article (Morin et al., 2016) à une importante conférence sur l’interaction humain-machine en contexte de jeu, CHI Play 2016 et la rédaction du second permet à l’auteur de ce mémoire de constater que déjà le sujet a été approfondi à l’édition de 2017 de cette même conférence par Frommel et al. (2017) et par Petersen et al. (2017) alors que le sujet n’avait pas été étudié depuis Andersen et al. (2012).

En matière de contributions managériales, cette étude peut apporter des réponses sur la rétention dans les jeux vidéo mobiles, mais aussi à d’autres applications possédant un modèle d’affaires *semi-payant.* En somme, elle peut contribuer à enrichir la littérature sur l’apprentissage en contexte d’interaction humain-machine, notamment en y soulignant l’importance du facteur d’expertise et de l’état psychophysiologique.

Dans le même ordre d’idées, cette recherche a utilisé une méthode de collecte de données mixte, soit avec des données auto-rapportées et physiologiques (électrodermale). Cette seconde technique permet d’approcher l’expérience vécue par l’utilisateur de façon non intrusive, continue et automatique. Suivant les indications de Riedl and Léger (2016), la méthodologie employée peut potentiellement enrichir le champ de l’évaluation de l’expérience utilisateur.

1.4 Information sur les articles

Le premier article de ce mémoire a été présenté à la conférence scientifique CHI Play 2016, parrainé par ACM SIGCHI en octobre 2016 à Austin (Texas, É.-U.). Les phases de conception du design expérimental, de prétest et de collecte de données ont été effectuées à l’automne 2015 par un groupe de travail au Tech3Lab, HEC Montréal, où travaillait l’étudiant de ce mémoire comme assistant de recherche à l’époque.

Les résultats du premier article (Morin et al., 2016) sont en fait issus de la deuxième phase d’analyse, la première ayant été consacrée aux besoins pratiques du partenaire. Le premier article a donc été rédigé ultérieurement dans le but de répondre à la première question de recherche et de promouvoir l’importance de son enjeu à CHI Play 2016.

Vu la portée du second article, il est rédigé dans le but d'une soumission au journal *Simulation and Gaming*, internationalement reconnu comme leader en recherche et développement sur l'apprentissage en contexte ludique. Un élément important à noter est que le même jeu de données a été utilisé pour produire les deux articles. Une seule étude en laboratoire a généré les données nécessaires à la rédaction de ces deux articles, ayant comme différences principales leur question de recherche, mais aussi l'introduction du construit d'une expérience riche et engageante dans le second.

Résumé du premier article

L'adoption du modèle d'affaires *semi-payant* dans la distribution d'applications et de jeux vidéo mobiles a eu comme conséquence de réduire fortement les barrières à l'essai. Du point de vue des consommateurs, les offres de ce marché compétitif sont devenues plus interchangeables que sous l'ancien modèle d'achat-avant-de-jouer. En conséquence, de récents rapports de l'industrie rapportent que les jeux optant pour ce modèle composent avec de très faibles taux de rétention et de conversion en utilisateur payant. Pour pallier à ce problème, les tutoriels sont communément utilisés afin de favoriser l'adoption d'un jeu par une présentation optimale des mécaniques de ce dernier. Malgré son utilisation populaire, la question à savoir si les tutoriels ont les mêmes effets sur l'intention d'achat et l'intention de rejouer pour tous les joueurs n'a jamais été posée. Nous posons l'hypothèse qu'un tutoriel a des effets différents sur un joueur non expérimenté qu'il ne la pour un joueur expérimenté. Les résultats suggèrent que l'absence de tutoriel pour les joueurs non expérimentés à un impact très négatif. Ils suggèrent également que cette absence n'influence pas les joueurs expérimentés. En somme, les résultats indiquent une différence significative entre les joueurs expérimentés et novices lorsqu'aucun tutoriel n'introduisait le jeu, suggérant que les capacités acquises sous d'autres systèmes sont effectivement transversales.

Résumé du second article

Dans la littérature sur les jeux vidéo, certains auteurs suggèrent que l'utilisation d'un jeu vidéo est discrétionnaire, en citant que le besoin d'apprendre y est moindre que dans une application de productivité (c.-à-d. centré sur une tâche à compléter). En d'autres mots, les émotions ressenties par les utilisateurs au moment où ils posent certaines actions sont plus importantes que les actions elles-mêmes. La recherche antérieure suggère aussi que les effets des tutoriels sont liés au contexte du jeu dans lequel ils sont introduits, soit simple ou complexe.

À l'aide de mesures auto-rapportées et physiologiques permettant de mesurer l'état de flow, nous explorons la médiation des tutoriels et de l'expertise sur l'intention de rejouer par l'expérience riche et engageante, tel que proposé par la littérature existante. Recrutés grâce au panel HEC, 40 participants ont participé à l'étude en laboratoire et ont été indemnisés avec un chèque cadeau de 20 $ CA à la Coopérative de HEC. 30 participants ont été retenus pour l'analyse de données suivant l'exclusion des données aberrantes. Nos analyses ont été entièrement réalisées sur SPSS 13. Les résultats de cet article vous sont accessibles en conclusion de ce mémoire.

1.5 Contributions et responsabilités dans la rédaction des articles

Afin de mieux comprendre mon apport aux articles, le tableau ci-dessous présente les étapes du processus de recherche et ma contribution pour chacune d'elle. J'inclus le pourcentage du travail que j'ai effectué à chacune des étapes.

Étapes du processus	Contribution
Définition des requis du partenaire et du devis de recherche	50 % - Receuillir les objectifs du partenaire et traduire ces derniers en question de recherche scientifique. • L'équipe responsable du partenaire a recueilli les besoins initiaux du partenaire et est arrivée à un consensus sur les objectifs pratiques de la recherche. - 0 % • Au regard du travail déjà réalisé, traduire ces objectifs pratiques et les opérationnaliser en question de recherche scientifique pour les articles. - 100 %
Revue de la littérature	100 % - Effectuer la revue de littérature pour déterminer l'approche optimale afin d'atteindre les objectifs de recherche. • Se familiariser avec la revue de littérature élaborée, analyser cette dernière et l'approfondir afin d'y comprendre ses forces et faiblesses.

	• Par souci de validité et de fidélité scientifiques, opérationnaliser certains outils de mesure de façon à mieux répondre aux objectifs de la recherche. • Sélectionner les outils de mesures qui seront conservés pour la rédaction de l'article.
Conception du design expérimental	50 % Élaborer la demande au CER et les demandes de changement au dossier afin d'en respecter les exigences. Concevoir le protocole d'expérimentation et l'adapter dans le cadre de l'atteinte des objectifs scientifiques
Prétests et collecte	20 % : L'équipe s'est essentiellement chargée d'une majorité de la collecte et de gérer les problèmes survenant pendant le test. • Participation à bon nombre de collectes et maintien des salles
Extraction et transformation des données (Partenaire)	50 % Extraction et mise en forme des données physiologiques et psychométriques pour permettre l'analyse statistique • L'équipe a procédé à l'extraction des données psychométriques et psychophysiologiques et à leur mise en forme. – 0 % • J'ai réalisé l'extraction de l'ensemble des données occulométriques sur l'attention visuel et à leur mise en forme pour l'analyse – 100 %
Extraction et transformation des données (Articles)	80 % Comme l'exploitation des données physiologiques est fondamentalement différente pour l'article que pour le partenariat, une seconde extraction et mise en forme furent nécessaires. • J'ai préparé l'extraction en spécifiant les temps des phases de chaque participant à partir des informations à ma disposition – 100 % • L'équipe a ensuite pu exporter les données physiologiques - 0% 100 % Transformation des données psychométriques selon des méthodes plus rigoureuses et suivant les directives écrites et verbales des auteurs des échelles de mesure. Cela était nécessaire pour une majorité des échelles collectées initialement.

	100 % Mise en forme des données psychométriques et physiologiques pour l'analyse
Analyse des données	100 % Analyses statistiques • Statistiques descriptives et tests statistiques réalisés sur SPSS – 100 %
Rédaction	100 % Contribution dans l'écriture des articles • Les autres auteurs ont assisté l'écriture avec leurs nombreux commentaires

Chapitre 2: Premier article

Dans les actes de

The ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play
- (October 2016) -

The Effect of Game Tutorial: A Comparison between Casual and Hardcore Gamers

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Abstract

Because a significant amount of players abandon mobile games definitly after their first minutes of play and because it is not all users who purchase premium content when the game is offered for free (i.e., the freemium model), the mobile gaming market faces two major issues: conversion and retention. To this end, tutorials are used to help players quickly understand a new game mechanic, thus optimize the chances that they engage with the main content, want to continue to play and later on spend money in them, but do they have the same effects on purchase and continuous-use intentions for all players? We suggest that tutorials have different effects on casual players *(i.e,. a gamer who is playing sporadically up to a few games a year, with a low gaming session average length) who are theoretically more in need of learning* vs. *hardcore gamers* (*i.e., a more dedicated gamer who is playing the various games downloaded for free or purchased more frequently*) which tutorials could delay gratification. Preliminary results involving 43 participants propose that casual players' purchase and continuous-use intentions are higher from those of hardcore players when exposed to the game tutorial.

Author Keywords: Mobile gaming; freemium; tutorial; flow; purchase intention; continuous-use intention.

Introduction

The mobile gaming market is growing at a rate with an estimated rise of 23% in 2015, representing a $20.6 billion industry worldwide NewZoo (2015)**.** Since 2011, most mobile games use a freemium business model (Valadares, 2011). Freemium mobile gaming is defined as a free and fully functional source of entzertainment, well-integrated to the user's schedule and on-the-go lifestyle where players can purchase virtual goods to enhance their performance (Wei, 2008). Based on the idea that offering a free core product limits the risks perceived by a user and encourages spontaneous downloads, the freemium model however leads to operating costs, a low conversion rate of 1 to 8% (Casual Games Association, 2012; Pinchefsky, 2013) and to a complex revenue power-law curve (Lovell, 2011; NewZoo, 2015). Moreover, a recent industry report suggests that the 1-Day abandon rate is around 77% (Emarketer, 2015). As a consequence, it is of the utmost importance to identify practices that could raise the retention rate during a player’s first interaction and learning phase. To this end, tutorials are taught to play an important role in the adoption process by guiding players through the game’s mechanics.

Previous research suggests that game complexity should drive a developer's decision to incorporate a tutorial or not (Andersen et al., 2012). However, game complexity depends on the gamer’s perception, and it is likely to vary according to the type of player. A casual gamer (Kapalo et al., 2015) *(*i.e., a gamer who is playing sporadically up to a few games a year, with a low gaming session average length*)* may find the learnability of a given game more difficult than a hardcore gamer (i.e., a more dedicated gamer who is playing the various games downloaded for free or purchased more frequently), because the latter transfer their experience to the new game.

Thus, this research examines the interplay of a tutorial’s presence or absence and the type of player (casual vs hardcore) on purchase and continuous-use intentions in a freemium gaming context. Overall, our study suggests giving the option to skip the tutorial, or at least integrate an adaptive component to it, may be an effective way to preserve the alignment between the type of player and appropriate guidance.

Previous literature and hypothesis

Behavioral consequences of Flow

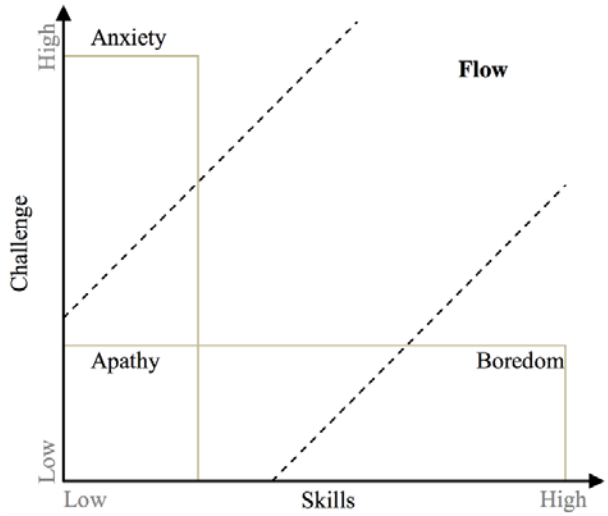
Since learning how to play a game will generally constitute the first experience a user will have with a game, the tutorial is a key element in the retention practice. Therefore, learnability has been broadly accepted as an integral component of new technology adoption (Grossman et al., 2009; Nielsen, 1994). For tutorials, the main goal is to provide the knowledge and skills to new users so that they become autonomous with more ease and faster, thus pursuing rewarding challenges. Consequently, a lengthy tutorial may postpone players' gratification, causing frustration or boredom. On the contrary, a tutorial which is too short may reduce the players' perceived skills with respect to the task and result in confusion or anxiety.

Defined as a holistic sensation that people feel when they act with total involvement by Csikszentmihalyi (1975), Flow is a multidimensional construct which involves many positive outcomes for oneself (Hoffman & Novak, 1996). There have been many studies on flow's behavioral consequences. By adding a flow construct to the TAM (Technology Acceptance model)(Davis, 1989), it has been proposed by Sánchez-Franco (2006) that flow state is positively influencing **continuous use intention**, which has also been concurred by other studies (Dailey, 2004; Webster et al., 1993). Moreover, Hamari (2015) posited that purchase intention in freemium gaming context are dependent on how long a player perceives they will interact with the game. Hence, a relation between flow state and **higher perceived enjoyment** has been observed on numerous occasions in the literature (H. Chen, R. T. Wigand, & M. S. Nilan, 1999; Hsiang Chen, 2006; Pilke, 2004; Webster et al., 1993). Finally, studies on online consumer's values and flow consistently led to a link between flow components, whether they are hedonic (e.g., telepresence, time distortion or arousal) or utilitarian (e.g., user skills, feel of control, response time to an action) and **purchase intentions** (Bridges & Florsheim, 2008; Sénécal et al., 2002).

This four-channel flow model by Csikszentmihalyi (1988) described in Nacke and Lindley (2008) (see Figure 1) suggests that the optimal experience is dependent on one's personal skills and is best defined as a "zone" rather than a strict linear relation

(Csikszentmihalyi, 1975). Based on cognitive science, information system, and gaming literature, the next section addresses the capacity of a player to transfer their skills to another context.

Figure 1 : Nack and Lindley (2008) Four-channel model of flow, based on Csikszentmihalyi (1988)



When the perceived challenge differs from optimal, an individual can enter three different states of mind: apathy, boredom, or anxiety.

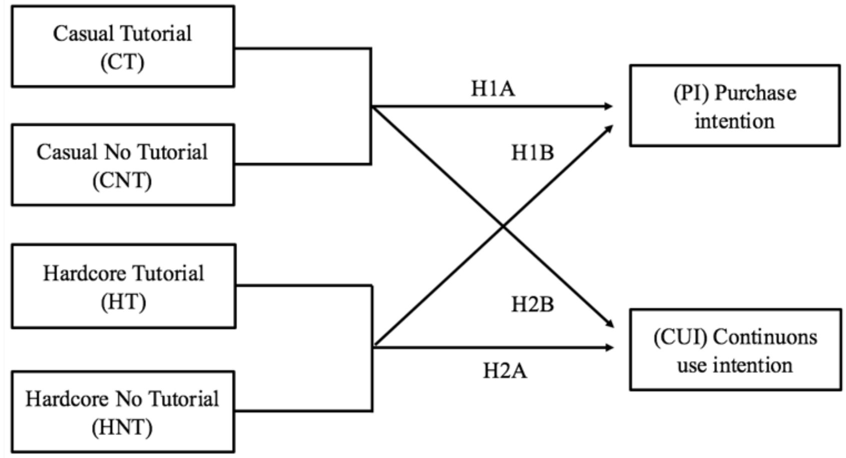
Gaming aptitude transferability

A vast literature covers the differences among novices and experts users with regards to problem solving (Barfield, 1986; Leger, Riedl, & vom Brocke, 2014)**,** information search strategies (Tabatabai & Shore, 2005), and cognitive processing (Bateson et al., 1987). Because of their past experience, experts feel more in control and able to use the information from a new video game to build their decision (Raggad, 1997). On the contrary, without experience, a high degree of novelty to a given stimulus is observed and consequently implies a great amount of uncertainty; thereupon, may cause stress or arousal; which, in turn, leads to increased attention and to a more controlled processing of the stimulus. Next time, the individual faces this same stimulus, a more automatic processing will occur because he has gained experience from their first encounter. This automation demands less cognitive effort and may result in an increased performance as the player filters more information cues (Haier et al., 1992; Hill & Schneider., 2006).

More specifically, training studies in cognitive psychology Dye et al. (2009); Green and Bavelier (2006) propose a causal effect of videogame playing with an enhanced basic visual attention. Building on Dye et al. (2009), evidence of enhanced performance differences between experienced gamers and non-gamers for both types of multi-task paradigm (i.e., dual or task-switching task) provides evidence gamers can improve their executive control ability after 15 hours of action video game practice (Strobach et al., 2012). As noted in this study, the underlying cognitive process of successful skill transfers is still a matter of debate, since many studies trying to establish transferability of other cognitive aptitude; spatial ability (Sims & Mayer, 2002) working memory function (Boot et al., 2008) skills were unsuccessful. Based upon our theoretical development, we propose that players have predisposed aptitudes that might impact their first interaction with a game. Therefore, we propose there is an optimal fit between user type and the guidance needed during the first interaction of a new game. Figure 2 presents our research model and the preliminary hypothesis of this research.

The relationship between independent variables is a matter of fit, more specifically a *matching as fit* (Venkatraman, 1989), because the adequation is developed independently from any individual anchor (i.e., the effect of the moderator varies accordingly with the independent variable). According to flow theory, if one lacks the skills to overcome a challenge, gaming experience will suffer, but if one receives guidance from a tutorial one should reach an optimal gaming experience more easily and faster. If, on the other hand, one's skills are too high compared to the challenge, gaming experience will also suffer. *De facto,* as one reaches a flow state, because of an optimal balance between skills and the task demand, one should exhibit a positive relationship with a continuous-use intention (CUI) (Dailey, 2004; Sánchez-Franco, 2006; Webster et al., 1993) and purchase intention (PI) (Bridges & Florsheim, 2008; Sénécal et al., 2002).

Figure 2 : Conceptual model and hypotheses



H1A: A casual player, exposed to a tutorial, will demonstrate higher PI than a casual player without tutorial guidance.

H1B: A casual player, exposed to a tutorial, will demonstrate higher CUI than a casual player without tutorial guidance.

H2A: A hardcore player, not exposed to a tutorial, will demonstrate a higher PI than a hardcore player with tutorial.

H2B: A hardcore player, not exposed to a tutorial, will demonstrate a higher CUI than a hardcore player with tutorial.

Methodology

Participants

To test our hypothesis, we conducted a laboratory experiment. Forty-three (43) casual and hardcore gamers had to play a new mobile game for the first time before it was publically released. Players were randomly assigned to one of two experimental conditions: with a didactic style tutorial, n = 22 (T) or without a formal tutorial phase, n = 21 (NT). The participants were recruited via our institution's research panel. The mean age was M=23 (SD = 3.98) with a range from 18 to 40; 28 were males. Based on Kapalo et al. (2015); Phan, Jardina, Hoyle, and Chaparro (2012) criteria, we were able to classify all participants in two categories: Casual (C) or Hardcore (H). Specifically, players were discriminated on reported self-categorization, average session played a week, average session length and previous gaming experience with video game. The average time played daily 2h 09m (SD: 1h 54m) for hardcore and 30 minutes (SD:39) for casual gamer. The hard-core players group was composed at 89% of men, in comparison to 42% in the casual group. Distribution between the four conditions is presented in Table 1. Before the experiment began, all participants freely reconfirmed their desire to take part in this 60 minutes' experiment for which they were compensated CA$20 (US$ 15.50) gift certificate.

Table 1: Sample distribution between the four conditions

	Casual	Hardcore
Tutorial (T)	9	13
No-Tutorial (NT)	10	11

Procedure

The experiment was composed as follows. A tutorial of 15 minutes was given to players in condition T. Players in condition NT played the game without any assistance (i.e. discovering freely the game) during this first phase. For the second part of the experiment, players in both conditions were asked to play freely for 12 minutes. The last part of the experiment began with an in-app purchasing task (paid with in-game currencies) followed by a 5 minutes gaming period. Dependent variables were measured between each of the three game sequences of the experiment. The goal behind collecting intentions over time was to identify the possible effect more playtime. Preliminary results shown very low variation, thus the scores obtained were averaged for our analysis. Finally, subjects were debriefed and thanked for their participation

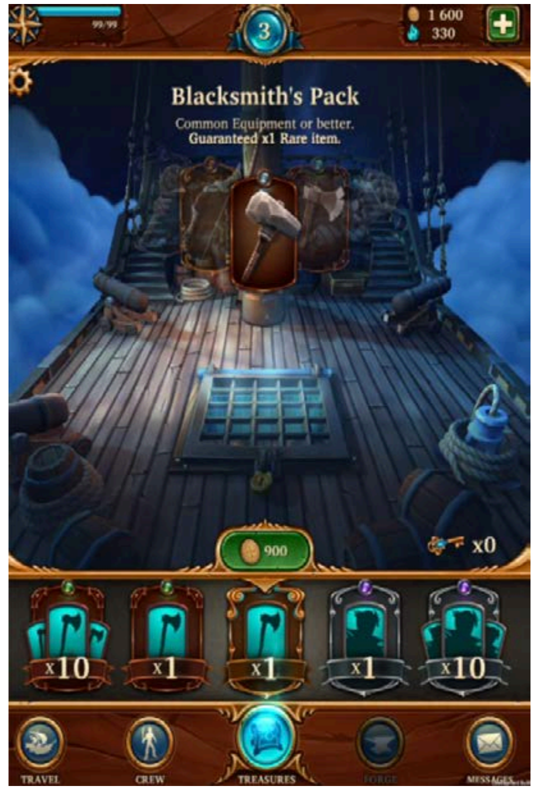
Experimental stimuli and apparatus

Saber's Edge by Hibernum is a Match3-RPG game. As the application had not yet been launched at the time of the experiment, all players were new to the game mechanics. Players were asked to connect series of the same item to attack the enemy team (see Figure 3). Players' moves were restrained because they had a limited number of consecutive actions equal to the number of their heroes in the field. Participants started with a certain amount of in-game currencies and received more after each victory. In-game currencies could be used to enhance their character's performance (see Figure 4). The experimental game was played on an IPAD Air 2 tablet.

Figure 3 : In-game screenshot of Saber's Edge combat system

Reproduced with permission of Hybernum

Figure 4 : In-game screenshot of Saber's Edge store



Questionnaires

Participants were invited to report their experience on the 10-item *Flow Short Scale* (Engeser & Rheinberg, 2008) (α=0.85).They reported their continuous-use intentions (CUI) using an adapted 4-item, 7-point Likert scale (α= 0.78)(Hess, Ganesan, & Klein, 2003) and their in-game purchase intentions, using real world money, (PI) were measured with a 3-item 7-point Likert scale (α= 0.94) (Guo & Barnes, 2011). Cronbach's alpha (α) is the most recommended measure for asserting internal consistency of a given instrument. A large alpha indicates the items of a given scale adequately capture the construct (Churchill, 1979). An alpha value larger than 0.70 is recommended, but complexity of the construct must be accounted for when judging this measure (Nunnally, 1978).

Results

Manipulation checks

As proposed by our theoretical premises and assuming unequal variance for the testing, a significantly higher reported optimal experience (flow fit presented among dependant and independent variable) was observed for casual players exposed to a tutorial (CT = 5.14) than those not exposed (CNT = 4.47, $t(15.87) = -1.67$, $p = 0.06$ (one-tailed)). No differences toward the optimal experience were observed among hardcores (HT = 5.09; HNT 5.15). Neither of the two conditions concerning the tutorial affected hardcore players' journey to an optimal experience, either positively or negatively ($t(19.34) = 0.170$, $p=0.43$). These results provide more evidence of the fit between expertise and the presence of a tutorial.

Purchase intentions (PI)

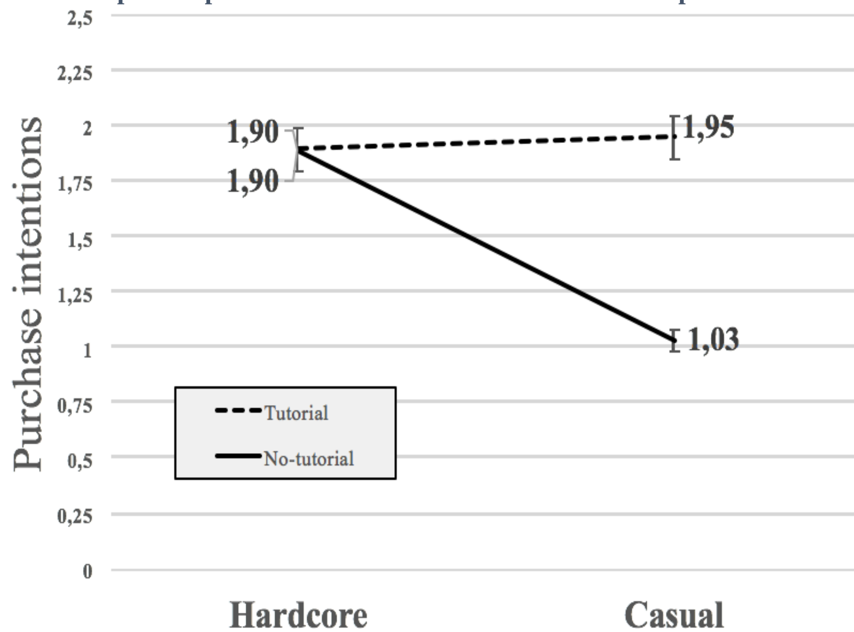
The reported purchase intention mean was 1.70 (SD: 1.09) and did not follow a normal distribution curve. With only 1 to 8 percent of players converting, in the freemium gaming context, low scores on purchase intentions were expected (Casual Games Association, 2012; Pinchefsky, 2013). However, the variations among conditions is noticeable and we try to explain this in the following paragraphs.

Global purchase intentions test failed the Kruskal-Wallis non-parametric test to achieve 0.05 significance threshold with $(\chi^2) = 6.605$, $p = 0.09$). Therefore, the four conditions were not statistically different one from another. However, we identified a trend in line with some of our hyposthesis in our post-hoc analysis that needs to be explored in more detail. Thus, we explored these variations using Mann-Witney non-parametric tests to compare means among independent groups of interest (see Figure 5).

Table 2 : Global mean rank for purchase intentions

Global Mean Rank	Casual	Hardcore
Tutorial (T)	24.78	22.27
No-Tutorial (NT)	14.20	26.50

Figure 5 : Reported purchase intentions between level of expertise and tutorial



H1A (CT > CNT on PI) was supported. The distribution difference in the two casual groups was significant (Mann-Whitney U=25.50, p=0.057 one-tailed). Casual with tutorial (CT) group's mean (12.17) was higher statistically than casual without a tutorial (CNT) group's mean (8.05). **H2A: (HT < HNT on PI) was not supported.** The hardcore groups' distributions were not significantly different, HT group's mean (11.35) was not statistically different from hardcore without a tutorial group's mean (13.86)

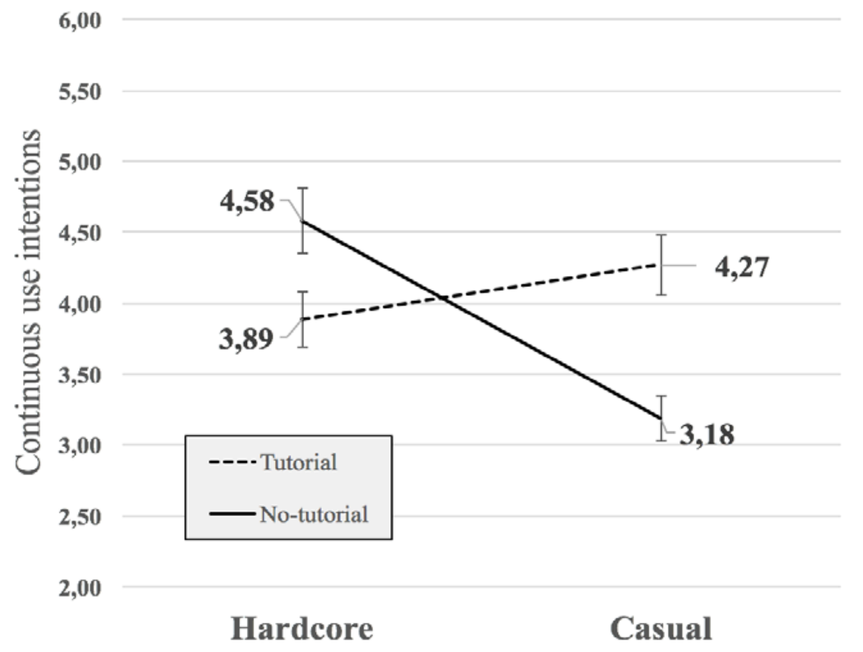
Continuous-use intentions (CUI)

The continuous-use intention mean (M=3.98 (SD: 1.42) was considerably higher than the purchase intention mean and followed a normal distribution curve. The median was 4.17 and scores ranged from 1 to 6.5, with 7 being the maximum. A two-way ANOVA was conducted to test the influence of the two independent variables on the purchase intention. The interaction effect was significant (F: 21.39 = 4.41, p = 0.042). We therefore proceeded to independent-sample t-test to explore the relations (see Figure 6).

H1B: (CT > CNT on CUI) was supported. Assuming unequal variance, casual with tutorial (CT= 4.27) group mean was higher than the casual without tutorial one (CNT= 3.18). For CUI, results suggested a significant difference among the two groups (t (15.6) =1.96, p = 0.032, one-tailed). **H2B: (HT < HNT on CUI) was not supported**.

For CUI, the empirical results were in accordance with our research hypothesis but this difference was not significant (t (20.2) = 1.13, p = 0.136, one-tailed). Assuming unequal variance, hardcore without tutorial (HNT= 4.58) group mean was not statistically higher than hardcore with a tutorial (HT = 3.89) group mean.

Figure 6 : Reported continuous-use intentions between level of expertise and tutorial



Discussion and conclusive comments

The first results of our study suggest that when a fit prevails between the type of user and the presence of a tutorial, positive consequences on purchase and continuous-use intentions are observable. Most importantly, H1A and H1B were confirmed and suggest that casual players indeed need tutorials and this guidance leads to desirable outcomes both in terms of purchase and continuous-use intentions. However, H2A and H2B, related to hardcore gamers, were not confirmed, since no differences in CUI and PI were observed between the two tutorial conditions for this type of players. One explanation for not supporting our hypothesis may relate to the state nature of boredom in games (Chen, 2007) and how players tolerate it. Our preliminary results offer guidance to developers, who in doubt of their 1st user level of expertise, should always provide a tutorial independently of developer's perceived difficulty (Andersen et al., 2012). In this study, challenge fit refers mainly to the flow construct, which has been empirically measured with self-reported questionnaires.

We are currently analysing neurophysiological data collected during this project, (i.e., eyetracking and physiological data). The objective is to have a better understanding of the psychophysiological state of the different types of players. For example, this data will allow a better understanding of the emotional intensity of player without tutorial and how this emotion evolves over time during the tutorial. We believe that by integrating some of these psychophysiological constructs, but also individual traits such: personality, learning preferences and demographic, we will be able to discern key characteristics of tutorial preferences. Therefore, this study is aiming to provide actionable results by identifying cues to flag a situation when it is preferable to offer guidance to a player, as well as key player characteristics to develop more intelligent or adaptive tutorials, adaptive to the new broader gaming market.

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Chapitre 3: Le second article

In preparation for a submission to

Simulation and Gaming
- SAGE Publications -

Demystifying Mobile Video Game First Experience : An Experimental Study about Tutorials in a Freemium Context

Raphaël Morin, Pierre-Majorique Léger, Sylvain Sénécal, Marc Fredette, and Lenart Nacke

Abstract

Video game tutorials are taught to help players understand new game mechanics with ease, thus to favour chances of early engagement with one's game main content. The mobile games market (i.e., phones and tablets) faces important retention issues caused by a high number of players who abandon games permanently within 24 hours after their download. This study investigates how tutorial presence and player expertise can impact users' psychophysiological states and continuous-use intentions. A laboratory experiment with 40 players was performed to test these relationships. Results suggest that the psychophysiological state of flow has a positive impact on CUI. Tutorials have a positive impact on non-expert perceived flow. Results suggest that tutorials are not needed by expert players, but also that they do not have a negative impact on their perceived flow state when present. Theoretical contributions and managerial implications of these results are discussed.

Keywords: Mobile gaming; freemium; tutorial; player expertise; electrodermal activity; flow; continuous-use intention.

Introduction

In comparison to other videogame platforms, mobile gaming is dominated by the *Freemium* business model (i.e., a free and fully functional source of entertainment, where players may purchase virtual goods to enhance their performance) (Valadares, 2011; Wei, 2008). On the one hand, by being free, barriers to download and play games are decreased in the freemium model. On the other hand, because substitute products are easily accessible and because players do not pay upfront to play, their loyalty is rather low. In addition, the revenue stream of freemium games comes from recurrent users and especially the ones that predict they will continue to interact with the game in the future. To measure this behavioural intent, continuous use intention measures have been extensively used in the information system literature since Davis (1989) (see Venkatesh et al. (2003) for an overview). This being said, recent industry reports suggest that the one-day attrition rate (i.e., the rate of players leaving a game within 24 hours following their original download) ranges between 61% (Appboy, 2016) and 77% (Emarketer, 2015) for freemium games and applications. Consequently, it is of the utmost importance to identify factors during players' first interaction with a game that are likely to increase their intention to continue to use the latter in the future (i.e., improve retention).

About users first interaction with a system, Nielsen (1994) suggests that one of the first significant interactions an individual will have with any system is to learn how to use it. Despite this prevalence of learnability (i.e. the capability of a system to enable the user to learn how to use it (ISO, 2010)) in the production application (utilitarian) research field, some authors in games user research (GUR) field argue that because the players' motivations in videogames are varied then learnability may be of lesser importance (Pagulayan et al., 2003). In other words, the technology acceptance model (TAM), which defines factors that influence a system usage on both short and long term in work context (Davis, 1989; Venkatesh et al., 2003), would not apply to a context where the user's aesthetic and emotional experience is predominant (Isbister & Schaffer, 2015). Furthermore, Isbister and Schaffer (2015, p. 38) propose that two of the TAM core constructs: *usefulness* (the support that the system offers toward task completion) and *usability* (learnability, usage costs, usage proficiency, etc.) are secondary to a rich and engaging experience for video gaming.

In the videogame industry, learnability translates mostly into the presence of tutorials in the first minutes of play, which are popularly referred to as the onboarding period. Unfortunately, tutorials have received only little empiric attention from the GUR community. To our knowledge, only Andersen et al. (2012) specifically explored tutorials need in the gaming context. Their main finding is that tutorials drive engagement in most complex games compared to games characterized by "mechanics that can be discovered through experimentation (*experiential learning*)", referred by Andersen et al. (2012, p. 1) as simple games. Specifically, play time increased by 29% when a tutorial introduced the most complex game of Andersen et al. (2012)'s experiment compared to when no tutorial was introducing the same game. Moreover, their results do not support any significant impact of tutorials in simple games.

Undoubtedly relevant, Andersen et al. (2012)'s research, however, does not address how a player transversal expertise may impact one's feeling and perception toward tutorial presence or absence. In the videogame context, tutorials are meant to offer knowledge to all users so they can overcome initial challenges because they are designed to increase game learnability. Tutorials, however, can play an important role in inexperienced players' first encounter because these players may suffer from a more substantial skill gap than some other gamers, who have accumulated expertise on other games and genres. Without the presence of a tutorial, a non-experienced gamer (i.e., a gamer who is playing sporadically to only a few games a year and with low average time per session*)* (Kapalo et al., 2015) might perceive the initial challenge of a system as more demanding than an expert gamer (i.e., a more devoted gamer who is playing various franchises that they download for free or purchases frequently) (Kapalo et al., 2015).

As a frame of reference, the relationship between one's personal expertise and the perceived challenge on hand is embodied in the Flow construct of Csikszentmihalyi (1975) which was originaly defined as a psychological state that a person undergoes when they immerse in a rich and engaging experience from a challenge they appraise as being in line with their faculties. With the world's highest yearly revenue growth among all platforms at 23% (NewZoo, 2016), mobile gaming attracts a broad audience composed of both expert and non-expert players that may benefit from a soft learning curve. Thus, developing a deeper understanding of the relation between expertise and tutorials on an engaging experience (flow) and the effect of the latter on continuous-use intention is relevant for both research and practice.

To investigate these issues, we performed a laboratory experiment. In this research, we investigate the effect of tutorial (i.e., presence or absence) and player expertise (i.e., low or high) on flow and on continuous-use intention. A multimethod approach was adopted to fully capture the rich conceptualization of the flow state by Peifer (2012). The latter integrates the original psychological construct and its modern physiological counterpart. Thus, we use both implicit (non-intrusive, continuous and automatic reaction of players measured by electrodermal activity) and explicit (self-reported questionnaires) measures to evaluate participants' experience as they are playing a mobile freemium game for the first time.

Literature and Hypotheses

Expertise, Learnability and Flow

Freemium games and applications are characterized by low switching costs (i.e., monetary, psychological, time based costs or effort for the adoption of a brand) which may partially explain the observed low loyalty behaviors. To alter the situation, a freemium game needs to rapidly appear more time-worthy than its competitors. One way of doing so is to have a more effective onboarding while the player still evaluates the game and their intention to continue to play the game.

Learnability has been defined as an integral component of technology adoption by the technology acceptance model (TAM) (Davis, 1989; Grossman et al., 2009; Nielsen, 1994). TAM defines factors, notably usefulness and usability, influencing user acceptance on both early and long-term use intentions over a system or technology (Venkatesh et al., 2003). Under the TAM frame of reference, but more specifically in a mobile commerce context, Lin and Wang (2006) propose that efficient learning influences early usage proficiency and habits development; therefore, it impacts long-term continuous-use intention. Meanwhile, early usage proficiency may also come from past experiences since not all players express equal capacity and expertise.

The existing expertise discrepancy among users has been studied in various contexts with regard to problem solving (Barfield, 1986; Leger, Riedl, et al., 2014)**,** information search strategies (Tabatabai & Shore, 2005), and cognitive processing (Bateson et al., 1987). Without experience, a high degree of novelty is inherent to any stimulus (stressor), thus implies a great amount of uncertainty and stress for a user (Haier et al., 1992; Hill & Schneider., 2006): This leads to a more conscious and alerted processing of the stimulus. Representing a defence mechanism, the occurring action consciousness allows an individual to cope with a given stressor (Folkman, Lazarus, Gruen, & DeLongis, 1986). Only the next time when an individual faces a similar stimulus that they may process their environment more automatically. Moreover, this automation will require less cognitive effort and is believed to lead to an increased performance as the user is capable of filtering more information cues (Haier et al., 1992; Hill & Schneider., 2006). Thus, we suggest that non-expert players during their first exposure to a video game are likely to be overwhelmed by the information displayed unless the information is concise and designed to favour their learning. In accordance with their past experiences, expert users are more inclined to feel in control in a new environment and tend to extract information available within a new system by themselves to build their decision (Raggad, 1997). In video games, a lengthy tutorial may postpone experts' need for gratification; thus, undermine their experience to an eventual state of boredom that is explained by an unbalanced skill-difficulty ratio; according to the Flow theory (Csikszentmihalyi, 1975).

Flow is a multi-dimensional construct which involves: a sense of being in control, a distortion of time, a positive attitude, a more effective information assimilation and greater concentration (Hoffman & Novak, 1996). The four-channels view of flow theory suggests that an individual may fall into one of three states when skills and challenge are unbalanced: apathy; boredom or anxiety (Csikszentmihalyi, 1988). For instance, Rani, Sarkar, and Liu (2005) suggest that the flow state is incompatible with anxiety and boredom because no participant reported such responses when playing a specifically designed Pong game version developed to favor flow in their study. Hence, the following hypotheses are posited.

H1a: Non-experts are more likely to experience flow when exposed to a tutorial than when not exposed to a tutorial.

H1b: Inversely, experts are more likely to experience flow when not exposed to a tutorial than when exposed to a tutorial.

Physiological Conceptualization of Flow

From a theoretical standpoint, Hanin (2000) states that to accurately understand both affective and cognitive conditions underlying the flow state, both psychological and physiological dimensions should be used. To this end, Peifer (2012, p. 148) proposes an integrative conceptualization of the optimal experiment which states that flow is “a positive valence state (affective component), resulting from an activity that has been appraised as an optimal challenge (cognitive component), characterized by optimized physiological activation |arousal| (physiological component) for full concentration on coping with environmental/task demands (behavioral).”

Exploring further Peifer (2012)’s psychophysiological definition of flow, Leger, Davis, et al. (2014) suggest that most of flow components, if captured strictly by self-report explicit measures, tend to suffer from mono-method biases and from their retrospective nature. Specifically, Leger, Davis, et al. (2014)’s results support that self-reported measures correlated only moderately with their respective psychophysiological equivalent (engagement $r^2 = 0.37$ $p < .01$ and cognitive load $r^2 = 0.58$, $p < .01$). Thus, it is important to measure both perceived (psychological) and physiological states to fully assert flow. As physiological activation is collected before self-reported perceived flow, the former is an antecedent of the latter.

H2: Psychophysiological flow positively influences perceived flow.

Numerous studies investigated flow behavioral consequences over various information systems. Extending the TAM, Agarwal and Karahanna (2000)’s supports that cognitive absorption (i.e., a deep involvement similar to flow construct) positively influences continuous-use intention (CUI). These results have been corroborated by human computer interaction (HCI) research, which some modelled flow as an antecedent and others as a consequence of usefulness and ease-of-use, but always as positively impacting behavioral outcomes (Dailey, 2004; Sánchez-Franco, 2006; Webster et al., 1993). Hence, the following hypothesis is proposed.

H3: Psychological flow is positively associated with continuous-use intentions

According to Boucsein (1992), electrodermal activity (EDA) correlates linearly with arousal. Aside from Kivikangas (2006), whose experiment did not uncover any specific relationship between arousal and flow, many studies have successfully reported this relationship. For instance, Nacke and Lindley (2008) designed three iterations of a first-person shooter game to ignite one of three different affective states: boredom, immersion (i.e., sensory absorption into atmospherics game elements) and flow. They observed the highest arousal values, as measured with electrodermal activity, in the flow condition. In addition, Keller, Bless, Blomann, and Kleinböhl (2011) explored cognitive workload and arousal relationship in different skill-demand-compatibility conditions measuring cortisol hormone levels. Keller et al. (2011) observed higher cortisol level in-skills-matching-demand (flow) condition, which they associated to a high arousal level, coherently with previous studies.

In contrast, the studies of Peifer, Schachinger, and Antoni (2011); Peifer, Schulz, Schächinger, Baumann, and Antoni (2014) propose that the flow experience follows an inverse quadratic relation with arousal; Therefore, Peifer et al. (2011); Peifer et al. (2014) suggest that flow is more likely to happen at a moderate level of arousal and that high arousal is related to anxiety. However, their results are limited by the fact that their cortisol activation generation task was not the same, nor related to the context of the experimental task and that the latter failed to sustain participant cortisol levels throughout the experiment. In other words, their results seem more likely to support that, if highly stressed, it is hard for an individual to enter a flow state while starting a new task rather than their proposed relation. Therefore, Peifer et al. (2014)'s model has not been accounted for in the elaboration of the current flow correlate conceptualization. Moreover, because of its simple context, we believe that even without tutorial presence learning how to play the current experimental game cannot result in participants expressing anxiety.

Additionally, Besthorn, Schellberg, Pfleger, and Gasser (1989) suggest that EDA variance analysis is a reliable source to apprehend one's variation of attention over audio-visual stimuli. Leger, Davis, et al. (2014) suggest that EDA variance (i.e., standard deviation) is relatable to flow, since the latter is a physiological state that requires one to be able to adapt accordingly to the situation before them; Thus, one's variation of arousal is a manifestation of one's capability to adapt to various stimuli as it demonstrates the elasticity of their past awareness levels.

In addition to flow's physiological correlates' influence on perceived flow, we suggest that physiological flow also impact continuous-use intention. We hypothesize that perceived flow, being recorded subsequently, plays a mediation role in the relationship between physiological flow and CUI in accordance with Peifer (2012).

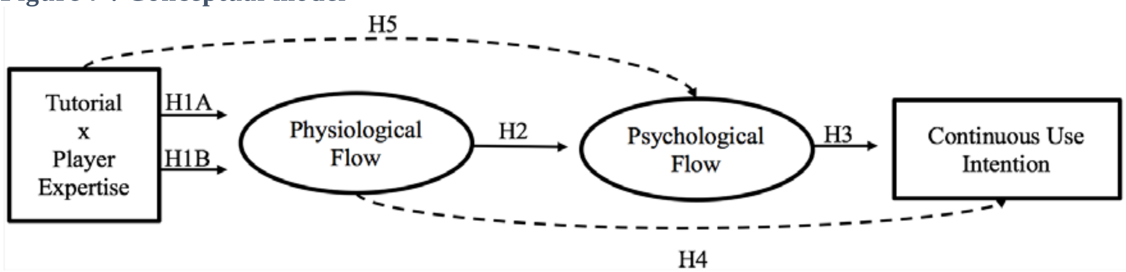
H4: Perceived flow mediates the relationship between psychophysiological flow and continuous-use intention.

Pagulayan et al. (2003) and Isbister and Schaffer (2015) theorize that the way a user feels about his actions is more important than the actions themselves in a video game context; that learnability (tutorial efficiency) is less potent than a rich and engaging experience (e.g., flow state). To the best of our knowledge, only Andersen et al. (2012) specifically explored this hypothesis in the mobile video game environment. Andersen et al. (2012)'s results are complimentary, because they suggest tutorials have no significant impact on play time behavior in simple games. In H1a and H1b, we suggest that there is an interaction between player expertise and tutorial presence on flow. Essentially, we hypothesize that player expertise moderates the relationship between tutorial presence and flow. Because flow is assessed both implicitly (physiological flow) and explicitly (psychological flow) and that the former proceeds the latter, we suggest that the physiological flow mediates the relationship between the tutorial-expertise interaction and perceived flow (i.e., a mediated moderation (Baron & Kenny, 1986)).

H5: Psychophysiological flow mediates tutorial and expertise interaction on perceived flow.

Figure 7 summarizes the research model and display our research hypotheses.

Figure 7 : Conceptual model



Method and Data

Participants

To test our hypotheses, an experimental approach reproducing players' onboarding was used. A total of 40 individuals (excluding 3 pretests) were recruited via our institution's research panel to take part in our laboratory experiment, approved by the Ethics Board of our institution. The participants were randomly assigned to either a didactic style tutorial (TUT) or played the game without a formal tutorial phase (N-TUT). Prior to their test day, players were invited to answer a short online questionnaire where they had to self-report their expertise (expert (E) or non-expert (N-E)). Because to our knowledge, no valid measures exist to evaluate one's expertise, we relied mostly on this self-classification to categorize participants. Though, we also developed an in-home questionnaire to assess subjectively participants' expertise. The questions asked (viz. the average number of sessions played weekly, the average session length, the number and types of game played, the amount spent on videogames per year and the preferred gaming platforms) were developed based on Kapalo et al. (2015); Phan et al. (2012).

Participant distribution among condition and expertise is as follows: N-E_TUT= 9, N-E_N-TUT= 9, E_TUT= 11 and E_N-TUT= 11. Ranging from 18 to 40 years old, the mean age was 23 (SD: 4.01). There were 26 males and 14 females. 18 of the expert players mentioned playing equal or more than 2-3 times weekly, whereas the mode for non-expert players is ''never play'' with 5 players. Non-expert players reported playing on average

31 minutes (SD: 39 min) per game session compared to 117 (SD: 91 min) for expert players.

Experimental Stimulus

The videogame used was Saber's Edge, a Match-3RPG developed by Hibernum (Montreal), and was played on an iPad Air 2 tablet. Saber's Edge puzzle aspect and initial linearity allowed a thorough standardization among participants. The game was unannounced to the public at the moment of the experiment; Therefore, players could not have any prior knowledge of the game, nor toward Hibernum company name, which remained undisclosed. Under Andersen (2009)'s definition, Saber's Edge is a simple game with mechanics that can be discovered through experimentation. Thus, this stimulus gives a particular context to the hypotheses, one that is similar to many games on the mobile market. In this game where players had to take turns against the computer (cf, both playing simultaneously), players had to connect different combinations of the same item (see bottom of Figure 8) to enact various moves (i.e., long/close-range attack, defence or heal) to neutralize their opponent characters. Players number of consecutive moves (combinations) per turn were restrained equally to their number of heroes alive on the battlefield (e.g., three for each player in Figure 8). Typical of its RPG genre, participants received in-game currencies at the beginning of the game and gained more after each victory. With the currencies, they could enhance their heroes between each battle at the in-game store (see Figure 9).

Procedure

Upon their arrival to our facility, all participants freely reconfirmed their desire to participate in our 45-minute experiment which they were compensated with a $15 gift certificate. To calibrate the apparatus, the experiment began with a 10 minutes recording of participants' baselines (i.e., a period of time when the player is asked to sit and to relax to record his EDA at rest). The data obtained has then been used to normalize the measure across all participants. Then participants were randomly assigned to one of the tutorial condition. In the TUT condition, participants started by completing a didactic tutorial of approximately 7 minutes and they then played freely for the rest of the 15 minutes phase.

In contrast, participants in the N-TUT condition were invited to play the 15 minutes sequence as they wished.

Figure 8 : In-game screenshot of Saber's Edge combat system

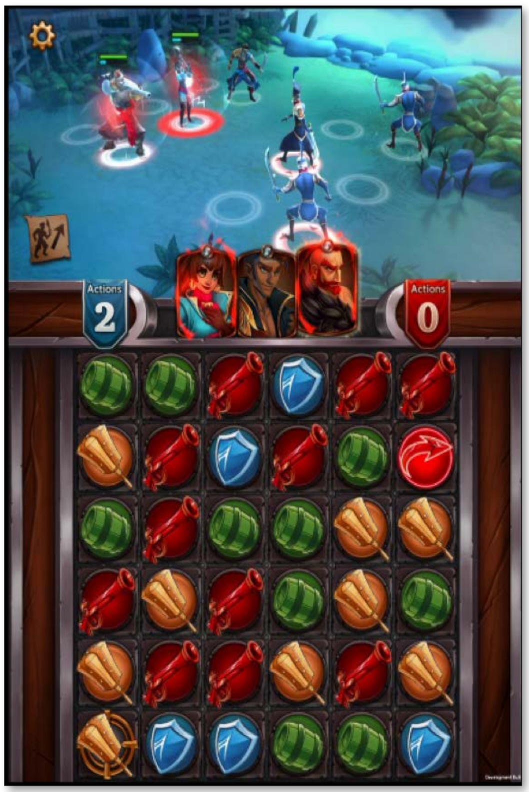
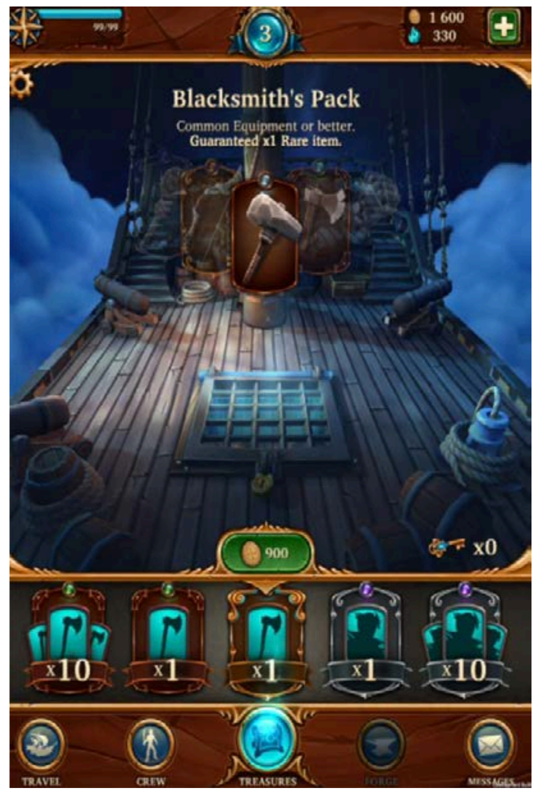


Figure 9 : In-game screenshot of Saber's Edge store



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Psychometric Measures

To assert participants' perceived flow (Per_Flow), participants were invited to report their experience on Flow Short Scale (FSS) (Engeser & Rheinberg, 2008; Rheinberg, Vollmeyer, & Engeser, 2003) immediately after each game sequence. The FSS is a 7-point Likert scale composed of 10 items and divided in two dimensions *Fluency* (6 questions: (e.g., "I feel I have everything under control"), for which we obtained a Cronbach α of 0.82) and *Absorption* (4 questions: e.g., "I don't notice time passing"), for which we obtained a Cronbach α of 0.78. Players were also invited to report their Continuous-Use Intention on Hess et al. (2003)'s CUI scale (α= 0.78). The latter is also a 7-point Likert scale and includes items such as "It is likely that I play this game in the future" and negative statements such as "I do not expect to play this game in the future."

All scale items were randomized. Both scales had satisfactory Cronbach alpha (α)(Churchill, 1979). An alpha superior to 0.7 is recommended (Nunnally, 1978).

Psychophysiological Measures: Electrodermal Activity

Electrodermal activity (EDA), as one means to measure flow physiological activation (arousal) component described in Peifer (2012) is the result of the skin conductance involved in the sweat production of the human eccrine glands, which are entirely controlled by the human sympathetic nervous system (Boucsein, 1992; Stern, Ray, & Quigley, 2001). In recent years, the physiological evaluation of arousal with EDA has earned attention among GUR (Keller et al., 2011; Kivikangas, 2006; Kivikangas et al., 2011; Mandryk & Atkins, 2007; Nacke & Lindley, 2008).

A Biopac MP-150 (Biopac, Goleta) amplifier was used to collect electrodermal activity from the participants (Biopac System, 2015). The baselined raw data extruded (average and standard deviation) is in microsiemens (μS) and had to vary between 0.1 μS to 50 μS to be considered as of normal values. By aggregating all data points, we obtained participants' tonic EDA average (EDA_Avg) and standard deviation (EDA_SD). The minimum and maximum EDA were also obtained for each participant across both conditions. These values served to normalise players' EDA (in percentage) following Mandryk and Atkins (2007); Nacke (2013).

Because of the tonic nature of our analysis, aberrant value spikes in small numbers were not judged critical, since they mostly represent the tool sensitivity to physical movements. However, if 1% of electrodermal data was to be judged as abnormal, the participant data set was excluded. Moreover, using real time processed graphics, we noted any malfunctioning of the apparatus throughout the experiment. These rigorous criteria led to the exclusion of 10 participants; a total of 30 participants were retained for the final analyses.

Analysis approach

Data analysis was conducted on SPSS 13. We tested H1a & H1b with two separate two-way ANOVA, each one assessing the effect of the experimental conditions on a flow indicator included in this research, namely EDA_Avg and EDA_SD. We then assessed the differences within groups with independent-sample t-test. We investigated H2 and H3 with the analysis of the correlation matrix. The analysis of H4 mediation and H5 mediated moderation hypotheses were made under a causal step approach (Baron & Kenny, 1986; Muller, Judd, & Yzerbyt, 2005). This method explores the path of 3 different regressions to account for a mediator effect. The process needed to be carried out separately for each independent variable tested. H4 mediation equations are presented below.

Table 3 : Per_flow mediation of Phy_flow equations (H4)

$$EQ.1 : CUI = A1 + A2_{Phy\_flow}Phy\_flow + E_{CUI}$$

$$EQ.2 : Per\_flow = B1 + B2_{Phy\_flow}Phy\_flow + E_{Per\_flow}$$

$$EQ.3: CUI = C1 + C2_{Phy\_flow}Phy\_flow + C3_{Perf\_flow}Per\_Flow + E_{CUI}$$

Note: Phy_flow = EDA_Avg or EDA_SD in function of what is being analyzed at the time.

Firstly, in EQ.1, independent variables should relate to CUI, such that $A2_{Phy\_Flow}$ is significant. Secondly, in EQ.2, Phy_flow variable must significantly influence the mediator (Per_flow). Then, in EQ.3, Per_Flow (mediator) is added to (EQ.1) and its effect on Phy_flow coefficient is analyzed. Three scenarios are considered: 1) Phy_flow coefficient remains strongly significant, thus no mediation, 2) Phy_flow coefficient loses statistical power compared to EQ.1, thus partial mediation and 3) The dependent variable's coefficient becomes null and non-significant, thus a total mediation by the mediator Per_flow occurs.

The analysis of a mediated moderation (H5) is different from classic mediation causal step analysis, as it needs to be adapted to the presence of an alleged moderation (Baron & Kenny, 1986; Muller et al., 2005). EQ.4 through EQ.6 depict those changes.

Table 4 : Phy_flow mediation of tutorial moderation of player expertise equations

$$\text{(EQ.4) } CUI = D_1 + D_{2pe}PE + D_{3Tut}TUT + D_{4pe\_tut}PE\_TUT + e_{CU}$$

$$\text{(EQ.5) } Phy\_flow = E_1 + E_{2pe}PE + E_{3Tut}TUT + E_{4pe\_Tut}PE\_TUT + e_{Phy\_Flow}$$

$$\text{(EQ.6) } CUI = F_1 + F_{2pe}PE + F_{3t}TUT + F_{4pe\_tut}PE\_TUT + F_{5phy\_flow}Phy\_flow + F_{6Phy\_flow\text{-}Tut}Phy\_flow\text{-}TUT + e_{CUI}$$

In EQ.4, independent variables PE, TUT, and their interaction term (PE_TUT) need to significantly influence CUI. In EQ.5, independent variables PE, TUT, and their interaction term (Pe_TUT)¸ should associate significantly to the Per_flow mediator. In EQ.6, CUI is regressed on independent variables and two other variables: the mediator and a computed variable formed of an interaction between the mediator and the moderator. To confirm the mediation of the moderator (TUT), the mediator needs to be significant, but its interaction with tutorial should not (Baron & Kenny, 1986; Muller et al., 2005). Then, the effect of the interaction coefficient is evaluated to determine which of the three scenarios discussed previously may apply in regard to the strength of the mediation: null, partial or total.

Results

Descriptive Statistics

Table 6 presents descriptive statistics and correlations among the measured variables. Continuous-Use Intention average is of 3.90 out of 7 (SD: 1.45). Perceived flow values are considerately high with an average of 4.8 out of 7 (SD: .84). These relatively high values are similar to those obtained in Kivikangas (2006), also a video game experiment.

The Combined Effect of Tutorial and Expertise on Flow State(H1a and H1b)

Because of the proposed causal effect of physiological flow on perceived flow, we tested the effect of expertise and tutorial presence on perceived flow. We observe a significant effect of TUT and PE interaction on Per_flow (F: 3,36 = 2.41, p= .08) (Table 5). Assuming unequal variance, independent sample one-tailed t-test supports a significant difference among the non-expert with tutorial (μ=4.94, SD=.45) and without tutorial (μ=4.14, SD=.96) groups; t (16) = -2.21, p= .024 (see Figure 10). No significant effect is observed for experts among tutorial conditions; t (18)= 0.44, p= .33. Thus, because experimental conditions have an effect only on non-expert players we reject H1b and accept H1a in regard to explicit measures. Nonetheless, expert average without tutorials (μ=5.01, SD=.74); t (18)= -2.09, p= .026, and with tutorials (μ=4.86, SD=.77); t (18)=-1.79, p= .047, are both significantly higher than non-expert without tutorials (μ=4.14, SD=.97), supporting theoretical premises on transversal expertise. To conclude, no statistical difference; (t (18)= -.23, p= .81) is observed between expert players without tutorial (μ= 5.01, SD= .74) and non-expert players with tutorial (μ=4.94, SD= .45), which supports the premises of transversal expertise and skill acquisition through tutorial.

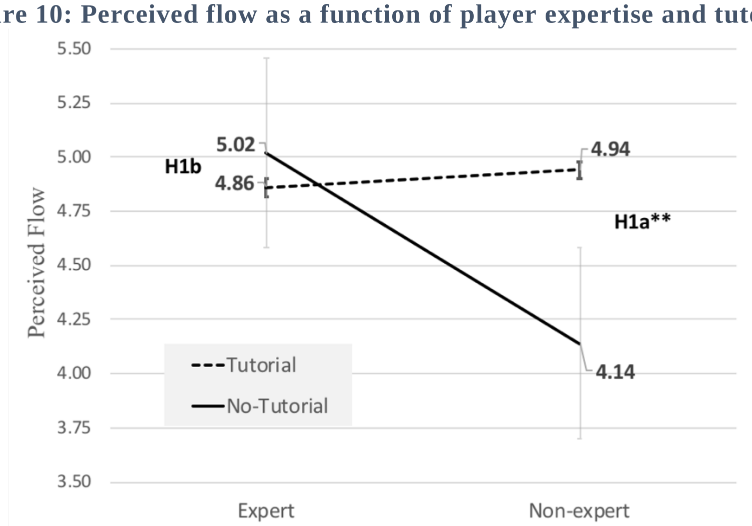
We observe no significant effect of PE and TUT's interaction, nor a significant main effect from these variables on the two physiological flow correlates, respectively EDA_Avg (F: 3, 26 = .86, p= .47) and EDA_SD (F: 3, 26= 1.41, p= .26). Together, these results suggest that neither tutorial presence, nor expertise have an impact on Phy_flow correlates. In conclusion, we reject both H1a and now H1b with a caveat because of the significant explicit results above.

Table 5 : Experimental conditions effect on flow

	EDA_Avg (%)				*EDA_SD* (%)				*Per_Flow*		
	Coef.	*SE*	*Sig.*		*Coef.*	*SE*	*Sig.*		*Coef.*	*SE*	*Sig.*
Tut	-6.60	9.38	.48		-6.03	3.00	.06		.80	.36	.04
PE	6.41	9.38	.50		-.4.56	3.00	.14		.87	.36	.02
PE-Tut	-1.82	12.32	.88		7.17	3.95	.08		-.96	.51	.07
Intercept	42.84	7.36	.00		9.71	2.36	.00		4.1	.27	.00
R2	-.09		.47		.14		.26		.17		.08

Two-tailed regressions, N=30

Figure 10: Perceived flow as a function of player expertise and tutorials



NOTE: ** DENOTES P<.05, PERCEIVED FLOW SCORES ARE ON 7

The Influence of Psychophysiological flow on Perceived Flow (H2)

Physiological flow correlates, EDA_Avg; (r=.23, n=30 p=.11) & EDA_SD; (r=.21, n=30 p=.14) are not related to perceived flow, as demonstrated by Table 6 correlation matrix. Thus, we reject H2.

The Relationship between Perceived Flow and Continuous Usage Intention (H3)

Table 6 shows that continuous-use intention correlates strongly with perceived flow (r= .58, n=40 p=.000), supporting H3.

Table 6 : Correlation matrix

No#	Variables	Means	SD	Correlation					
				1	2	3	4	5	6
1	CUI	3.90 (/7)	1.45	1	-	-	-	-	-
2	TUT	0.5	0.51	.07	1	-	-	-	-
3	PE	0.53	0.51	.03	.5	1	-	-	
4	TUTxPE	0.28	0.45	-.07	-.62***	.59***	1	-	-
5	Per_Flow	4.76 (/7)	0.84	.58 ***	-.17	.24*	.08	1	-
6	EDA_Avg	42.17 %	16.34	-0.02	-.25	.19	-.06	-.15	1
7	EDA_SD	5.85 %	5.38	.25*	-.17	-.023	-.05	-.02	.39**

Note : * Denote p<0.1, ** Denotes p<0.05, * Denotes p<0.01, CUI= Continuous-use intention, Per_flow = Perceived flow, EDA_avg= Average arousal, EDA_SD= Arousal standard deviation**

Perceived Flow as a Mediator (H4)

Two of the three regressions generated in EDA_SD analysis are presented in Table 7. Results reflect that EDA_SD significantly influences CUI in EQ.1 (F (1,28) 1.79, p=.096), with an R^2 of .245. They, however, do not support an influence of EDA_SD on Per_flow mediator EQ.2 (F (1, 28) 0.11, p=.51), with an R^2 of -0.04. As a consequence, we reject H4. Because no significant correlation is observed between EDA_Avg and CUI (r= -.02, n=30, p=.49) (see Table 6), it fails to answer the first criterion of the causal step approach used of EQ1; therefore, H4 is not supported for EDA_Avg.

Table 7 : Per_flow mediation of Phy_flow regressions

	EQ.1 : CUI				*EQ.2 : Per_Flow*		
	Coef.	*SE*	*Sig.*		*Coef.*	*SE*	*Sig*
EDA_SD	.62	.24	.096		-.003	.09	.51
Intercept	3.61	0.36	.000		4.79	.21	.00
R^2	.025		.096		-.035		.51

One-tailed regressions, N=30

Psychophysiological Flow as a Mediator (H5)

Because there are no significant relationships observed between the interaction between player expertise and tutorial presence on psychophysiological flow (H1a and H1b) and because this is a necessary condition for mediated moderation to exist H5 is not supported. Table 8 presents results summary in regard to the hypotheses of this research.

Table 8 : Results summary

H#	Hypothesis	Support
H1a	Tutorial effect on non-expert relation with flow	Not supported
H1b	Tutorial effect on expert relation with flow	Not supported
H2	Physiological flow is positively related to perceived flow	Not supported
H3	Perceived flow influences positively continuous-use intentions.	Supported
H4	Physiological flow correlates relation on continuous-use intentions is mediated by perceived flow	Not supported
H5	Tutorial interaction with player expertize influence on continuous-use intention is mediated by physiological correlates	Not supported

Discussion

From an **affective** point of view, player expertise and tutorial did not affect physiological correlates as proposed by H1a and H1b. Taking in accounts anterior literature, Andersen & al. (2012), that states that simple games do not require a tutorial, we believe the current simple game environment may not have asked players to go beyond their adaptive capabilities in either tutorial conditions. Since experimental conditions did not make the correlates of adaptive behavior (EDA_SD) vary accordingly, it restricts our interpretation of this correlate on Per_flow in the current experimental game setting. Coherently, we reject H5 for EDA_SD measure.

As for EDA_Avg, it did not have a consirable impact on perceived flow in the current experiment. In addition, no difference of EDA_Avg was observed among conditions. In the current simple game, our results suggest physiological activation emerged independently of tutorial presence. Therefore, our findings support Andersen et al (2012) findings and reject H1a and H1b from a physiological point of view, which also disconfirms expected H5 mediated moderation.

In addition, we also discern a trend in H4 mediation analysis that adaptive behaviors lead to greater continuous-use intentions (F (1,28) 1.79, p=.096). Specifically, it proposes that one ease to adapt to various game's stress level is found to be related to greater intentions to continue to play the game.

From a **self-reported** point of view, the experimental conditions did significantly influence the emergence of flow. Specifically, these results suggest that even in the context of a simple game, tutorials have an impact on non-experts perceived flow state. This finding is in line with our preliminary analysis where a similar effect on continuous-use intention was observed (Morin et al., 2016). In addition, we note that perceived flow is strongly correlated with continuous-use intention.

Our results add to Andersen et al. (2012) study which concluded to a non-significance of tutorials in simple games, because the current study does explore tutorial presence in regard to players expertize and came to more comprehensive conclusions. This being said, we discern an absence of "negative'' influence on expert player's relation with perceived flow, accordingly to Andersen et al. (2012)'s results. We believe it could be because Saber's Edge tutorial length (approximately 7 min) was matching expert players' expectations, thus may have created a "momentary fuzzy safe zone where mood does not intrude" (Chen, 2007, p. 34). In GUR field, Chen (2007) theorizes that challenge failure to engage the player instantly may not automatically result in negative outcomes such as abandoning the game. He posits that players have a tolerance for a temporary lack of stimulation as long as the game sustains their hope that more is to come. In addition, because we observe higher FSS scores from experts without tutorials than non-experts without tutorials, the general expertise transversality central postulate of this research is supported.

Since physiological correlates of flow failed to vary in accordance with perceived flow, the last could not possibly be related to the others, thus we reject H4. Although the inverse quadratic relation of physiological flow relation with perceived flow discussed in Peifer et al. (2011); Peifer et al. (2014) has not been retained for this study, it is possible that this choice is partly responsible for the current lack of relationship between the two constructs.

Theoretical Contributions and Managerial Implications

This paper makes one main theoretical contributions and have one main managerial implication. The theoretical contribution of this research is that it deepens the knowledge accumulated by the extensive HCI literature on the flow construct. More specifically, it offers additional evidence that the flow psychophysiological state impacts positively behavioral outcomes, such as continuous-use intentions (Dailey, 2004; Sánchez-Franco, 2006). Furthermore, because we observe significant differences in players reported psychological states and in their continuous-use intention (Morin et al., 2016) based on their expertise, our results support that general player expertise is transversal and should be asserted or controlled when investigating the flow to accurately measure the latter and its consequence on various games or systems.

Secondly, this study main managerial implication is certainly to highlight the weight that tutorials have on the users' first experience, especially in the case of an inexperienced player onboarding. The fact we did not observe a negative impact of tutorials over expert players is also interesting, as it diminishes the popular ideology claiming that experts have a visceral aversion to tutorials. If true, it did not translate into lesser continuous-use intentions in the current onboarding which is characterized by many situation scenarios. The current stimulus being comparable to the mobile market modern offer, this contribution is directly applicable by the industry in order to favor retention. Moreover, results suggest that tutorials should be thought far ahead in the game development to enact certain desirable psychophysiological states. Specifically, it proposes that games should provide the means for the player to adapt to different situations and that succeeding in doing so is beneficial to continuous-use intentions.

Limitations and Further Research

Some limitations in this study need to be acknowledged. First, we relied on self-discrimination to categorize players in either expert or non-expert condition, because to our knowledge, no valid questionnaires or guidelines currently exist on this matter. This being said, we developed a short questionnaire based on (Kapalo et al., 2015) and proceeded in a group of 3 to a throughout evaluation of every participant expertise.

Secondly, relying on self-perceived measure to assert continuous-use intention, participants had to make projections on their future behavioral intents. Thus, some subjects may have been inclined to under evaluate or over evaluate their intention scores based on other factors; some that have not been controlled in this study. To this end, collecting more factors such learning preferences, general motivations to play video games (Lafrenière, Verner-Filion, & Vallerand, 2012) or more specific preferred gaming styles (Tondello, Wehbe, Orji, Ribeiro, & Nacke, 2017) is one way to mitigate this limitation. Other research designs could also mitigate this limitation by collecting data over a longer period of time with a certain number of questionnaires or with in-game tracking systems to measure behaviors at its sources (Andersen et al., 2012).

Future research should aim to incorporate more physiological constructs than electrodermal activity to be more representative of Peifer (2012)'s rich conceptualization of the flow construct. For instance, following Ekman, Friesen, and Hager (1978) Facial Action Coding System (FACS), many game user research measured electrical activity involved in the contractions of muscles and set of muscles at the surface of specific facial regions to analyze subjects emotional valence state (Kivikangas, 2006; Mandryk & Atkins, 2007; Nacke & Lindley, 2008). Notably, Mandryk and Atkins (2007) demonstrate the possibility to categorize players affective states according to a model that combines arousal (i.e., EDA_Avg) and emotional valence.

Moreover, recent technologies enable a less invasive recording of subjects' emotional valence than with facial electrodes. Effectively, software solutions such Facereader

(Noldus, Wageningen) are able to differentiate automatically basic facial expressions as recorded on a HD webcam. For example, recent game user research opted for this last methodology in their assessment of physiological flow in group context (Bastarache-Roberge, Léger, Courtemanche, Sénécal, & Fredette, 2015) and another (Robinson, Rubin, Segura, & Isbister, 2017) used it to observe how the approach may enhance the esport experience.

Furthermore, the inclusion of cognitive load (i.e, mental effort used in working memory) which can be obtained from, but not limited by, analyzing pupil-size variation (i.e., collected via an eye-tracker) is also a relevant research avenue to the flow research field. Conjointly to the use of eye-tracking technology, (Georges et al., 2016) developed a tool capable of triangulating users' gaze data with their inferred cognitive and emotional states to produce physiological heatmaps. This tool allows practitioners and researchers to associate different neurophysiological states to visual artefacts. Despite the fact that this proposed tool can't analyze interfaces in motion for now, the use of this technology on tutorials screenshots could significantly help to make them more immersive and likely to match players expectations. This would allow game designers to dose the right amount of cognitive effort for the players, at moment *XYZ*, so that they can devote their resources to learning activities instead of analyzing peripheral cues (Haier et al., 1992; Hill & Schneider., 2006). Therefore, this innovative technology may be in position to close further debates surrounding tutorials context based sensitivity.

This research findings contribute to the current need for players' insights on retention in mobile context, but also point out the importance of transversal expertise as an influencing factors of flow emergence and more importantly game continuous-use intention. Given the high rate to which some players abandon games within the 24 h after they download them, this research highlights the impact of inadequate tutorialization and argue for its attention. With direct managerial implications, it supports tutorial importance for players with less experience in a simple-to-learn game (c.f., complexe). It also proposes that tutorials impact on expert players behavioral intent are less important than theoretically expected. More broadly, this research sets ground for the exploration of the players first experience with psychophysiological measures, which could open new frontiers in the development of adapted, thus more effective and enjoyable tutorials.

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Conclusion

Les deux articles de ce mémoire avaient pour objectif d'explorer de façon empirique l'effet conjoint des tutoriels et de l'expertise des joueurs sur l'état psychophysiologique du flow et l'impact de ce dernier sur l'intention de rejouer. Plus particulièrement, ce mémoire a permis d'approfondir comment un état de flow perçu et ressenti est susceptible d'influencer l'intention de rejouer en contexte ludique. Le premier article explore la nature du *fit* liant l'expertise des joueurs au tutoriel, à l'effet qu'il explore directement l'interaction de ces variables sur l'intention de rejouer. En d'autres mots, le premier article explore le besoin allégué en tutoriel des non-experts en opposition à une possible aversion pour les joueurs experts. Le second article, quant à lui, construit sur les postulats émis et qui se sont avérés soutenus par le premier article. De surcroît, il approfondit de façon marquée ce dernier par sa prise en compte de l'état psychophysiologique vécu des participants au moment même de leur première prise en main.

L'expérience en laboratoire a employé une approche mixte de collecte de données joignant un outil de mesure physiologique (c.-à-d., amplificateur de signal électrodermale : EDA) à des mesures auto-rapportées (c.-à-d., des questionnaires). Une seule collecte de données a servi à produire les deux articles, dont le premier a été présenté au Texas à CHI Play 2016, qui est une importante conférence centrée sur l'interaction entre l'humain et tous systèmes dans un contexte de jeu. La période séparant la rédaction de ce premier article au dépôt du présent mémoire concorde avec une année passée par l'étudiant de ce mémoire à travailler en recherche utilisateur chez Ubisoft, un important développeur de jeu vidéo AAA (c.-à-d., avec le plus haut niveau de développement et de budgets). Cette année lui a certainement permis de peaufiner la maîtrise de son sujet.

Ce dernier chapitre a pour objectif d'effectuer un bref retour sur les buts de chacun des articles de ce mémoire et de discuter des résultats principaux. Finalement, les contributions théoriques, les implications managériales et les limites intrinsèques de cette étude vont être présentées et vont permettre une ouverture pertinente sur des recherches futures.

3.1 Réstultats principaux

D’abord, la question de recherche du premier article était :

1- *Est-ce que la présence ou l’absence des tutoriels en fonction de l’expertise des joueurs ont un effet sur l’intention de rejouer et d’acheter du contenu en jeu ?*

Cet article suggère qu’il existe un *fit* entre le type d’utilisateur et la présence ou non de tutoriels. Particulièrement, nous observons un impact positif et important lié à la présence de tutoriels pour les joueurs les moins expérimentés. Cet effet fut noté aussi bien sur leurs intentions de rejouer que d’achat en jeu. En conséquence, cela propose que l’aide apportée par un tutoriel aux non-experts amène des conséquences désirables. En contraste, bien qu’une très légère tendance semble se dessiner quant à l’effet des tutoriels pour les joueurs experts, aucune aversion n’a été statistiquement supportée. Notons que le premier article s’intéressait aussi aux intentions d’acheter du contenu en jeu, qui suite à de riches discussions à CHI Play 2016 sur l’approche méthodologique expérimentale de cette étude furent délaissées.

À la suite de cette première exploration du sujet, nous voulions savoir comment ce *fit* pouvait possiblement influencer l’expérience des joueurs, qui théoriquement impacte l’intention de rejouer. Rehaussés par l’analyse de mesures physiologiques, nous cherchions à explorer dans le deuxième article la vision dichotomique opposant la facilité d’apprendre à utiliser le jeu à la valorisation supérieure d’une expérience optimale (c.-à-d. l’état de flow).

Ainsi, cette étude suggère que les joueurs moins expérimentés bénéficient de la présence de tutoriels, puisque leur inclinaison à se percevoir en état de flow augmente significativement lorsque c’est le cas. Tout comme dans l’article 1, aucune aversion, ni tendance négative imputable à la présence des tutoriels sur l’état de flow perçu n’est observable pour les joueurs experts. Tel que propose Chen (2007), ce n’est possiblement pas parce qu’un jeu vidéo ne parvient pas à être engageant instantanément que les joueurs vont l’abandonner. En fait, Chen (2007) propose que si la durée du tutoriel répond aux attentes du joueur et que ce joueur peut espérer davantage de défis dans un avenir rapproché, alors il en résulte une période où l'humeur du joueur n'impacte pas son comportement. De surcroît, les joueurs expérimentés ont exprimé en moyenne un état de flow auto-rapporté supérieur aux joueurs moins expérimentés sans tutoriel. Cela suggère aussi l'existence d'une transversalité de l'expertise, tel que discuté dans l'article 1.

En conclusion, les corrélats physiologiques associés au flow, précisément le niveau d'intensité émotionnel (c.-à-d. moyenne de l'EDA) et l'artefact d'une adaptabilité affective (c.-à-d. l'écart-type de l'EDA), n'ont pas variés entre les conditions expérimentales. En somme, ceux-ci n'étaient pas corrélés à l'état flow perçu. Nous avons observé que le corrélat lié à un comportement d'adaptation était cependant corrélé à l'intention de rejouer. Cela atténue l'absence de relation entre cette mesure physiologique et l'état de flow perçu, puisque les deux influencent positivement l'intention de rejouer.

3.2 Contributions

Contributions théoriques

Cette recherche apporte les contributions théoriques suivantes. Tout d'abord, elle enrichit les connaissances entourant la première expérience d'utilisateurs avec un système de jeu. Plus spécifiquement, cette étude porte une attention particulière au concept d'expertise et à sa transversalité en contexte de jeu. Cette recherche vient donc combler un manque dans la littérature en explorant l'existance d'un *fit* entre la présence d'un tutoriel et l'expertise des joueurs. En soi, les effets observés de l'expertise et des tutoriels suggèrent que ces variables se devraient d'être contrôlées pour l'obtention d'une mesure plus précise du flow. À notre connaissance, l'association de ces deux variables n'avaient jamais été explorés dans la littérature du jeu vidéo et du flow.

La deuxième contribution importante de ce mémoire provient de son approche méthodologique. Cette approche mixte permet réellement de s'approcher de la riche conceptualisation du flow définie par Peifer (2012). Bien que les résultats de cette recherche ne supportent pas que le flow perçu médie globalement les corrélats physiologique dans un contexte de jeu simple, certains indices soutiennent l'utilisation de cette approche mixte pour de recherches futures. D'une manière effective, notre recherche supporte une forte corrélation du flow perçu et de l'intention de rejouer, alors que nous observons également que l'intention de rejouer est dépendante de l'adaptabilité affective.

Implications managériales

Pour les développeurs de jeux vidéo, et ce plus particulièrement dans un contexte mobile, les résultats démontrent l'importance des tutoriels dans leur jeu, spécialement pour les joueurs moins expérimentés. Il est intéressant de noter qu'en dernière analyse, nous n'avons pas observé d'aversion des joueurs expérimentés envers les tutoriels dans leur intention de rejouer ou de flow. Conséquemment, nous concluons qu'il est possible de développer des tutoriels rejoignant les attentes des joueurs en termes de durée et de design. Les résultats de cette recherche proposent que les tutoriels, vu leur importance, doivent être pensés tôt dans le développement d'un jeu, même qu'il devrait être tenu de les incorporer à la première version jouable du jeu, communément appelé le premier prototype jouable (*First Playable Prototype (FPP))*, afin de standardiser les tests utilisateurs subséquents (Isbister & Schaffer, 2015; Pagulayan et al., 2003). Alors qu'il a été observé qu'une adaptabilité affective est corrélée à l'intention de rejouer, nous suggérons au praticien de concevoir des niveaux et des « entre-niveaux » présentant des intensités diversifiées. En d'autres mots, un designer de jeu ne devrait pas cibler une excitation constante et élevée, du moins pas dans les premières minutes de jeu.

3.3 Limites et recherches futures

Afin de contextualiser les résultats de cette étude, il est important de mentionner les quelques limitations entourant cette étude.

Premièrement, cette recherche s'est appuyée principalement sur l'autodiscrimination afin de catégoriser les joueurs selon leur niveau d'expertise. À notre connaissance, il n'existe pas d'outil validé empiriquement permettant de réaliser un tel regroupement, ni même de consensus précis dans la communauté scientifique définissant l'expertise en contexte de jeu vidéo. Afin de limiter la portée éventuelle de cette limite, les joueurs ont été amenés à répondre à un court questionnaire sur le sujet de leur expertise (voir Annexe I) développée à partir des résultats de Kapalo et al. (2015). Grâce à leurs réponses, nous avons pu procéder à une validation subjective de la catégorie qu'ils avaient auto-rapportée. Certes, il s'agit d'un sujet important qui mérite d'être davantage étudié dans des recherches futures, mais nous croyons qu'il bénéficierait également à être discuté à des conférences, tel CHI Play, ce qui permettrait l'intervention de différentes parties prenantes de l'industrie.

Deuxièmement, l'échelle de mesure basée sur l'intention de continuer à jouer invite les sujets à se projeter dans l'avenir lorsqu'ils expriment leurs intentions comportementales. Conséquemment, certains participants ont peut-être été enclins de prendre en considération des facteurs qui ne furent contrôlés dans cette expérimentation. Contrôler pour certains de ces facteurs, telle la motivation à jouer aux jeux vidéo (Lafrenière, Verner-Filion, & Vallerand, 2012) ou le style de jeu préféré (Tondello, Wehbe, Orji, Ribeiro, & Nacke, 2017) pourrait aider à atténuer cette limite. Sinon, il est possible d'y pallier en réalisant une étude longitinuale à partir de données de jeux comme dans Andersen et al. (2012).

Le type de jeu utilisé dans cette étude est caractérisé par des mécaniques pouvant s'apprendre par essaie-erreur et un jeu de type puzzle-RPG (c.-à-d. un jeu centré sur la résolution de *casse-têtes* et dont la progression est intrinsèquement liée à l'amélioration de personnages). Les recherches futures devraient faire appel à des jeux de complexité plus importante et d'un autre type de jeu, afin de pouvoir généraliser la portée des résultats obtenus.

En conclusion, les recherches futures devraient tenter d'évaluer le flow physiologique des participants non seulement avec l'activité électrodermale, mais aussi avec d'autres outils de mesures, ce qui aurait permis une analyse plus riche de leur expérience vécue. Par exemple, il serait judicieux de s'intéresser à la valence émotionnelle des sujets, telle que décrite dans la définition du flow de Peifer (2012). Certaines études ont démontré qu'il est possible de mesurer ce construit de deux façons différentes : 1) par l'activité électrodermale collectée sur des muscles précis du visage qui sont associés à des émotions positives ou négatives (Kivikangas, 2006 ; Mandryk & Atkins, 2007 ; Nacke & Lindley, 2008) ou 2) par l'utilisation de solutions informatiques, tel Facereader (Noldus, Wageningen), capables d’estimer la valence émotionnelle globale à partir de vidéo HD du visage des participants et d’algorithmes sophistiqués. Cette dernière approche, moins invasive, fut utilisée dans des recherches récentes afin de mesurer l’effet de jouer en groupe sur le flow physiologique (Bastarache-Roberge et al., 2015), mais aussi dans le but d’explorer comment l’outil est susceptible d’améliorer l’expérience du spectateur du sport électronique (eSport) (Robinson et al., 2017).

En somme, il serait opportun d’incorporer encore plus de mesures physiologiques que l’éveil et la valence émotionnelle. En fait, nous identifions la charge cognitive (c.-à-d., la charge mentale associée à l’exécution d’une tâche) comme un construit fort prometteur dans un contexte d’apprentissage. À cet effet, Georges et al. (2016) ont développé un outil d’analyse permettant de trianguler l’éveil, la valence émotionnelle à la charge cognitive et de lier cette analyse à ce qu’un utilisateur regarde (requiers l’utilisation d’un oculomètre). Cet outil est en fait des cartes de chaleur physiologique qui permettent d’associer différents construits neurophysiologiques à des artefacts visuels. Malgré que l’utilisation de cet outil soit strictement limitée à l’évaluation d’interface 2-D (ex. un site web) pour le moment, il pourrait tout de même être utilisé dans l’évaluation des éléments composant les tutoriels. De cette façon, chercheurs et praticiens pourraient améliorer les tutoriels et donc optimiser les probabilités de répondre aux attentes des joueurs.

ANNEXE

I. Questionnaire d'expertise

Les questions suivantes furent développées, afin de s'assurer que l'expertise auto-déclarée par les participants à cette étude reflétait la réalité. Ce questionnaire a été développé à partir de l'article suivant : Kapalo, K. A., Dewar, A. R., Rupp, M. A., & Szalma, J. L. (2015). *Individual Differences in Video Gaming Defining Hardcore Video Gamers.* Paper presented at the Proceedings of the Human Factors and Ergonomics Society Annual Meeting.

1) **À quelle fréquence jouez-vous à des jeux vidéo ? {1, Jamais - 8, Plusieurs fois par jour**

2) **Combien d'heures jouez-vous en moyenne par jour ? (Texte)**

3) **À quel(s) type(s) de jeux vidéo vous intéressez-vous ? (oui ou non)**

   a) RPG - Role playing game
      (Exemple: Final Fantasy, Pokemon, Skyrim, Mass effect, etc.)
   b) Action, aventure
      (Exemple : Super mario bros, Zelda, Tomb raider etc.)
   c) First person shooter
      (Exemple : Call of duty, Team forteress, Counter strike etc.)
   d) Puzzles
      (Exemple : Portal 2, Candy crush, tetris etc.)
   e) Stratégie
      (Exemple : League of legends, Starcraft, Age of empire, civilisation etc.)
   f) MMORPG - Massively multiplayer online role-playing games
      (Exemple : World of Warcraft, Guild Wars, Tera etc.)
   g) Jeux de sport
      (Exemple : FIFA, NHL, NBA, Madden etc.)
   h) Jeu de course
      (Forza, Need for speed, Mario Kart, Dirt etc.)
   i) Jeux mobiles
      (Exemple: Angry birds, Clash of clans, Fruit ninja etc.)
   j) Jeux de group

(Mario party, Mario Kart, Super smash bros, Kinect adventures, etc.)

k) Autres types – TEXT –

4) **À quelle fréquence jouez-vous sur les plateformes suivantes ? (1, Jamais – 7, tous les jours)**

a) Console (xbox, playstation, wii)
b) Ordinateur
c) Mobile/Tablette
d) Console portative (Nintendo DS, PSP)

5) **Avez-vous déjà fait achat non obligatoire à l'intérieur d'un jeu (in-game) ? (oui ou non)**

6) **Pourquoi n'avez-vous jamais fait ce type d'achat ? (Cocher - Texte)**

a) Pour continuer de jouer sans attendre (exemple acheter une vie)
b) Pour accélérer le rythme de jeux
c) Pour obtenir quelque chose qui n'est pas disponible autrement
d) Pour personnaliser l'apparence de mon personnage/sa monture/etc.
e) Pour être meilleur que les autres
f) Autre – TEXT-
g) Autre-TEXT

7) **Dans quelle mesure êtes-vous en accord avec les énoncés suivants ? (1, Tout à fait en désaccord – 7 tout à fait d'accord)**

a) La qualité graphique et artistique est importante
b) La mécanique de jeu est importante
c) L'histoire du jeu est importante
d) La collaboration avec d'autres joueurs est importante
e) La compétition avec d'autres joueurs est importante
f) La personnalisation du personnage est importante
g) La musique et l'audio sont importants

II. Autres références bibliographiques

Dans cette section, nous vous présentons les références bibliographiques qui ont servies à alimenter les réflexions de l'étudiant, mais qui ne furent pas directement utilisées dans ce mémoire.

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