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HEC MONTRÉAL

L'influence des attentes et des compétences des consommateurs sur leur comportement d'achat dans un contexte omnicanal

par

Ariane Roy

Sciences de la gestion

(Option Expérience Utilisateur dans un contexte d'affaires)

Sous la codirection de

Sylvain Sénécal, Ph. D. et Pierre-Majorique Léger, Ph. D.

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Comité d'éthique de la recherche

Le 26 novembre 2019

À l'attention de :
Sylvain Senecal
Marketing, HEC Montréal

Cochercheurs :
Bertrand Demolin; Frederique Bouvier; David Brieugne; Pierre-Majorique Leger; Ariane Roy; Shang-Lin Chen; Emma Rucco; Marc Fredette

Projet # : 2020-3496

Titre du projet :
Évaluation de l'autonomie de l'utilisateur en contexte expérience de magasinage en ligne à l'aide de mesures implicites et explicites

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Nom de l'étudiant(e) : Ariane Roy

Titre du projet supervisé/mémoire/thèse :
Exploration des profils des consommateurs et leur comportement à travers leur expérience vécue dans un contexte multichannel

Titre du projet sur le certificat :
Évaluation du processus décisionnel de l'utilisateur en contexte d'expérience de magasinage en ligne à l'aide de mesures implicites et explicites

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Chercheur principal / directeur de recherche :
Sylvain Sénécal

Cochercheurs :
Bertrand Demolin; Frédérique Bouvier; David Brieugne; Pierre-Majorique Léger; Shang-Lin Chen; Emma Rucco; Marc Fredette; Marion Korosec

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Maurice Lemelin
Président
CER de HEC Montréal

Résumé

L'utilisation de différents canaux par les consommateurs lors d'un processus d'achat, comme le clavardage en ligne couplé à la visite en magasin, amène les entreprises à adopter une approche d'expérience plus holistique sur leurs canaux de vente, contrairement à l'attention unique de la vente ferme. Toutefois, afin de conserver une expérience client homogène et constante sur tous les canaux entreprises-consommateur, la gestion de ceux-ci demande des stratégies centrées consommateurs. Le défi d'optimiser l'expérience utilisateur dans tous les points de contact réside principalement dans la difficulté de mesurer adéquatement chaque interaction du parcours consommateur, afin d'assurer la qualité constante de son expérience.

Ce mémoire par article étudie donc deux aspects du comportement consommateur en ligne dans un contexte d'achat à multiples canaux. Premièrement, une exploration de l'influence des compétences et attentes des consommateurs sur leur expérience vécue et perçue en ligne est conduite. En utilisant la segmentation, les parcours utilisateurs omnicanal sont mesurés à l'aide de leur expérience émotionnelle et comportementale. Cet article contribue à la recherche sur le comportement du consommateur, les préférences de canaux menant à l'achat, ainsi que la segmentation des différents groupes de consommateurs en ligne et hors ligne. Pour ce faire, une étude en laboratoire a été conduite auprès de 26 participants, ayant pour objectif d'adresser l'influence de la segmentation consommateur sur l'expérience en ligne. Les résultats de cette étude exploratoire démontrent qu'il existe différents segments de consommateurs basés sur les attentes, les compétences et l'engagement des consommateurs en ligne, et que ceux-ci ont une expérience émotionnelle partiellement distincte ainsi qu'un comportement différent dans leur parcours d'achat omnicanal.

Le second chapitre de ce mémoire concerne l'utilisation simultanée de différents canaux de communication et de vente lors d'un processus d'achat. Ce phénomène

donne lieu à l'utilisation de points de contacts physiques (p. ex. magasinage en magasin) et en ligne (p. ex. utilisation d'un téléphone mobile pour trouver de l'information) de façon complémentaire. Ainsi, une autre étude en laboratoire menée auprès de 24 participants avait pour objectif de développer une méthodologie afin de mesurer l'expérience utilisateur physique avec un produit technologique. À l'aide d'outils psychophysiologiques, cette méthodologie permet de mesurer et comparer l'expérience vécue et perçue en considérant les parcours utilisateurs non linéaires. D'ailleurs, la méthodologie proposée permet d'assurer l'optimisation de la gestion synergique des canaux de vente et communication, en conservant une expérience utilisateur constante.

Mot-clés : expérience utilisateur, test utilisateur, omnicanal, attentes, autonomie de l'utilisateur, parcours utilisateur, comportement consommateur, achat en ligne, mesures psychophysiologiques, points de friction

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CSP = Fournisseur de services de communication

EDA = Activité électro dermique

EEG = Électroencéphalographie

ECT = Théorie des Attentes – Confirmation

HCI = Interaction homme-machine

PII = Inventaire de l'implication personnelle

PPP = Point de friction psychophysiologique

SST = Technologie de libre-service

UX = Expérience utilisateur

Avant-propos

L'approbation de la direction administrative du programme de Maîtrise ès Science de la Gestion de HEC Montréal a été obtenue, en vue de rédiger ce mémoire par article. Ce mémoire comporte donc deux articles complémentaires.

Le consentement des coauteurs pour tous les articles a été obtenu afin que ceux-ci puissent être inclus dans ce mémoire.

Le premier article est en préparation pour soumission à AIS Transactions on Human-Computer Interaction. Ce premier chapitre est complémentaire au deuxième chapitre en s'intéressant au comportement de l'utilisateur lors d'un achat d'un équipement technologique en ligne tout en étant dans un contexte d'achat multicanal.

Le second article a été accepté à la 22e conférence internationale sur les interactions humain-machine, HCI International 2020. Cet article porte sur la conception d'une méthodologie détaillée afin de pouvoir la reproduire pour évaluer l'expérience vécue d'un utilisateur lors d'une interaction avec une technologie physique, tout en conservant la validité écologique nécessaire.

Ce projet de recherche a été approuvé par le comité d'éthique en recherche (CER) de HEC Montréal 15 mai 2019, projet #2020-3496.

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Introduction

Problématique générale de l'étude

Les parcours consommateurs impliquant la consommation d'un produit ou d'un service amènent les consommateurs à prendre des mesures pour choisir des produits, des marques ou des technologies. Ensuite, les consommateurs s'engagent dans des expériences de vente au détail en ligne ou hors ligne, et finalement à utiliser ces produits et services (Hamilton & Price, 2019).

Dans un environnement d'achat multicanal, le consommateur se voit offrir de multiples possibilités de canaux de ventes (Verhoef et al., 2015). Neslin et al. (2006) définit formellement la gestion client multicanal comme la conception, le déploiement, la coordination et l'évaluation des canaux pour améliorer la valeur client par acquisition, ainsi qu'assurer une rétention et un développement efficaces du client. La littérature sur l'approche multicanal a traité de plusieurs concepts depuis le début, tel que : stratégie, tarification, processus décisionnel des consommateurs, cannibalisation des canaux, qualité de service, fidélité à la marque, satisfaction du client, attribution multicanal, optimisation de la combinaison des canaux, changement de canal, expérience client, coordination, intégration (voir Lazaris & Vrechopoulos, 2014 pour une revue). Découlant de recherches antérieures, les réalités du comportement consommateur dans l'ère numérique ont soulevé des déficiences dans l'approche multicanal afin d'optimiser l'expérience client (voir Lazaris & Vrechopoulos, 2014 ; Verhoef, 2012). Du côté managérial, l'attention grandissante des commerçants pour l'expérience client multicanal a été principalement enclenchée par la croissance des canaux en ligne. L'arrivée de nouveaux canaux numériques, et spécifiquement mobiles, a entraîné un autre changement perturbateur dans l'environnement de la vente au détail (Rigby, 2011). La différence entre les canaux de l'expérience devient plus indéfinie lorsque les frontières naturelles entre les canaux commencent à disparaître (Lazaris & Vrechopoulos, 2014).

C’est dans l’étude de l’intégration des différents canaux que les résultats de Görsch, D. (2002) ont suggéré que « l’objectif de l’intégration multicanal doit être de fournir une expérience client supérieure, cohérente et transparente sur tous les canaux » (Görsch, 2002, p. 757). Le concept de l’omnicanal provient de cette tentative de combiner les techniques de commerce électronique avec la vente au détail physique traditionnelle, afin d’améliorer la valeur générale de l’expérience d’achat (Otto & Chung, 2000). Selon Ortis (2010), l’approche de vente omnicanal désigne l’utilisation simultanée par le consommateur de multiples canaux entreprise-consommateurs offerts, tout en ayant une expérience constante. Premièrement, l’omnicanal permet donc aux consommateurs de faire leurs recherches en ligne pour ensuite magasiner sur place, en étant informés et indépendants, au même rythme et avec la même expérience qu’ils peuvent d’abord rechercher des informations hors ligne et puis compléter l’achat en ligne. Deuxièmement, la convivialité de l’utilisation des téléphones cellulaires permet même l’utilisation simultanée de différents canaux entreprise-consommateurs (Lazaris & Vrechopoulos, 2014), c’est-à-dire que les consommateurs peuvent se rendre en magasin tout en comparant et recherchant des informations en ligne. Par exemple, le « *showrooming* » et le « *webrooming* » sont deux phénomènes connus de l’accessibilité à l’information et de l’habitude des magasins physiques traditionnels qui s’ajoutent à l’expérience d’achat (Baal & Dach, 2005 ; Chiu et al., 2011). Finalement, l’approche omnicanal sollicite une gestion particulière de tous ces canaux, en unifiant les nombreux canaux et points de contact offerts, de manière à optimiser de façon constante l’expérience client et la performance des canaux (Verhoef et al., 2015).

Le contexte d’achat omnicanal en ligne façonne désormais différemment le parcours de l’utilisateur. En plus de voir s’agrandir l’offre proposée, la variété de choix et l’instantanéité d’acquisition du produit ou service, les utilisateurs ne vivent plus uniquement une expérience linéaire lors de contacts avec les marques (Carroll and Guzmán, 2013). C’est donc l’expérience entourant l’achat vécue par le consommateur qui laisse place à des interactions plus complexes et fréquentes avec l’entreprise (Van Bruggen et al., 2010). En outre, l’expérience du

consommateur ne se limite pas exclusivement aux points de contact d'une expérience numérique. Les interactions précédentes et suivant la décision d'achat sont très importantes afin de comprendre l'expérience désirée par l'utilisateur.

Toutefois, plusieurs défis s'imposent lors de la mesure de cette expérience en contexte omnicanal. Entre autres, l'approche omnicanal compte de multiples points de contact qui donnent lieu à des parcours consommateurs difficiles à prédire. Effectivement, l'utilisation simultanée de plusieurs de ces canaux rend l'interaction avec une marque plus diluée et donc les effets sur le comportement d'achat difficile à mesurer. La transformation de l'approche omnicanal a mené les entreprises à concentrer leurs efforts dans la transition transparente d'un canal à l'autre. Ceci a donc contribué à diminuer ainsi les avantages prononcés de l'utilisation d'un certain canal sur un autre (Homburg et al., 2017 ; Verhoef et al., 2007). Afin de comprendre le réel comportement de l'utilisateur à travers plusieurs canaux, la mesure de chacune de ses interactions physiques et digitales nécessite une combinaison de plusieurs méthodes. La littérature sur les méthodes établies dans le but de mesurer l'expérience client se concentre fréquemment sur un seul point de contact entre l'entreprise et le consommateur (Johnston et al., 1990). Des méthodes d'évaluation, comme celle de la « carte du parcours client », sont un premier pas vers la considération de l'entièreté des interactions dans l'évaluation du comportement (Rawson et al., 2013). Toutefois, cette méthode considère faussement que chacune des interactions est aussi importante les unes que les autres (Rosenbaum et al., 2017). En effet, il demeure important de distinguer certaines interactions clés dans le parcours, et ce, en mesurant les interactions physiques comme numériques de façon à pouvoir comparer le parcours hors ligne et en ligne sur des bases similaires. Il est suggéré d'utiliser une combinaison de méthodes complémentaires qui offrent une compréhension approfondie de l'expérience utilisateur, en incluant des mesures implicites, telles que des outils physiologiques pour permettre une mesure plus précise du parcours émotionnel du participant à travers ses interactions avec la marque (Bigras et al., 2018).

Avec la profusion d'outils et d'éléments numériques, la présence en ligne d'une entreprise est désormais la force centrale de ses opérations de vente. Le canal en ligne peut être utilisé comme le centre de vente et de service, l'outil qui recueille et diffuse les informations qui facilitent l'expérience client sur tous les autres canaux (Peterson et al., 2010). De plus, maintenir une expérience client constante et adaptable aux désirs des consommateurs devient plus accessible grâce aux avantages qu'offrent les canaux en ligne. En effet, ceux-ci peuvent combler les lacunes dans l'expérience client et faciliter une segmentation client sophistiquée, basée sur l'abondance et l'accessibilité de données web sur chaque interaction (Peterson et al., 2010). Ainsi, alors que les revenus de l'industrie du commerce en ligne atteindront les cinq trillions de dollars d'ici 2021 (Lipsman, 2019), il est de l'intérêt à la fois du domaine théorique et managérial de consolider une meilleure compréhension des différents impacts émotionnels et comportementaux d'une expérience sur les utilisateurs, dans l'ensemble du parcours d'achat en ligne. De plus, afin d'optimiser l'expérience vécue en ligne à travers tout le parcours utilisateur, il est crucial d'explorer les sources d'insatisfaction critiques soulevées par l'achat en ligne dans un contexte omnicanal.

Problématique spécifique de l'étude

L'expérience client est définie par Meyer et Schwager (2007) comme les réponses internes et subjectives d'un consommateur, causées par tout contact (directe ou indirecte) avec une entreprise. Le domaine de l'expérience client favorise une approche holistique qui tient compte de tous les aspects de l'offre de l'entreprise (Zomerdijk & Voss, 2010). En raison de la prise de connaissance de l'expérience complète vécue par le consommateur, les commerçants peuvent obtenir une meilleure compréhension des perceptions et les choix de l'utilisateur dans leur parcours. En outre, conformément à l'augmentation des expériences numériques dans le processus d'achat, l'expérience utilisateur (UX) représente l'expérience globale d'une personne utilisant un produit tel qu'un site web ou une application informatique, notamment en termes de facilité ou de plaisir d'utilisation, et se pose donc comme un complément intéressant de l'expérience client. Provenant de la

discipline des interactions humain-machine (HCI), le concept de l'expérience utilisateur est définie comme l'ensemble des perceptions de l'utilisateur et ses réponses qui sont le résultat de l'utilisation ou de l'anticipation d'utilisation d'un système, d'un produit ou d'un service (International Organization for Standardization [ISO], 2018). Afin de mesurer et de comprendre l'expérience utilisateur vécue en contexte omnicanal, il est nécessaire de considérer la complexité des parcours d'achat aujourd'hui, faisant appel à des mesures d'exploration plus élaborées des répercussions sur l'expérience du consommateur. En effet, mesurer l'expérience de l'utilisateur exige de comprendre les états internes et physiques de celui-ci, originairement accumulés au fil des expériences vécues.

Par contre, les utilisateurs ne vivent pas tous la même expérience lors d'une même interaction, puisque ceux-ci sont soumis à des états affectifs et cognitifs différents. Comprendre comment les variables affectives et cognitives influencent l'utilisateur dans son parcours contribue à déterminer les moteurs clés de la satisfaction globale de celui-ci.

Premièrement, la cognition et les émotions constituent deux concepts psychologiques qui ont une influence sur le comportement et l'expérience client (Bagozzi et al., 1999 ; Frow & Payne, 2007 ; Tynan & McKechnie, 2009). Les mesures explicites utilisées lors des tests utilisateurs impliquent la participation de l'individu, en utilisant des mesures rétrospectives comme l'entrevue ou les questionnaires. Pourtant, il a été souvent rapporté que les mesures se fiant uniquement à la mémoire des utilisateurs sont souvent sujettes aux biais cognitifs (Cockburn et al., 2017 ; Cockburn et al., 2015 ; Eich & Schooler, 2000 ; Giroux-Huppé et al., 2019 ; Lourties et al, 2018). Parmi les biais cognitifs, le « peak effect », à titre d'exemple, démontre la tendance de l'utilisateur à mieux se souvenir du moment le plus intense de l'expérience (Cockburn et al., 2015). Afin de remédier à ces biais, utiliser des mesures implicites favorise une approche centrée sur les émotions réellement vécues par les utilisateurs dans l'étude de l'expérience lors des interactions. L'utilisation d'outils neurophysiologiques

permet à présent d'obtenir un portrait très précis des émotions ressenties par les utilisateurs, et ce, à chaque seconde de l'interaction (Kahneman & Riis, 2005).

Deuxièmement, si les mesures explicites rétrospectives sont sujettes à des biais cognitifs, il est donc primordial d'explorer l'expérience vécue et le comportement de l'utilisateur à travers son parcours de façon complémentaire. Le parcours émotionnel de l'utilisateur est donc le produit de ces mesures implicites choisies pour le mesurer. En effet, la mesure de l'expérience vécue permet aussi d'établir les moments négatifs ressentis par l'utilisateur et ainsi discerner la source d'une insatisfaction critique, afin de développer des recommandations pour optimiser l'expérience (Giroux-Huppé et al., 2019). En combinant le parcours émotionnel et comportemental, ces observations peuvent accorder une compréhension plus riche de l'expérience vécue durant une interaction tout au long du parcours d'achat, en vue de compenser aux défis de mesurer des parcours complexes dans un contexte d'achat omnicanal. En effet, il est donc possible de mieux comprendre le parcours de l'utilisateur à travers l'environnement omnicanal en examinant l'effet que peuvent avoir différentes émotions discrètes, négatives ou positives, vécues tout au long de son parcours.

Troisièmement, maintenir une expérience constante pour l'utilisateur au travers des canaux de ventes offerts nécessite d'abord de comprendre cette expérience et les répercussions potentielles sur le comportement consommateur futur. Puisque les utilisateurs éprouvent une expérience émotionnelle, mesurer l'influence de celle-ci peut donc prédire leur comportement futur (de Guinea et al., 2009). De plus, la segmentation des utilisateurs permet de centraliser les efforts d'optimisation des canaux vers des stratégies personnalisées au comportement de certains segments (Wedel & Kamakura, 2002). Afin de comprendre cette expérience émotionnelle, mesurer de façon précise l'expérience utilisateur nécessite une méthodologie qui permet davantage de comparer chaque interaction entreprise-consommateurs à travers les points de contact (Rosenbaum et al., 2017). Les méthodes largement utilisées jusqu'à maintenant dans le domaine de l'expérience client et l'expérience utilisateur sont fondées en général sur des

données rétrospectives, souvent biaisées par l'utilisation de techniques auto déclarée, par exemple les questionnaires (Moon et al., 2016 ; Nenonen et al., 2008 ; Rawson et al., 2013).

Finalement, le contexte d'achat omnicanal apporte plusieurs chemins de recherches exploratoires, visant à mesurer l'expérience utilisateur dans un contexte qui demande deux dimensions peu étudiées : les parcours utilisateurs non linéaires ainsi que l'intégration des interactions entre le monde digital et physique. Ces problématiques forcent les entreprises à assurer une expérience utilisateur constante et satisfaisante dans tous les points de contact de l'achat, que ce soit en ligne ou hors ligne (Carroll & Guzmán, 2013). Pour atteindre ce résultat, la compréhension du parcours émotionnel et comportemental de l'utilisateur lors d'une interaction en ligne est cruciale, afin d'optimiser la gestion synergique de tous les points de contact entreprise-consommateurs. Selon Lemon et Verhoef (2016), les approches de mesure éprouvées pour l'expérience globale du client doivent être tenues de couvrir chaque étape du parcours client (préachat, achat et post-achat) et pour tous les points de contact. Cependant, la recherche dans le domaine ainsi que les pratiques actuelles offrent un éventail de mesures beaucoup plus fragmentées (Lemon & Verhoef, 2016).

Enfin, deux principaux concepts ressortent afin d'explorer les impacts de l'environnement omnicanal sur les parcours utilisateurs :

1. L'existence de segments différents d'utilisateurs pourrait permettre de comprendre l'influence et l'impact de leurs parcours émotionnel et comportemental sur leur expérience lors d'un processus d'achat en ligne.
2. Le manque de méthodologies visant à comprendre le comportement omnicanal appelle à l'exploration de méthodes complémentaires afin de comparer, sur une même base, l'entièreté du parcours du consommateur à travers les différents canaux.

Ce mémoire par articles permettra d'explorer davantage l'expérience du consommateur omnicanal, dans le but d'optimiser le design et la gestion des

différents canaux mis à disposition pour obtenir une expérience unifiée et adaptative aux besoins des consommateurs.

Questions de recherche

L'objectif de ce mémoire est donc de répondre à deux questions de recherche primordiales afin de mieux comprendre comment les utilisateurs se comportent dans un contexte omnicanal. Dans un premier temps, le parcours en ligne de l'utilisateur est examiné à l'aide d'une combinaison de méthodes implicites et explicites.

Question de recherche Article 1 :

Existe-t-il des segments de consommateurs concernant leurs attentes et compétences qui influencent l'expérience vécue et perçue dans un contexte omnicanal ?

Dans un deuxième temps, une méthodologie exploratoire est proposée afin d'explorer de façon fiable chacune des interactions tout au long du parcours utilisateur, en ligne ou hors ligne. À cet effet, l'expérience client doit être mesurée dans son ensemble sur tous les points de contact, de façon à pouvoir comparer les points de contact sur les mêmes pratiques implicites, déjà utilisées pour les interactions en ligne.

Question de recherche Article 2 :

Comment mesurer de façon écologiquement valide l'expérience vécue par les utilisateurs dans une interaction avec un point de contact physique du contexte omnicanal ?

Ce mémoire est présenté en deux parties complémentaires, la première visant à explorer le comportement en ligne des utilisateurs dans un contexte omnicanal et les impacts découlant des attentes et compétences de ceux-ci sur leur parcours émotionnel, tandis que la deuxième partie est une proposition méthodologique afin

de mesurer de façon écologiquement valide chacune des interactions de l'utilisateur, que ce soit en ligne ou hors ligne.

Informations sur les articles

Article 1

La collecte de données en laboratoire de cet article a été réalisée à l'été 2019. Cet article est en préparation pour soumission à *AIS Transactions on Human-Computer Interaction* et rédigé en accord avec le partenaire de recherche de la Chaire industrielle (Chaire UX).

Pour cette recherche, 26 participants ont été recrutés afin de participer à une étude en laboratoire. Chacun d'entre eux a mené à terme l'achat d'un abonnement pour une nouvelle proposition de services de télécommunication sur un prototype réaliste d'un site transactionnel. À l'aide des données psychophysiologiques recueillies, une approche inductive, à l'aide d'une analyse en grappe des attentes et compétences des utilisateurs, a permis d'explorer les impacts émotionnels et comportementaux d'une situation d'achat en contexte omnicanal.

Résumé de l'article 1

Cet article vise à étudier l'impact des attentes et des compétences des utilisateurs avant l'interaction avec la marque sur leur parcours émotionnel et comportemental dans un contexte omnicanal. En utilisant la segmentation de consommateurs, il a été ainsi possible d'examiner le parcours émotionnel, mais aussi comportemental, de l'utilisateur, qui découle de l'achèvement d'un achat de service de télécommunication, entièrement réalisé en ligne. Des données implicites, soient l'activation émotionnelle et la valence émotionnelle, et explicites, soient les attentes, compétences et l'engagement perçu de l'utilisateur, ont été recueillies sur 26 participants. Les données explicites, une entrevue et un questionnaire ont permis l'exploration de profils à l'intérieur de l'échantillon, à l'aide de la méthode statistique d'analyse en grappes, afin de définir des segments différents. Aussi, la triangulation des données physiologiques implicites a servi à explorer l'expérience

émotionnelle vécue par les participants. Les données explicites et rétrospectives ont contribué à l'analyse comportement omnicanal afin de mieux décrire les segments étudiés. En utilisant de façon complémentaire les mesures rétrospectives, l'entrevue et les questionnaires, ainsi que les mesures psychophysiologiques, les résultats de cette étude démontrent l'existence de trois groupes de consommateurs omnicanal distinct dans leur parcours émotionnel et comportemental. Cette approche exploratoire de segmentation illustre que l'impact des frustrations intenses vécues par l'utilisateur au cours de son parcours d'achat sur son expérience peut varier en fonction de son profil de consommateur avant même l'interaction. L'implication de cet article exploratoire démontre que l'optimisation de l'expérience utilisateur à travers chaque canal doit être conduite en pleine connaissance du segment de consommateurs ciblés, afin de minimiser les frustrations qui peuvent mener à la sortie du processus d'achat.

Article 2

Le deuxième article se concentre sur l'exploration d'une nouvelle méthode d'évaluation de l'expérience utilisateur, développée dans le cadre de ce mémoire, qui permet de mesurer l'expérience vécue d'un utilisateur dans un contexte d'utilisation de points de contact physiques. Cet article est en préparation pour une soumission au Dictionnaire Encyclopédique de l'Ergonomie (édité par Éric Brangier & Gérard Vallery). Celui-ci propose un protocole à suivre ainsi que les outils à utiliser afin d'assurer la validité écologique d'un test impliquant un déplacement physique du participant. Pour ce faire, l'article comporte l'illustration d'une collecte en laboratoire sur un cas d'installation d'un modem technologique à l'aide du support d'un manuel d'instruction. En effet, ce cas illustre une méthodologie afin de mesurer l'expérience utilisateur dans un point de contact entreprise-consommateur physique.

Les étapes détaillées de la méthodologie visent à guider la reproduction de l'évaluation d'une expérience d'interactions technologiques physiques en contexte d'affaires.

Résumé de l'article 2

Ce deuxième article se pose comme un premier guide exploratoire afin de partager et favoriser l'intégration de la recherche scientifique au sein des organisations. Afin de comparer et de contextualiser chaque interaction dans l'ensemble du parcours de l'utilisateur, ce guide méthodologique exploratoire vise une meilleure intégration des mesures de l'expérience utilisateur à travers l'évaluation de son parcours, tout en considérant son comportement omnicanal. Ce chapitre présente donc une méthodologie écologiquement valide qui permet d'obtenir l'expérience vécue, en continu, de l'utilisateur, malgré l'unicité des étapes entreprises jusqu'au but et de l'aspect physique de l'expérience. Le cas illustratif figure une mise en contexte de désinstallation et d'auto-installation d'équipements de télécommunication pour une nouvelle plateforme de divertissement. À l'aide des mesures physiologiques utilisées, l'activité électrodermale (EDA) et l'électroencéphalographie (EEG) ainsi que les mesures rétrospectives, l'entrevue et les questionnaires, le cas illustratif a permis de comprendre l'expérience émotionnelle vécue d'un utilisateur en interaction avec une technologie physique. La notion d'identification des manifestations émotionnelles négatives (points de friction) est utilisée afin d'obtenir un portrait visuel des parcours émotionnels des utilisateurs. De plus, cet article démontre l'importance d'observer les parcours non linéaires des utilisateurs, puisque les étapes menant au succès du but à accomplir peuvent varier d'un utilisateur à l'autre. Cette méthodologie présente donc une opportunité de visualiser les moments d'insatisfaction intenses. Finalement, cet article propose une évaluation de l'expérience qui permet d'uniformiser les mesures de l'expérience utilisateur dans son évaluation, et ce dans l'intention de pouvoir comparer chaque point de contact, que ce soit en ligne ou hors ligne.

Contributions et responsabilités personnelles

Les articles de ce mémoire ont été écrits dans le cadre d'expériences réalisées au Tech3Lab du HEC Montréal. Le tableau ci-dessous détaille ma contribution dans les différentes étapes menant à la réalisation des expérimentations et de l'écriture

des articles qui ont suivi. Ma contribution individuelle est présentée en pourcentage.

Table 1. Contributions et responsabilités personnelles

Étape du processus	Contribution
Définition des requis	Définition de la question de recherche et la problématique — 75 % ● Problématique apportée par l'entreprise partenaire ● Contextualisation de la problématique dans un contexte de recherche ● L'équipe a contribué à la définition des questions de recherche, de l'approche scientifique à contextualiser et des concepts à utiliser
Revue de littérature	Revue de littérature sur le comportement de l'utilisateur en contexte omnicanal — 100 % Revue de littérature sur les mesures neurophysiologiques utilisées — 100 %
Conception du design expérimental	Élaboration de la demande au CER et des demandes de changements – 50 % ● Demande de CER

	● Développement des formulaires de consentement et de compensation à partir de modèle de gabarit ● L'équipe opérationnelle s'est occupée de mettre à jour les changements apportés au CER Protocole de l'expérience — 100 % Installation de la salle de collecte — 15 % ● Salle de collecte et outils de mesure installés par l'équipe d'opération ● Des modifications mineures au protocole ont été apportées afin d'assurer le bon déroulement de l'expérience Conception du design expérimental — 75 % ● En collaboration avec le partenaire
Conception du prototype du site web transactionnel	Développement de la solution — 0 % ● Équipe de designers chez le partenaire

Recrutement	Recrutement des participants — 75 % Gestion des compensations, cartable d'expérience pour le suivi des participants — 50 % ● Recrutement par le panel du laboratoire
Prétests et collecte	Chargé des opérations lors des prétests — 100 % Chargé des opérations lors de la collecte — 80 % ● Présence lors de la totalité du processus de collecte ● Modération auprès des participants lors des tests ● Présence en cas de problème ou besoin d'aide technique
Analyse des données	Analyses statistiques — 75 % ● Les données recueillies ont été analysées avec l'aide de l'équipe d'opération
Rédaction	Écriture des articles — 100 % ● Les articles ont été rédigés avec les commentaires et la rétroaction des coauteurs

Structure du mémoire

Le problème et les questions de recherche sont établis lors de l'introduction. Une revue de littérature permet de situer la présente recherche dans un cadre plus large des théories et concepts approchés. L'approche méthodologique, l'analyse des résultats et la conclusion permettent ainsi de conclure la thématique globale des deux articles. Le premier article présente une exploration des segments d'utilisateurs omnicanal selon leurs attentes et compétences et l'impact de ceux-ci sur l'expérience émotionnelle et comportementale d'un contexte d'achat en ligne. Le second article concerne plutôt une proposition élaborée de méthodologie à utiliser en contexte d'entreprise afin de mesurer l'expérience neurophysiologique vécue des utilisateurs en contexte d'utilisation physique. La combinaison des deux articles permet d'explorer et de mettre en lumière les défis apportés par l'approche omnicanal dans le parcours client et les interactions entreprise-consommateur.

Chapitre 1: Premier article
An Exploration of the Effects of Consumers' Profiles on Their Emotional Purchase Experience in an Omnichannel Context[1]

Ariane Roy[1], Sylvain Sénécal[1], Julie Gagne[2], Émilie Bigras[2], Pierre-Majorique Léger[1]

{ariane.roy, sylvain.senecal, pierre-majorique.leger}@hec.ca

[1] HEC Montréal, 3000 Chemin de la Côte-Sainte-Catherine, Montréal, Québec, Canada H3T 2A7

[2] Vidéotron, 612 rue Saint-Jacques, Montréal, Québec, Canada, H3C 1C8

{emilie.bigras, julie.gagne}@videotron.com

Abstract:

The multiple purchase channels available today, from social media to in-store experiences, leads to complex and numerous customer-firm interactions in the omnichannel environment. This phenomenon emphasizes the importance of user experience for personalized, seamless interaction under those circumstances. The increase of non-linear user journeys across multiple purchase and communication channels offers new marketing opportunities but also multiplies customer-firm contacts through alternative channels for information request or seeking technical assistance. This paper proposes a typology of online consumers within an omnichannel context based on self-efficacy, expectations and purchase involvement dimensions, and explores their moment-to-moment emotional journey and purchase behaviour. A sample of 26 consumers was used to generate the proposed profiling. Using cluster analysis, three groups of consumers who

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differed in terms of self-efficacy, expectations and purchase involvement were identified: the “detached,” the “passionates,” and the “practicals.” Customer segmentation allowed a deeper understanding of differences in an emotional and behavioural journey throughout the interaction, such as insights about how occurrences of implicit pain points will differ according to their profile. Theoretical and managerial implications are discussed.

Keywords: User Experience (UX) · Cluster Analysis · Segmentation · Omni-Channel · Purchasing Behaviour · Emotional Experience · Implicit Pain Points · Psychophysiological Measures

1.1 Introduction

E-commerce presents an important role in the way modern consumers carry out purchase decisions. With the ubiquitous use of mobile channels, tablets, social media, and their integration in offline and online channels, consumers have greater product choices, price ranges and purchase methods. One consequence of this increase in diverse electronics and physical consumer touch points is the need for seamless integration of customer experience and tactics across multiple channels and the customer life cycle (Neslin & Shankar, 2009). To manage interactions with consumers, business operations aim to provide new channels and facilitate contact with their customers. In this new reality, multi-channel customer management can be defined as “the design, deployment, coordination, and evaluation of channels to enhance customer value through effective customer acquisition, retention, and development” (Neslin et al., 2006).

However, if all the channels are optimized in silos, independently of each other, it becomes impossible to consolidate each of the interactions of the same client in order to get a comprehensive picture of his experience. Therefore, firms have unified their current channels with the new ones into their daily operations to reshape the interaction approach with current and prospective customers (Melero et al., 2016). Experts suggest that companies need to change their multiple single-channel views of their business model and instead look at a unified view of all

these available channels completing the customer experience (Carroll & Guzmán, 2013). Given the importance of the customer in value creation, the omnichannel retailing model is now the channel integration and management companies should strive for (Verhoef et al., 2015). Omni-channel refers to "the synergetic management of the numerous available channels and customer touch points, in such a way that the customer experience across channels and the performance over channels are optimized" (Verhoef, et al. 2015, p. 176). As though omnichannel concepts are not new, today they are ubiquitous, as enabling technologies are widely accessible and consumers are accustomed to them (Roussos et al. 2003; Kourouthanassis et al. 2007).

In the light of omnichannel consumer behaviour, as presented by Dijk, Laing & Minocha (2005), multichannel or omnichannel interaction is found to be complex and dynamic: consumers switch between channels in order to reach the best offers and support, throughout the shopping process (Dijk et al., 2005). The traditional "purchase funnel" path starting with awareness, through consideration and evaluation and ending with purchase and retention is now undercut with much less predictable exits along the consumer journey to purchase (Carroll & Guzmán, 2013). Enabled by technology, consumers now have the possibility to continuously circle around the evaluation process, and interchangeably move across channels, from online browsing to call centres to in-store visits, their choices modelled according to their specific moment to moment needs (Carroll & Guzmán, 2013). For instance, a consumer can begin their purchase journey following the recommendation of a friend, online research, or even a company (Melero et al., 2016). Next, the user can go in-store to feel and touch the product, while comparing competitors' options online, to finally decide to complete the purchase on his mobile on his way home. After the reception of the product, the same user can go online to give his review and explore other online resources on how to best use the product.

Hence, the user's purchasing journey becomes continuous; customers' interactions with touch points multiply as they are repeatedly exposed to them at

various times in their purchasing process. For instance, a user can search for information online prior to his visit in-store, only once in-store he goes back online with his mobile phone to compare prices and products. For this consumer, there is almost no distinction between the online and offline channel, they are complementary in their use in his purchase decision. Indeed, omnichannel adds to the customer experience by conferring the opportunity for customers to take control of the buying process at their convenience (Cook, 2014). All in all, the assorted combination of numerous channels to final purchase raise the occurrences of channel switching, and the addition of complex and dynamic interactions, which are a crucial aspect to consider when measuring consumer experience across their journey (Carroll & Guzmán, 2013).

Under the circumstances of omnichannel, consumer behaviour becomes key in determining factors that can influence the purchase decision. Over the decades, researchers and marketers have studied many aspects of consumer behaviour, including their online behaviour (Lu, 2017). A multitude of factors have been found to influence online consumer behaviour, such as demographic and geographic information, perceived risk, social influence, websites designing, personal digital skills, as well as diffusion of technologies (Lu, 2017). While researchers may have unveiled the key motivation to consumer behaviour, there are still several research and business opportunities in order to mobilize efficiently the concepts as to improve consumer experience (Lazaris & Vrechopoulos, 2014). The emergence of user-consumer behavioural patterns creates various opportunities to use multidisciplinary resources, through both theoretical and empirical approaches, to uncover the consumer experience (Lazaris & Vrechopoulos, 2014).

To deliver on this promise of a personalized, seamless and consistent experience across the overall user journey calls for a dissection of the operating model with insight-driven data (Carroll & Guzmán, 2013). Customer-centric research allows understanding consumers' demands and expectations for personalized and contextualized interactions by accessing, maintaining and combining meaningful

customer data. Research suggests that the combination of complementary methods, such as explicit (self-perceived measures) and implicit (unconscious and automatic psychophysiological responses) methods, renders a deeper comprehension of the user's experience that can reduce common method bias (Tams et al., 2014; de Guinea et al., 2014). However, to our knowledge, there is no research that studied the influence of consumer segmentation on the emotional and behavioural online and overall experience.

Thus, the objective of this paper is to explore how consumers' psychophysiological online journey, using profiles formed through individual characteristics from past user experiences, can influence their online behaviour in an omnichannel context. We use a practical case involving the new online buying process of a communication service provider (CSP) to attempt to explore the potential impact of individuals' emotional experience on their purchasing behaviour. This empirical approach allows an exploration of the behavioural and emotional implications of omnichannel in understanding how to prevent negative channel switching and consumer churning behaviour, both consequences of unsatisfactory online experiences. More specifically, the research question is: *Are there segments of consumers with respect to their expectations and competencies that influence the lived and perceived experience in an omni-channel context?* Results from this study aim to explore if there are differences in micro moment-to-moment emotional reactions and in the behaviour of online users with the use of consumer segments.

1.2 Background

1.2.1 From multi-channel to omnichannel

The importance of multi-channel research resides in the discoveries of consumers' purchasing process, which increasingly involve two or more channels. Previous industry research showed that multi-channel consumers can be engaged in three types of activities: 1) They shop across at least two channels, such as brick and mortar and online. 2) They purchase various products from the same retailer but

through multiple channels. 3) They leverage different channels to make a singular purchase (PWC, 2015). This distinctive behaviour shines a light on the thinnest separation between online and offline channels. Hence, consumers do not see a difference between channels as they primarily seek to find a vast choice of products to meet their needs, looking for a great value in terms of money and price (Garcia, 2015).

In order to study that behaviour, multi-channel research typically falls under topics such as the impact of channels on business performance, the study of shoppers' behaviour across channels and the exploration of retail mix across channels (Verhoef et al., 2015). As business performance is tailored to responding to consumers' needs and demands, understanding shoppers' behaviour across channels is crucial in determining what consumers expect in their purchase process. As such, previous research focused on different shopper behaviours across the multiple channels, centralizing their focus on channel adoption, channel choice, and channel usage (e.g., Ansari et al., 2008; Venkatesan et al., 2007). Indeed, an examination of the drivers of channel adoption, channel choice and usage in concordance with customer socio-demographics, psychographics and customer relationship characteristics have allowed researchers to better understand individuals' choice regarding channel preferences (Verhoef et al., 2015). In addition, research on customer segmentation, based on different purchase phases in a multi-channel environment, provided insights into interesting elements to consider in order to improve the overall customer experience (Konus et al., 2008). However, measuring consumer behaviour in siloed different channels blurs the organic purchase journey that would involve multiple channels for the same product.

Consequently, the increased adoption and diffusion of the multichannel approach in business models have spread and evolved into different management and conceptions of customer experience across their journey. Ortis & Casoli (2009) suggest the omnichannel approach is the evolution of the multi-channel, as the consumer uses channels simultaneously in the former rather than in parallel in the

latter (Ortis & Casoli, 2009). Omnichannel raises key issues in managing the channels. Notably, customers can now start their journey at any touch points and from any device (Accenture, 2014). In addition to the unexpected start of their journey, consumers also expect integration; if they stop at one point, they wish to pick up where they left off, sometimes even on another device or channel (Accenture, 2014).

Moreover, omnichannel retailing expands the overall market exchange by extending the market reach and introducing consumers to products they may not have known about (Brynjolfsson et al., 2013). Retailers can no longer shield consumers from competition, geography or ignorance as information barriers are lower than before. With the help of smartphones, consumers' decision-making process can be formed with information from store channels to social media (Brynjolfsson et al., 2013). As a result, omnichannel creates a more complex purchase behaviour from consumers (Balasubramanian et al., 2005). Indeed, Shankar et al. (2011) emphasize the need for a seamless experience across channels, achieved by providing "the same information in the same style and tone across the channels" (p. 33), as it will lead to satisfaction and shopper retention. It raises the need for companies to know more about individual behaviours and preferences to explore how, when, and why consumers choose specific channels in their buying process (Albesa, 2007). The number of new channels to acquire valuable consumers' data, like social, mobile and local channels, is part of the great opportunities provided by the omnichannel environment. This abundance of consumer-driven data creates the opportunity for retailers to understand not just single completed transactions but customers' interactions through visits in-store, like on Facebook, searches on the web, etc. (Brynjolfsson et al., 2013.)

Hence, the challenge now resides in the analysis, combination and mobilization of all this data, which can still remain difficult. Certainly, previous research already explored the differences between channel choice and the mobilization of customer segments and purchase behaviour. Namely, recent research by Polo and Sese (2016) shows that offline channels are still preferred by consumers, especially for

richer and trustworthy information. As the information is provided by face-to-face, high-touch interactions, consumers are granted with real-time synchronous communication between the business and the customer. The same study also shows that for purchase behaviour, the extent to which accumulated channel experience influences future channel choices depends on the nature of the interactions (Polo & Sese, 2016).

Given these new circumstances, omnichannel customers are better informed in their purchase process. Due to their easy access to technology, they tend to demand a lot more from retailers they want to do business with; but if their high expectations are met, their loyalty lies once they find a retailer they are satisfied with, therefore becoming profitable if the experience is maintained (Cook, 2014).

1.2.2 Online consumer behaviour

Under the circumstances of omnichannel, consumer behaviour becomes key in determining factors that can influence the purchase decision. Schiffman and Kanuk (2010) defined consumer behaviour as the behaviour that consumers exhibit in various steps of brand interactions, such as searching, purchasing, using, evaluation and disposing of products and services that satisfy their needs or expectations. Several other variants of this definition are also used in consumer research. Jinzhao Lu (2017) rather describes consumer behaviour as an assortment of psychological and physical activities that the consumer or organizational consumers display during need recognition, searching, comparing, purchasing, and post-purchasing of products or services. Furthermore, according to Statista, revenue from the e-commerce industry is expected to grow by 10.4% annually (Statista, 2019), emphasizing occurrences of online consumer behaviour at some point in the purchase process.

Previous research involving consumer behaviour in the multi- and omnichannel environment focused primarily on two areas: understanding customers' channel preferences and choice, usually probing singular points into the customer journey, or understanding customers by segmenting and profiling them over certain

behaviour patterns or attributes. Even though previous research explored the key motivations of online consumer behaviour, most of the knowledge and discoveries still failed to be mobilized into solutions to optimize customer satisfaction and experience (Jinzhao Lu, 2017). Indeed, there is a lack of research on the emotional online consumer journey in an omnichannel environment. As emotions are felt by consumers in all their experiences, their overall evaluation of those experiences will contribute in shaping their future behaviour (Hassenzahl, 2013). Moreover, as their emotional experience will be highly linked with their physiological state (Purves et al., 2001), online experiences are valuable to measure emotions in order to understand their perceptions and behaviour. Hence, measuring online experiences is crucial as Melis et al. (2015) demonstrated that online shopping experience affects the way customers use and compare channels within and across different chains.

In this article, we are hoping to suggest a complementary exploration of perceived and subjective online customer experience in the research about omnichannel consumer behaviour. In light of establishing divergent profiles, online customer behaviour will be explored through their physiological experience to better understand their omnichannel behaviour.

1.2.3 Consumer segmentation

As online consumers can differ in their preferences, prior research suggests the use of customer typologies to segment the whole market into homogeneous groups (Ganesh et al., 2010). A customer segmentation basis can be described as a "set of variables or characteristics used to assign customers to homogeneous groups" (Wedel & Kamakura, 2000). Previous research on consumer typologies has focused further on general segmentation bases, for instance web usage, shopping motivations, Internet habits (Brengman et al., 2005; Ganesh et al., 2010; Gehrt et al., 2012; Swinyard & Smith, 2003). Hence, customer segments can help managers better tailor their offers to groups with specific needs. In the hope of a seamless experience through all channels, customer typologies can be useful to recognize

homogeneous behaviour within the consumer market. In order to use segments in the exploration of omnichannel consumers, three distinct psychological variables were used to describe consumers' groups.

Satisfaction and expectations

Satisfaction has been widely used in consumer research and marketing literature as a key driver of customer retention, loyalty and as a subsequent behaviour predictor. In this paper, we use Kim, Ferrin & Rao's (2009, p. 237) definition of consumer satisfaction: "*An attitude formed through a mental comparison of the service and product quality that a customer expects to receive from an exchange with the level of quality the consumer perceived after actually having received the service/product."* Satisfaction, post-purchase behaviour, and service marketing, in general, is widely studied in the consumer behaviour research using expectation-confirmation theory (ECT) (Anderson & Sullivan 1993; Dabholkar et al. 2000; Oliver, 1980; Mano & Oliver, 1993; Patterson & Spreng, 1997; Tse & Wilton 1988). The ECT theory asserts that "customer satisfaction develops from a customer's comparison of post-purchase evaluation of a product or service with pre-purchase expectations" (Kim, 2012, p. 220).

Indeed, expectation-confirmation theory dictates the process by which consumers forge repurchase intentions (Oliver, 1980); first, consumers hold expectations of a specific product or service before their engagement into the purchase process. Second, they buy and use that product or service. Then, they evaluate the product or service following consumption about its performance. Third, they will assess its performance in contrast with their initial expectations and verify the extent by which their expectations are confirmed (confirmation). Finally, they form a satisfaction, or affect, influenced by their confirmation (or disconfirmation) level; satisfied consumers will develop repurchase intentions, while dissatisfied users disregard its future use (Bhattacherjee, 2001). This theory holds a highly predictive ability to measure a large range of product repurchase and service continuance contexts (Bhattacherjee, 2001), such as a car repurchase (see Mano

& Oliver, 1993). Namely, ECT stresses the key role of maintaining and building loyalty played by satisfaction on subsequent usage of a product or service since consumers' intentions to repurchase is primarily based on satisfaction with prior use (Anderson & Sullivan 1993; Oliver 1980; Mano & Oliver, 1993).

In an omnichannel context, disconfirmation of expectations in ECT can be hurtful in the adoption of an online channel. Previous research suggests that disconfirmation has the strongest direct influence upon satisfaction (Chen et al., 2010) and is modelled by the paradigm of disconfirmation-of-expectations (Oliver, 2010).

Purchase Involvement

The concept of involvement received widespread attention in consumer research throughout the years. Especially useful to address consumer behaviour as a way of thinking, involvement does not appear merely as another determinant of behaviour but also has paradigmatic implications (Poiesz & Bont, 1995). Furthermore, involvement can be integrated easily into already existing concepts and theories, giving a more complete and complex view into consumer behaviour and stimulating further varied research. Involvement construct has been known to cover an individual's subjective sense of the concern, care, importance, personal relevance, and significance attached to an attitude (Zaichkowsky, 1986), *a person's motivational state of mind* (Mittal & Lee, 1989), or even as the mobilization of behavioural resources for the achievement of relevant individual goals (Poiesz & Bont, 1995).

However, previous research seems to commonly agree that involvement varies by individuals and circumstances, with relation to "importance" or "interest." No agreement is shared about conceptualization of involvement and the bonds by which it operates (Antil, 1984). In the context of our study, we deem useful to use the conceptualization of the construct by Zaichkowsky (1986), which implies that involvement is believed to be concerned with three major antecedent factors. The first factor relates to the individual's characteristics, the second factor relates to

the characteristics of the stimulus, and the third factor is the situation specifically (Zaichkowsky, 1985). These factors within the involvement construct consist of the main defining features of attitudes that predict or explain behaviour (Olsen, 2007).

Since involvement is mainly based on individual experiences, it is necessary to take into account its influence on online purchase behaviour. In a focus activity like product choice and purchasing, product or task involvement in an omnichannel context tend to be generally the dominant determinant of arousal, while they might not be the only one (Clarke & Belk, 1979). Consequently, involvement is likely to influence the emotional journey of users throughout their purchasing process.

Self-efficacy

According to Bandura (1997), perceived self-efficacy is defined as people's beliefs and personal judgment about their abilities to perform different types of actions. Popular in social psychology studies, behavioural intentions hold to be determined not only by emotional drivers (e.g., satisfaction) but by cognitive drivers as well (Ajzen, 1991; Bandura, 1986). Social cognition theory states that self-efficacy beliefs are a key cognitive factor of human behaviour (Wang et al., 2013). It is important to note that perceived self-efficacy is a major determinant of intention, but those two constructs are separable (Bandura, 1997). The positive effect of self-efficacy on behaviour intention is the logic that people are more likely to be involved in a task where they think they can successfully complete and avoid those they do not think they can (Wang et al., 2013).

The theory of planned behaviour also supports the role of self-efficacy in dictating behavioural intentions, even if it is placed in a more general framework of the relations between beliefs, intentions, and behaviour (Ajzen, 1991). As long as perceived self-efficacy (or perceived control) is realistically measured in the task context, it can be used to predict the probability of a successful behaviour attempt (Ajzen, 1985). In a purchasing context, self-efficacy beliefs can alter preparation

for the task, effort expended during the process, in addition to influence thought patterns and emotional reactions (Bandura, 1982; 1991).

With increasing online purchases of technological products, customers often lack touch luxury and demonstration trials before the purchase decision. Not unlike the use of self-service technology context (SST), customers are co-producers of the service, meaning their beliefs in their capabilities to use a product successfully becomes extremely relevant (Wang et al., 2013). New innovative technological experiences, like in the communications service industry, require consumers to adapt and acquire new skills, supporting the importance of assessing perceived self-efficacy before they engage with the task.

1.2.4 Emotions in Human-Computer interactions

First, out of the several uses of emotions in diverse research fields, this article will focus on the behavioural effects of emotions. Emotional behaviour rests on both spontaneous, expressive behaviour (e.g. facial expression) and emotionally motivated instrumental behaviour (cf. Bagozzi et al., 2003; Lazarus, 1991; Mesquita & Frijda, 1992). Studies have shown that affect (emotional responses and feelings induced by an attitude object) and subsequent evaluation (thoughts, beliefs, and judgments about an attitude object) display discriminant validity (Breckler & Wiggins, 1989). Further research has also stressed the predictability role of behaviour by measuring affect rather than only evaluation (Breckler & Wiggins 1989; Abelson et al., 1982). These findings showcase the meaningful impact of emotions on behaviour and justify further the need for acknowledgment in exploring omnichannel behaviour.

Measures and constructs based on physiological metrics allow obtaining a moment-to-moment glance on the emotional journey undertaken by customers in their purchase experience. A moment-to-moment experience, which will guide how we measure the emotional experience, is an ongoing experience captured in real time (Hetland et al., 2018). The extensive research conducted by Kahneman and his colleagues (Kahneman et al., 1993; Kahneman et al., 1999; Kahneman &

Deaton, 2010), shows that individuals will have a memory of their feelings created based on specific key points like beginning, end and emotional peaks during the experience instead of an accumulation of moment-to-moment feelings (Hetland et al., 2018). This approach allows measuring how users' emotional experience can affect their behaviour. While observable behaviour and perceived measures are still of interest, we aspire to take a step further into omnichannel segmentation and look at how profiles can differ in terms of emotional and observable behaviour.

1.2.5 Implicit measurements

The role of emotions in technology adoption and consumer behaviour is widely studied in literature; major conclusions suggest that the connection between those two concepts can take place without a person being consciously aware of this connection, and also that the effect of emotions may not directly induce a particular behavioural intention but rather can modify a previously formed behavioural intention about continuing IT use (de Guinea et al., 2009). Reporting emotions can be a challenge for users for different reasons. When totally immersed, individuals tend to have trouble accurately recalling their emotional experience (Nilsen & Kaszniak, 2007). Hence, in order to investigate the role of emotions in a person's online experience, we need accurate physiological measures as an evaluation tool. Kahneman and Riis (2005) have demonstrated that when properly validated, physiological measures like electroencephalography (EEG), heart rate or skin conductance levels would offer a continuous moment-to-moment report of emotions. Also, prior research in user experience shed a light on the need for more data-driven recommendations, which requires the use of quantitative research (Georges et al., 2017).

Focusing on moment-to-moment experiences allows decreasing research bias such as users' inability to recall emotions accurately. Even when asked immediately after a task is completed, users tend to recall the experience in a much different way than what was actually experienced (Eich & Schooler, 2000; Cockburn et al., 2017). Consequently, research suggests that a combination of complementary

methods might be more appropriate to evaluate user experience, while physiological tools can support a more precise measure of the user's emotional journey (Bigras et al., 2018). Physiological metrics, such as arousal and valence, will necessarily involve automatic coding in the analysis. While methods for coding facial expressions or interpretation of actions are still developing (Hetland et al., 2018), the advantages of automatic coding in most cases surpass the cost, with a rise in popularity for this method in various fields: human-computer interaction (Cohen & Huang, 2003), consumer behaviour (Garcia-Burgos & Zamora, 2013 ; de Wijk et al., 2014), educational research (Terzis et al., 2012, 2013; Chiu et al., 2015).

This situation leads to a use of multiple physiological data in synchronization. Indeed, the psychophysiological pain points (PPPs) identification method allows for a deeper representation of the user journey as they include automatic, often unconscious, negative physiological manifestation of the user (Giroux-Huppé et al., 2019a). In this article, Valence-arousal PPPs are defined as moments when the user simultaneously experiences high emotional arousal and high negative emotional valence that is caused by non-optimal interaction moments (Giroux-Huppé et al., 2019b). Indeed, triangulation of valence and arousal data offers an even more precise temporal and content standpoint of the user journey, allowing to precisely identify frustrations and comparison of users' journeys with competitors (Giroux-Huppé et al., 2019b).

This study builds on recent previous research on implicit pain points (Giroux-Huppé et al., 2019a, 2019 b, 2019 c ; Lamontagne et al., 2019) and the use of segmentation and profiles (e.g. Ganesh et al., 2010), by going further into exploring how those pain points can differ from one user to another in online purchase behaviour within a multichannel context. This article is the first, to our knowledge, to propose an online consumer behavioural typology based on objective physiological measures in order to describe consumer segments' online behaviour, while mobilizing psychophysiological frustrations during an online interaction.

1.3 Research Hypotheses

1.3.1 Proposition 1

The concept of market segmentation can be defined as "a state of demand heterogeneity such that the total market demand can be disaggregated into segments with distinct demand functions" (Dickson & Ginter, 1987, p. 5). In order to segment the overall market, the use of a segmentation basis, which refers to a "set of variables or characteristics used to assign customers to homogeneous groups" (Wedel & Kamakura, 2000, p. 7), will determine how groups are formed. As per segmentation bases, they can be general (independent of products, services and/or particular circumstances), or product-specific (related to both the customers and the products, services or circumstances). Segmentation bases will also be classified as either observable (measured directly), or unobservable (implied) (Wedel & Kamakura, 2000). The strategic purposes of segmentation will influence the bases and methods used in research; different consumer segments can be identified in the same population of customers in different segmentation studies, since the study's purpose will differ (Wedel & Kamakura, 2002).

To begin with, differences between online and offline consumers have frequently been studied by developing segmentation bases such as demographics, shopping motivations, innovativeness, and more to illustrate those differences (Mathwick et al., 2001; Sheehan, 2002; Bressolles et al., 2014). Consumer typologies have also been explored based on e-satisfaction in e-quality dimensions to assess different types of Internet use in consumption (Bressolles et al., 2014). Previous work also focused on consumers' interaction preferences or what influences their channel choice (e.g. Barwitz & Maas, 2018; Konus et al., 2008). Hence, according to literature, there are existing behavioural differences in how users behave in multi- and omni-channels. In this article, we aim to understand how the omni-channel consumers are similar in their journey's differences, and how those profiles will behave online as opposed to dividing on—and offline worlds. As stated above,

individual characteristics, especially within their expectations and perceived competencies, can shape consumers' decision-making and preferences.

First, we must identify if online users can be configured into different relatively homogeneous groups to better assess online experience. Segmenting the consumer market using psychological characteristics of users prior to the firm-consumer interaction makes it possible to comprehend how different groups of individuals will experience the same online interaction.

Expectations

The relationships among prior user experience, current satisfaction, and future interaction choice have been validated in a number of previous studies (e.g., Bolton & Lemon 1999; Dholakia et al. 2010; Van Birgelen et al., 2006). When confronted with a purchasing process in an omni-channel context, loyalty derived from satisfaction offline does not necessarily endorse a loyal online behaviour. E-service quality is believed to play an important role in the e-loyalty development process (Li et al., 2015). Hence, online e-tail quality has a key role to play in assessing the customer experience from the beginning to the end of the transaction, such as information searches to delivery and satisfaction with the ordered product (Wolfinbarger & Gilly, 2003). Under the omni-channel context, the online shopping process is viewed as a delivery process where customers interact with the website. Measuring satisfaction from e-quality is then essential, for its influence on decision-making during the online shopping process is a determinant of improved loyalty intention (Yen & Lu, 2008). Differences in loyalty between consumers can arise from the confirmation/disconfirmation paradigm, with satisfaction developed as the outcome of the difference between perceived product performance and initial expectations (Oliver, 1997). This trade-off between expectations and actual performance gives place to different levels of expectations and perception of performance within the customer pool, affecting the general satisfaction and consequently behaviour.

Involvement

Consumer involvement has been conceptualized in a number of ways, fitting specific objects or contexts. Generally, involvement is described as an internal state of arousal, unfolding in three major properties: intensity, direction, and persistence (Andrews et al., 1990; Mitchell, 1981). Those properties create a wide range for which different combinations will uphold different initial internal states; levels of involvement can be interpreted on a continuum from low to high (Antil, 1984) and will vary across product ranges and individuals. Purchase situations or product categories can also affect the expected level of involvement, for some are generally perceived to be more high-involvement context than others, even if individuals can exhibit different levels of involvement within those situations (Hupfer & Gardner, 1971). Situations associated with high involvement from consumers generally consist of more time and effort spent in research-related activities (Bloch et al., 1986), more extensive decision-making, greater perceived differences in product attributes, and a greater likelihood of establishing brand preferences (Zaichkowsky, 1985, 1986). Involvement is a construct form primarily in consumers' internal state; therefore, one can expect various outcomes of emotional journey depending on the initial level of attachment. For the purpose of this study, we will closely examine the initial level of product involvement, defined as the perceived relevance of a product class based on the consumers' inherent needs, interests, and values (Zaichkowsky, 1985), and its expected role in purchase behaviour in an omni-channel context.

Self-efficacy

Diverse levels of self-efficacy are expected to be observed due to the perception attribute of beliefs in one's capacities. According to Bandura's contention, self-efficacy contains a motivational property that will determine the time and duration of one's engagement in overt behaviour to achieve their desired goal (Bandura, 1986). Sustained efforts to achieve a desired outcome can be too costly for certain individuals, except if they are committed to particular personal objectives (Bouffard-Bouchard, 2010). High achievement goals will influence how efforts are to be sustained and exerted by an individual to reach a satisfactory solution

(Bandura, 1986). But even achievement goals are influenced by one's beliefs in their capacities; a recent research in educational research showed that a high self-efficacy group of students had determined higher achievement goals than those of the low self-efficacy group (Bouffard-Bouchard, 2010).

Those discrepancies in expectations of self-efficacy make it a powerful determinant of behavioural change (Bandura, 1977); it determines the initial decision to perform a certain behaviour, the efforts deployed to reach a goal, and the level of persistence in the face of challenges (Sherer et al., 1982). The history of experiences of success will also impact the initial level of self-efficacy expectations of consumers, who are expected to have higher self-efficacy expectations in a variety of situations than individuals who accumulate failures or limited success (Sherer et al., 1982). In short, from these premises, it can be expected that individual differences in general self-efficacy expectancies exist and have behavioural correlates (Sherer et al., 1982). Users will predictably not experience the same emotional and behavioural journey as their level of self-efficacy will influence their perception of difficulty and their willingness to persist towards a satisfactory outcome.

Therefore, differences in levels of expectations, competencies and involvement should exist, and groups should emerge from those differences. We pose our first proposition, stated as follows:

Proposition 1: There are different consumer segments based on expectations, personal skills and user involvement in a population of online omnichannel shoppers.

1.3.2 Proposition 2

As segmentation allows for a division of consumers into homogeneous groups, the managerial decisions and implications revolve around the mobilization and targeting of one or few specific groups of consumers. However, emotions play a key role in shaping consumers' decisions and perceptions, as emotional reactions to the consumption experience are fundamental for the determination of

satisfaction and post-consumption behaviour (Liljander & Strandvik, 1997; Mano & Oliver, 1993). Research has supported the need for empirical studies to demonstrate the use of emotions as segmentation variable and to test the association with behavioural intentions (Wirtz et al., 2000). There is, however, little research done on the use of emotional reactions as a descriptive variable in segmentation. Indeed, Moore, Harris and Chen (1995) suggested that consumers can be differentiated relatively to their intensity with which the emotions are experienced. The intensity of any given emotion can be described as the strength of the emotional response to a given level of stimulus (Moore et al., 1995). There is still yet to explore if belonging to different groups of omnichannel consumers can have an impact or be a predictor of the online emotional journey experienced.

Henceforth, based on the theoretical and empirical importance of emotions, our study poses the second proposition as follows:

Proposition 2a: Belonging to a consumer segment will influence the emotional user journey.

Proposition 2b: Belonging to a consumer segment will influence the behavioural user journey.

Our experimental study measures solely one phase of the shopping process, purchase, but benefits from the unusual context of online purchase of telecommunication services as well as the challenges raised by the omnichannel environment.

1.4 Material and Method

1.4.1 Sample and procedure

Telecommunications service providers grant interesting research possibilities since their industry faced real challenges in their attempt to unify their customer experience. Multiple mergers and acquisitions combined diverse service region or siloed branches created over their expansion and may have caused the

communication service providers (CSPs) to have leadership disparities and sparse strategic objectives (Carroll & Guzmán, 2013). Their increased effort to undertake changes to maintain or recover market share results in faster adaptation to the omni-channel model. This phenomenon created changes in the traditional behaviour of consumers, since new channels emerged in their usual purchase journey. For this aforementioned context, the following laboratory correlational study is based on the case of a telecommunication provider's launch of an online buying process for a new entertainment platform and devices.

26 participants took part in the study (15 women; 58%, 11 men; 42%). Participants' age is 33 years on average; the sample is composed of 14 students (age avg. = 24 years old) and 12 professionals (age avg. = 43 years old). This range of profiles allowed us to have a fairer representation of real-life users of the technology.

Criteria for selecting the subjects were as follows: participants must be older than 18 years old; participants have to be able to work on a computer without correction glasses for sight; participants cannot have skin allergies or special sensitivity; participants cannot have a pacemaker; participants cannot have a neurological or psychiatric diagnosis; participants cannot have laser vision correction; participants cannot have astigmatism; participants cannot suffer from epilepsy; participants cannot have a diagnosed health problem. Those screening criteria were essential because of the use of psychophysiological tools. In addition, participants had to make online purchases on a regular basis, and had to be interested (min of 7-score on a scale of 1 to 10) in this new type of telecommunication services in order to properly represent the targeted type of users that will use this new online website to purchase the product and service.

A laboratory correlational study was conducted using the experimental prototype for subscription purchase to telecommunication services developed by a telecommunication provider. The twenty-six individuals who participated in the study had the same task to complete, from the home page until final purchase. The

scenario provided to participants was elaborated in order to give them enough context to be able to purchase a subscription to telecommunication services provided by a new entertainment platform. Details on the equipment's features were given as complementary information to facilitate the context of the purchase. The core task participants had to complete was to subscribe to the Internet and TV cable plan that corresponded to their needs through the prototype through the final purchase. Participants received monetary compensation for their participation. This experiment was approved by the research committee of our institution.

1.4.2 Experimental task and stimuli

For the task, participants could choose one of two paths to explore the telecommunication offers and to subscribe to a plan. Participants could either build and customize their own plan though the option "Customizable Packages" or choose a plan from the packages available through "Multi-Product Packages." Participants would then follow the same steps leading to the final purchase. Indeed, each participant would go through the steps presented in the figure below.

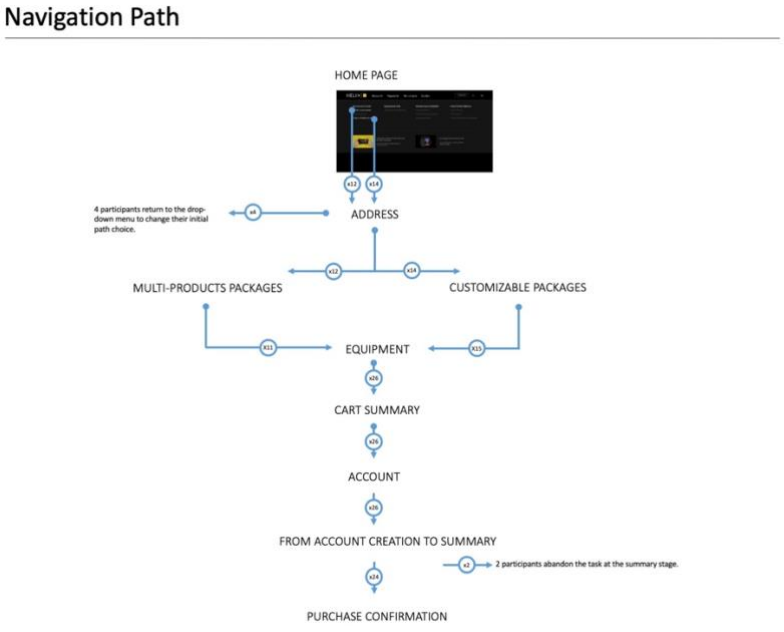

Figure 1. Navigation path

To preserve participants' confidentiality, we provided fictional personal information for them to complete the purchase. The information was accessible through an iPad beside the participant and included the following: name, address, phone number, email address, credit card information, actual telecommunication service providers (company X) and the associated account number.

At the end of the experience, a 30-minute interview was conducted by research professionals in order to get more insights on users' perceptions of the new purchasing experience, mostly to understand their future behavioural intentions concerning channel switching.

Apparatus

The experimental prototype used for the experiment was presented through Axure RP 8 (Axure Software Solutions, San Diego, USA), on a monitor with a 1680 x 1050 resolution.

1.4.3 Explicit measurement

Before the task, participants completed a questionnaire to measure their self-efficacy (Bandura, 1977), expectations (eTailQ; Wolfinbarger & Gilly, 2003) and purchase involvement (Revised Personal Involvement Inventory; Zaichkowsky, 1985).

Self-efficacy

In our study, perceived self-efficacy was evaluated with a 6-item measure (Sherer et al., 1982).

Expectations

The etailQ is a general reliable and valid scale to measure 4-dimensions e-tail quality, website design, customer service, security, and fulfillment, proposed by Wolfinbarger and Gilly (2003). Since the interaction is of online nature,

expectations vis-à-vis the experience is measured through etailQ relevant dimensions. The etailQ is used as a multidimensional construct to be able to measure and quantify expectations, as their role on behaviour is justified with the Expectation-Confirmation theory.

Purchase Involvement

The 10-item PII revised scale (Zaichkowsky, 1994) was used in this context, which is more convenient for time-sensitive studies and much similar to the original scale, with still high reliability by measuring the affective and cognitive components of involvement.

The operationalization of the explicit variables table is available in the appendix.

1.4.4 Implicit measurement

Three physiological measures were recorded throughout the study for each participant.

First, facial emotions were used to assess participants' emotional valence. The software Facereader v6.0 (Noldus, Wageningen, Netherlands) was used to register the emotional valence in real time. Next, using the Facial Action Coding System (FACS) developed by Ekman and Friensen (Ekman & Friensen, 1978), Facereader system analyzes participants' facial movements in order to detect the 6 core emotions: happiness, sadness, anger, disgust, fear and surprise, as well as the neutral emotion (Loijens & Krips, 2018). Indeed, this software quantifies the intensity of those emotions, scoring them between 0 and 1 (Loijens & Krips, 2018). The emotional valence is subsequently calculated from the intensity score of the emotions as the intensity of the only positive emotion, happy, minus the highest intensity between the negative emotions, which are sad, angry, scared, and disgusted (Loijens & Krips, 2018). In the end, the emotional valence has a value between 0 and 1, from negative to positive (Loijens & Krips, 2018).

Secondly, their electro-dermal activity (EDA) was used to assess participants' emotional arousal. The Acqknowledge software (BIOPAC, Goleta, USA) was used to capture the skin conductance response, also known as electro-dermal amplitude, to measure the participants' excitement spectrum (Dawson et al., 2008). To do so, two sensors were positioned on the hand of the user, which is obtained by the activity of the eccrine sweat glands by the electrical conductance response of the skin (Dawson et al., 2008). Indeed, sweat glands in the hands are activated by affective arousal, thus it is possible to convert the palmar sweating activity into the level of effective arousal (Dawson et al., 2008). A very low-voltage electric current is constantly passing through the two electrodes on the participant's hand, which is converted following Ohm's law. The Acqknowledge software also stores the data to specifically pinpoint moments of interest in the analysis.

Third, eye-tracking data was recorded in the Tobii Studio software (Tobii, Stockholm, Sweden) with a Tobii Pro X-60 eye tracker, sampled at 60 Hz, as suggested by Laeng et al. (2012). A 9-point (3 x 3) calibration grid was used. Calibration was repeated for each participant until sufficient accuracy was reached (± 2 degrees of accuracy). This software was also used as a recorder and to position event markers at the beginning and at the end of each video and task. The event markers were posteriorly used to analyze the PPPs. To avoid interpretation bias, automatic coding and pain points identification complied with the proposition of having more than one independent researcher perform the analysis and then assess inter-reliability (Gwet, 2014). The synchronization of the apparatus and event markers was performed by The Observer XT software (Noldus, Wageningen, Netherlands). This synchronization allowed the triangulation of the user data with Cube HX (Noldus, Wageningen, Netherlands) to obtain the PPPs (Courtemanche et al., 2019; Léger et al., 2019).

The psychophysiological measures were then triangulated to calculate critical points in time that will be considered psychophysiological pain points for each participant using the statistical software SAS 9.4 (Cary, USA). In this context, the

threshold for valence-arousal PPPs followed Giroux-Huppé et al. (Giroux-Huppé et al., 2019a.) The moments of interests were those where the participant is both in the ninetieth percentiles of standardized EDA (i.e., high arousal), compared to his baseline state, and in the tenth percentile of valence (i.e., large negative valence) (Giroux-Huppé et al., 2019a).

Distance analysis markers

In order to measure PPPs in different sub-task steps in an online interaction, a distance variable has been created to standardize journeys between participants. Since the total duration of the purchase process varied for each participant, time in seconds could not be used to compare PPPs between participants. Indeed, PPPs distance between sub-tasks could not be measured in seconds since participants did not have a time limit, and therefore standardization would have been impossible. To overcome this problem, a journey map with all 13 web pages on a timeline was produced. The distance between each website page of the purchase flow was in centimetres and was equally distributed across all 13 timeline points. In this sense, to include new variables comparing negative physiological manifestations in time, the triangulation of physiological data will result in a list of PPPs classified by steps in the user journey, hence a more accurate picture of pain points occurrence and distribution across the interaction. From the distance in centimetres calculated on the user journey timeline, the following variables of interest were calculated in relation to implicit pain points: Time to first pain points, Time to most intense pain points. Both variables resulted in centimetres for each participant.

1.4.5 Data Analysis

Psychophysiological data such as valence, arousal and eye tracking were collected to be able to use triangulation in the creation of four descriptive variables, such as the total amount of pain points experienced, distance to the first pain point, distance to the highest intensity pain point, and finally the categorical classification of the type of pain points.

Following triangulation of the physiological data, the list of pain points is sorted and cleaned. Then, the research expert will interpret each moment of frustration within an interval of 10 seconds before and after the precise listed time in order to identify the cause of this frustration. Since the frustration can be related to an action or an event, a larger time frame allows the research expert to gain context on the possible source of the frustration. Finaly, the last step in PPPs analysis would be to regroup the individual occurrences into relevant categories to facilitate comprehension. Following the well-known Bastien and Scapin (1993) 10 heuristics for evaluating a user interface, individual occurrences are first regrouped by task to facilitate additional grouping and to eliminate the division by individual participants. Next, each individual occurrence is manually codified using *PPPs Category_ID* for the total of PPPs (see table 2).

Table 2. Pain points are regrouped into categories listed below based on relevant heuristics.

Title	Definition	PPPs Category ID
Navigation:	Users do not seem to know where to go	NAV1
Grouping/Distinction Between Items:	Unclear difference between two items on the website	GDISTIN2
Interface item:	Problems during an interaction with a site feature (buttons, fields, dynamic objects)	INTERITEM3
Protection against errors:	No preventive features install to detect and prevent errors	PROTERR4
Navigation (lost):	User journey faults (lost)	NAVLOST5
Explicit action:	When the user interacts with a feature but there is no way to predict what will happen when the required action in undertaken	EXPACT6
Comprehension:	Comprehension problem or the user seeks to understand a particular section or feature	COMPR7
Flexibility:	When the system does not offer the ability to modify the interface to facilitate interaction	FLEX8
Marketing communication:	When the user is confronted with marketing pitfalls	MKGCOM9
Workload/Cognitive load:	Too much information on the site for the user/heavy on decision-making	WORKCOG10

Grouping/Distinction by location:	Items are not grouped in an intuitive manner, as expected by the user	GLOCAT11
Workload/Concision:	No reduction of the workload at the perceptual and mnemic level with respect to individual input or output elements	WORKCONCI12
Information density:	Concerns the users' workload from a perceptual and cognitive point of view, with regard to the whole set of information presented to the users rather than each individual element or item.	INFODENS13

Based on the interview part of the experience, two variables were created from semi-structured interview verbatim: reasons for leaving the online channel (if the case) and type of additional information, if required, to complete the purchase. Analysis of interview data followed the procedure suggested by Burnard (1991) to systematically find themes and seek a categorization process across participants' qualitative answers. To fit the need of our analysis, we used the online platform *Optimal Workshop Reframer* to conduct the procedure until stage 10, which is where the method demands the review process from participants. The platform used allows for themes' aggregation automatization based on prior tags' classification. To assess validity, another researcher was asked to review the transcription of verbatim and the categorization process. In case of a difference in interpretation, a third researcher was asked to interpret the same statements to offer neutrality separately and support.

After collecting data, statistical procedures were performed respectively by using the statistical analysis software SPSS 16.0 (Chicago, USA) during the data analysis process. To analyze if customers can be divided into distinct groups of customers, two-step cluster analysis using K-means was conducted. To detect if there is heterogeneity within the population, individual psychological characteristics prior to firm-consumer interaction was used as segment bases in an objective methodology. Cluster analysis enables grouping of individuals in such a way that there is homogeneity within a cluster but heterogeneity between clusters (Hair et al., 1998). As for the interpretation of values, we initially took into account

these factors, which influence P value according to Dahiru (2008): effect size, the size of sample and the spread of data. The aim of the following test is not to determine the effect between two instances (ex: two procedures in health research), and we do not possess a large sample size with dispersed data. Even Fisherian and Neyman-Pearson (N-P) schools are not supporting the universal threshold as mandatory (Dahiru, 2008; Moore & McCabe, 1993). Indeed, we will deliberately use a Type I error rate (alpha) threshold of .10 as it was suggested that choice of significance level should be made with careful consideration of the key factors of hypothesis testing and should reflect the nature and objective of the research first (Kim & Choi, 2019). In fact, a higher power of the test can be achieved when the Type I error rate is set as a decreasing function of sample size in consideration of statistical power (Kim & Choi, 2019). Hence, we will make the significant test less stringent by moving the borderline to 0.10, as to avoid the loss of information due to the dichotomy of p-values (significant vs nonsignificant) in this exploratory research.

Then, descriptive statistics, such as mean and standard deviations of subjects, were calculated for three clusters. Critical mass was calculated using non-parametric ANOVAs to determine the significant differences among clusters regarding three continuous variables: four dimensions of expectations, self-efficacy and purchase involvement.

Finally, non-parametric analysis of variance was used to analyze mean differences between clusters regarding their emotional experience and their online choices regarding seven variables—three binary, paths taken on the website (predetermined subscription and “make your own” subscription), seven-category reasons for leaving the online channel, seven-category types of additional information needed to complete the purchase successfully; four continuous, 13-category pain points classifications, number of total pain points, distance to the most intense pain point, distance to the first pain point.

All statistical analyses were performed with software SAS 9.4 (Cary, USA) and SPSS 16.0 (Chicago, USA).

1.5 Results

1.5.1 Measurement scales and descriptive statistics

Before proceeding to any tests, the possibility of outliers in the data set was examined, which resulted in the elimination of one participant from the valid participant pool. Using an empirical approach, the participant's questionnaire results were extensively dissimilar to the other participants' observations. A possible explanation for this occurrence can be found in the experimental design, since occasional delays in the overall participant's laboratory experiment could have led to irritation or fatigue when completing certain tasks. However, because of cluster analysis's particular sensitivity to outliers or irrelevant variables, we decided to remove P10 to avoid structural distortion of the clusters (Hair et al., 1998).

Once our valid sample data verified, we conducted a reliability test to corroborate the reproducibility and accuracy of the sample's scale results. We used Cronbach's alpha measure since it is the most commonly used measure to assess internal consistency reliability, especially for items with Likert scales, such as expectations and self-efficacy constructs in this study (Gliem & Gliem, 2003). As expectations were measured using the eTailQ expectations 4-dimensions, Cronbach's alpha was calculated for each dimension: Web Design, Fulfillment, Security, Customer Service. We then repeated Cronbach's alpha calculations for self-efficacy 6-items (Likert scale) and purchase involvement using the Personal Involvement Inventory (semantic differential scale). Table 3 provides a summary of the Cronbach's Alpha Based on Standardized Items for all measures. All Cronbach's alpha's scores are higher than the widely used threshold of 0.70 (Gliem & Gliem, 2003).

Table 3. Reliability verification

	Web Design	Fulfillment	Security	Customer Service	Purchase Involvement	Self-efficacy
N— Valid	25	25	25	25	25	25
N— Missing	0	0	0	0	0	0
Mean	6.22	6.79	6.64	6.65	4.94	5.38
Std. Deviation	0.48	0.40	0.77	0.42	1.51	1.021
Skewness	-0.22	-2.41	-2.61	-0.71	0.46	-0.62
Kurtosis	-0.38	6.81	6.51	-1.27	-0.40	-0.01
Minimum	5.20	5.33	4.00	6.00	2.70	3.00
Maximum	7.00	7.00	7.00	7.00	8.30	7.00

Since Cronbach's alpha does not allow for intercorrelation detection, we also examined the intercorrelations among the measures. This is particularly important when searching for some degree of discriminant validity (Schmitt, 1996). In that case, we need to avoid correlation between measures as we aim to detect groups in the sample that are similar inward but different outward. Table 4 presents the reliability results. All coefficients are generally small enough to assume no correlations between measures. Table 4 provides the correlation coefficient and the p-value below in an intercorrelation matrix.

Table 4. Intercorrelation verification

	Web Design	**Fulfillment**	**Security**	**Customer Service**	**Purchase Involvement**

Expectations dimensions	Coeff Two-tail P	Coeff Two-tail P	Coeff Two-tail P	Coeff Two-tail P	Coeff Two-tail P
Web Design	1.000				
Fulfillment	0.329 .108	1.000			
Security	0.441 .027*	0.102 .627	1.000		
Customer Service	0.373 .066*	0.368 .070*	0.098 .641	1.000	
Purchase Involvement	0.017 .937	-0.295 .152	-0.322 .117	-0.071 .737	1.000
Self-efficacy	0.394 .051*	0.404 .045*	0.087 .679	0.119 .571	-0.431 .032*

* p <.10

Clustering variables with different scales should be standardized to allow comparison between them and to eliminate the effects due to scale differences within our analysis (Baeza-Yates, 1992). Standardization of the variables was carried through the most common method known as Z-score, which consists of converting each variable to standard scores by subtracting the mean and dividing by the standard deviation for each variable (Hair et al., 1998).

1.5.2 Cluster analysis

Two-Step Cluster analysis was performed with k-means method allowing for comparison between BICs to discover the optimal number of clusters to choose. Because of our small sample size, we initially tested only for three or four group formations within the participants. The table 5 below shows the results for the formation of three groups using K-means. Results were conclusive and generally significant for the established three separate groups.

Table 5. Two-step cluster analysis with frequency distribution of three different groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Group 1	8	32.0	32.0	32.0
	Group 2	11	44.0	44.0	76.0
	Group 3	6	24.0	24.0	100.0
	Sample Total	25	100.0	100.0	

Next, using ANOVA one-way non-parametric, we validated the general significant differences between all three groups from the cluster analysis using a non-parametric test statistic, Kruskal-Wallis Test. Indeed, for the aforementioned argument in the Data Analysis section, Type I error rate (alpha) was deliberately set at .10, rather than the traditional .05. Moreover, we verified significant differences between each pair of groups with the non-parametric test statistic, Mann-Whitney Test. Table 6 summarizes the test results for each group.

Table 6. Overview of ANOVAs p-values result comparison between groups.

	K-W	M-W	M-W	M-W
		Two-tail (1) vs (2)	Two-tail (1) vs (3)	Two-tail (2) vs (3)
Web Design	.094*	.429	.191	.030*
Fulfillment	.078*	.037*	.889	.050*
Security	.112	.311	.052*	.104
Customer Service	.0002*	.014*	.007*	.0002*
Purchase Involvement	.0004*	.0003*	.003*	.421

Self-Efficacy	.046*	.021*	.271	.158

* p <.10

Hypothesis 1

Profiles

The profile of each group was determined by expectation dimensions, the purchase involvement and self-efficacy level. The three groups were of different sizes, ranging from 24% to 44% of the total sample size (25). The three groups were differentiated based on their level of each expectation dimensions (Web Design, Fulfillment, Security, Customer Service), ranging from 5.93 to 7 on a scale of 1 to 7; by their level of purchase involvement, ranging from 3.96 to 6.72, on a scale of 1 to 10 (*inverted*; statements are alternating between negative and positive, hence we had to reverse results from negative statements.); by their level of self-efficacy, ranging from 4.70 to 5.90 on a scale of 1 to 7. Variables from the three groups are detailed below. Table 8 showcases the respective means of the three clusters as well as their standard deviation.

The second column of Table 7 presents the first group: the "detached" consumers. This group has medium-high expectations in all dimensions, low purchase involvement, and medium-low self-efficacy. The "detached" group seems to expect support and efficiency in the interaction. They express medium-high expectations about their experience but tend to perceive themselves as uninvolved from the task, in addition to a low perception in one's capacities to complete the task independently. Overall, this group seems to believe in an experience where they will get the most benefits for the least amount of effort.

The most engaged group was the second group, the "passionate," presented in the third column of Table 7. This group presents high expectations in all dimensions, high purchase involvement and high self-efficacy (compared to other groups). The "passionate" group could be qualified as the overly involved consumers. They have high expectations about their experience, and consider themselves highly

involved with their anticipated purchase, in addition to exhibiting confidence in their capacities to successfully complete the purchase independently.

The third group, the "practicals," presented in column 4 of Table 7, had mixed levels in the segment bases variables. This group displays really high expectations in the security dimension but showcases lower scores in web design and customer service dimension. They also present medium-high purchase involvement and medium-high self-efficacy. The "practicals" group is considered involved with the product they anticipated to purchase, but their expectations are focused around security and fulfillment. This group seems to value less the experiential and design aspect of an interaction, and more a secure interaction and to be able to fulfil the order properly. Interestingly, they are almost as confident in their capacities as the "passionate" group.

Table 7. Coefficient values of the three heterogeneous groups

	"Detached" group		**"Passionates" group**		**"Practicals" group**	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Web Design	6.22	0.48	6.38	0.52	5.93	0.27
Fulfillment	6.71	0.33	6.97	0.10	6.56	0.66
Security	6.13	1.21	6.82	0.27	7.00	0.00
Customer Service	6.67	0.36	6.97	0.10	6.06	0.14
Purchase Involvement	6.73	0.89	3.96	0.89	4.35	0.77
Self-Efficacy	4.71	1.10	5.91	0.79	5.31	0.85

By successfully generating three groups which are relatively homogeneous inwards and heterogeneous outward, we have enough evidence to suggest that H1 is supported.

Proposition 2a and 2b

The second proposition suggests that there will be differences on the emotional and behavioural journey between different profiles. To test this proposition, we ran a one-way non-parametric ANOVA between three groups for each variable of interest. The detailed results for mean and standard deviation for each variable tested are presented in the appendix. Additionally, results from ANOVAs are provided in table 9 for partly significant variables, for presentation concision. The variables' legend is available in the appendix.

Examination of the influence of profiles on PPPs experienced leads to significant differences only within certain pairs of profiles. Perhaps the most interesting result appears to be that the total number of PPP experienced is significantly different between all 3 groups (*K-W*, p <.10; *M-W Two-tail* 1 vs. 3, p <.10; *M-W Two-tail* 2 vs. 3, p <.10). However, the total number of PPP is not statistically significant when the pair "detached" and "passionate" are compared (*M-W Two-tail* 1 vs. 2 P-value=.33), although the mean scores suggest a difference (5.40 and 7 respectively).

As per differences within certain pairs of groups, the following results present the various instances where emotional differences are statistically significant. Indeed, the distance to the first PPP is significantly different between the "passionate" and the "practicals" (*M-W Two-tail* 2 vs. 3, p<.10). The distance to the most intense PPP is significantly different between the "detached" and the "passionate" (*M-W Two-tail* 1 vs. 2, p<.10). As for categories of pain points, out of the 13 categories coming from the interpretation of PPPs during the automatic coding procedure, only navigation (*K-W*, p<.10; *M-W Two-tail* 1 vs. 3, p<.10; *M-W Two-tail* 2 vs. 3, p<.10), protection against errors (*K-W*, p<.10; *M-W Two-tail* 1 vs. 3, p<.10), and explicit action (*M-W Two-tail* 1 vs. 3, p<.10) show significant differences between profiles. Details can be found in the table below.

Table 9. Overview of ANOVAs p-values result comparison between groups only for partly significant descriptive variables.

	K-W	M-W

		Two-Tail 1 vs. 2	Two-Tail 1 vs 3	Two-Tail 2 vs 3
Path chosen	.191	.563	.215	.072*
Distance to the first PPP	.177	.661	.169	.080*
Distance to the most intense PPP	.187	.079*	.584	.245
Total number of PPP	.083*	.333	.054*	.089*
Reason to leave 2	.086*	.103	.079*	.460
Type of information 4	.153	.169	.049*	.407
Category PPP: Navigation	.052*	.584	.095*	.024*
Category PPP: Protection against errors	.075*	.245	.034*	.172
Category PPP: Explicit action	.210	.419	.086*	.288

*****p-value <.10

Thus, Proposition 2*a* is partially supported, as the results are significant for certain pairs of groups only. Even if results are polarized, the mean scores do suggest a trend of emotional differences experienced between different profiles of consumers.

Examination of profiles' differences in observable behaviour and qualitative data with significant variables is limited to certain pairs of groups on the path taken (*M-W Two-tail* 2 vs. 3, $p<.10$), reason 2 for leaving the online channel (*K-W*, $p<.10$; *M-W Two-tail* 1 vs. 3, $p<.10$), type of information requested 4 (*M-W Two-tail* 1 vs. 3, $p<.10$). The choice of paths is significantly different for "passionate" group and "practicals" group, with fewer cases of the customizable subscription path for the former. Moreover, when asked about their exit behaviour, significant differences between the "detached" group and "practicals" were observed in their justification. Indeed, the "detached" group mentioned they would exit the online

channel in the scenario because of a lack of information about subscription options. Finally, the "detached" group and "practicals" group exhibit significant differences in the additional type of information they would require finalizing the purchase. The "detached" group did not mention a need for additional billing information in the purchase scenario, as the "practicals" group mentioned it.

Table 10. Mean scores of variables with significant differences between group "detached" and group "practicals."

	Detached		**Passionates**		**Practicals**	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Path Taken	0.50*	0.54	0.64	0.51	0.17*	0.41
Reason to leave the online channel: need for more information	0.43*	0.54	0.09	0.30	0.00*	0.00
Type of information required to proceed to an informed purchase: **billing information**	0.00*	0.00	0.25	0.46	0.50*	0.58

* M-W test significant difference p-value <.10

As shown above, there is not enough evidence to support Proposition 2*b* for profile differences in all the variables' categories. However, interestingly, profiles do tend to behave differently according to their respective group for certain variables, suggesting a trend towards behavioural differences between each group. These mixed results are likely to be related to the small sample size.

1.6 Discussion

This article presented three heterogeneous groups of omni-channel users who had different levels of expectations, purchase involvement and self-efficacy, and a first exploration of the influence of their profile on their emotional journey and their

purchase behaviour. However, the impacts of profiles on emotional responses and disparities of behaviour were not equally important across all groups.

The total amount of pain points experienced during the online shopping seem to be the most consistent emotional reaction differentiator among the profiles. Indeed, the results seem to vary between pairs of groups. The conclusion showcases that segmented groups seem to have differences in their experience in relation to their psychological characteristics-based profiles. Indeed, these mixed results shine light on the possible effect of profiles' endpoints in the various levels of the psychological characteristics used. The significant differences in descriptive variables are often observed among groups that are polarized on the spectrum of certain individual psychological characteristics. Notably, the "detached" group portray the levels of characteristics that could be considered as a very average user, which would be positioned towards the middle of the spectrum in question. However, significant differences in emotional and behavioural reactions seem to appear when profiles tend to each extremes of the spectrum on the psychological measures. In fact, the "practicals" group positions itself further along a utilitarian spectrum, as the "passionate" group are better described by the hedonic spectrum. When comparing emotional experiences, those groups could be more likely to experience challenges in purchase experience due to the nature of the value sought from the exchange.

This unexpected spectrum of utilitarian versus hedonic consequences and implications is congruent with value-in-use theory. In fact, prior research showed that ultimate value exists and underlies the reasons for interaction choice in profiles of online interaction behaviour (Barwitz & Maas, 2018). This value-in-use is defined by Macdonald et al. (2011), drawing on Woodruff (1997) and Woodruff and Flint (2006), as a customer's functional and/or hedonic outcome, purpose or objective that is directly served through product/service usage. This outcome sought by consumers is also a construct of the cognitive evaluation of the customer experience that different types of individuals will pursue (Sandström et al., 2008). The range can vary from utilitarian to hedonic also allows for a mixture

of the two in nature (Chitturi et al., 2008). Since value-in-use represents the actual benefits sought by different types of consumers, it is expected that emotional responses will widely depend on the importance one grants to hedonic versus utilitarian aspects.

Moreover, there seem to have clearer differences in the behaviour and the emotional experiences (PPPs) between groups exhibiting different hedonic and utilitarian levels within the descriptive variables. Although there are not enough evidence that hedonic or utilitarian aspects of the online experience can shape the emotional journey of different levels within their profiles, we can see a trend of evidence suggesting that those aspects could affect how consumer segments experience moment-to-moment frustrations. Future research is needed to verify if intrinsic and extrinsic online experiences can impact consumer behaviours and how it could influence consumers' emotional and behavioural journey.

All in all, this exploratory research shows the value of consumer-centred research for omnichannel behaviour and supports the value of emotions in the measure of online experiences. Despite the mixed significant differences in emotional and behavioural reactions between profiles, our findings uphold the theoretical and managerial trend in consumer experience. Furthermore, our findings suggest that consumer segmentation does offer a useful approach to understand the emotional journey in online experiences, rooted in the complexity of omnichannel purchase processes and overall consumers' demands for a seamless, personalized experience. Indeed, experiential value has been said to provide both extrinsic and intrinsic benefit in consumers' experiences (Babin & Darden, 1995; Batra & Ahtola, 1991; Crowley et al., 1992; Mano & Oliver, 1993). For example, in a retail context, extrinsic benefits can be derived from shopping trips that are more utilitarian in nature, such as "an errand" (Batra & Ahtola, 1991; Holbrook & Hirschman, 1982). For extrinsically oriented shoppers, happiness will often solely need to come from this type of exchange encounter (Babin et al., 1994). However, intrinsic value derives primarily on the experiential aspect, as an "appreciation of

an experience for its own sake, apart from any other consequences that may result" (Holbrook, 1994, p. 40).

1.7 Conclusion

The aim of the present research was to examine how consumers' psychophysiological online journey, using profiles formed through individual characteristics from past experiences, can influence their online behaviour in an omnichannel context. Prior multichannel and omnichannel research focused on topics such as the impact of channels on business performance, the study of shoppers' behaviour across channels and the exploration of retail mix across channels (Verhoef et al., 2015). Moreover, although research uncovered multiple key motivations for online consumer behaviour, most of the knowledge and discoveries to this day fail to be mobilized into solutions to optimize customer satisfaction and experience (Lu, 2017). As emotions have been shown to shape future consumer behaviour (Hassenzahl, 2013), measuring online shopping experience is crucial in understanding the omnichannel shopper. Indeed, Melis et al. (2015) showed that online shopping experiences affect the way customers use and compare channels within and across different chains. This study has shown that consumer segmentation is useful in understanding online omnichannel shoppers, and some differences in emotional and behavioural reactions could be observed between some pairs of groups. Thereupon, it is significant to take consumer heterogeneity into account when establishing omnichannel experiences.

Hence, our exploratory research has both theoretical and managerial implications. First, our case study offered a particular research context, since telecommunications services purchase experiences are recently available online in the region of the research. Indeed, building on previous research by Giroux et al. (2019a), psychophysiological pain points (PPP) were used to measure the online emotional experience of consumer profiles based on particular individual psychological characteristics prior the interaction. Thus, our findings contribute to

understanding better how segments of online consumers experience emotional and behavioural reactions in a purchase process within an omnichannel environment.

Second, our work supports the role of the user experience dimension in an omni-channel context. Indeed, experiential value has been said to provide both extrinsic and intrinsic benefit in consumers' experiences (Babin & Darden, 1995; Batra & Ahtola, 1991; Crowley et al., 1992; Mano & Oliver, 1993). As consumers can seek extrinsic and intrinsic value in specific experiences, the intrinsic-driven experiences, derived from the experiential aspect of an interaction, will allow consumers to appreciate the experience for its own sake (Holbrook, 1994). Hence, the natural spectrum of experiential versus extrinsic value present within the three groups presented in this study stresses the importance of user experience design and research. As the competitive omni-channel environment pursues seamless and personalized experiences, our findings suggest a use for profiles in hope of developing intrinsic or extrinsic experience tailored to enhance the emotional experience in an online channel, ultimately leading to nudge behaviour of the consumer profiles of interest.

From a managerial point of view, our results show that by segmenting consumers with relevant individual characteristics before they enter in their purchase process, firms can tackle their frustrations and overall experience accordingly. In order to perform in an omnichannel environment, offering a personalized consumer experience allows for optimized seamless interactions since firms can mobilize and elevate the emotional experience. Considering the importance of personalization and the monitoring of consumer behaviour in omnichannel shopping, these results support the usefulness of user-centric data in order to understand the consumer and how to best address its needs and desires.

However, this paper has several limitations that need to be considered for follow-up studies. First, the sample size used for this study was following the recommendation from Lamontagne et al. (2019) to optimize the finding of most PPPs. Additionally, the research of Riedl, Fischer & Léger (2017) has shown that

research with psychophysiological measures commonly have fewer subjects due to the expensive resources required. However, the analysis performed did not involve neuro variables directly in the consumer segmentation. Indeed, statistical limitations were imposed as the sample size was under 30 and could be the source of our mixed test results. As to acquire more statistical validity and weight, reproducing the experiment with a larger sample size would allow for more statistical significance. The larger sample size would potentially grant a place to new consumers' groups. Indeed, differences, if any, in the emotional pathways of the groups could therefore be validated in order to further generalize these results to the consumer population.

Furthermore, there is also a lack of external validity in the settings, as the experiment was conducted in a controlled research lab, and only one type of online shopping experience was measured. Indeed, different emotions could have been triggered by the context and the intrinsic motivation of the participants, which could have an effect on the outcome (Yi & Davis, 2003). Hence, it would be interesting to replicate the study with different users to compare the results. Also, different industries could be used in measuring online experiences.

Finally, for experimental reasons, the subjects could not deviate from the final purchase. Further studies should aim to measure the complete omnichannel experience, to follow as closely as possible the real user journey through multiple channels.

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Appendix

Table 11. Mean scores and Std. Deviation for each variable tested for significant differences across three groups.

	"Detached" Group		"Passionates" Group		"Practicals" Group	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Path chosen	0.500	0.535	0.636	0.505	0.167	0.408
Distance to the first PPP	199.934	181.240	76.524	161.252	5.833	4.622
Distance to the most intense PPP	368.890	209.110	173.594	183.647	292.302	213.818
Total number of PPP	5.400	3.050	7.000	1.773	9.167	2.317
Reason to leave 1	0.286	0.488	0.455	0.522	0.500	0.548
Reason to leave 2	0.429	0.535	0.091	0.302	0.000	0.000
Reason to leave 3	0.143	0.378	0.182	0.405	0.333	0.516
Reason to leave 4	0.143	0.378	0.000	0.000	0.000	0.000
Reason to leave 5	0.000	0.000	0.000	0.000	0.167	0.408
Reason to leave 6	0.000	0.000	0.182	0.405	0.000	0.000
Reason to leave 7	0.000	0.000	0.091	0.302	0.000	0.000
Type of information 1	0.143	0.378	0.250	0.463	0.000	0.000
Type of information 2	0.167	0.408	0.125	0.354	0.000	0.000
Type of information 3	0.143	0.378	0.000	0.000	0.000	0.000
Type of information 4	0.000	0.000	0.250	0.463	0.500	0.577
Type of information 5	0.429	0.535	0.250	0.463	0.000	0.000
Type of information 6	0.000	0.000	0.125	0.354	0.250	0.500
Type of information 7	0.143	0.378	0.000	0.000	0.250	0.500
Category PPP: Navigation	0.400	0.548	0.250	0.463	1.500	1.378
Category PPP: Group / Distinction between items	0.600	0.894	0.125	0.354	0.000	0.000
Category PPP: Interface item	1.600	2.074	3.000	2.070	2.833	1.722

Category PPP: Protection against errors	0.000	0.000	0.500	1.069	1.167	1.169
Category PPP: Navigation (lost)	0.400	0.894	0.125	0.354	0.167	0.408
Category PPP: Explicit action	0.200	0.447	0.625	0.916	1.167	0.983
Category PPP: Comprehension	0.400	0.548	1.000	1.069	0.333	0.516
Category PPP: Flexibility	0.000	0.000	0.125	0.354	0.000	0.000
Category PPP: Marketing communication	0.200	0.447	0.125	0.354	0.333	0.516
Category PPP: Workload / Cognitive load	0.200	0.447	0.125	0.354	0.500	1.225
Category PPP: Group / Distinction by location	0.400	0.548	0.125	0.354	0.000	0.000
Category PPP: Workload / Concision	0.000	0.000	0.000	0.000	0.167	0.408
Category PPP: Information Density	0.200	0.447	0.250	0.707	0.000	0.000

Table 12. Screening constructs for recruitment

Screening Construct	Measure	Threshold
Regular Online Buyer	How often do you shop online? Never Rarely Sometimes Regularly	Sometimes

Interest in new telecommunication technologies	Would you say that you totally agree, somewhat agree, somewhat disagree, or strongly disagree with each of the following statements? ● I am learning very quickly to use the new technologies. ● I am fascinated by the technologies of the future. ● Initially, I do not have fears to use the new technologies. ● I have a great interest in the technologies that control the devices of the house via a smartphone, a tablet or a computer (camera, alarm, lighting, appliances, etc.). ● I am often aware of technological developments before they become popular. ● As soon as a technological innovation is introduced on the market, I am among the first to buy it.	One or less "somewhat disagree."

Table 13. Overview of construct used to collect data.

Construct	Definition	Measure	Moment of measure
Self-efficacy	From Bandura's definition of self-efficacy. Perceived self-efficacy is measured to better understand the users' perception of his own capacities.	Self-efficacy 6-items put in context of the task. On a Likert- 7 items scale: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Neither Agree Nor Disagree (4), Somewhat Agree (5), Agree (6), Strongly Agree (7).	Before the purchase—task

Purchase Involvement	Revised Personal Involvement Inventory is proposed by Judith Lynne Zaichkowsky (1994). The initial Personal Involvement Inventory (Zaichkowsky, 1985) was created to measure a person's involvement with a product. Shortened, the 10-item scale used in this study still allows to reliably capture the affective and cognitive components of involvement.	10-items bipolar affective states (1 to 10).	Before the purchase—task
Expectations	eTailQ is a general model of quality for online businesses. The condensation of 40 items into 14-item scale measures the factors at a global level. The scale grasps expectations of users' interactions with an online company. (Wolfinbarger & Gilly, 2003)	eTailQ 14 items On a Likert 7-item scale: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Neither Agree Nor Disagree (4), Somewhat Agree (5), Agree (6), Strongly Agree (7). • Fulfillment/ Reliability • Web Design • Security/Privacy	Before the purchase | task

		• Customer Service The categories' statements are detailed in table 14 below.	
Information type	In order to get participants level of understanding of the purchasing process, we interviewed them to dig into what additional information could have been provided in order for them to complete the purchase in a real-life setting. For those who answered positively, the additional information required would indicate a poor understanding of the purchase realized in an experiment context. In this case, the need for additional assistance, off—or online is predictable.	1- According to you, is there one or more moments in your career where you * would have needed more information than what you were given * to complete the purchase in a real context? 2- What kind of information would have helped you complete the purchase?	Post task: Categorization of the additional type of information required by participants who answered "yes" to the first question.
Multichannel preferences		Would you have preferred to complete the subscription purchase by other channels, such as by	Post task: Categorization of the reasons to leave the online channel to complete the

		phone or in a store? Why?	purchase via other channels (in-store or by phone)

Table 14. Statements of expectations construct detailed.

Expectations eTailQ scale	Fulfillment / Reliability	Website Design	Security / Privacy	Customer Service
Statements	The product that came was represented accurately by the website.	The website provides in-depth information	I feel like my privacy is protected at this site.	The company is willing and ready to respond to customer needs.
	You get what you ordered from this site.	The site doesn't waste my time.	I feel safe in my transactions with this website.	When you have a problem, the website shows a sincere interest in solving it.
	The product is delivered by the time promised by the company	It is quick and easy to complete a transaction at this website.	The website has adequate security features.	Inquiries are answered promptly.
		The level of personalization at this site is about right, not too much or too little.		
		This website has good selection.		

Table 15. Spreadsheets used to manually identify pain points per participant.

For a detailed methodology on pain points calculation and interpretation, see Giroux-Huppé et al. (2019). This table below depicts the list of pain points of interest and its associated information. The last row represents the interpretation

by the expert of the action or event occurring in the time frame (10 seconds before and after the precise pain points) of frustration.

Pain Point (1=Yes, 0=No)	Time (sec)	Time Tobii Studio (mm.ss)	Participant	Task	Pain point interpretation
1	1	0 m: 1 s	P08	Home	Click on the search icon (magnifying glass) and nothing happens
1	380.67	6 m: 21 s	P08	Account Set Up	After fixing a long time (big point on Tobii), finish writing the date of birth (the year)
1	503.84	8 m: 24 s	P08	Services Transfert	Look at 'television services' in Transfer Service
1	610.34	10 m: 10 s	P08	Payment	Click on the field 'Credit card number' in Pre-authorized payment
1	724.3	12 m: 4 s	P08	Confirmation	Go down to the confirmation page and look at the first bill (just before clicking the 'View Channels' button but nothing happened)

Chapitre 2 : Deuxième article
Measuring Users' Psychophysiological Experience in Non-linear Omnichannel Environment

Ariane Roy[1], Sylvain Sénécal[1], Bertrand Demolin[1], Pierre-Majorique Léger[1], Julie Gagne[2], Émilie Bigras[2]

[1] HEC Montréal, 3000 Chemin de la Côte-Sainte-Catherine, Montréal, Québec, Canada H3T 2A7

{ariane.roy, sylvain.senecal, bertrand.demolin, pierre-majorique.leger}@hec.ca

[2] Vidéotron, 612 rue Saint-Jacques, Montréal, Québec, Canada, H3C 1C8

{emilie.bigras, julie.gagne}@videotron.com

Abstract:

The objective of this research is to explore a methodological guide aimed at a better integration of user experience measures through the evaluation of the user's journey, while considering his omnichannel behaviour. This article presents an ecologically valid methodology that makes it possible to obtain the user's lived experience, on a continuous basis, despite the uniqueness of the steps undertaken up to the final goal as well as the physical aspect of the experience. The illustrative case used is a context of uninstallation and self-installation of telecommunications equipment for a new entertainment platform. Twenty-four subjects participated in a new physical user context and results demonstrate that this methodology is useful in measuring the overall user experience despite the challenges of physical interactions. This research provides guidelines about what could provide a standardize measure of user experience across all business channels available to users.

Keywords: User experience (UX) · Methodology · Psychophysiological measures · Psychophysiological pain points · User journey

2.1 Introduction

Technological objects are all around us by now. The Internet of Things phenomena, which consists of the vision where the Internet expands into the real world embracing every object, makes users' experience with technology an omnipresent affair (Mattern & Floerkemeier, 2010). This increase of technology in physical products constantly connects users to the digital world, as "smart" devices act as physical access points. Hence, users are able to react quickly in an automatic, rapid and informed manner to events in the physical world (Mattern & Floerkemeier, 2010). As a result, this poses new opportunities for companies to deal with complex situations, but also raises new challenges, especially in an omnichannel environment. Indeed, the omnichannel business approach refers to the alignment of a company's different channels into a consistent, seamless customer experience across all touchpoints (Verhoef et al., 2015). This management of business-consumer touchpoints sometimes implies the use of on— and offline channels at the same time. This simultaneous use of digital and physical world generates complex user journeys across multiple channels (Carroll & Guzmán, 2013). For example, one user can start their purchase journey with the recommendation of a friend, another with online research, or even from a company advertisement (Melero et al., 2016). Next, the user can go in-store to feel and touch the product, while comparing competitors' options online, to finally decide to complete the purchase on his mobile on his way home. After the reception of the product, the same user can go online to give his review and explore other online resources on how to best use the product. This type of complex behaviour raises the users' expectations for a personalized experience, mostly because whenever or wherever they interact with a touch point, they view them as the same entity. In order to deliver on this promise of a personalized, seamless and consistent experience across the overall user journey, there are needs for businesses to re-examine their operating model with insight-driven data (Carroll & Guzmán, 2013). Customer-centric research provides a way to understand and capture

consumers' demands and expectations for personalized and contextualized interactions by accessing, maintaining and combining meaningful customer data.

The field of user experience (UX) research is defined by the *International Organization for Standardization* as the set of user perceptions and responses resulting from the use or anticipation of the use of a system, a product or a service (International Organization for Standardization [ISO], 2018). User experience encompasses all consumer-firm touch points and interactions encountered within the user journey. Generally, to measure this experience, user testing has been mostly associated with online interactions. Indeed, UX professionals create tasks to replicate real interactions that are logically organized and monitor the user in this artificially rational process (Nielsen, 2012). In the assessment of this experience, most UX research focuses on explicit and self-reported measures, such as questionnaires and various constructs' scale. However, prior research also demonstrated that there is an important discrepancy between what users feel during the experience and how they recall it afterward (Cockburn et al., 2017; Eich & Schooler, 2000). As such, implicit psychological measures are favourable to overcome the potential self-reported biases (Léger et al., 2014). Indeed, cognition and affect are psychological constructs that have been proved to influence customer behaviour and customer experience (Bagozzi et al., 1999; Frow & Payne, 2007; Tynan & McKechnie, 2009). Recent research also demonstrated the effectiveness of implicit psychological pain points in insights during peak emotional responses in a user's experience. Implicit pain points are defined here as a moment, in reaction to an event during the interaction, during which the user experiences an automatic physiological activation characterized by a high level of emotional arousal and negative emotional valence (Giroux-Huppé et al., 2019). But to use psychological measures and tools, ecological validity is necessary and easier to ensure in an online experience, where the user does not have to move or to manipulate an object. In omnichannel shopping, however, as more frequent business-consumer interactions with technology take place within a physical context, challenges arise in measuring the emotional and cognitive user experience.

As the use of technological products in the complex user journeys has increased, both the physical and digital worlds need to be considered in measuring the customer's experience. Enabled by technology, users expect to interact with companies interchangeably across channels (Carroll & Guzmán, 2013). Consequently, consumers' path can be more or less direct, but the use of different channels within the same journey favour non-linearity. Their journey can encompass multiple much less predictable exits, even as consumers can circle back to previous choices and steps until their final purchase (Carroll & Guzmán, 2013). Hence, measuring customer experience requires to embody multiple sets of non-linear interactions. In a physical context of interactions, the uniqueness of the user's physical experience and the ecological validity issues have to be taken into account. Various methods already exist to measure customer journeys, but those methods rely mostly on retrospective measures, like questionnaires, interviews, or focus groups. For example, Customer Experience Modelling has been used in the service sector to gain an accurate picture of the whole customer journey, by exploring touchpoints sequence with customer-centric soft goals (Verma et al., 2012). Indeed, user journeys have been observed further in qualitative and retrospective assessments. However, previous research has shown that there are significant differences between users' emotional experiences and what they can recall afterward (Cockburn et al., 2017; Eich & Schooler, 2000; Giroux-Huppé et al., 2019). In order to mirror the actual complexity of the omnichannel customer interactions, a quantitative analysis must be combined with qualitative, judgment driven evaluations (Rawson et al., 2013).

In this article, we propose a methodology to collect and analyze insightful psychophysiological data in a non-linear physical interaction. We will use the case study of a telecommunication provider's equipment set up using implicit psychophysiological measures and explicit qualitative assessment. The task consisted of completing the un-installation and installation of technological equipment for cable and television services, with sole support of the instruction manual to replicate as close as possible the real-life context. We aim to measure the cognitive and emotional experience of a user in their interaction sequence from

uninstalling existing equipment to installing a new technological experience, using novel types of equipment in the telecommunication industry.

2.2 Description of the proposed methodology

The proposed methodology aims to overcome the different challenges raised by measuring user experience in physical interaction. Physiological measures, such as electrocardiography (ECG), respiration rate, skin-based measures (EDA), and psychological measures (EEG) allow a deeper understanding of the emotional and cognitive experience of a user without interfering with the interaction (Dufresne et al., 2010). Moreover, the use of non-intrusive psychophysiological measures provides the opportunity to test multiple aspects of an experience that cannot be accurately reported by the users at a precise moment in time. Many of those measures are related to the user experience field, such as valence, arousal, and cognitive load (de Guinea et al., 2009). However, the main disadvantage when using physiological tools is that their use requires great execution precision and minimum external noise, which are complicated to overcome in the case of physical interactions with technology.

First, the elaboration of the experimental design should help to identify some events of interest prior to the experiment. An event can be defined as an action or situation of interest expected to happen or that has happened during the interaction measured. Those events are the results of variations in constructs such as valence, arousal, and cognitive load. The value of analyzing events resides in the interpretation of concrete observations of the emotional and cognitive experience within a certain time frame in the overall interaction. For example, in a relatively linear website interaction, one can predict, prior to the test, that in order to complete a purchase (the final objective), the user will have to create an account first. Hence, the account creation step will be considered as an event and can be interpreted as a moment of interest in the evaluation of the emotional and cognitive user experience. The early identification of those events—i.e. defining tasks or subtasks—lightens the post-processing of the data and facilitates the

understanding of the context. Indeed, the events will also serve as markers and delimiters to the analysis of the psychophysiological metrics. Hence, those events should be aligned with the objectives of the research. It is highly possible that some of the defined events will require modifications or adjustments post-experience, but at least this pre-experience preparation gives a general guideline as to what should be closely observed and noted. However, it is possible that new events emerge during the experiment, hence the importance of observation.

2.2.1 Preparation

In order to protect the ecological validity of the study, the laboratory room needs to depict as close as possible the real context of the interaction. Laboratory settings can be stressful for some participants, therefore creating a familiar environment can help alleviate some of the experiment-related anxiety. In our case, as the most common area of telecommunication types of equipment installation is a living room, the laboratory room was adapted to imitate this type of setting for the participants to perform the tasks required. Thereafter, it is crucial to pretest the protocol of the experiment to ensure the quality of the data recorded but also that the tools used, and the tasks' steps order run fluently and consistently from one participant to another. For running experiences in physical contexts, we suggest pretesting the protocol with at least three participants, as improvements from the first one to the last will make this more complex experiment easier to run when collecting the real data.

Then, once the protocol has proved to run fluently, each experiment should be closely observed by researchers. Detailed note taking on any predetermined events of interest or on participants' actions should be recorded and kept clarifying, if need be, some context while viewing video recordings in the analysis phase. If possible, especially if more than two research team members are present during the experiment, identify and apply live markers in the recording software as the participants perform them—this can save a lot of time during the analysis phase. Depending on the context, posterior coding is preferable to protect the time

accuracy of the observation. Finally, it is important to take note of any new events that could emerge from observing each experiment, since it is unlikely that all relevant events are identified exclusively beforehand.

2.3 Illustrative case

2.3.1 Experimental procedure

The objective of this case is to demonstrate the feasibility of the proposed methodology. The context of this illustrative case is an auto-installation of a new entertainment platform using novel types of technological equipment. In order to acquire valid data, it is important to replicate the setting of real-life usage. In a laboratory setting, the participant completed the tasks in a room arranged to replicate as close as possible the living room environment of the installation. The laboratory setting allowed for a mirror room for researchers to observe and follow the experiment closely.

We anticipated an average of two and a half hours for each participant, including tool installation. It is important to be mindful of the length of the experiment to minimize the exhaustion of the participant. Indeed, participant's fatigue caused by the context of an experiment can skew the data and lead to biased conclusions. After all, our final sample consisted of 24 participants (10 women, 14 men). All participants provided signed consent. Participants recruited from research panels each received a card as compensation. This experiment was approved by the research committee of our institution.

2.3.2 Experimental tasks

The study was divided into five sub-tasks to successfully complete the installation, as shown in the instruction booklet support given to participants. In general, determining sub-tasks allows for more control over the potential non-linearity factor of any physical interaction. Indeed, dividing the ideal path to success into smaller steps will help to maintain the same user journey language throughout participants, and also facilitates the elaboration of a user's path to completion.

Finally, sub-tasks can also be used as event markers during or after the test, to dissect the overall task into several pieces. In our case, participants performed all five sub-tasks with the support of an instruction booklet:

- *Unboxing*: this task is the first step of the experiment and the first contact the customer has with the new product. Participants needed to take the equipment out of the delivery box.
- *Uninstalling*: this task is crucial to the process flow for a successful installation. Since the equipment already in place can be unique to each user, participants needed to follow the instructions carefully in order to take out the right cables and equipment.
- *Installation*: this task includes the installation of the two different pieces of equipment needed to fully assess the experience.
    - *Gateway*: the participant has to install this piece of equipment first, which allows access to an online entertainment platform and serves as a Wi-Fi device. Then, the participant would have to configure his personalized Wi-Fi in order for it to function adequately.
    - *Terminal*: the participant has to install this piece of equipment following the installation of the *gateway* in order to access the cable and available online programs on his TV(s).
- *Remote control configurations*: to finalize the installation, the participant has to activate the smart remote control equipped with a voice command. A pairing of the remote control and the TV is the last step to fully complete the installation.

The proper order of those tasks was as stated above in the instruction booklet. However, the participants were free to complete the auto-installation as they would at home. To keep the results as close as possible to reality, the only verbal instruction they were given is the following scenario:

"*Telecommunication provider X recently announced a brand-new experience with smarter Wi-Fi and a new world of entertainment. You contacted the customer service department and chose to include in your package a terminal and a Wi-Fi*

gateway. You have chosen to install your own devices to avoid paying the costs associated with the intervention of a technician. You have been told that you will need to uninstall your current devices, your Internet modem, your Wi-Fi router, and your illico TV, and then install your new devices. The order you just received by mail is on the table in the room. Besides, everything you need to uninstall your current devices and install your new devices are there too. Above all, do not hesitate to manipulate the material as if you were at home. You can use everything on the table and in the room, including the iPad that you can use as a mobile device. For the purpose of the exercise, this installation will be done using prototypes. As a result, some features may not be available, and some screens may be in English. It is also important to understand that it is not you personally that we evaluate, but the material that is put at your disposal to complete the task. There are no good or bad ways to do it. Try to act in the most natural way possible and be very comfortable if there are things you do not know or are unclear. Do you have questions before starting the test?"

The figure below provides an overview of the experimental procedure.

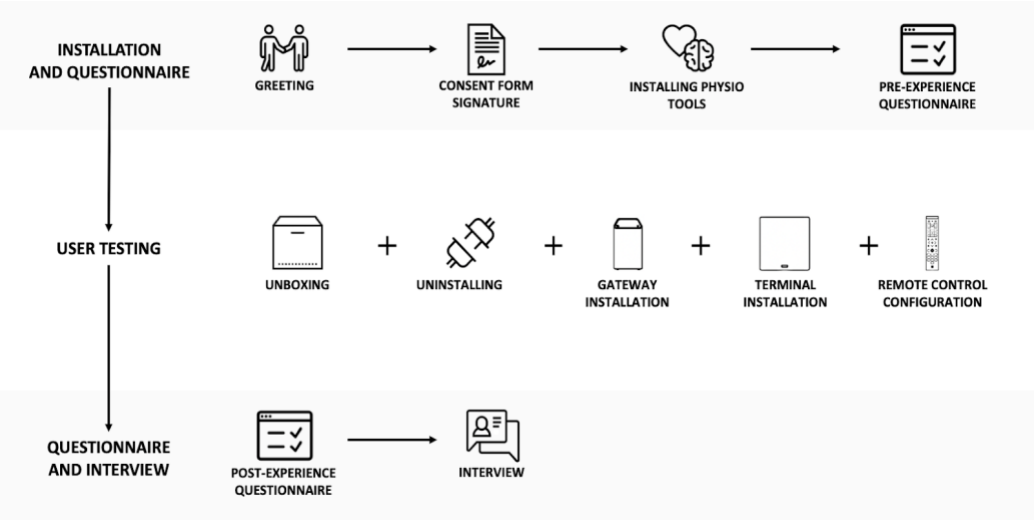

Figure 2. Procedure

Before the experiment, all events of interest identified with the help of the experimental procedure were codified into the behavioural and analysis software used, in our case we opted for Observer XT (Noldus, Wageningen, Netherlands).

We will use those events to average values of psychophysiological data in between each of them. During the experiment, the execution of those events can be done by pressing on the existing marker pre-coded when the participant reaches this event. However, when the interaction measured is exposed to non-linear steps in the journey, a manual codification of those events of interest can be done posterior to avoid errors.

2.3.3 Instruments and apparatus

A total of five cameras were placed around the experiment room to record movements from different angles. Those cameras not only facilitate the observation of the participant's reactions at every step of the experience but also allow to review all the actions that could be reported in synchronization with the other tools. Indeed, recordings grant a posteriori identification of the specific moments in time coupled with varying levels of arousal and cognitive engagement. Hence, the cameras ensure a safe recall option to complete the notes taken during the experiment if needed and also allow for researchers to have a more accurate view of the participant's actions even during the analysis phase.

In addition, an observation grid was used during each test for the note-taking of any noticeable events that occurred and any moments in time that might need revisiting later on.

All in all, the crucial objective of a wide range of camera coverage is to capture all the micro-actions performed by the participant while accounting for his movements through the room. While determining cameras' placement, it is crucial to choose adequately room locations where a sync markers' light would be visible to the researcher, to ensure the cameras are working properly throughout the experience. Indeed, the use of a sync light issued by all five cameras secures that all cameras start recording seamlessly, and that they function in sync during the whole experiment. In fact, the cameras should be synchronized using a sync box to facilitate the analysis. We followed Léger et al. (2014) guidelines for synchronization. The automatic data stream will allow additional precision when

placing markers in Noldus Observer XT (Wageningen, Netherlands) during the analysis phase.

Finally, the cameras were placed in strategic places to cover all the room's angles to the maximum extent (see figure below for an example):

- One camera on the ceiling over the unboxing table (initial place of the box)
- One camera on the ceiling, on the top of the coaxial wire (to see if fixated correctly)
- One camera on the wall to see the side of the television (to see the connection—the disconnection of wires)
- One camera below the TV furniture (to see from the TV the participants during the remote-control configuration)
- One camera on the wall in front of the TV (to see what was displayed)

Figure 3. One view of the experiment room

Besides, the use of a Go-Pro is optional but allows for more precise visuals on participants' manipulations. The Go-Pro can act as a zoom on an event of interest that can be too subtle for long-range camera recording. Depending on the objects of interest to observe, the Go-Pro can simply be strapped around the participant's chest, since the EEG helmet prevents the support of any other devices on the participant's head.

2.4 Research variables

2.4.1 State Factors

This illustrative case focuses on three physiological state factors: arousal, valence, and cognitive engagement. Users' emotions are considered an important factor in their experience, since the emotional evaluation of that experience allows them to compare possibilities (Russell, 2003) and substantiate future behaviour (Hassenzahl, 2013).

Valence

Emotional valence can be defined as "the value associated with a stimulus as expressed on a continuum from pleasant to unpleasant or from attractive to aversive" according to the APA Dictionary of Psychology (Online APA Dictionary of Psychology, 2020). Emotions are of interest since they are an omnipresent part of consumers' decision-making and behaviour. Measuring the emotional experience of a user allows for the identification of unwanted negative emotional states.

Arousal

Arousal refers to the user's emotional state indicating physiological activity (Deng & Poole, 2010; Russell, 2003). A measure of a user's arousal will allow to nuance its affective state, since different level combinations of valence and arousal lead to diverse states, for example, a positive valence with high arousal (happy) will be different than a positive valence with low arousal (pleasant).

Cognitive Engagement

Cognitive engagement refers to the mental effort required to carry out certain tasks (Fredricks et al., 2004). In this experiment, participants are to achieve goals, such as the installation. Fredericks et al. showed that cognitive and metacognitive strategies are crucial to achieve the aforementioned goals (Fredricks et al., 2004). Namely, metacognitive strategies refer to the setting and planning of goals when performing a task. Hence, cognitive engagement can influence how the user will employ the best strategies to install the new electronic devices.

2.4.2 Attitudinal factors

Attitudinal factors can be examined in relation to variations in emotional experiences. For example, Maunier et al. (2018) explored the level effect of valence, arousal and cognitive engagement on the impact of success rates during a task. Attitudinal factors can be used as discriminant elements that can explain variation in a user's emotional journey. This illustrative case focuses on two attitudinal factors that could be of interest in measuring the emotional and cognitive experience of a user: self-efficacy and task success.

Self-efficacy

Perceived self-efficacy is concerned with people's beliefs in their capabilities to produce given outcomes (Bandura, 1997). Indeed, self-efficacy plays a key role in the likeliness of task accomplishment. Previous research suggests that individuals with a high level of self-efficacy think they possess the capacity to succeed in specific tasks (Walker et al., 2006). Consequently, individuals who believe they are self-efficient at completing a task will in fact generate the necessary efforts to succeed (Bandura, 1993).

By using a theoretical scale construct like self-efficacy, the performance results of the study can be separated into groups based on the high and low levels to examine significant differences between groups, if any. Given the usefulness of a theoretical construct, it is relevant to find previously established constructs and measurement scales, appropriate for the research objectives. Indeed, this will

favour more insights in analysis, as it can support the interpretation of the experiment's results. Especially within studies involving a spatial context, attitudinal measures can help understanding and explaining the sequence of actions undertaken by the participant.

Moreover, experts suggest that combining complementary methods of assessment offers a deeper understanding of user experience, while adding implicit measurement, such as physiological tools, allows for a more rigorous measure of the participant's emotional journey (Bigras et al., 2018). In other words, measuring emotions through a physiological measure provides the advantage of being accurate, precise and relatively easy once the equipment is acquired (Bradley & Lang, 1994). However, emotional reactions to events are more often than not subjective to each individual. Self-reporting measures of emotions, like the Self-Assessment Manikin (Bradley & Lang, 1994), can also be administered to be able to see the personal differences across participants. Therefore, using additional self-reported behavioural measures will nuance the physiological data collected. In this particular experiment, the measure of a self-reported scale like self-efficacy verifies if there is a significant variation in arousal and valence between the participants with a high self-efficacy and those with a low one. This finding can be impactful for future considerations in the product and service development of the telecommunication provider.

Success Variable

To evaluate the success of each user's path, which could be different from one another, we developed thresholds of success for each identified task. Installation task success was measured using sub-tasks success thresholds (such as the completion of the task, the appropriate installation of the wire connections, the firmness of the cable fastening). Thus, overall success was achieved when the participant completed the installation with few or no mistakes. The figure below provides the success criterion for each sub-task.

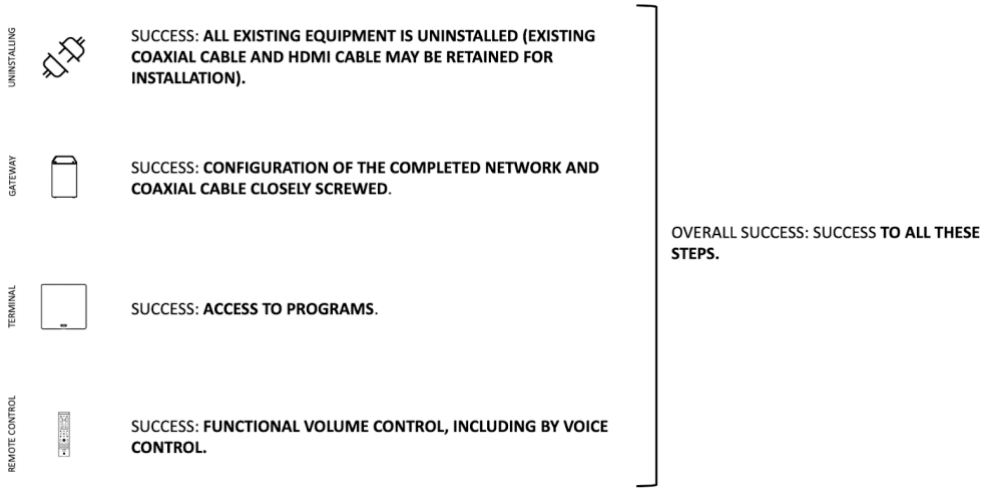

Figure 4. Measure of success

2.5 Measurement

2.5.1 Psychophysiological measures

In order to accurately measure users' reactions and behaviours, it is crucial to choose measurement tools that are adequate for a moving subject. Aligned with the objectives of the experiment, psychophysiological measures were used to capture participants' emotions, arousal, and cognitive load (Riedl & Léger, 2016).

A precise measure of arousal is needed to assess a quantitative activation level of emotion, from not aroused to excited. For this study, arousal was measured using the electro-dermal activity with the Acqknowledge software (Biopac, Goleta, USA) as pictured in the figure below. Sensors (BIOPAC, Goleta, USA) were applied in the palm of the hand of participants to measure skin conductance during the experience.

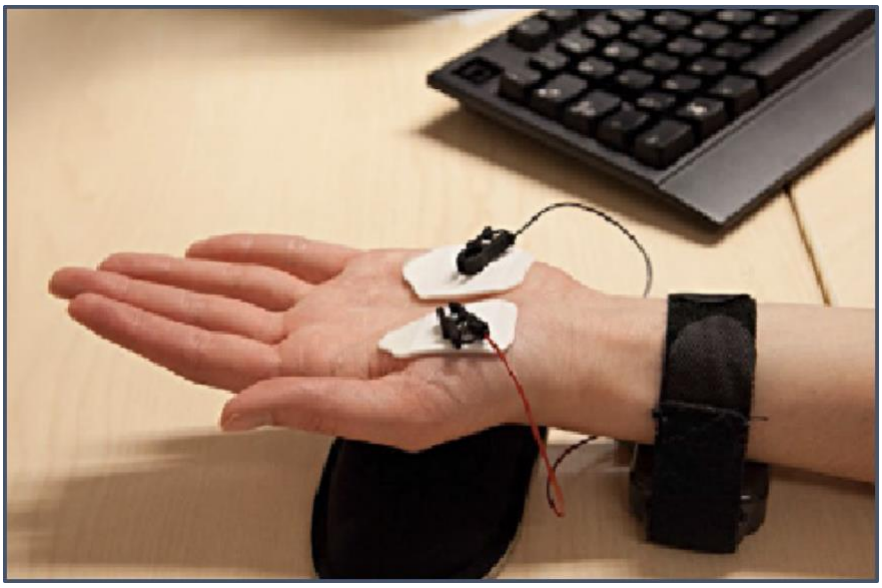

Figure 5. Measure of electro-dermal activity using the Acqknowledge software (Biopac, Goleta, USA), with sensors in the palm of the hand

Valence is typically measured through facial expressions (Ekman, 1993), as micro-movement on the user's face can be detected using a video webcam. However, the constant movement of participants does not allow for a precise facial detection, hence valence and cognitive load needed to be measured with tools that can easily move with the participant. As such, a wireless EEG cap (Brainvision, Morrisville, NC) was used, which allows to detect "inner" emotions and cognitive load, as shown in the figure below. The mobile EEG cap contains 32 Ag-AgCl electrodes and an amplifier (Brainvision, Morrisville, NC), and was used to measure variations in brainwave activity in the θ (4–8 Hz), α (8–12 Hz) and β (12–30 Hz) bands, isolated by a bank of filters. Previous research has also used EEG signals to detect emotions (Maunier et al., 2018; Chanel et al., 2007; Brown et al., 2011) and to collect cognitive load data (Teplan, 2002; Anderson et al., 2011; Park et al., 2014; Maunier et al., 2018).

Figure 6. Installation of an EEG cap (Brainvision, Morrisville) used for recording brain waves activity.

2.5.1 Psychophysiological pain points

Among the different models of emotion classification, the research by Russel (1979) proposed the use of a two-dimensional Arousal-Valence model, where pleasure-displeasure and level of arousal are sufficient to represent a wide range of emotional states (Russel, 1979). As such, the implicit pain point identification method used in this article allows arousal, cognitive load, and valence data to be triangulated into specific points in time that we can identify as implicit psychophysiological pain points (PPPs) (see figure below). An implicit psychophysiological pain point can be defined as a precise moment in time, when the user both feels a high level of emotional arousal and negative emotional valence, compared with his baseline state (Giroux-Huppé et al., 2019). However, PPPs are easier to diagnose in an online interaction context since recordings of the interaction are clearer to interpret via a 2D screen recording. In fact, identification

of precise points in a user's journey using mouse movement is more straightforward than with physical actions performed by moving subjects.

Consequently, the objective of PPPs in this experiment would relate to portray users' emotional frictions throughout the tasks of the physical experience to avoid relying solely on emotional memory recall (Cockburn et al., 2017; Eich & Schooler, 2000), as shown in figure 7. The main actionable insight of PPPs analysis is the possibility to rectify and optimize the experience to promote users' autonomy during any interaction. Frustrations along the user journey can serve as optimization's starting points in the physical interaction stage with a new technology, where the quality of the first experience can be a crucial determinant of future usage and adoption. Indeed, an unpleasant first experience can have negative consequences for the user's experience and perceptions of the brand (Brakus et al., 2009). Therefore, PPPs can be used as a preventive tool to ensure satisfaction and future usage.

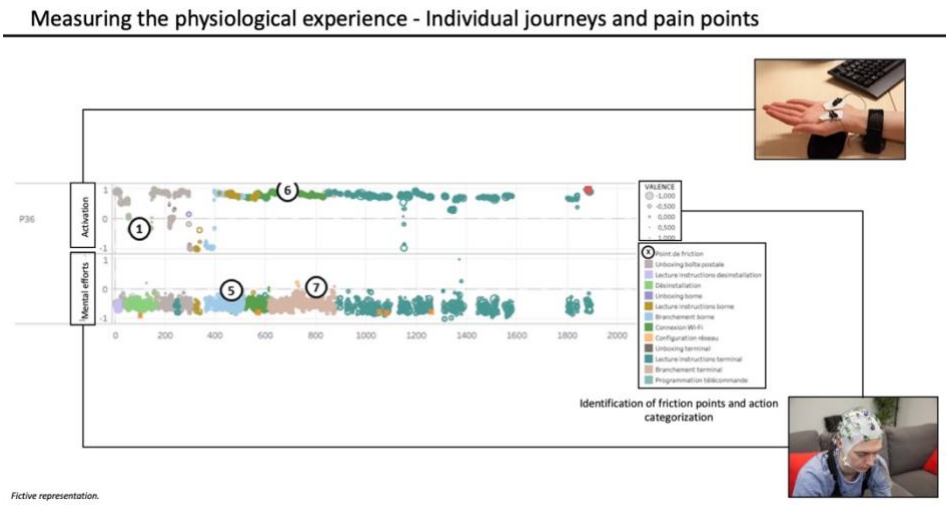

Figure 7. How to mobilize physiological data into pain points

2.5.3 Psychometric Measures

Perceived self-efficacy was measured via questionnaire before and after the experiment, to evaluate any discrepancies that can be linked to the effects of the

tasks performed. A 6-item measure was used to assess perceived self-efficacy construct (Sherer et al., 1982).

2.6 Analysis

Once the data collection is completed, an extraction of the data is necessary to proceed to the analysis phase. Depending on the software used to collect the data, this step will be different; see the software provider's specific instructions to ensure an optimal extraction. Once all the recordings and the psychophysiological data are exported into separate files under the participants' number (i.e pXX), the first step consists of viewing the video recordings in a behavioural coding and analysis software (we maintained the use of Noldus Observer XT) in order to place the proper markers, which correspond to the event of interests previously established. To avoid multiple rounds of review, it is essential to examine the notes taken during each experiment to see if any new events should be added to the existing list entered before the beginning of the experiment. If this is the case, new event markers should be added into Noldus Observer before the viewing process.

Then, once all the markers are in place in each participant's recording file, it is easier to code each of them with the different views offered by the five angles of the cameras. The markers always need to have a "start" and an "end," in order for the analysis to be performed accurately. Precision is key in this process, since coding errors in the timeline could lead to false results and interpretation. It is also crucial that every marker is properly coded into each participant's file (if the case may be) before extracting the data for further analysis.

In addition, all events of interest, including the tasks, coded into the software will allow for an interpretation of the physiological data in time. The next step in the analysis process is to transform the physiological data to allow their use in the interpretation of the participants' emotional and cognitive experiences.

2.6.1 EEG-Based Emotion Recognition and Cognitive Load

In order to extract the valence and cognitive load of the raw data files, cleaning of the files is needed. We used the NeuroRT software (Mensia, Rennes) to analyze the EEG data. The acquisition rate was 500 Hz. The following steps were performed: decrease the acquisition rate up to 256 Hz, filters 1–50 Hz, cleaning the ocular artifacts with the help of source separation, re-referencing to the mean reference and artifact detection by calculating the Riemannian distance between the covariance matrix and the real-time mean. Then, we apply a MATLAB transformation to clean the data using ASR. It is important to verify after the cleaning that no critical channel was lost. After a cleanse of the raw files, we export the clean data into NeuroRT Studio to pass it into a pre-existing general EEG pipeline. Cognitive load was calculated as a ratio using (power) $\beta/(\alpha + \theta)$ from F3, F4, O1, O2 on the international 10–20 system, following procedure from Pope (1995). Valence, collected by EEG technology, will be detected as follows: "Valence: positive, happy emotions result in a higher frontal coherence in alpha, and higher right parietal beta power, compared to negative emotion" (Bos, 2006). Once the process stops, a ".csv" file should be ready to import into the next step, a triangulation software.

2.6.2 Identifying Pain Points

Once each physiological data file is properly transformed and the recordings are properly set with the relevant markers to speed up the visualization and interpretation steps, we have to prepare the necessary data files to allow for a triangulation of the separated data files into a valuable and understandable output. We previously developed a methodology to be able to easily find the implicit frustrations in a user journey (Giroux-Huppé et al., 2019). We will use the same method here to be able to identify more accurately the difficulties faced by users in physical interaction.

Comparing their psychophysiological journey will make it possible to see where there are similarities and common challenges, even if their journey can be very different. PPPs method aims at identifying specific micro-moment frustrations that

users are not able to recall precisely when asked after the task is completed (Giroux-Huppé et al., 2019). Therefore, the frustrations in time create additional insights on the user journey in a more challenging physical context and grants a deeper understanding of users' emotions. To facilitate PPPs triangulation and identification, CubeHX software was used (Courtemanche et al., 2019; Patent US10,368,741 B2, 2019), which is a cloud-based lab management and analytics software for triangulated human-centred research (Léger et al., 2019). This software used to triangulate all the data accumulated during the experiment generates outputs of UX attentional, emotional, and cognitive heat maps, and can also export to statistical packages from one or multiple projects (e.g., cross-project analyses, compatibility with third-party visualization software, i.e. Tableau software) (Léger et al., 2019).

Concretely, calculations of pain points are performed using a specific threshold, built on previous research, with the statistical software SAS 9.4. In this context, to be qualified as a pain point, the data point needed to be both in the ninetieth percentiles of EDA (i.e., high arousal) and in the tenth percentile of valence (i.e., large negative valence) (Giroux-Huppé et al., 2019). Once a list of all the PPPs experienced throughout the experiment's relevant time frame is generated, the researcher has to manually identify and interpret the users' actions during the window of time when the pain point occurs. To ensure a precise interpretation, unique micro-moments pain points can be regrouped into pain points moments if they are consecutive seconds apart. Using the same software for video recordings' viewing (Noldus Observer XT), one must put himself in the shoes of the participant by reviewing, using the different angles of the multiple cameras, the moments when each of the points of friction is experienced (±10 seconds before and after the precise time listed to gain context). Having the same researcher interpreting all the pain points moments will limit labelling errors. To compensate for research bias, another researcher can then perform the same exercise separately and a combination of the two labelling lists can allow for a more reliable classification (see appendix table 29 for an example). Whenever there is a discrepancy of interpretation, a third researcher should do the same exercise, as to

serve as a decisive interpretation. Once the micro-moment regrouped into pain points moments and interpreted, they can be classified and arranged into similar categories across participants, as to improve the actionable insights from a high-level overview instead of on a per participants level (see appendix table 20 for an example). Precise interpretation is central to benefit from decoding the root of the frustrations, and the regrouped categories of pain points are an easy and understandable way to present the problems to the rest of the research team and to high-level management.

To summarize the analysis performed, the table below offers a summary of all physiological tools and software used for recording and analysis in this illustrative case.

Table 16. Tools used for every step of data collection, cleaning and analysis.

Procedural Steps	Tool used	Construct and measures
1. To capture the data 1.1 Cameras	Cameras, GoPro	Automatic data stream synchronization (using sync markers from sync box)
1.2 Cognitive load (EEG cap)	NeuroRT software (Mensia, Rennes)	Brainwaves activity
1.3 Arousal	Acqkowledge software (Biopac, Goleta, USA).	Electro dermal activity
2. Synchronization of the data	Observer XT (Noldus, Wageningen Netherlands)	Behavioural coding and analysis post-experiment
3. Triangulation of the data	Cube HX (Noldus, Wageningen Netherlands;	Triangulation of all scientific data to "generate attentional, emotional, and cognitive heat maps; Generate global experience map; Enable longitudinal and multiple project analysis; Export to statistical packages from one or multiple

	Patent US10,368, 741 B2, 2019)	projects (e.g., cross-project analyses, compatibility with third-party visualization software, i.e. Tableau software)" (Léger, 2019)
4. Analysis of the data	SAS (Cary, USA) or SPSS (Chicago, USA) or Tableau® (California, USA) or any data processing software	Identification of psychophysiological pain points (using a specific threshold)
5. Visualization of the data	Tableau® (California, USA)	Individual journey maps Comparison of different participants' journeys

2.7 Results from the illustrative case

2.7.1 Visualization of users' emotional journey

Once all the psychophysiological data treated, we may be able to build user experience journey maps and identify the different pain points in a more visual way. In addition to the interpretation of each moment of frustration, another mobilization of users' intense frustration is the visualization of PPPs across the tasks in the form of journey maps (see figure 8). Timeline visualization of PPPs allows the researchers to gain a deeper understanding of the participants' emotional journey. Using Tableau® (California, USA), individuals' journey maps coded with the sub-tasks simplify the recognition of the most problematic tasks or subtasks but also the most critical implicit pain points in time (see figure 8).

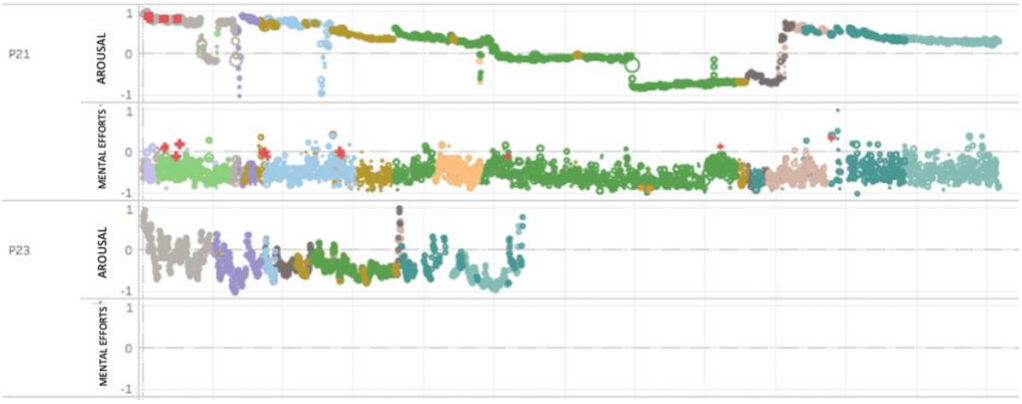

Figure 8. Visualization of the psychophysiological user journey by task with clear pain points moments identification (red dots)

As figure 9 below shows, the coloured circles on the following cards illustrate all the different psychophysiological points in time through tasks undertaken by participants. Second, the user's moments of frustration are illustrated by the red colored points. The size of the circles represents, from the smallest, a lower intensity PPP to the largest, most intense PPP. Finally, the scale on the y-axis represents the user's activation and cognitive effort from the lowest to the highest. The x-axis represents the timeline of each task performed per participant. The most intense or most frequent moments of frustration can then be visually prompted by a legend similar to figure 9. This way, one quick look at the journey map can reveal the unique emotional journey of each participant, as well as how the moments of frustration unfold through the task completion.

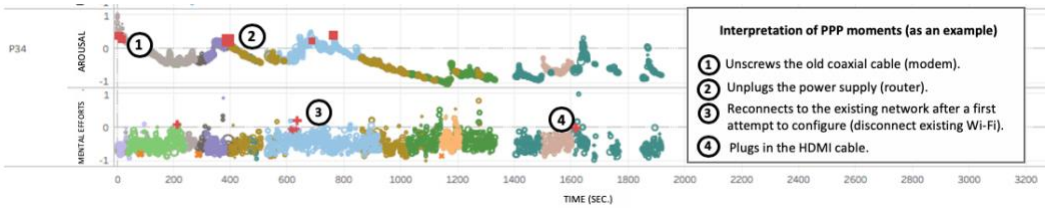

Figure 9. Visualization of an individual psychophysiological user journey by task with pain points interpretation

This visualization of an emotional journey has multiple advantages granted by its comparison elements. First, it is easy to compare users' journeys with each other for the same task (see figure 10), thus being able to tell a real story for each

identified user. Common difficulties can be identified and classified with users' same frustrations, therefore emphasizing the need for a change in the experience process. Second, users' journeys can be compared with competitors,' in order to benchmark the emotional experience across different approaches or paths of a similar product or service. Within the same test, participants can be asked to perform a similar task with two different products or websites, then the intra-subject data can be used to assess opportunities originated by the comparison of a competitor's experience. Third, the users' journeys can also grant an overview of the sub-tasks' effects on a user's emotions. Certain sub-tasks can create more accumulation of frustrations than others, hinting at the source of problematic instances instead of re-evaluating the whole journey process. Finally, the visualization of the users' physical journeys can serve as a common tool to evaluate user experience across all touch points. Ultimately, the emotional and behavioural journey of users can be compared equally across each channel, no matter their nature.

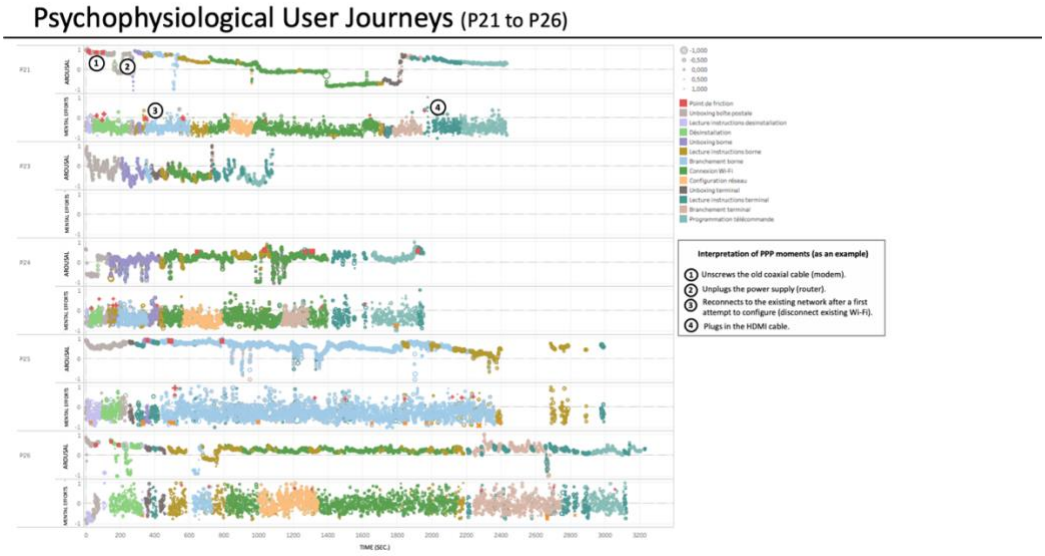

Figure 10. Complete visualization of the psychophysiological user journey for different participants (example)

2.7.2 Complementarity of quantitative and qualitative data

The use of physiological data and retrospective measures allow a more complete understanding of the users' experience with the technology. Self-reported measures are an interesting addition to physiological measures, because they allow to see if there are any differences between groups of different attributes. For this study, self-efficacy was used in the elaboration of two different groups, low and high self-efficacy, to test for any significant differences in overall success rates between the two groups. As portrayed in table 17, no statistically significant difference was found between the high and low self-efficacy groups. However, results lean towards an overall higher success rate for the low self-efficacy group.

Table 17. Difference in success rates between high and low self-efficacy groups

		Average Success Rate (%)	Wilcoxon Sum Rank Test Two-tail p-value
Groups	Low self-efficacy group	69%	0.675 (NS)
	High self-efficacy group	55%	

Furthermore, as self-efficacy was measured before and after the experiment, it can be useful to uncover any significant differences. As shown in table 18, participants significantly felt more confident about their own capacities after they accomplished the task. Such findings could imply that the task has some empowerment implications and could encourage users to do it again.

Table 18. Difference in average self-efficacy before and after the task

		Average Score (scale 1 to 7)	Wilcoxon Signed Rank test Two-tail p-value
Individual	Self-efficacy pre-experience	4.5	0.0011*
	Self-efficacy post experience	5	

*p<.05

Moreover, as represented in figure 11 below, the success variable was used as an overall presentation of the journey flow undertaken by all the participants. This variable can support the identification of problems in the subtasks by comparing success rates across the journey. This refining of the overall task is useful for constructing a step-by-step success map. Compared with the emotional journey, similarities between the two journeys are raised to strengthen the insights uncovered.

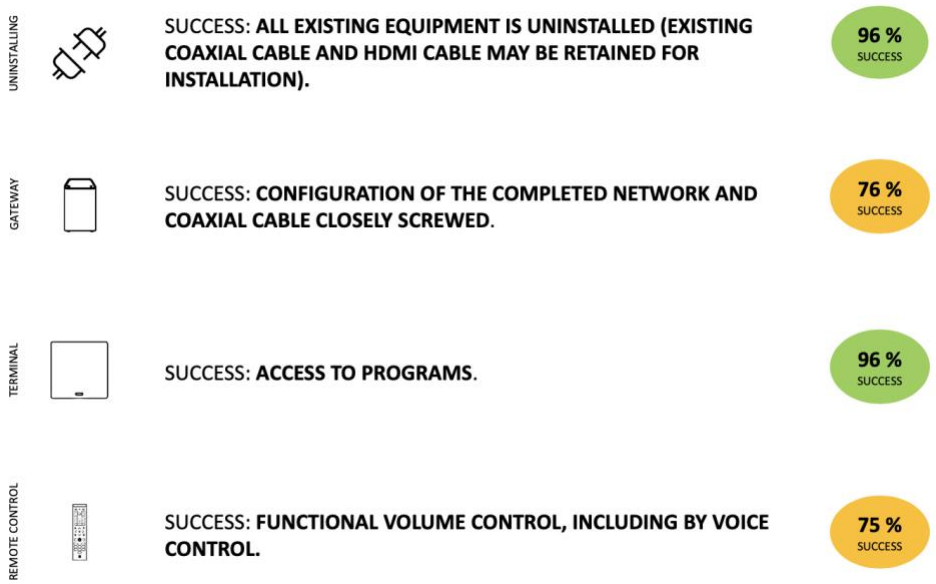

Figure 11. Illustration of quantitative measures of success

All in all, each additional retrospective measure included in the study must have relevant insight potential, even if the proposition is not sustained after the analysis. The combination of psychophysiological, behavioural and psychometric measures provides, beyond insights about task successes, a complete picture of emotional and cognitive influences and impacts on the user experience.

2.8 Discussion and conclusion

The simultaneous use of physical technology (e.g. mobile phones) and online resources (e.g. websites) in various day-to-day activities call for a closer exploration of each user interaction with a brand. As user experience is a

consolidation of all consumers' touch points throughout its journey, tangible interactions with technology is to be of interest. As the omnichannel approach suggests, a unified experience has to be maintained across all touchpoints (Verhoef et al., 2015). Despite the need for consistency across channels, there was still no established methodology, to our knowledge, to measure and compare user experience across both on—and offline interactions. Indeed, frequent switches between offline and online touchpoints result in higher complexity of user journeys. The combination of interactions can almost be unique to each consumer, with various exit points in their journey as they want to compare other options, retrieve more information and then as they circle back to previous choices (Carroll & Guzmán, 2013).

This article presented a methodology better suited to measure users' experience in the omnichannel environment. Through psychophysiological variables and self-reported metrics, this article serves as a comprehensive methodological approach for experts to have a precise overview of the emotional journey of consumers. Overall, we succeeded in demonstrating the interest of this methodological approach through an illustrative case study.

Indeed, the methodology we proposed for measuring physical interaction can allow businesses to evaluate with precision in-store experiences as well as face-to-face interactions. Consequently, our case study demonstrated that the measure of user experience has to include a fair assessment of emotional and behavioural influences, impacts or consequences across all touch points, regardless of the online-offline element. Despite the cost of resources to run an experiment with moving subjects, the methodology presented shows a potential for faster and more accurate identification of dissatisfaction and intense frustrations is a tremendous competitive advantage for companies.

Although the usefulness of the proposed methodology is clear, it is still the first exploration into the preservation of ecological validation in a physical interaction study. A few recommendations are stated for replication intention or future research. First, we recommend pretesting the whole experiment until the protocol

runs seamlessly and the quality of physiological data recorded is high. By doing so, we make sure the synchronization of the data is adequate, and the noise is reduced to the minimum. Since the methodology proposed requires the mobilization of EEG data, we suggest having individuals with cognitive science expertise or previous experience with EEG technology within the team. This will facilitate the execution of the tests but also ensure the quality of the data during the data collection and analysis. Also, it is important to consider that although it is a systematic approach, there is still a human factor embedded in the analysis process, in order to identify and interpret psychophysiological data. Hence, it is critical to be mindful of potential interpretation biases. We suggest relying on consistency throughout the analysis by ensuring that the same researcher performs all analysis interpretation first (event coding, pain points analysis), and then repeating the process with another researcher to compare interpretation results. In addition, it is recommended to keep the analysis period short in order to avoid bias or memory loss that can happen when there are long periods of inactivity.

As businesses tend to be competitive on all channels, modern consumer behaviour urges companies to approach commerce in an omnichannel way. The user experience does not end when the purchase is completed on the website and is rather an ongoing process of interactions with the physical product or service, before and after. It is usually difficult to measure the interaction with ecological validity in a non-linear physical experience because of the noise created by the subject's movements. This article proposed a complex yet simple methodology that allows for researchers to grasp the users' experience using a combination of psychophysiological metrics and qualitative data, despite barriers such as movements, bias, and noise. The proposed methodology allows for companies to optimize and cultivate a relationship with the user throughout the channels, identify opportunities within the interactions, and correct service failures even outside the Internet world. As utilisability testing prevents missteps that could be fatal to the user-business relationship, it is of equal importance to consider the physical interactions with the technology, pre-and post-purchase. Indeed, all interaction, no matter their nature, can have an impact on users' future usage and

satisfaction. This new approach consolidates user-centric data, as well as a multi-method evaluation of user experience to be applied in each step of a consumer journey, from their search of information to their unboxing at home. Not to mention that conducting valuable user testing, even in physical contexts, can assure a constant experience quality in an increasingly omnichannel world, without compromising the ecological validity of the experiments.

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Appendix

Table 19. Extract of PPP's lists with interpretations

participant	task (markers)	eda	engage	valence	pain_va	pain_vch	pain_vcl	time		time_observer	ACTIONS
P05	reading uninstalling instructions	14.3	0.6187	-2.5282	1	0	0	42866	0 m: 43 s		Free his hand holding the instructions to take the box out of the big box
P05	reading uninstalling instructions	14.2	0.589	-1.6875	1	0	0	43866	0 m: 44 s		Free his hand holding the instructions to take the box out of the big box
P05	reading uninstalling instructions	13.8	0.7644	-1.6586	1	0	0	51866	0 m: 52 s		Stop moving to read instructions
P05	uninstalling	2.96	0.9449	-1.7526	0	1	0	1E+05	1 m: 56 s		Difficulty disconnecting the coaxial cable
P05	uninstalling	3.37	0.9698	-1.7827	0	1	0	1E+05	1 m: 57 s		Difficulty disconnecting the coaxial cable
P05	gateway connection	2.6	0.8756	-1.682	0	1	0	4E+05	6 m: 51 s		Finished plugging in the terminal
P05	reading terminal instructions	2.69	0.8756	-1.682	0	1	0	4E+05	6 m: 51 s		Finished plugging in the terminal
P05	WIFI connection	8.42	0.3267	-1.6794	0	0	1	7E+05	11 m: 38 s	1012	Check if the iPad is connected to Wi-Fi on Safari
P05	network configuration	8.42	0.3267	-1.6794	0	0	1	7E+05	11 m: 38 s	1012	Check if the iPad is connected to Wi-Fi on Safari
P08	uninstalling	9.51	0.7617	-1.8011	1	0	0	49733	0 m: 50 s		Reading instructions to unplug terminal
P08	unboxing mailbox	9.46	0.7617	-1.8011	1	0	0	50000	0 m: 50 s		Reading instructions to unplug terminal
P08	uninstalling	9.48	0.7856	-2.1207	1	0	0	50733	0 m: 51 s	506.07	Reading uninstall instructions
P08	unboxing mailbox	9.52	0.7856	-2.1207	1	0	0	51000	0 m: 51 s	506.07	Reading uninstall instructions
P08	uninstalling	9.83	0.7276	-1.388	1	0	0	54733	0 m: 55 s		Seeking how to remove the cables from the terminal
P08	unboxing mailbox	9.83	0.7276	-1.388	1	0	0	55000	0 m: 55 s		Seeking how to remove the cables from the terminal
P08	uninstalling	7.88	0.6017	-1.3437	0	0	1	1E+05	2 m: 2 s	577.07	Reading uninstall instructions
P08	unboxing mailbox	7.85	0.6017	-1.3437	0	0	1	1E+05	2 m: 2 s	577.07	Reading uninstall instructions
P08	unboxing mailbox	6.92	0.5775	-2.7439	0	0	1	2E+05	3 m: 50 s	685.07	Removes an extra cardboard box
P08	unboxing terminal	7.1	1.5311	-2.1849	0	1	0	3E+05	5 m: 41 s		Seeking where to put the box on the floor
P08	unboxing terminal	4.92	1.4552	-1.3282	0	1	0	8E+05	12 m: 57 s		Look at the terminal code to enter on the iPad
P08	WIFI connection	4.89	1.4552	-1.3282	0	1	0	8E+05	12 m: 57 s		Look at the terminal code to enter on the iPad
P08	network configuration	4.88	1.4552	-1.3282	0	1	0	8E+05	12 m: 58 s	1233.07	Between the infos for connection to the network (before configuration)
P08	unboxing terminal	5.71	0.6287	-1.4818	0	0	1	9E+05	15 m: 37 s	1392.07	Between the infos for connection to the network (before configuration)

Note:

Time 0 = first marker of the first task (except baseline) for each participant.

pain_va	Low valence + high activation (EDA)
pain_vch	Low valence + high engagement (EEG)
pain_vcl	Low valence + low engagement (EEG)

ACTIONS red	Coded by X
ACTIONS bla	Coded by X

Table 20. Interpretation of pain points moments (final categories)

Tasks (markers)	Occurrences/Number of participants	Interpretations
gateway connection	p09/p32/p34	Coaxial connection
gateway connection	p25	Power connection
gateway connection	p36	Storage of two additional cables (useless)
terminal connection	p16/p32/p36	Connecting the power cable and choosing the outlet
terminal connection	**p32/p34/p09/p10/p11/p16/p25/p26/p27**	**Connecting HDMI cable**
network configuration	p08/p24/p33	Between the infos for connection to the network (before configuration)
WIFI connection	p05/p11/p17/p20/p36/p09	Verification and delays of the Wi-fi connection
WIFI connection	p09/p11/p24	Between the CDM written under the terminal
uninstalling	p05/p26/p32/p36/p29	Disconnecting the coaxial cable (Terminal)
uninstalling	p09/p20/p29/p32	The location of the terminal below the TV seems to be a point of friction
uninstalling	p10/p12/p21/p34	Unplugging the router (power supply)
remote control programming	p10/p11/p24/p26/p32	First use of the remote control (voice command)

Legend	
	Rare occurrences - Low priority
	Low occurrences - Worth exploring solutions
	Frequent occurrences - Severe problems
	High occurrences - Must optimize

Conclusion

L'objectif de ce mémoire était d'explorer le parcours émotionnel et comportemental des consommateurs omnicanal. En effet, ce mémoire visait à approfondir la compréhension du comportement consommateur en étudiant l'influence des antécédents et conséquence des attentes, compétences et engagement sur la perception et les émotions de l'utilisateur lors d'une interaction. Plus précisément, ce mémoire a offert des pistes méthodologiques et pratiques afin d'aligner davantage la complexité grandissante des parcours consommateurs avec les mesures d'expérience utilisateur dans le but d'optimiser cette dernière.

Deux expériences en laboratoire ont été réalisées pour atteindre cet objectif, avec un total de 24 et 26 participants, respectivement. La première étude est une installation d'équipements de télécommunication dans un espace physique, nécessitant que les participants désinstallent d'anciens équipements pour auto-installer une nouvelle gamme d'équipements pour le câble et l'Internet. Les mesures psychophysiologiques et rétrospectives recueillies dans cette étude servaient à établir une méthodologie écologiquement valide. Cette méthodologie permet de comparer l'expérience vécue et perçue des utilisations lors d'une interaction physique avec un point de contact entreprise-consommateur.

La deuxième étude est une expérience de magasinage en ligne pour des services de télécommunication d'une nouvelle plateforme de divertissement. Les participants devaient compléter l'achat en ligne d'un forfait mensuel depuis la page d'accueil du prototype reproduisant fidèlement une version du site web développé par l'entreprise partenaire. Cette étude visait à explorer l'influence des attentes, compétences et de l'engagement des segments de consommateurs sur leur parcours émotionnel et leur choix comportemental dans un contexte omnicanal. Les résultats démontrent qu'il existe des profils consommateurs de différents niveaux d'attentes, compétences et engagement et qu'il y a une différence sur

certains attributs de leur parcours émotionnel et comportemental. Ces deux collectes de données ont permis de rédiger deux articles complémentaires.

Ce dernier chapitre consiste à rappeler les questions de recherche de ce mémoire et présente les résultats notables des deux articles. Finalement, les contributions théoriques et pratiques de ce mémoire sont exposées, ainsi que les limites de cette recherche et les futures avenues de recherche sont évoquées.

Rappel des questions de recherche et principaux résultats

Les résultats de ces deux articles ont permis de concilier une réponse aux deux questions de recherche de ce mémoire, soit :

Q1. Existe-t-il des configurations de consommateurs concernant leurs attentes et compétences qui influencent l'expérience vécue et perçue dans un contexte omnicanal ?

Q2. Comment mesurer de façon écologiquement valide l'expérience vécue par les utilisateurs dans un contexte d'interaction non linéaire d'un point de contact physique dans l'environnement omnicanal ?

Prendre note que le chapitre 1 de ce mémoire énonce deux hypothèses, tandis que le chapitre 2 de ce mémoire démontre la légitimité de la méthodologie proposée.

En premier lieu, l'hypothèse 1 du chapitre 1 postulait que différentes configurations de consommateurs selon leur niveau d'attentes, de compétences et d'engagement existaient. Les résultats de cette étude ont supporté cette hypothèse. En effet, 3 groupes distincts, les « *passionnés* », les « *détachés* » et les « *pragmatiques* », comportent différents niveaux et combinaison d'attentes, d'engagement et de compétences. En second lieu, la deuxième hypothèse du chapitre 1 postulait que les segments de consommateurs donneraient lieu à des différences au niveau de leur parcours comportemental et émotionnel. En effet, ces groupes de consommateurs omnicanals traversent un parcours émotionnel qui divergent selon certains pairs de profils. Le résultat le plus intéressant démontre que le nombre total de points de frictions vécus lors d'une expérience en ligne

varie selon le type de segment. Ainsi, les frustrations intenses vécues peuvent dépendre des attentes, des compétences et de l'engagement des utilisateurs. Ensuite, le parcours comportemental des utilisateurs est partiellement influencé par les pairs de profils. En effet, les justifications quant à l'abandon de la tâche, ainsi que le parcours web choisi varient en fonction de certains pairs de profils. Les résultats de cette étude ont supporté partiellement la deuxième hypothèse. Malgré leur nuance, ces résultats ont montré, dans l'ensemble, que les parcours psychophysiologiques et comportementaux dans une situation d'achat omnicanal ont d'avantages à être mesurés à l'aide de la segmentation consommateur.

En ce qui concerne le chapitre 2, les résultats ont démontré qu'il est possible de mesurer une interaction entreprise-consommateur physique de façon écologiquement valide. Grâce à la complémentarité des mesures implicites comme l'activation et la valence, et explicites comme les données rétrospectives, la méthodologie proposée permet de mesurer l'expérience utilisateur à travers chaque étape de leur parcours omnicanal. D'ailleurs, cette méthodologie sert de support aux gestionnaires d'entreprise ayant plusieurs canaux de communication et de vente, afin d'analyser les états cognitifs et émotionnels des utilisateurs ainsi que les comportements et les points de friction rencontrés, sans compromettre la validité écologique.

En général, ce mémoire a présenté une méthodologie permettant de pouvoir comparer l'expérience utilisateur dans tous les canaux d'entreprise offerts, que ce soit en ligne ou hors ligne, afin de contribuer à l'optimisation de l'expérience utilisateur omnicanal. Alors, il ne s'agit pourtant pas seulement de pouvoir comparer l'expérience utilisateur, mais aussi de comprendre l'influence que peuvent avoir différents segments de consommateurs sur celle-ci. Pour cela, le premier article pose une segmentation basée sur les caractéristiques psychologiques des utilisateurs, qui a permis de comparer leur parcours émotionnel et individuel entre trois segments établis. Décidément, ce mémoire contribue à la recherche consommateur en utilisant une approche et des données

centrées utilisateurs afin d'explorer le comportement omnicanal, qui se fait de plus en plus présent avec l'utilisation omnisciente des technologies.

Contributions

D'un point de vue théorique, ce mémoire a offert un contexte de recherche particulier, puisque les expériences d'achat de services de télécommunications sont depuis peu disponibles en ligne dans la région de la recherche. Ainsi, à l'aide de mesures psychophysiologiques, les résultats de ce mémoire contribuent à la recherche consommateur et à l'exploration des segments de consommateurs en ligne, en étudiant leur parcours vécu et perçu à travers les expériences en ligne et hors ligne.

Ensuite, les résultats soutiennent le rôle de la dimension de l'expérience utilisateur dans un contexte omnicanal. En effet, les résultats soutiennent que la valeur expérientielle apporte un bénéfice à la fois extrinsèque et intrinsèque dans l'expérience des consommateurs (Babin & Darden, 1995 ; Batra & Ahtola, 1991 ; Crowley et al., 1992 ; Mano & Oliver, 1993). Par conséquent, les expériences intrinsèques, dérivées de l'aspect expérientiel d'une interaction, permettront aux consommateurs d'apprécier l'expérience pour elle-même (Holbrook, 1994). Ainsi, un spectre de la valeur expérientielle par rapport à la valeur extrinsèque est démontré à travers les trois groupes présentés dans cette étude, et qui a un impact sur le parcours émotionnel et comportemental de ceux-ci. L'aspect expérientiel souligne l'importance de la conception et de la recherche en matière d'expérience utilisateur.

Alors que l'environnement omnicanal compétitif exige de plus en plus des expériences utilisateurs sans failles et personnalisées, nos conclusions suggèrent l'utilité des profils consommateurs dans l'espoir de développer une expérience intrinsèque ou extrinsèque adaptée. Finalement, l'expérience émotionnelle et comportementale peut être optimisée en ligne et hors ligne, dans le but de conduire les profils de consommateurs d'intérêt vers une expérience constante à travers les canaux d'entreprise.

D’un point de vue pratique, nos résultats montrent qu’en segmentant les consommateurs avec des caractéristiques individuelles pertinentes avant qu’ils n’entrent dans leur processus d’achat, les entreprises peuvent s’attaquer à leurs frustrations et à leur expérience globale en conséquence. Ces résultats permettent donc d’améliorer les mesures d’expérience utilisateur, puisque la technique de segmentation permet de prioriser et de centraliser les efforts d’optimisation à travers les canaux.

En effet, la segmentation peut donc être utilisée de façon multidisciplinaire, non seulement pour les efforts marketing, mais aussi afin d’offrir une expérience émotionnelle optimale en limitant les sources de frustrations. D’une part, offrir une expérience personnalisée au consommateur permet d’optimiser les interactions sans frictions, puisque les entreprises peuvent mobiliser et élever l’expérience émotionnelle. Compte tenu de l’importance de la personnalisation et du suivi du comportement des consommateurs dans les achats omnicanals, les résultats de ce mémoire confirment l’utilité des données centrées sur l’utilisateur afin de comprendre le consommateur et de répondre au mieux à ses besoins et ses désirs. D’une autre part, les résultats de ce mémoire permettent aussi aux entreprises d’assurer une expérience constante à travers tous leurs canaux, en utilisant la méthodologie présentée en chapitre 2. De cette façon, l’expérience utilisateur peut être mesurée et comparée dans l’entièreté du parcours utilisateur, en ligne comme hors ligne.

Limites et recherches futures

Afin de contextualiser les résultats de ce mémoire, quelques limitations doivent être énoncées.

Premièrement, la taille de l’échantillon utilisé pour les deux études suivait la recommandation de Lamontagne et al. (2019), afin d’optimiser la découverte de la plupart des points de friction psychophysiologiques. D’ailleurs, Riedl, Fischer, & Léger (2017) ont aussi montré que les recherches avec des mesures psychophysiologiques ont généralement moins de sujets en raison des ressources

coûteuses requises. Néanmoins, des limites statistiques ont été imposées en raison de la taille de l'échantillon qui était inférieure à 30 et pourrait donc être la source de nos résultats de tests mitigés au chapitre 1. Quant à acquérir plus de validité et de poids statistique, il serait intéressant de reproduire l'expérience avec un échantillon plus important pour obtenir une meilleure signification statistique. De plus, la taille plus importante de l'échantillon pourrait potentiellement accorder donner lieu à de nouveaux groupes de consommateurs. En effet, les différences éventuelles dans les parcours émotionnels des groupes pourraient donc être validées afin de généraliser davantage ces résultats à l'entièreté de la population des consommateurs.

Deuxièmement, les deux chapitres de ce mémoire ont été réalisés avec des cas de recherche d'une même industrie. Il serait intéressant de reproduire ces études dans d'autres contextes d'achats omnicanal, afin de valider si les résultats trouvés peuvent être généralisés à l'ensemble des achats omnicanal.

Finalement, il y a également un manque de validité externe dans les paramètres des études, car les expériences ont été menées dans un laboratoire de recherche contrôlé, et un seul type d'expérience d'achat en ligne ainsi que d'interaction physique ont été mesurées. En effet, différentes émotions ont pu être déclenchées par le contexte et la motivation intrinsèque des participants, ce qui a pu avoir un effet sur les résultats (Yi & Davis, 2003). Il serait donc intéressant de reproduire l'étude avec différents utilisateurs afin de comparer les résultats. Enfin, pour des raisons expérimentales, les sujets ne pourraient pas s'écarter de l'achat final (chapitre 1) et de l'achèvement de l'installation d'équipement (chapitre 2). Des études ultérieures devraient viser à mesurer l'expérience omnicanal complète, afin de suivre le plus fidèlement possible le parcours réel de l'utilisateur à travers les différents canaux.

En conclusion, ce mémoire démontre l'importance et les bénéfices de mesurer l'expérience utilisateur dans son ensemble, afin d'arrimer et d'optimiser chaque canal entrepris par un consommateur. Nonobstant, d'autres recherches sont nécessaires afin d'approfondir davantage la compréhension de cette expérience.

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