HEC MONTRÉAL

L'effet des caractéristiques des salles d'attente virtuelles sur la perception du temps d'attente et l'évaluation de l'attente

par

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(Option Expérience Utilisateur dans un Contexte d'Affaires)

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Certificat approbation éthique

HEC MONTRÉAL

Comité d'éthique de la recherche

Le 12 novembre 2020

À l'attention de :
Pierre-Majorique Léger
HEC Montréal

Objet : Approbation éthique de votre projet de recherche

 # Projet : 2021-3904

Titre du projet de recherche : L'effet des interfaces de remplissage et des indices de progression sur la perception du temps d'attente, l'évaluation de l'attente et l'attribution dans un environnement de salle d'attente virtuelle

Source de financement : CRSNG - Chaire UX - CCS : R2185

Votre projet de recherche a fait l'objet d'une évaluation en matière d'éthique de la recherche avec des êtres humains par le CER de HEC Montréal.

Un certificat d'approbation éthique qui atteste de la conformité de votre projet de recherche à la *Politique relative à l'éthique de la recherche avec des êtres humains* de HEC Montréal est émis en date du 12 novembre 2020. Prenez note que ce certificat est **valide jusqu'au 01 novembre 2021.**

Dans le contexte actuel de la pandémie de COVID-19, vous devez vous assurer de respecter les directives émises par le gouvernement du Québec, le gouvernement du Canada et celles de HEC Montréal en vigueur durant l'état d'urgence sanitaire.

Vous devrez obtenir le renouvellement de votre approbation éthique avant l'expiration de ce certificat à l'aide du formulaire *F7 - Renouvellement annuel*. Un rappel automatique vous sera envoyé par courriel quelques semaines avant l'échéance de votre certificat.

Si des modifications sont apportées à votre projet avant l'échéance du certificat, vous devrez remplir le formulaire *F8 - Modification de projet* et obtenir l'approbation du CER avant de mettre en oeuvre ces modifications. Si votre projet est terminé avant l'échéance du certificat, vous devrez remplir le formulaire *F9 - Fin de projet ou F9a - Fin de projet étudiant*, selon le cas.

Notez qu'en vertu de la *Politique relative à l'éthique de la recherche avec des êtres humains de HEC Montréal*, il est de la responsabilité des chercheurs d'assurer que leurs projets de recherche conservent une approbation éthique pour toute la durée des travaux de recherche et d'informer le CER de la fin de ceux-ci. De plus, toutes modifications significatives du projet doivent être transmises au CER avant leurs applications.

Vous pouvez dès maintenant procéder à la collecte de données pour laquelle vous avez obtenu ce certificat.

Nous vous souhaitons bon succès dans la réalisation de votre recherche.

Le CER de HEC Montréal

NAGANO Approbation du projet par le comité d'éthique suite à l'approbation conditionnelle
Comité d'éthique de la recherche - HEC Montréal 1 / 2

HEC MONTRĒAL

Comité d'éthique de la recherche

CERTIFICAT D'APPROBATION ÉTHIQUE

La présente atteste que le projet de recherche décrit ci-dessous a fait l'objet d'une évaluation en matière d'éthique de la recherche avec des êtres humains et qu'il satisfait aux exigences de notre politique en cette matière.

Projet # : 2021-3904

Titre du projet de recherche : L'effet des interfaces de remplissage et des indices de progression sur la perception du temps d'attente, l'évaluation de l'attente et l'attribution dans un environnement de salle d'attente virtuelle

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Maurice Lemelin
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Résumé

Il est démontré dans la littérature qu’attendre sur Internet est stressant, frustrant et préjudiciable à l'évaluation d'un site Web par les utilisateurs, déclenchant ainsi des comportements d'abandon. Les systèmes de file d'attente virtuelle sont de plus en plus populaires comme moyen de gérer le temps d'attente sur Internet. Afin de détourner l'attention des utilisateurs de l'attente dans une file d'attente virtuelle, les praticiens utilisent des éléments de conception tels que des images, du texte et des vidéos comme élément de remplissage. Ces éléments de remplissage sont censés occuper les pensées des utilisateurs pendant qu'ils attendent et, en fin de compte, transformer le temps d'attente en une expérience agréable et divertissante. Toutefois, très peu de recherches ont étudié la relation entre ces éléments de conception et leur effet sur le temps d'attente perçu et l'impression générale de l’attente dans le contexte d'une file d'attente virtuelle.

En adoptant la théorie de l'allocation des ressources, de la compétition pour l'attention et de l'effet de mouvement, nous avons conçu des files d'attente virtuelles avec divers éléments de remplissage et avons examiné leurs effets sur les réponses des consommateurs. Le modèle de recherche proposé tient compte des facteurs d'absorption cognitive, tels que la dissociation temporelle et le plaisir accru, mais aussi des réactions physiologiques des utilisateurs. Une expérience intra-sujet, comprenant 43 participants, a été menée dans un environnement contrôlé où les participants devaient attendre dans plusieurs salles d'attente virtuelles en utilisant quatre marques (Pepsi, Coca-Cola, Nike et Adidas) et quatre types d’éléments de remplissage (aucun remplissage, texte, image et GIF).

Les résultats suggèrent que l'affichage de n'importe quel type de remplissage est bien meilleur pour gérer le temps d'attente qu'une condition sans remplissage en ce qui concerne son effet positif sur les réactions physiologiques et le plaisir des utilisateurs. En outre, les conditions GIF et texte sont celles qui ont l'effet le plus positif sur le plaisir, ce qui se traduit ensuite par une perception temporelle plus courte et une impression générale plus élevée.

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Avant-propos

L'Autorisation de rédiger ce mémoire par article a été obtenue par la direction du programme de M.Sc. de HEC Montréal. Tous les co-auteurs ont fourni leur accord pour que l'article scientifique soit présenté dans ce mémoire. Ce mémoire est ainsi composé d'une recension des écrits et d'un article empirique.

L'approbation du Comité d'éthique de la recherche (CER) de HEC Montréal a été reçue pour cette étude en novembre 2020.

Remerciements

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J’aimerais finalement exprimer ma gratitude au Conseil de recherches en sciences humaines du Canada (CRSH) et PROMPT pour le financement de ma recherche.

Chapitre 1

Introduction

1.1 Mise en contexte de l'étude

À l'occasion du plan de soutien à l'industrie touristique annoncé par le gouvernement du Québec en 2020, la SEPAQ offrait en quantité limitée leur carte d'accès annuelle à 50% de rabais. Les détenteurs de cette passe annuelle pouvaient ainsi avoir un accès illimité aux parcs nationaux dans l'ensemble du Québec. L'événement promotionnel s'est déroulé en ligne, sur le site Web de la SÉPAQ. Après quelques heures seulement, la file d'attente virtuelle affichait plus de 80 000 personnes connectées simultanément (voir annexe 1.1 pour capture d'écran). Le site de la SÉPAQ ne pouvait traiter que 75 à 150 sessions à la minute, ce qui a généré des temps d'attente excessif (Durivage, 2020). Dix heures après le début de l'événement, 76 000 personnes étaient encore en file d'attente. Pour toutes les personnes qui jusque-là attendaient, cela a certainement généré du stress et de la frustration.

En effet, dans bien des cas, les consommateurs n'aiment pas être dans une situation où ils doivent attendre pour l'achat d'un produit ou d'un service (Davis & Heineke 1998; Ryan, 2015; Taylor, 1994; Tom & Lucey 1995). Plusieurs études ont démontré que l'attente dans des environnements traditionnels, tels que les hôpitaux, les supermarchés, les banques, les aéroports ou les restaurants est une expérience qui induit des sentiments de frustration, d'ennui, de colère, de stress et d'anxiété chez les individus (Garaus & Wagner, 2019; Hong 2013; Larson, 1987; Lee, 2019; Maister, 1985; Nah 2004; Norman, 2008; Zhou et al., 2003). D'ailleurs, dans ces environnements, les individus vont fréquemment surestimer le temps qu'ils passent en file d'attente et plus ils perçoivent une augmentation du temps d'attente, plus l'insatisfaction du service sera élevée (Baker, 1996; Hornik, 1984; Katz & al., 1991).

A priori, le principal moyen par lequel les entreprises tentent d'atténuer l'insatisfaction à l'égard de l'attente consiste à gérer le temps d'attente réel par la gestion des opérations (Baker, 1996). Bien qu'il ne soit pas toujours possible de maîtriser la durée de l'attente objective (réelle), il est toutefois possible d'avoir un impact sur le temps d'attente subjectif (perçu) de la clientèle (Antonides & al. 2002; Baker, 1996; Dellaert & Kahn 1999; Lee & al. 2012). Les chercheurs et les concepteurs ont en effet proposé différentes solutions pour atténuer la frustration liée à l'attente, notamment par l'installation de différents éléments dans les aires d'attente communes (e.g., musique, télévisions, magazines, etc.). L'objectif principal de ces éléments de distraction est de transformer le temps d'attente en une expérience agréable et divertissante pour le consommateur (Antonides & al., 2002; Katz & al., 1991). Certains éléments de distraction non temporelle ont en effet démontré qu'ils permettent de détourner l'attention des individus, qui pourrait autrement être consacrée à l'estimation du temps, réduisant ainsi considérablement le temps d'attente perçu (Antonides & al. 2002; Block & al.,2010; Dellaert & Kahn 1999; Garaus & Wagner, 2019; Lee & al. 2012;).

Tout comme ces environnements traditionnels, l'attente est un élément omniprésent et indissociable de notre expérience quotidienne de navigation sur le Web. Cependant, l'attente sur le Web diffère de l'attente dans les environnements traditionnels : « (1) les individus ont des temps d'attente beaucoup plus courts et sont plus impatients en ligne, (2) le temps d'attente perçu des visiteurs peut être manipulé avec des éléments de conception de site Web, et (3) l'impact de l'attente sur l'évaluation du service octroyé en ligne peut être plus important que dans des environnements de brique et mortier » (Lee & al. 2012, p. 366). Des études récentes ont montré qu'un long temps d'attente sur le Web a un effet défavorable sur l'expérience utilisateur, car il est susceptible de réduire la satisfaction du client, affectant ainsi négativement l'attitude et le comportement des utilisateurs (Buell 2011; Egger & al. 2012; Lee 2012; Lee 2019; Ryan & al. 2015; Yu & al. 2020).

Pour gérer le temps d'attente en ligne, l'utilisation de salles d'attente virtuelle s'est révélée efficace pour augmenter l'immersion des utilisateurs, détournant ainsi leurs ressources attentionnelles vers autre chose que la perception du temps (Lee & al., 2012). L'affichage d'éléments de distraction dans l'interface de remplissage (i.e., image, texte, GIF, etc.) semble avoir un effet accru sur l'immersion, la dissociation temporelle et le plaisir pendant l'attente (Lee & al., 2012). Pour tenir les utilisateurs informés de la durée de l'attente, il a été démontré que l'affichage d'une barre de progression réduisait considérablement l'incertitude perçue par les utilisateurs (Chen & al., 2018). Toutefois, l'affichage d'un trop grand nombre d'éléments temporels (comme un indicateur de pourcentage d'achèvement) peut entraîner une attention accrue sur l'attente, ce qui se traduit par une augmentation du temps d'attente perçu (Lee & al., 2017). Une autre façon de réduire le temps d'attente perçu en ligne, comme l'ont montré Lee & Chen (2019), consiste à concevoir les indices et les caractéristiques des interfaces de remplissage de manière plus hédonique. En effet, il a été démontré que le plaisir perçu a un effet important sur le temps d'attente perçu et l'évaluation du temps d'attente (Lee & Chen, 2019).

1.2 Question de recherche

Selon la littérature récente, comme il a été discuté ci-dessus, présenter une "interface de remplissage" aux utilisateurs pendant qu'ils attendent permet de détourner l'attention des individus vers autre chose que la perception du temps, réduisant ainsi le temps d'attente perçu (Lee & al., 2017 ; Zakay, 1990 ; Zakay, 1995). Toutefois, la majorité des études à l'appui de ces résultats n'ont testé qu'un seul type d'attente : le temps de chargement d'une page Web (i.e. "le temps d'attente pour qu'une page web soit téléchargée et apparaisse sur l'écran de l'utilisateur") (Ryan, 2015, p.262), ce qui ne comprend que des attentes allant de 200 millisecondes à environ 30 secondes. Dans un contexte de salle d'attente virtuelle, une seule étude analyse l'effet du nombre de personnes derrières nous ainsi que les indicateurs temporels (Zhou, R. & Soman, D., 2003), ce qui limite drastiquement nos connaissances à ce qui a trait à l'attente en ligne. Afin de combler cette lacune dans la littérature, la présente étude vise à analyser les réactions psychophysiologiques induites par l'attente chez les utilisateurs durant l'utilisation d'une telle interface et ce, pour des attentes au-delà de 30 secondes. Dans un contexte où les services en ligne, ou plus largement l'Internet, sont de plus en plus adoptés par les utilisateurs, avoir des files d'attente virtuelles qui durent plus de 30 secondes n'est pas rare. Nous avons notamment observé des files d'attente virtuelle allant bien au-delà de 30 secondes dus à l'augmentation de la demande des services en ligne depuis le début de Covid-19. Les facteurs situationnels tels que les indices d'interface qui peuvent être manipulés et qui font partie intégrante de l'interface seront également étudiés. Par conséquent, la présente étude vise à répondre aux questions suivantes:

Question 1 : Dans un contexte de salle d'attente virtuelle, quelles sont les caractéristiques de conception d'une interface de remplissage qui peuvent être utilisées dans le but d'influencer la perception temporelle des utilisateurs ?

Question 2 : Comment pouvons-nous favoriser une évaluation positive de l'attente ?

Objectifs et contributions

À terme, ce mémoire a pour objectifs principaux de formuler des recommandations quant à la gestion de l'attente en ligne pour des attentes au-delà de 30 secondes. On s'intéresse principalement à l'impact de différents stimuli, tels que du texte, des images et des GIFs, sur la perception du temps et l'évaluation de l'attente dans un contexte de salle d'attente virtuelle. En étudiant cette relation, ce mémoire nous permettra de clarifier le manque dans la littérature en matière de gestion de l'attente virtuelle. D'un point de vue pratique, nous serons en mesure de formuler des recommandations quant au design d'une interface de remplissage, par exemple lors d'un lancement de produit ou d'un site Web, et ce dans le but de favoriser la rétention du client et l'évaluation positive du service de gestion de l'attente.

Contribution de l'étudiant aux étapes du projet de recherche

Ce projet de mémoire a été réalisé en collaboration étroite avec l'équipe d'opérations du laboratoire de recherche Tech3Lab de HEC Montréal. Le tableau 1 suivant permet d'identifier les contributions et responsabilités de l'étudiant ainsi que celles de l'équipe du Tech3Lab sous forme de pourcentage.

Tableau 1

Contribution de l'étudiant aux étapes du projet de recherche

Étape du projet	Contributions
Formulation des questions de recherche	Identifier la question de recherche – 90% ● L'étudiant a initialement proposé une question de recherche à ses codirecteurs. Ceux-ci ont ensuite aidé l'étudiant à préciser la question de recherche.
Revue de la littérature	Recherche initiale à l'identification des construits et théories observées dans les études antérieures sur la gestion de l'attente en ligne – 100% Rédaction de la revue de littérature – 100%
Conception du design expérimental	Définir et proposer les outils de mesure à utiliser selon les construits et théories choisies – 90 % ● L'étudiant a initialement proposé plusieurs outils de mesures à ses codirecteurs. Ceux-ci ont ensuite aidé l'étudiant à préciser les outils de mesures utilisés. Élaboration du contexte dans lequel on positionne les participants dans l'étude – 60% ● Plusieurs discussions entre l'étudiant et les codirecteurs de recherche ont permis d'élaborer la mise en contexte de l'étude. Remplir le formulaire de demande au CER – 100% Élaborer et rédiger le protocole d'expérimentation – 90% ● L'étudiant a pu adapter son protocole de recherche aux requis nécessaires à son projet d'étude à partir du protocole d'un projet antérieur. L'étudiant a produit deux versions du protocole de recherche: francophone et anglophone. Ces deux versions ont été révisées par l'équipe du Tech3Lab avant la collecte de données. Création du prototype d'une salle d'attente virtuelle – 95%

	● Avec Axure RP 9, l'étudiant a créé et présenté plusieurs itérations de salle d'attente virtuelle à ses directeurs de recherche. Ceux-ci ont ensuite aidé l'étudiant à préciser la nature des stimuli ainsi que leurs dispositions dans l'interface. L'étudiant a conduit deux prétests avec l'équipe du Tech3Lab avant la collecte de données. Création du questionnaire Qualtrics – 95% ● L'étudiant a créé et présenté plusieurs itérations d'un questionnaire de recherche à ses codirecteurs. L'étudiant a pu également intégrer son prototype de salle d'attente virtuelle au questionnaire Qualtrics. Les codirecteurs de recherche ont ensuite aidé l'étudiant à ajuster le flow du questionnaire ainsi que son contenu. Préparation des sessions Lookback.io – 95% ● L'étudiant a créé et préparé en amont les sessions Lookback.io pour l'accueil des participants.
Recrutement des participants	Recruter les participants – 0% ● Tous les participants et participantes ont été recrutés par l'équipe d'opération du Tech3Lab via le Bluepanel. Élaborer et rédiger le questionnaire de recrutement et le formulaire de consentement – 90% ● L'étudiant a pu adapter son questionnaire de recrutement aux requis nécessaires à son projet d'étude à partir des formulaires d'un projet antérieur.
Prétests et Collecte des données	Exécution de prétests – 90% ● L'étudiant et l'équipe du Tech3Lab ont procédé à quelques prétests avant la collecte de données. Effectuer les collectes de données – 80% ● L'étudiant a reçu le soutien de l'équipe du Tech3Lab pour la collecte de quelques participants.

Extraction et transformation des données	Extraire, calculer et mettre en forme les données psychométriques – 100% Coder les timestamps et extraire les captures d'écran Lookback.io – 100% Coder les timestamps et extraire les données Facereader – 85% ● L'étudiant a reçu le soutien de l'équipe du Tech3Lab quant à l'extraction des données Facereader.
Analyse des données	Effectuer les analyses statistiques – 75% ● L'étudiant a déterminé les hypothèses de recherche. ● L'étudiant a ensuite reçu l'aide d'un statisticien afin de faire des tests statistiques. ● L'étudiant a interprété les résultats des tests statistiques.
Rédaction des articles	Rédaction des articles – 100% ● Les codirecteurs ont aidé l'étudiant avec plusieurs commentaires constructifs tout au long de la rédaction afin d'améliorer la qualité des articles et de s'assurer que tous les concepts pertinents étaient abordés.

Structure du mémoire

Ce mémoire a été rédigé sous la forme d'articles cumulés et il est structuré de la façon suivante. Premièrement, une revue de littérature sera présentée au chapitre 2 (article 1). Celle-ci adresse principalement les effets qu'engendre l'attente dans les environnements traditionnels et en ligne. Nous dresserons également le portrait des différentes théories et méthodes pertinentes à l'étude de la perception temporelle. Deuxièmement, le chapitre 3 (article 2) présente l'étude effectuée et tente de répondre aux questions suivantes: quelles sont les caractéristiques de conception d'une interface de remplissage qui peuvent être utilisées dans le but (1) d'influencer la perception temporelle qu'ont les utilisateurs de l'attente en ligne? (2) Comment pouvons-nous favoriser une évaluation positive de l’attente? Finalement, le chapitre 4 conclut le mémoire par une discussion détaillée de la revue de littérature et l’article de recherche, ainsi que sur les limitations et les futures avenues de recherche.

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Chapitre 2

How to Mitigate the Negative Consequences of Online Waiting: A Literature Review

Abstract

Virtual queueing systems have recently been utilized to manage online and offline wait circumstances. To distract users' attention away from the wait in a virtual queue, practitioners have been using design elements, such as images, text, and videos as "fillers." These fillers are meant to fill users' thoughts while they wait and ultimately transform waiting time into enjoyable and entertaining experiences. This review investigates the literature on time perception theories, attributional responses to waiting, and wait management methods commonly used in traditional and online environments. Despite the growing interest in waiting perception management, this review finds that no study has yet explored how filler interfaces affect users' psychophysiological reactions and perceptions to prolonged waiting in a virtual queue. Theoretical models of time perception, time-related methodological procedures, and wait management methods are discussed.

Keywords: filler interface, time perception theory, wait perceptions, wait evaluation, wait management, virtual queue.

2.1 Introduction

Online traffic has seen a significant amount of growth during the last few years. In fact, as of January 2020, there were 4,437,215,927 (4+ billion) Internet users worldwide, and in 2019, the average Internet user spent 6 hours and 43 minutes online every day (with any devices), comprising of 3 hours and 14 minutes on mobile, and 3 hours 28 minutes on the computer and tablets (Ahlgren, 2020). Statista (2020) indicates that total Internet users could reach 296.7 million in the US by 2025. Consequently, it can be difficult, expensive, and slow to implement the necessary infrastructures for e-businesses to accommodate such a large number of people on their websites (Lee & al. 2019). Further, seasonal, online product launches or exclusive online sales causing traffic fluctuations make it even more challenging to plan for adequate capacity for a website (Zhang & Fan, 2008), which at times may cause underperformance during website navigation. In a worst-case scenario, online traffic may cause a server failure or shutdown, which is very costly to firms (i.e., $5600/minute or over $300k/hour, on average) (Malik, 2014; Alsop, 2020). As a result, website administrators may limit simultaneous open connections on a firm's website to maintain acceptable performance (Zhang & Fan, 2008). To accommodate traffic exceeding the threshold for which the website was designed to handle, some companies have chosen to use virtual queueing systems, such as Queue-it, Qminder, or QLess.

Having users wait in a virtual waiting room rather than in a traditional, physical, brick-and-mortar store is very interesting from a marketing and information system perspective. On the one hand, waiting in traditional environments has been linked to severe issues, such as lost revenue, boredom, anger, stress, anxiety, and overall lower service satisfaction (Garaus & Wagner, 2019; Hong 2013; Larson, 1987; Lee, 2019; Maister, 1985; Nah 2004; Norman, 2008; Ryan, 2015; Taylor, 1994; Zhou & al., 2003). On the other hand, waiting for longer periods of time has also been linked to increased purchase intention and quality perception (Giebelhausen & Robinson, 2011; Koo & Fishbach, 2010; Ülkü, 2020).

2.1.1 Aim and Scope

First, this literature review aims to provide an in-depth understanding of the relationship between circumstances where users are waiting online (as described above) and their perceived time of the wait. To this end, our focus will be on analyzing the theories and paradigms pertaining to temporal perception and estimation. Thus, it will be made clear why time perception and estimation are thought of in different ways for every individual. Second, wait management methods commonly used in the traditional service industry and e-commerce will be analyzed. Finally, a summary of the findings will close this chapter.

2.2 Theories and Paradigms Pertaining to Temporal Perception and Estimation

To this day, many studies have focused on time perception and time estimation (Allan, 1979; Brown, 1985; Fraisse, 1984; Grondin, 2010; Hogan, 1978; Thomas & Brown 1974; Zakay & Block, 1999), but both concepts remain elusive subjects (Grondin, 2010) because they are a cognitive process that is influenced by external elements "other than the actual time that has elapsed" (Lee & al., 2017; Zakay, 1995). Indeed, time perception and time estimation are affected by individuals' differences, such as emotion, attention, and memory (Block & Zakay, 1997; Fraisse, 1984; Lee & al., 2017; Zakay & Block, 1995). Furthermore, time perception and estimation are contingent upon "environmental context-specific factors," such as non-temporal tasks and informational cues, rendering both concepts sensitive to the conditions under which they are measured (Lee & al., 2017; Zakay, 1990; Zakay, 1995).

Time *perception,* as defined by Fraisse (1984), is the "ability to apprehend successive events as perceptively more or less simultaneous, within the framework of the psychological present" (Fraisse, 1984, p.10). Hence, given this definition, time perception is more concerned with attention during the wait (Fraisse, 1984). On the other hand, time *estimation* is where "memory is used either to associate a moment in the past with a moment in the present or to link two past events" (Fraisse, 1984, p.9). Hence, time estimation happens after the wait and thus relies more on memory (Fraisse, 1984).

A common view in time-related literature is that increasing attentional demand directly impacts time estimation (Lee & al., 2017; Grondin, 2010; Block & Zakay, 1995). Indeed, the amount of cognitive resources individuals will allocate to time influences how they perceive it (Grondin, 2010; Lee & al., 2017; Zakay, 1989). Individuals have limited attentional resources (Lee & al., 2012; Zakay, 1989). As such, if someone directs his/her attention to anything other than the passage of time (e.g., filler elements), that person is less likely to form an accurate representation of a perceived wait (Lee & al., 2017). Similarly, when individuals are too absorbed cognitively, they will have less attentional resources allocated to the perception of time (Lee & Chen, 2019). Indeed, Maister (1985) proposed that unoccupied time feels longer than occupied time (Maister, 1985, p.3).

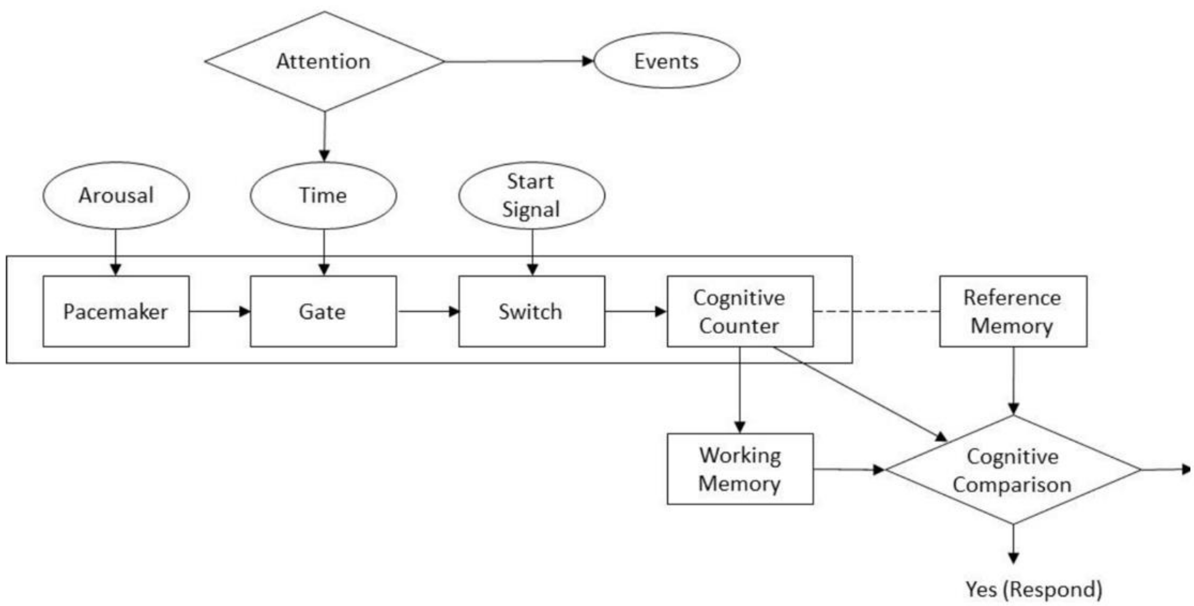
In the following sections, one time perception theory and a conceptual construct that explains how humans perceive time with limited attentional resources will be examined: Zakay and Block's Attentional Gate Model (1995), as well as Argawal and Karahanna Cognitive absorption construct (2000).

2.2.1 Attentional-Gate Model

The Attentional Gate Model (AGM) is a combination of many earlier time estimation models, including Treisman's internal clock model (1963), Gibbon, Church & Meck's scalar-timing model (1984), and Thomas and Weaver's attentional model (1975) (Lee & al., 2017; Zakay & Block, 1995).

Figure 1

Block and Zakay's Attentional Gate Model (1995)



For humans to perceive the flow of time, Zakay and Block (1997) hypothesize a pacemaker located in the brain, which in general will produce pulses at a steady rate. When people experience arousal, it will cause variations in the pacemaker's rate (Zakay & Block, 1995). The average number of pulses produced then needs to go through a cognitive mechanism called a gate (Zakay & Block, 1995). The gate is either opened or closed depending on whether individuals allocate attention to time (Zakay and Block, 1995). In other words, by allocating attention to time, the gate opens, thereby allowing more pulses to go through. Whereas by allocating attention to environmental cues (i.e., not on time), the gate is then closed, thereby reducing the pulses that go through. Once the pulses go through the gate, they are then picked-up by a form of cognitive counter (Lee & al., 2017; Zakay & Block, 1995). The pulses captured by the cognitive counter are then transferred to the working memory. This count will then serve as a cognitive comparison with the average number of pulses stored in the reference memory from past waiting experiences, thus enabling us to estimate time intervals based on that comparison (Lee & al., 2017; Zakay & Block 1995). In order to start and stop the count of pulses, there is also the need of a "switch", which either opens or closes the access to the cognitive counter (Zakay & Block 1995). The switch will only open once there is a temporal meaning assigned to a stimulus (Zakay & Block, 1995). In other words, when there is a perception that a stimulus is signaling the beginning of a relevant interval, the switch will open, the counter is set to zero, and the signal flow can be counted (Zakay & Block, 1995, p.175). When there is a perception that a stimulus is signaling the ending of a relevant interval, the switch will close, preventing more pulses from entering the counter. At the same time, the pulse count is transferred to the short-term memory (Zakay & Block, 1995, p.175).

2.2.2 Cognitive Absorption Construct

Now more than ever, individuals' and businesses' use of technologies include both hedonistic and experiential features, such as music, videos, and pictures (Lee & Chen, 2019). Information Systems researchers have proposed and applied theories that explain users' holistic responses (i.e., physical, emotional, and social responses) to these technologies (Lee & Chen, 2019). Cognitive absorption is a construct that considers individuals' experiences with new technology and takes roots in previous research of cognitive and social psychology (Agarwal & Karahanna, 2000).

Cognitive absorption, defined as "a state of deep involvement with software", originates from three lines of research: the personality trait dimension of absorption, the state of flow, and the notion of cognitive engagement (Agarwal & Karahanna, 2000, p. 673). By incorporating these theoretical fundamentals, Agrawal and Karahanna (2000) developed Cognitive absorption as a five-dimensional construct consisting of: (1) temporal dissociation, (2) focused immersion (or attention), (3) heightened enjoyment, (4) control, and (5) curiosity (Agarwal & Karahanna, 2000; Lee & Chen, 2019). Agarwal and Karahanna

(2000) define these dimensions as follows: *Temporal dissociation* refers to the inability to track the flow of time throughout an interaction; *Focused immersion* (or attention) refers to the experience of total engagement to a specific activity, while other surrounding attentional demands are ignored; *Heightened enjoyment* refers to the capture of pleasurable aspects of an interaction with an activity; *Control* refers to the user's perception of being in charge of the interaction; *Curiosity* refers to circumstances where users' sensory and cognitive interests are simulated (Agarwal & Karahanna, 2000).

Block, Hancock & Zakay (2010) defined cognitive load as the "amount of information-processing (especially attentional or working-memory) demands during a specified time period; that is, the amount of mental effort demanded by a primary task" (Block & al., 2010). According to the Cognitive absorption construct, cognitive load may affect individuals' attention when performing a task, which is consistent with Block & Zakay's Attentional Gate Model (Agarwal & Karahanna, 2000; Block & al., 2010; Lallemand & Gronier, 2011). If a task requires a high level of information processing during a time interval, it will pull individuals' attentional resources away from temporal information, thereby reducing perceived waiting time (Lallemand & Gronier, 2011). Block, Hancock and Zakay (2010) indeed agree that time estimation is influenced by cognitive load, but they add that it will affect duration judgment in opposite directions depending on the paradigm in which the study as been conducted (prospective or retrospective paradigm, which will be discussed in the next sub-section) (Block & al., 2010).

2.2.3 Paradigms and Other Factors Surrounding Time Estimation and Time Perception

Prospective and Retrospective Interval Judgment

Consistent in the literature is the notion that when participants are asked to estimate time explicitly, researchers need to consider if the study will be performed in a prospective or a retrospective setting (Block & Zakay, 1997; Grondin, 2010; Vatakis & al., 2018).

In a prospective study, participants are aware that time perception is measured, and that in the subsequent tasks, they will have to make a duration judgment of a target interval (Block & Zakay, 1997; Grondin, 2010; Vatakis & al., 2018). Thus, in a prospective study, participants are more actively monitoring time and are more aware of temporal cues during a task. Given participants are informed beforehand that time is of interest, *attention* is key in this scenario. In a prospective study, then, participants' attentional resources should be split among the flow of time and the non-temporal task. Prospective studies are more numerous than retrospective studies and are generally more concerned with short wait length (from 100 milliseconds to just a few seconds) (Vatakis & al., 2018). The variability of estimates is what is of interest in prospective studies.

Alternatively, a retrospective study is where participants are only informed that they must make an interval judgment of a target duration after the experiment has been completed (Block & Zakay, 1997; Grondin, 2010; Vatakis, 2018). Research using retrospective duration judgments are far less numerous, mostly because of methodological complications. Indeed, a retrospective setting implies that only one interval estimation can be performed by participants before becoming aware that time estimation is relevant in the experiment, and that they may be asked to judge a subsequent time interval for following tasks- which is the defining characteristic of a prospective judgment (Block & Zakay, 1997; Grondin, 2010; Vatakis & al., 2018). Consequently, retrospective studies make it very difficult to measure variability. Thus, researchers have proposed a solution where participants would not only be asked to make a duration judgment, but to also provide a larger interval (i.e., min/max) in which the duration is certainly included, arguing that the difference between these measdure could be interpreted as a measure of uncertainty and variability (Bisson & Grondin 2013; Grondin & Plourde 2007; Tobin, Bisson, & Grondin, 2010; Tobin & Grondin 2012; Vatakis & al., 2018). That said, several researchers have demonstrated that it is possible to collect more than one judgment per participant, but only if the experimental design is made in a way that participants have to complete a series of tasks before they make a duration judgment (i.e., learning melodies (<15 seconds) before duration reproduction (Boltz, 1995); listening to musical excerpts (Tobin, Bisson, & Grondin, 2010); the completion of cognitive tasks lasting from 2 to 8 minutes before asking for a verbal estimation (Grondin & Plourde, 2007)) (Vatakis & al., 2018). Furthermore, retrospective studies are more focused on the memory process than attention, because participants are required to remember the duration of a past interval rather than actively monitoring time during the task, as it is being done in prospective studies (Grondin, 2010). Studies set in a retrospective paradigm are generally more focused on longer wait duration (from 1 minute, up to several hours, even days) (Hui

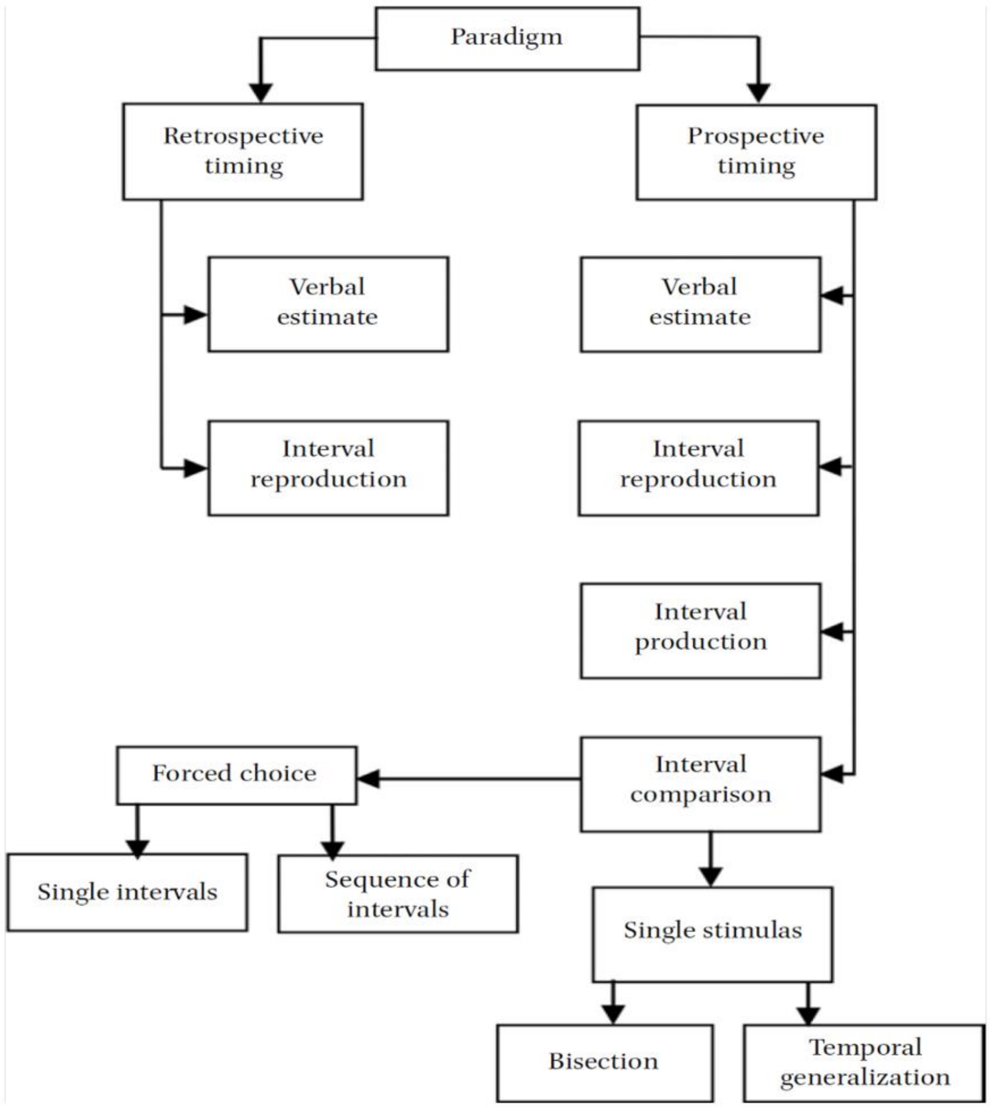
& Tse 1996; Hui, 1997; Vatakis & al., 2018), and the accuracy of judgment is usually what is of interest (Vatakis & al., 2018). To be noted that even if participants are not told explicitly that time perception is of interest in a study, as is the case for retrospective paradigm, "participants may incidentally encode temporal information, and whatever information is relevant may be later retrieved from memory" (Vatakis & al., 2018).

2.3 Methods for Studying Timing and Time Perception

In the time-related literature, many methodological procedures have been proposed to assess mean duration estimates and variability (Grondin, 2010). The four main procedures being when a participant may be asked to estimate a duration interval by verbal estimation, interval reproduction, interval production, or interval comparison (Grondin, 2010; Vitakis & al., 2018). Figure 2 summarizes the four main methods (illustration from Vatakis & al., (2018) adapted from Grondin (2010)), as well as their sub-categories, for studying timing and time perception.

Figure 2

Summary of the main methods utilized for studying time perception (Grondin, 2010)



From a retrospective point of view, methods using verbal estimates and interval reproductions have most frequently been used (Vatakis & al., 2018). A verbal estimation means that participants will be asked to provide a verbal estimation of a target interval that has previously been experienced by them during an experiment (Grondin, 2010; Vatakis & al., 2018). For a verbal estimation to take place, participants need to understand chronometric units (seconds, minutes, and hours). Therefore, this method is not suitable for studies involving children, as they may not yet understand what seconds and minutes are (Vatakis & al., 2018). The verbal estimation method is said to produce a lot a variability, as participants tend to round up their estimates (Vatakis & al., 2018)). Alternatively, interval reproduction tasks are where participants are asked to reproduce the duration of an interval that has previously been presented to them (Grondin, 2010; Vatakis & al., 2018). To do so, participants are exposed to a target duration (encoding phase), after which they must provide an interval equivalent to the duration that they have just been presented (reproduction phase), by pressing a button (Vatakis & al., 2018). For practical reasons, the interval reproduction method is commonly used when the interval to be reproduced is not too long. For longer intervals, verbal estimation is more appropriate (Vatakis & al., 2018).

Verbal estimation, and interval reproduction methods are also utilised within the prospective paradigm, though interval production and interval comparison are other time measurement methods that are included in this paradigm. Interval production is where a participant must produce a target duration (using chronometric units) given by the experimenter (Grondin, 2010; Vatakis & al., 2018). Production of the target interval involves the two finger taps signaling the beginning and end of the interval or the pushing a button for a duration that is judged equivalent to the interval (Grondin, 2010, p.563). Lastly, an interval comparison is where participants are asked to judge the relative durations of intervals presented to them successively in the form of a continuous sound or flash. By pressing a button, participants must indicate if the second duration was shorter or longer than the first (Grondin, 2010; Vatakis & al., 2018).

2.4 Time Perception and Estimation of Waiting Experiences in Traditional Service Environments

When it comes to wait management methods, one place to look for insights is in traditional brick-and-mortar stores. In traditional service environments, the primary method by which companies attempt to reduce dissatisfaction with waiting is to manage actual waiting time through operational management (Baker, 1996). While it is not always possible to control the duration of objective (actual) waiting time, it is possible to have an impact on the subjective (perceived) waiting time of customers (Antonides et al. 2002; Baker, 1996;

Dellaert & Kahn 1999; Larson, 1991; Lee et al. 2012; Maister, 1985). Researchers have been studying waiting circumstances in traditional service environments, such as waiting delays and queueing, since the early 80s (Hornik, 1984; Larson, 1987; Maister, 1985; Milliman, 1982). In 1985, Maister published The Psychology of Waiting Lines (1985) which was reviewed and updated under the same name in 2008 by Norman, and in which they propose eight principles that organizations can use to influence customers' satisfaction with waiting time:

1. Unoccupied time feels longer than occupied time.
2. Preprocess waits feel longer than in-process waits.
3. Anxiety makes waits seem longer.
4. Uncertain waits are longer than known, finite waits.
5. Unexplained waits are longer than explained waits.
6. Unfair waits are longer than equitable waits.
7. The more value the service, the longer people will wait.
8. Solo waiting feels longer than group waiting.

These principles have since then been studied in a wide variety of service contexts, such as hospital waiting rooms (Pruyn & Smidts, 1998), delays in airline travel (Taylor, 1994), banks (Chebat & al., 1993; Hui & al., 1997), supermarket chain stores (Garaus & Wagner, 2019), call centers (Antonides & al., 2002), and restaurants (Milliman, 1982). Studies have shown that waiting in these traditional environments is an experience that induces feelings of frustration, boredom, stress, and anxiety (Garaus & Wagner, 2019; Hong 2013; Larson, 1987; Lee, 2019; Maister, 1985; Nah 2004; Norman, 2008; Zhou & al., 2003). Additionally, people will frequently overestimate the time they spend in a queue, and the more they perceive an increase in waiting time, the higher the level of service dissatisfaction (Baker, 1996; Hornik, 1984; Katz & al., 1991). That said, there are cases where waiting and queuing is not necessarily perceived as bad, such as in the case of a queue for a quality product (e.g., newly released iPhone or game consoles) as opposed to a queue for a service such as in airline travel, or the renewal of a driver's licence. However, even within these queues that are not perceived as bad, users will still experience boredom, stress, and anxiety, especially if the product that is sought for is offered in limited quantity.

2.4.1 Distractors

Non-temporal distractors have been shown to divert individuals' cognitive attention away from time estimation, thereby significantly reducing perceived waiting time (Antonides & al. 2002; Block & al.,2010; Dellaert & Kahn 1999; Garaus & Wagner, 2019; Lee & al. 2012; Taylor, 1994). Researchers and designers indeed have proposed various solutions to alleviate waiting frustration in traditional environments, including the use of various elements in common waiting areas (e.g., music, televisions, magazines, queueing information). The academic literature often refers to these distractors as "fillers", meaning that they are meant to fill customers' thoughts in an attempt to avoid time perception, and ultimately transform waiting time into enjoyable and entertaining experiences for consumers (Antonides & al., 2002; Garaus & Wagner, 2019; Katz & al., 1991; Lee & al., 2012; Taylor, 1994).

One such filler was tested by Garaus & Wagner (2019). They analysed the relationship between digital signage at the checkout of a grocery store on perceived waiting time and store satisfaction. A digital signage is a mounted digital display, which in this study was located at a store's checkout desk, communicating relevant store related information to the customers (Garaus & Wagner, 2019). While in a queue at a grocery store checkout without any digital signage, on average, people tend to overestimate the perceived waiting time compared to the actual waiting time (171.7 seconds of perceived waiting time as opposed to 109.1 seconds of actual waiting time) (Garaus & Wagner, 2019). When adding digital signage to the waiting lines, Garaus & Wagner found an average of 43% reduction in perceived waiting time. Similar results have been reported by Katz & al. (1991), which analysed queueing at a bank in Boston, where the average overestimate is about one minute and waits of five minutes or less are considered reasonable (Katz & al., 1991). According to Garaus and Wagner (2019), digital signage will contribute positively at reducing perceived waiting time and increases affective queuing time evaluations (Garaus & Wagner, 2019, p.337). These results are again in line with Katz & al. (1991) suggesting that distractions make the waiting experience more enjoyable and will increase customer satisfaction (Katz & al., 1991, p.51). In Katz's & al. (1991) study, televisions in hospital waiting rooms had no effect on customer's perceived waiting time and did not effectively contribute to alleviate "wait-related boredom" (Katz & al., 1991). Instead, Katz & al. (1991) suggest that people in hospital waiting rooms tend to chat with other people waiting and read magazines before watching TV (Katz & al., 1991).

Taylor (1994) studied delays in airline travel services. Amongst other things, she examined the degree to which users' time is filled on affective and evaluative responses (Taylor, 1994). By occupying customers' thoughts, Taylor observed a reduction in boredom, restlessness, and anxiety (Taylor, 1994). In her study, customers filled their own time with several different fillers (i.e., reading materials, watching other people on planes, talking with others, doing paperwork, eating or drinking, walking around, thinking or daydreaming, sleeping, or doing nothing) (Taylor, 1994). According to Taylor (1994), activities requiring thought, such as reading or doing paperwork, contribute to filling time most effectively (p.66) Talking with other people is also a great way to reduce perceived waiting time (Taylor, 1994). Taylor's findings further demonstrate the fact that filled waiting time is more pleasant than unfilled time, just as Maister suggested back in 1985 (Katz & al., 1991; Larson 1987; Maister 1985; Taylor, 1994).

2.4.2 Positive Effects of Longer Queues and Waits

Despite the positive effects of improving the queueing experience using distractors, the literature on waiting time also suggests that longer queues and waiting for longer periods of time has a favorable effect on quality perception (Giebelhausen & Robinson, 2011; Koo & Fishbach, 2010; Ülkü, 2020). Indeed, longer queues can serve as a form of social proof (or social influence) that the product or service is worth waiting for (Cialdini, 1985; Giebelhausen & Robinson, 2011; Koo & Fishbach, 2010). Additionally, when consumers are "in search of quality (vs. convenience), the increased quality signaled by a wait is [also] enough to overcome the negative impact of that wait" (Giebelhausen & Robinson, 2011, p.901). These results are in line with Koo & Fishbach (2010), suggesting that individuals will perceive a greater product value as more and more people queue-up behind them (Koo & Fishbach, 2010). Koo & Fishbach (2010) also suggest that the more customers focus their attention on people behind them, the more value those customers will put into the purchased products or services (Koo & Fishbach, 2010).

Perceived Fairness

Longer single queues (such as the ones found at airports and banks), rather than multiple smaller queues (such as the ones found at Costco or McDonalds), have an increased positive effect on customer satisfaction (Katz & al., 1991). According to Larson (1987), even though multiple shorter lines are more efficient, a single longer line is perceived as fairer, because it is based on a "first in, first out" scenario (Larson, 1987). Additionally, stress and anxiety can arise when a customer must choose between multiple lines (Larson, 1987). At McDonalds, for example, a customer may choose the line that seems faster, but end up with someone in front of him paying with pennies. Meanwhile the line right next to him might ultimately go faster. According to Larson (1987), humans do not perceive as fair seeing someone that came after us to be served before us (Larson, 1987). Furthermore, single longer lines can remove uncertainty and frustration (i.e., from not having to choose which line is shortest in a multiple line setting). Longer single queues are also making customers cover more ground, thus providing a greater sense of progress (Larson, 1987). To be noted, though, that people indeed value fairness over efficiency, as Katz & al. (1991) suggest, but people will still experience boredom, stress, and anxiety in a single longer line (Katz & al., 1991).

To summarize, the literature on waiting experiences in traditional service environments is suggesting that there is a compromise between a better customer experience and satisfaction (i.e., by distracting people's attention away from the wait and shorter wait perception), and purchase intention and perceived fairness (i.e., obtained with objectively longer queues and waits, such as in the case of restaurants and auction houses). Intuitively, offering a better customer experience has a better chance at making the consumers want to come back. In fact, some companies will take advantage of the queues surrounding their businesses. To generate additional income, Disney offers their recreational park customers the opportunity to subscribe to their Fastpass+ virtual queueing system, which allows customers to skip the waiting lines entirely. According to Chiu (Gartner, 2019), waiting should not only be considered as something bad and that can only be made tolerable. On the contrary, what the consumer experiences while waiting can ultimately be a strategic asset to the customer experience, especially if waiting is an unavoidable step in the transaction process.

2.5 Time perception and estimation of waiting experiences in e-commerce

Surprisingly, most of the research on online waiting has largely ignored a wide range of online waiting circumstances (Ryan, 2015). Indeed, most of the academic literature about waiting on the Internet focuses on just one type of online waiting situation: Page loading time (i.e., "the time involved in waiting for a web page to download and appear on the user's screen") (Ryan, 2015, p.262), and their associated progress cues. Other studies have focused on the time customers are willing to wait for a page to load on a website (Nah, 2004). Nevertheless, a review of the current literature on page loading time will be made in an attempt to gain insights as to how different types of feedback affect customer behavior while waiting.

2.5.1 Filler Interfaces

Filler interfaces are what users see while they wait for results or expected outputs (Lee & al., 2012). Filler interfaces may include a variety of different background colors and Web design elements, such as images, text, progress cues, or even multimedia (Lee & al., 2012). While waiting for information to load, users experience increased *focused immersion* when viewing a filler interface (with either text or image, or the combination of both) than when not seeing a filler interface (Lee & al., 2012). The combination of design elements on filler interfaces (text and image) works significantly better than single elements (image only) (Lee & al., 2012). Furthermore, displaying relevant elements to the users' use context in the filler interfaces will induce more *focused immersion*, *temporal dissociation*, and *heightened enjoyment* while waiting (Lee & al., 2012). Those results are consistent with Garausse & Wagner (2019). That is, in a traditional brick-and-mortar store, communicating relevant store related information to customers through a digital signage reduces perceived waiting time and increases affective queuing time evaluations (i.e., it increases users' satisfaction with the store, product or service with regards to waiting time) (Garause & Wagner, 2019).

2.5.2. Hedonic Cues and Features, and Perceived Enjoyment

According to Chen & al. (2018), high hedonic progress cues induce fun and enjoyment by using, for intense, pictures and images with known characters or celebrities as a progress ticker (Chen & al., 2018). A progress bar with low level hedonic valence would only use simple rectangular bars (Chen & al., 2018).

According to Chen & al. (2018), the use of hedonic progress cues (compared to utilitarian progress cues) had a significant positive effect on attention, time distortion, and heightened enjoyment (Lee & al., 2018; Lee & Chen, 2019). According to Chen & al. (2018), high level hedonic cues and features will distract people from thinking about the wait by steering individuals' attentional resources towards visually appealing cues during wait, thereby increasing enjoyment and reducing perceived waiting time (Chen & al., 2018). Results from Lee & Chen (2019) suggested that heightened enjoyment had by far the "strongest effect on perceived waiting time, and thus confirming the importance of framing interface features as more hedonic" (Lee & Chen, 2019, p.10).

Larson (1987) suggested that overestimating the waiting time allows the opportunity to offer a pleasant surprise to waiting customers once they realize that the wait is shorter than expected (Larson, 1987). Lee & al. (2017) tested this hypothesis, and their results suggest that presenting search results to users before a progress bar reaches completion will further distort users' estimation of waiting and make them lose track of time (Lee & al., 2017). Those results have also been found when using the combination of both hedonic progress cues and exaggeration estimation, but only for long waits (i.e., 16 seconds in the context of this study) (Lee & al., 2017). "That is, when users viewed a progress bar with an animated airplane symbol and the results appeared earlier than expected, the combination of distractor cues further increased perceived enjoyment and perceived time distortion in the long wait condition" (Lee & al., 2017, p.251).

To summarize, the literature on online wait and page loading time does shed light on a few things. While waiting for information to load, users experienced an increased focused immersion when seeing a filler interface than when not seeing a filler interface. Lee (2012) has shown that temporal dissociation and heightened enjoyment while waiting can be further increased by including elements that are relevant to the user's use context in the filler interface (Lee & al., 2012). According to Lee & Chen (2019), heightened enjoyment had by far the “strongest effect on perceived waiting time [in his study], and thus confirming the importance of framing interface features as more hedonic” (Lee & Chen, 2019, p.10).

2.6 Conclusion

The aim of this literature review was to provide an in-depth understanding of the relationship between circumstances where users are waiting online and their perceived time of the wait. To that end, we first analyzed the theories and paradigms pertaining to temporal perception and estimation. Wait management methods commonly used in traditional service industries as well as e-commerce were then examined.

2.6.1. What we know

Time perception is affected by individuals’ emotion, attention, and memory (Block & Zakay, 1997; Fraisse, 1984; Lee & al., 2017; Zakay & Block, 1995). Since humans have limited attentional resources, increases in attentional or cognitive demand was shown to have a direct impact on time perception (Lee & al., 2017; Grondin, 2010; Block & Zakay, 1995). As far as theoretical models of time perception, the Cognitive absorption construct and Attentional-Gate model have proved to be adequate at predicting human behavior in the context of waiting for both online and offline environments.

To manage waiting time in traditional environments, non-temporal distractors have been shown to divert individuals' cognitive attention away from time estimation, thereby significantly reducing perceived waiting time and increase affective waiting time evaluation (Antonides et al. 2002; Block et al.,2010; Dellaert & Kahn 1999; Garaus & Wagner, 2019; Lee et al. 2012; Taylor, 1994). According to Taylor (1994), occupying users’ thoughts will also reduce boredom, restlessness, and anxiety (Taylor, 1994).

To manage waiting time in online environments, the use of filler interfaces has shown to be effective at increasing users focused immersion, thereby deviating users’ attentional resources away from time perception (Lee & al., 2012). Including elements that are relevant to participants’ search enquiry in the filler interface seemed to have an increased effect on focused immersion, temporal dissociation, and heightened enjoyment while waiting (Lee &

al., 2012). Another way to reduce perceived waiting time online, as was shown by Lee & Chen (2019), is to design cues and features of filler interfaces in a more hedonic fashion. Indeed, perceived enjoyment was shown to have a strong effect on perceived waiting time and waiting time evaluation (Lee & Chen, 2019).

2.6.2. What we do not know

The literature provides a very rich documentation on time perception and estimation as far as waiting in traditional environments but is limited when it comes to relevant online waiting instances (e.g., virtual queues). Studies supporting online waiting results that have been analysed in this chapter have only tested one type of waiting occurrence: page loading time (i.e., “the time involved in waiting for a web page to download and appear on the user’s screen”) (Ryan, 2015, p.262), which only encompasses waits ranging from 200 milliseconds up to roughly 30 seconds. This severely hinders the generalizability of the results. As Ryan & al. (2015) said: “The overriding emphasis on measuring just tolerance of download time has left many questions unanswered and many gaps in our knowledge of the wider consumer experience while waiting on the Internet” (p. 262). According to Ryan & al. (2015), this is particularly disconcerting from a marketing perspective since waiting has been linked to serious issues, such as lost revenue, boredom, anger, stress, and anxiety (Garaus & Wagner, 2019; Hong 2013; Larson, 1987; Lee, 2019; Maister, 1985; Nah 2004; Norman, 2008; Ryan, 2015; Taylor, 1994; Zhou & al., 2003).

According to Lee & al. (2012) and Chen & al. (2018), website developers and designers are creating waiting screens (i.e., filler interfaces) “base[d] on their own instincts, gut feelings, or educated guesses, with limited scientific research” (Chen & al., 2018, p.558). The present study intends to address this gap in the literature so that valid and reliable guidance and insights for broader online wait management methods can be provided with regards to the use of filler interfaces. To that end, in the following chapter, we will investigate users’ psychophysiological reactions to waiting while encountering filler interfaces in a virtual queue. Situational factors such as interface fillers that can be manipulated and are an integral part of the interface will thus be examined.

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Chapitre 3

The Effect of Filler Interfaces on Perceived Waiting Time and Wait Evaluation in an Online Waiting Room Environment

Abstract

Long waits online have shown to be stressful, frustrating, and detrimental to users' evaluation of a Web site, triggering abandonment behaviors. As a means of managing waiting time on the Internet, virtual queueing systems are becoming increasingly popular. To distract users' attention away from the wait in a virtual queue, practitioners have been using design elements such as images, text, and videos as "fillers." These fillers are meant to occupy users' thoughts while they wait and ideally transform waiting time into enjoyable and entertaining experiences. Yet, very little research has investigated the relationship between these design elements and their effect on perceived waiting time (PWT) and general impression (GI) in the context of a virtual queue. By adopting resource allocation theory and human computer interaction (HCI) theories (i.e., competition for attention and motion effect), we designed online queues with diverse fillers and examined their effect on antecedents of PWT. The proposed research model considers cognitive absorption factors, such as temporal dissociation (TD) and heightened enjoyment (HE), but also physiological reactions to PWT. A within-subject experiment, comprising 43 participants, was conducted in a controlled environment where participants had to wait in several virtual waiting rooms using four brands (Pepsi, Coca-Cola, Nike, and Adidas) and four filler types (no filler, Text, Image, and GIF). Results suggest that displaying any filler type is much better than a no-filler condition with respect to its positive effect on users' physiological reactions and HE. Furthermore, the GIF and Text conditions are found to have the most positive effect on HE, which in turn translates into shorter PWT and increased GI. Theoretical and practical implications of these findings are provided.

Keywords: virtual queue, filler interface, time perception theory, wait perceptions, wait evaluation, wait management.

3.1 Introduction

The Internet has become an integral part of our daily lives, and its adoption continues to grow. In 2019, the average Internet user spent 6 hours and 43 minutes online every day (with all devices combined) (Ahlgren, 2020). It is predicted that by 2025, in the US, Internet user growth could reach 296.7 million users (Statista, 2020). Consequently, it can be difficult, expensive, and slow to implement the necessary infrastructure for e-businesses to accommodate such a large number of people on their websites (Lee & al. 2019). Additionally, seasonal, online product launches, or exclusive online sales causing traffic fluctuations make it even more challenging to plan for adequate capacity for a website (Zhang & Fan, 2008), which at times may cause underperformance during website navigation. In a worst-case scenario, online traffic may cause a server failure or shutdown, which was shown to be very costly to firms (i.e., $5600/minute or over $300k/hour, on average) (Malik, 2014; Alsop, 2020). As a result, website administrators may limit simultaneous open connections on a firm's website to maintain acceptable performance (Zhang & Fan, 2008). To accommodate traffic exceeding the threshold for which the website was designed to handle, some companies have chosen to use virtual queueing systems, such as Queue-it, Qminder, or QLess. Such a system allows firms to monitor their website and position their users in a queue at their virtual front door when the website is overwhelmed with incoming traffic, thus maintaining optimal performance.

The recent literature suggests that waiting in traditional service environments may generate unpleasant user sentiment, such as boredom, anger, stress, anxiety, and overall lower service satisfaction (Garaus & Wagner, 2019; Hong 2013; Larson, 1987; Lee, 2019; Maister, 1985; Nah 2004; Norman, 2008; Ryan, 2015; Taylor, 1994; Zhou et al., 2003). Prior research in resource allocation theory suggests that distractions may be used to alleviate individuals' perceived waiting time in common waiting areas, such as hospital waiting rooms, restaurants, and banks (Antonides & al., 2002; Lee & al., 2012; Katz & al., 1991; Taylor, 1994). Indeed, the use of fillers such as magazines, music, and videos have been found to distract users away from the wait and thus negatively influence their perceived waiting time (i.e., time is perceived to pass more quickly) (Antonides & al., 2002; Dellaert and Kahn 1999; Katz & al.,1991; Lee & al., 2012).

Virtual queueing systems are the filler-like online interfaces that users see while waiting for expected outputs. Filler interfaces may include different design elements to occupy users' thoughts, such as texts, images, or multimedia. Much like waiting in the service and traditional retail environments, waiting online has also been demonstrated to generate stress and frustration (Lee & al. 2012). Since waiting is mostly seen as a cost, waiting online may also generate unwanted user behaviour, such as purchase abandonment, resulting in lost revenue (Hong 2013; Larson, 1987; Lee, 2019;). In fact, it has been estimated that "approximately 60-70 percent of the shopping carts are abandoned before purchases are made […] and trade data suggests that each incidence of shopping cart abandonment represents approximately $175 in lost sales to the online retailer," resulting in $6.5 billion yearly lost revenue for the e-commerce industry. (Rajamma & al., 2009, p. 188). As Internet adoption continues to rise, studying user experience in a virtual queue context becomes even more essential for any e-businesses.

To the best of our knowledge, only one study has analyzed perceived waiting time in the context of a virtual queuing system (Hui & Zhou, 1996). In such a context, Hui & Zhou (1996) showed that displaying waiting duration information in the virtual queue (i.e., how long customers are expected to wait) has no effect on users' perceived waiting duration but increases users' sense of control and wait acceptability. Furthermore, displaying a high count of people waiting behind a customer reduces the likelihood of that customer leaving the queue (Hui & Zhou, 1996).

Since Hui & Zhou's study (1996), virtual queueing system companies have implemented new features, such as texts (e.g., Twitter feed, product reviews, etc.), images, and GIFs. From a theoretical point of view, it is important to study these newly added fillers since we do not yet completely understand customer sentiment and behaviour while exposed to these newly added fillers and their relation to users' perceived waiting time. Additional analysis of these fillers will also increase our knowledge as to where it is more efficient and profitable for practitioners to deploy their efforts and resources to attract and retain customers.

Although Hui and Zhou's (1996) study contributed greatly to the wait management literature, much remains to be understood with regards to fillers in the context of virtual queueing systems. To address this gap in the literature, this study aims to (1) clarify the relationship between fillers of type Image, Text, and GIF with regards to users' cognitive absorption factors - namely, temporal dissociation (TD) and heightened enjoyment (HE), as well as physiological reactions to the wait (i.e., valence and arousal). Additionally, this paper intends to (2) clarify the aforementioned variables with regards to their relation with users' perceived waiting time (PWT). Finally, our analysis will (3) shed some light on the relationship between users' PWT and users' general impression (GI) of the wait. To achieve this, we performed a within-subject experiment where 43 participants had to wait in several virtual waiting rooms. Our results thus add to Hui and Zhou's (1996) findings pertaining to the study of waiting time perception in the context of a virtual queueing system. Consequently, this study tackles the following question:

Question: What are the design features of a filler interface that can be used to positively influence users' temporal perception when waiting in a virtual queue?

In the following section, we first develop hypotheses upon the review of different theories: resource allocation (Block and Zakay 1997; Zakay, 1989; Zakay and Hornik, 1992), Cognitive absorption (Argawal and Karahanna, 2000), and human-computer interaction (HCI) - namely, competition for attention (Janiszewski, 1988; Lee & al., 2012) and motion effect (Bacon and Egeth 1994; Folk & al., 1992; Lee & al., 2012; Yantis and Egeth, 1999). Second, materials and methods that have been utilized in our experiment will be detailed. Third, we examine the main constructs' results on perceived waiting time and overall impression of the wait. Results from our controlled experiment are then presented. A discussion around theoretical contributions, practical implications, limitations, and future research directions will close this chapter.

3.2 Theoretical Background

3.2.1 Attentional Gate Model

The Attentional Gate Model (AGM) is an attentional resource-allocation model and asserts that humans have limited cognitive resources available to them (i.e., attention, capacity, or cognitive effort) (Lee & al., 2012; Zakay, 1989). Researchers have successfully used the AGM to explain how attention and other cognitive processes affect how individuals perceive time (Lee & al., 2012; Lejeune, 2000; Zakay and Block, 1995). While waiting, according to this theory, individuals are continually concerned about the passage of time and are actively estimating its duration (Lee & al., 2012). Furthermore, Maister (1985) suggested that individuals who allocate more attention to time during a waiting period will perceive longer waiting time, especially when users' waiting instances are not "filled" (Lee & al., 2012; Taylor, 1994). Indeed, research has shown that introducing nontemporal stimuli (e.g., video, reading material, or music) during a wait segment can serve as a distractor, thereby alleviating users' attentional resources away from time perception, which results in a shorter perceived waiting time (Lee & al., 2012; Taylor, 1994; Zakay, 1989). In other words, AGM suggests that when more cognitive resources are needed to process nontemporal stimuli, users have less attentional resources available to assess time and vice-versa (Lee & al., 2012). All in all, AGM provides us with a relevant theoretical basis as to how attention and other cognitive processes affect how individuals estimate time intervals (Lee & al., 2017; Block & Zakay, 1997). Since all our virtual queue prototypes are likely to capture participants' attention, AGM provides us with a relevant theoretical basis as to how attention and other cognitive processes affect how individuals estimate time intervals in an online setting (Lee & al., 2017; Block & Zakay, 1997).

3.2.2 Cognitive Absorption

Cognitive absorption draws its theoretical foundations from three research lines: the personality trait dimension of Absorption, the state of flow, and the notion of cognitive engagement (Agarwal & Karahanna, 2000). Absorption has long been conceptualized as a *trait* (Lee & al., 2012). That said, Argawal and Karahanna (2000) conceptualize Absorption as a *state* in which the essence of an individual's subjective experiences emerges from the outcome of a particular configuration of individual and situational factors (Argawal and Karahanna, 2000; Lee & al., 2012). Thus, Cognitive absorption is defined as "a state of deep involvement with software" (Argawal and Karahanna, 2000, p. 673) and encompasses five dimensions: (1) temporal dissociation, (2) focused immersion (or attention), (3) heightened enjoyment, (4) control, and (5) curiosity (Agarwal & Karahanna, 2000; Lee & al., 2012; Lee

& Chen, 2019). Temporal dissociation refers to the inability to track the flow of time throughout an interaction; Focused immersion (or attention) refers to the experience of total engagement to a specific activity, while other surrounding attentional demands are ignored; Heightened enjoyment refers to the capture of pleasurable aspects of an interaction with an activity; Control refers to the users perception of being in charge of the interaction; Curiosity relates to circumstances where users' sensory and cognitive interests are stimulated (Agarwal & Karahanna, 2000; Lee & al., 2012). Thus, the Cognitive Absorption Construct allows us to mobilise its relevant dimensions in the context of our study: temporal dissociation and heightened enjoyment.

3.2.3 Competition for Attention and Motion Effect

Competition for attention and motion effect theories allow us to investigate the design of various filler interfaces and our selected stimuli (i.e., text, image, and GIFs). The premise of these theories is that humans have a finite amount of information processing capabilities at their disposal (Kahneman, 1973; Lee & al., 2012). Indeed, individuals "selectively process information by responding to various stimuli in their visual field (Van der Heijden, 1992)" (Lee & al., 2012, p. 368). Moreover, implementing distinct and visually appealing stimuli in filler interfaces can force an "attention shift" that captures and holds users' attention, thereby influencing waiting time perception (Lee & al., 2012).

Competition for Attention. Research in Competition for Attention and experimental psychology suggests that, amongst all that is visible on a user interface, elements with distinct salient characteristics (e.g., text, image, or GIF) are highly likely to capture more attention than other competing elements (Janis- Zewski 1998; Lee & al., 2012; Todd and Kramer 1994; Yantis and Egeth 1999). Indeed, "salience […] of an object within the visual field determines the amount of attention an object receives [while also partially ignoring] other competing elements in that field (e.g., waiting time)" (Lee & al., 2012, p. 374). As such, providing users with filler interfaces displaying a stimulus (i.e., text, image, or GIF) as a focal point during an online wait may direct users' attention towards the visual stimulus, thereby reducing cognitive resources allocated to the passage of time (Antonides & al., 2002; Dellaert and Kahn 1999; Katz & al., 1991; Lee & al., 2012). To that end, Maister (1985) also suggested that time feels shorter when it is “filled.” Redirecting users' attention to such stimuli while they wait may contribute to the perception that their time is filled, thus creating greater temporal dissociation, and promoting a more pleasurable user experience than simply waiting for expected outcomes (Lee & al., 2012).

Motion Effect. With the advances in multimedia technologies, the use of animation (e.g., flashing objects, pop-up ads, video, animated products, or GIFs) has seen an increase in popularity on the Internet (Lee & al., 2012; Zhang, 2000). While animations are considered to be more entertaining (Lee & al., 2012; Thomas and Calder, 2001), they also serve as a focal point that attracts users’ attention to what is being animated on the screen (Lee & al., 2012). Research in motion effect theory suggests that users’ attention is very sensitive to stimuli that include motion (Lee & al., 2012). A GIF animation is a stimulus that includes motion and is also very distinct from any competing elements (e.g., a static image or even waiting time) (Hong & al., 2007; Lee & al., 2012; Reeves and Nass 1996). Such an animation has been found to induce sudden attention shifts due to its novel, meaningful, or surprising nature, even if users are engaged in preassigned tasks (Lee & al., 2012). Based on Motion Effect theory, we expect a GIF as a stimulus will make users shift their attention to that motion, thereby distracting them away from the wait.

Additionally, moving images have been found to induce a state of heightened enjoyment during online waits, as opposed to fixed images (Lee & al., 2012). Indeed, previous research in HCI on motion effect and visual search shows that users exposed to moving images experienced increased emotional responses such as arousal, entertainment, and excitement (Lee & al. 2009; Lee & al., 2012; Philips and Lee 2005; Reeves & al. 1999; Simons & al. 2000).

According to Kim and Goetz (1995), “reading is a complex cognitive process in which the reader, through interaction with a text, constructs meaning” (p. 205). Since time perception is also a cognitive task that requires our attention, adding a text stimulus in a virtual queueing system may further pull users’ attentional resources away from time perception. In Taylor’s (1994) study for delays in airline travel, customers filled their own time with several different fillers (i.e., reading materials, watching other people on planes, talking with others, doing paperwork, eating or drinking, walking around, thinking or daydreaming, sleeping, or doing nothing). According to Taylor (1994), "those engaged in activities requiring thought, such as reading or doing paperwork, filled their time most effectively" (p. 66). In the context where there is enough text to fill an entire wait period, users may find it difficult to assess or recall a wait length, thus underestimating the wait.

Additionally, Taylor (1994) demonstrated that by occupying customers' thoughts, it is possible to reduce boredom, restlessness, and anxiety. Taylor's findings further demonstrate that filled waiting time is more pleasant than unfilled time, just as Maister suggested in 1985 (Katz & al., 1991; Larson 1987; Maister 1985; Taylor, 1994). Indeed, filler interfaces displaying texts, images, or GIFs provide users with something to do and occupy their thoughts while they wait.

Enjoyment is another element that has been said to influence perceived waiting time during a wait experience (Lee & al., 2017). According to Block (2010) and Zakay (1989), human sentiment makes it so that time flies when you are having fun (Agarwal, R., & Karahanna, E., 2000; Block & al., 2010; Lee & al., 2017; Zakay, 1989). Additionally, according to Hornik (1992), individuals experiencing a positive mood state tend to underestimate an event's length (Hornik, 1992). In contrast, individuals experiencing a negative mood state revealed a small tendency to overestimate events (Hornik, 1992). Hornik (1992) mentions that these results provide further empirical support to the notion that people perceive time as "passing more quickly when they are elated than when they are in either a depressed or a neutral affective state" (Hornik, 1992, p. 223). Other researchers, such as Fraisse (1984), found that interesting text sentences were perceived as more enjoyable and judged to be shorter than boring ones (Lee & al., 2012).

In sum, the recent literature seems to suggest that filler interfaces displaying a stimulus (i.e., text, image, or GIF) to users may contribute to capturing more attention as well as filling users' thoughts while they wait in a virtual queue, thereby distracting them away from thinking about the wait and providing a more pleasurable experience of the overall wait.

Hypotheses Development

H1 is based on the literature suggesting that filler interfaces may capture users' attention while waiting, alleviating attention away from thinking about the wait, thus making the wait seem shorter (Agarwal & Karahanna, 2000; Janis- Zewski 1998; Lee & al., 2017; Todd and Kramer 1994; Yantis and Egeth 1999; Zakay & Block, 1995).

H1: *Users exposed to filler interfaces displaying a stimulus (i.e., text (H1a), image (H1b), or GIF (H1c)) will experience GREATER temporal dissociation (i.e., underestimation of the wait) than users that are exposed to filler interfaces that do not display a stimulus.*

H2 - H4 are based on the literature suggesting that filled time is more pleasant and entertaining than unfilled time (Fraisse, 1984; Katz & al., 1991; Larson 1987; Lee & al., 2012; Maister 1985; Philips and Lee 2005; Taylor, 1994). Other research also shows that moving stimuli (i.e., GIFs and multimedia) are more entertaining than fixed images (Lee & al. 2009; Lee & al., 2012; Philips and Lee 2005; Reeves & al. 1999; Simons & al. 2000).

H2: *Users exposed to filler interfaces displaying a stimulus (i.e., text (H2a), image (H2b), or GIF (H2c)) will experience GREATER enjoyment than users exposed to filler interfaces that do not display a stimulus.*

H3: *Users exposed to filler interfaces displaying a stimulus (i.e., text (H3a), image (H3b), or GIF (H3c)) will experience more POSITIVE emotional valence than users exposed to filler interfaces that do not display a stimulus.*

H4: *Users exposed to filler interfaces displaying a stimulus (i.e., text (H4a), image (H4b), or GIF (H4c)) will experience GREATER emotional arousal than users exposed to filler interfaces that do not display a stimulus.*

Temporal dissociation (TD) can go both ways. Users experiencing larger TD on the downside (i.e., underestimating a wait) should also perceive a wait to be shorter overall. In contraste, users experiencing larger TD on the upside (i.e., overestimating a wait) should perceive a wait to be longer. H5 reflects this logic:

H5: *Users reporting LARGER temporal dissociation to the downside (i.e., underestimation of the wait) due to a filler interface will report SHORTER perceived waiting time.*

H6 - H8 are based on the literature suggesting that enjoyment and a positive mood state makes it so time flies when your are having fun (Agarwal, R., & Karahanna, E., 2000; Block et al., 2010; Fraisse, 1984; Hornik, 1992; Lee et al., 2017; Zakay, 1989).

H6: *Users experiencing GREATER enjoyment due to a filler interface will express SHORTER perceived waiting time.*

H7: *Users experiencing more POSITIVE emotional valence will express SHORTER perceived waiting time.*

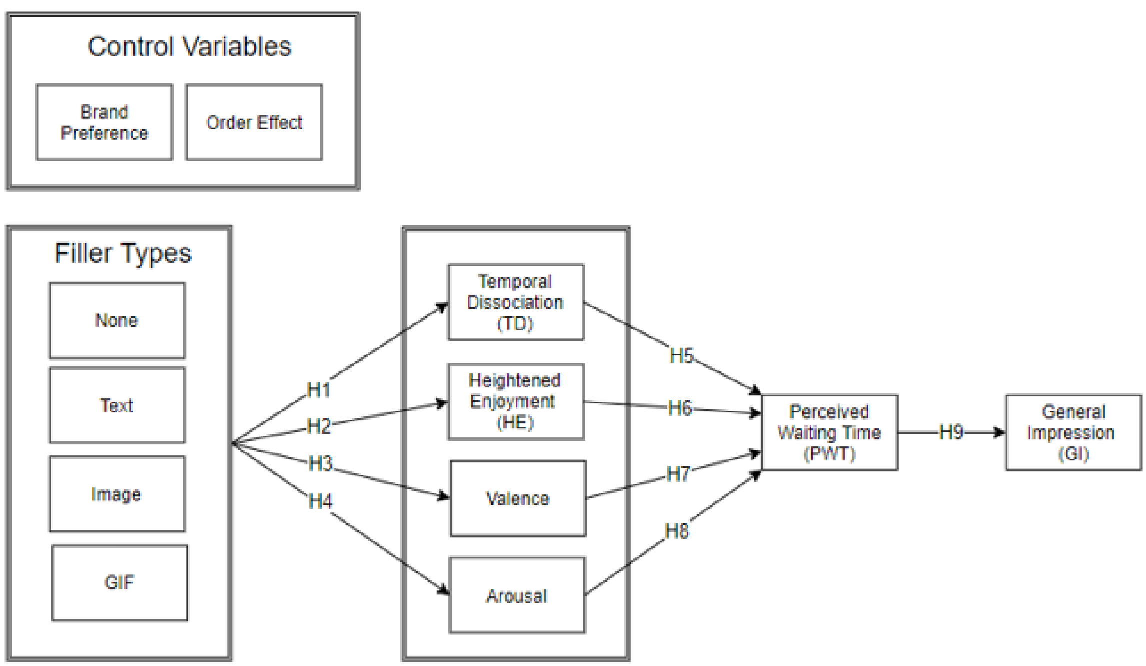
H8: *Users experiencing GREATER emotional arousal will express SHORTER perceived waiting time.*

H9 is based on the literature suggesting that shorter perceived waits, as opposed to longer perceived waits, will result in a better general impression with regards to the overall wait (Baker, 1996; Hornik, 1992; Katz & al., 1991).

H9: *Users experiencing SHORTER perceived waiting time will express HIGHER scores for general impression.*

Figure 3

Research Model



3.3 Method

3.3.1 Study design and stimuli

All in all, 16 different conditions were tested. That is, a 4 (filler type: Image, Text, GIF, and no filler) x4 (brands: Pepsi, Coca-Cola, Nike, and Adidas) within-subject experiment that was conducted, where participants had to wait in several virtual waiting rooms. The experimental conditions were randomized in such a way that participants would be exposed to all stimuli and brands twice once they had gone through height queues. Out of all 16 experimental conditions, we limited participants to height randomized queues to respect the 60 minutes we had available with each participant. The height tasks were designed and counterbalanced between four known brands: Nike, Adidas, Pepsi-Cola, and Coca-Cola. We chose these four brands as they are popular and fast-moving products that are sold in high volume, and where participants are likely to prefer a brand over the other.

The stimulus used for each filler interface during the waiting tasks was either a text, a GIF, a fixed image, or none of these items. The text stimulus was in the form of a product review that was captured directly from the Website of the brand they were assigned to (i.e., the Coca-Cola filler interface had Coca-Cola product reviews, and so on). For the GIF stimuli, three GIFs were displayed for each of the branded filler interfaces. For each of the four brands, one GIF was used to display the brand logo, another to display the main product, and the last one to display the product being consumed. All GIFs used in the experiment are available at giphy.com. For the image stimuli, we captured a single frame from the GIFs and reproduced the same method. In other words, for each of the four brands, one image was used to display the brand logo, another to display the main product, and the last one to display the product being consumed, but this time as a fixed image. All 16 conditions had similar, but different waiting times (i.e., between 45 and 55 seconds). In order not to give any advantage to one of the brands, we randomized each of the waiting times using a random number generator. We consider those stimuli ecologically valid in the context of a virtual waiting room, as most of the firms that offer this service do display texts, fixed images, or multimedia in their filler interfaces (see Appendix 1.2 for a visual representation of a virtual queueing system).

Each experimental prototype was created using Axure RP 9, and their dimensions were 850 (w) x 450 (h) pixels. A logo, a progress bar, positional information, and a small text (i.e., "please wait …") were displayed to the left-hand side of each of the filler interfaces. A space of 500 (w) x 450 (h) pixels were reserved to the right-hand side of the filler interface for the stimuli selected in our experiment. Only the filler interface that did not display a stimulus was positioned in the middle of the screen (see Appendix 1.3).

3.3.2 Sample and Procedure

Participants were primarily recruited from our institution's student pool. A total of 43 participants between the ages of 19 and 63 participated in the study. A $200 Amazon gift card was given to the winner of a draw between all participants. This study was approved by our institution's Ethics Research Committee (Certificate # 2021- 3904).

First, we asked participants to sign a consent form, after which they answered demographic questions. Participants were then asked to answer two questions to assess their preferences between four brands: first, between Pepsi-Cola and Coca-Cola, then between Nike and Adidas.

To position our participants in the context of our study, we simulated a contest whereby participants had to accumulate as many participating tickets as possible by joining virtual queues and waiting. Participants received one participant ticket for each virtual queue they experienced, for a total of eight queues. Each queue length was anywhere between 45 and 55 seconds.

Before the tasks began, participants received the following information:

1. You need to accumulate as many participation tickets as possible, for each ticket increases the probability of winning the final prize ($200 Amazon!);
2. to get a ticket, you have to wait;
3. you need to write down the participation ticket number when you are given one;
4. that the number of participation tickets is limited, and;

5. that hundreds of participants have been recruited on Amazon's Mechanical Turk and that these users go through the same experiment as them at the same time and will be waiting for tickets as well.

That last bit of information was a deception (point 5).[1] Our objective for using this deception was to make the simulated virtual queueing system believable and increase our study's ecological validity.

After each task, participants had to complete a questionnaire that measured their perceived waiting time (Lee & al., 2012), general impression Taylor (1994), temporal dissociation (Agarwal & Karahanna, 2000), and heightened enjoyment (Agarwal & Karahanna, 2000). After the height tasks, all participants went through an interview to assess their opinion of the virtual queues. At the end of the experiment, all participants were debriefed. Overall, the experiment lasted approximately 60 minutes.

3.3.3 Measures

Valence and Arousal. We choose to capture valence and arousal using physiological data since research suggests that self-reported measures are subject to individual biases (de Guinea & al., 2014). Additionally, we were interested in participants' temporal dimension of emotional reactions. Physiological data output is normalised between a min/max of -1 to 1.

Users waiting in a virtual queue may experience different emotions throughout the wait. For instance, valence may go down in the first 10 seconds of the wait, since users generally do not like to wait. On the other hand, valence may go up in the last 10 seconds of the wait, since users may be happy and excited that the wait is over and would thus expect an output. To capture these effects, we measured valence and arousal through several different

[1] To achieve better ecological validity in a retrospective study setting, researchers may use deception when initially engaging participants. The use of methodological deception in psychological research has seen an on-going discussion (Boynton & al., 2013). Since the 60s, many ethical and psychological studies analysed the use of methodological deception and its potential psychological impact on the participants (Jamison & al., 2008; Boynton & al., 2013; Bortolotti & al, 2006). According to the recent literature, the use of methodological deceptions in research is permissible if specific conditions are met (Bortolotti & al., 2006; Boynton & al., 2013). That is, "(1) no other nondeceptive method exits to study the phenomenon of interest; (2) the study makes significant contributions to scientific knowledge; (3) the deception is not expected to cause significant harm or severe emotional distress to research participants; and (4) the deception is explained to participants as soon as the study protocol permits" (Boynton & al., 2013, p.7).

methods: (1) the mean and standard deviation of valence and arousal for the full length of the wait, (2) the mean and standard deviation of valence and arousal for the first 10 seconds of the wait, and (3) the mean and standard deviation of valence and arousal for the last 10 seconds of the wait. Mean valence and mean arousal will give us a good look at where most participants stand with regards to their emotions during the wait. Standard deviation will allow us to verify if there are any extremes in the data. Additionally, a slope will be calculated to verify valence and arousal during the first and last 10 seconds of the wait, as well as the full length of the wait, thus giving us a better sense of users' physiological reaction for different time stamps.

Perceived Waiting Time (PWT). PWT refers to the participants' thoughts about the length of the wait (i.e., short versus long) (Lee & al., 2012). We measured PWT after each task by asking participants their perceived waiting time on a 5-point Likert scale ranging from "very short" (1) to "very long" (5).

General Impression (GI). GI refers to the participants' overall impression of the virtual queue. As suggested by Taylor (1994), we asked participants "Considering all aspects and experience of the virtual queue, would you rate your overall impression as very bad, very good or somewhere in between?" Participants answered on a 5-point Likert scale ranging from "very bad" (1) to "very good" (5).

Temporal Dissociation (TD). TD is a dimension from Agarwal & Karahanna (2000) Cognitive absorption construct. It refers to the inability to track the flow of time throughout an interaction (Agarwal & Karahanna, 2000). We assessed TD by deducing participants' time estimation of the wait from the real waiting time. Specifically, we asked: "How long do you think you had to wait between the time you entered the queue and the time you left?" All time estimations were asked to be provided in seconds.

Heightened Enjoyment (HE). HE is another dimension from Agarwal & Karahanna (2000) cognitive absorption construct. It allows researchers to capture the pleasurable aspects of the interaction by encompassing 4 dimensions: pleasant, enjoyable, fun, and exciting. We measured these variables with a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7) (Agarwal & Karahanna, 2000; Koufaris & Kimmel, 2002; Lee & al., 2012).

3.3.4 Control Variables

Order effect. Since participants had height tasks to perform (i.e., height virtual queue experiences), we suspected that the subsequent waits after the first one might have an effect on the overall results. Indeed, after the first wait, participants became aware that time is of interest in the experiment, and so they knew what the question was to come. For this reason, we added the order effect as a control variable.

Brand Preference. The latest research in perceptual awareness suggests that brands with highly positive preferences (i.e., brands we like) are significantly more likely to be perceived consciously than brands with a low preference rating (i.e., brands we like less) (Skove, 2014). Indeed, behavioral responses and perceptual processing are known to be affected by an object's subjective valence (Öhman and Mineka, 2001; Skove, 2014). That is, more attentional resources are allocated for "perceptual computation" of objects for which individuals have strong emotional attachments to, as opposed to neutral stimuli, which was demonstrated to increase detection accuracy (Algom & al., 2004; Estes and Verges, 2008; Nasrallah & al., 2009; Skove, 2014). Strong and positive emotional responses that consumers have towards a brand thus increases the likelihood of that brand to be later detected in an environment (Skove, 2014). In other words, the more an individual prefers a brand, the better the chances that this individual allocates visual attention to the preferred brand (Skove, 2014). As discussed, attention is the main predictor in our capability to assess time. Therefore, if individuals are exposed to a virtual queue from a brand they particularly like, then those individuals are likely to allocate more attention to the non-temporal branded stimulus (i.e., text, image, or GIF). In which case, those individuals are less likely to form an accurate recall of the perceived wait. For those reasons, we have included brand preference as a control variable. We measured brand preferences before the experiment began by asking participants to indicate their degree of liking or preference for a brand relative to another in the same product category (i.e., Pepsi vs. Coca-Cola and Nike vs. Adidas). Participants needed to choose one or the other, so we used a 4-points Likert scale ranging from “I prefer (brand A)” (1) to “I prefer (brand B)” (4). Brand preferences were assessed in two questions: first for Nike and Adidas, second for Coca-Cola and Pepsi.

3.3.5 Apparatus

To comply with distancing constraints put in place by local authorities during Covid-19, we used the platform Lookback.io as our primary communication tool between the participants and the researchers. Lookback.io comes in the form of a Chrome plug-in on the computer, making it very easy and convenient for our participants to install on their device. As part of this study, the Lookback.io platform was also used to film, record, and capture the participant's computer screen's image. The captured videos were then used to analyze all actions and conversations during the experiment. Facial emotions were also analysed post-experimentation with FaceReader 7.0 (Noldus, Wageningen, Netherlands). This non-intrusive technology enables us to do real-time emotional reactions analysis, via a webcam.

EDA and EKG data were collected with a small portable apparatus called a Cobalt box (see Annexe 1.4 for visuals). Research has shown that using such devices does not affect the ecological validity due to the non-intrusive nature of the equipment (Brissette-Gendron & al., 2020; Léger & al., 2010; Nacke & al., 2010; Passalacqua & al., 2020). Portability and convenience were necessary since the experiment took place outside a lab. Participants had to position all electrodes by themselves, with the help of the researchers over the webcam. The Cobalt box itself is made of 3D printed material and comprises a BITalino (r)evolution Freestyle Kit (PLUX Wireless biosignals S.A.) (Batista & al., 2019; Brissette-Gendron & al., 2020). To synchronize each task to variations in the physiological data, we used a synchronization technique developed by Courtemanche & al. (2018). At the beginning of the experiment, a light pattern is triggered and displayed by the Cobalt box. That light pattern is then picked up by the participant’s webcam, which allows us to precisely set markers onto the physiological data file.

3.4 Results and Analysis

A total of 43 participants participated in this study, including 22 (51%) women. Participants are between the ages of 19 and 63. Table 1 below summarizes the main task variables for all experimental conditions. Participants mean age is 27.1 years (SD = 9.4). For 2 participants, observations for valence and arousal are missing due to technical issues. For another participant, observations for valence (1 observation) and arousal (1 observation) have been lost due to data entry error.

Table 1
Task variables by experimental conditions

	GIF		Image		Text		No Filler	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Temporal Dissociation	-8.51	13.88	-10.42	14.35	-9.40	14.28	-8.66	14.81
Heightened Enjoyment	3.60	1.45	2.65	1.04	3.24	1.22	2.56	1.04
Perceived Waiting Time	3.26	0.86	3.27	0.93	3.08	0.88	3.36	0.96
General Impression	3.14	0.83	2.78	0.77	3.15	0.76	2.69	0.82
Mean Valence During Waits								
Valence Full Wait	-0.16	0.16	-0.16	0.15	-0.16	0.16	-0.18	0.17
Valence First 10 sec	-0.16	0.18	-0.16	0.16	-0.15	0.16	-0.18	0.17
Valence Last 10 sec	-0.16	0.15	-0.16	0.16	-0.16	0.15	-0.17	0.18
Mean Arousal During Waits								
Arousal Full Wait	0.26	0.03	0.26	0.04	0.27	0.04	0.26	0.04
Arousal First 10 sec	0.27	0.04	0.27	0.04	0.27	0.04	0.27	0.05
Arousal Last 10 sec	0.26	0.04	0.26	0.05	0.26	0.06	0.26	0.04

We conducted a manipulation check to assess if participants could correctly identify the type of filler that is being manipulated throughout the experiment. After each task, participants were asked to identify the stimulus they were just exposed to (i.e., user reviews (text), animated product images (GIFs), non-animated product images (image), or none of these items. We calculated a chi-square analysis, results were significant and revealed that 86.9% of participants correctly identified the manipulation (DF=9, p < .000). That is, 82,2% of participants correctly identified the GIF condition, 89,5% correctly identified the Image condition, 89,5% correctly identified the Text condition, and 88,4% correctly identified the No Filler condition.

3.4.1 Effect of Fillers on Cognitive Absorption (H1-H2)

Our first hypothesis tested if there are any differences in users' temporal dissociation (TD) between four filler types (i.e., image, text, GIF, or none) while waiting in a virtual queue. We expected that displaying an image (H1a), a text (H1b), or a GIF (H1c) in a filler interface, rather than displaying none of these filler types, would positively affect users' TD. The dependent variable included in this analysis was TD, as well as control variables order effect (sig. $p < .01$) and brand preference (not sig.). A repeated measures linear regression was calculated to predict TD based on the displayed filler type. As illustrated in Table 2, results revealed no main effect of GIF ($F(1,42)=0.00$, $p < .990$, SE=2.01), nor Image ($F(1,42)=1.08$, $p < .305$, SE=1.63), nor Text ($F(1,42)=0.21$, $p < .646$, SE=1.82) on the mean TD, as opposed to displaying no filler. Contrary to our expectations, we have not found enough evidence to support H1a, H1b, or H1c. That is, displaying an image, a text, or a GIF in a filler interface had no significant effect on TD as opposed to displaying none of these filler types.

Table 2
Filler Type on TD Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.026	-0.01	0.990	-4.08	4.03
Image	-1.687	-1.04	0.305	-4.97	1.59
Text	-0.841	-0.46	0.646	-4.51	2.83
No Filler	-10.416	-2.27	0.029	-19.68	-1.15

1. Order effect sig. $p < 0.01$
2. Brand Preference not sig.

Our second hypothesis tested if there are any differences in users' Heightened Enjoyment (HE) between four filler types (i.e., image, text, GIF), versus no filler, while waiting in a virtual queue. We expected that displaying an image (H2a), a text (H2b), or a GIF (H2c) in a filler interface, rather than displaying none of these filler types, would positively affect the dependent variable: users' HE. Order effect (sig. $p < .05$) and brand preference (not sig.) were also included in the analysis. A repeated measures linear regression was calculated to predict HE based on the displayed filler type. As shown in Table 3, results revealed no main effect of Image condition ($F(1,42)=0.41$, $p < .527$, SE= 0.53) on HE, as opposed to displaying no filler. However, we found a significant positive effect of the GIF condition (F(1,42)=23.40, $p < .000$, SE= 0.86) and the Text condition (F(1,42)=14.87, $p < .000$, SE= 0.70) on users' HE, as opposed to displaying no filler. Additionally, we have found significant differences between the GIF and Image condition (F(1,42)=26.93, $p < .000$), between the GIF and Text condition (F(1,42)= 3.15, $p < .100$), and between the Image and Text condition (F(1,42)=22.66, $p < .001$). The captured variance explained by the regression for HE (R^2) is 0.128 ($p < .001$). Overall, we have found significant differences for the GIF and Text condition, thus providing support to H2b and H2c. However, we have not found enough evidence to support H2a. That is, displaying a GIF or a text in a filler interface has a significant positive effect on HE as opposed to displaying an image or no filler in the virtual queue.

3.4.2 Effect of Fillers on Physiological Data (H3-H4)

The next two hypotheses tested if there are any differences in users' Valence and Arousal between four filler types (i.e., Image, Text, GIF or none) while waiting in a virtual queue. We expected that displaying an Image (a), a Text (b), or a GIF (c) in a filler interface, rather than displaying none of these filler types, would positively affect users' valence (H3) and arousal (H4). The dependent variables included in this analysis are valence and arousal. A repeated measures linear regression was calculated to predict valence and arousal based on the displayed filler type. Control variables of order effect and brand preference were also included in the analysis.

Table 3

Filler Type on HE Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	4.164	4.84	0.000	2.43	5.90
Image	0.339	0.64	0.527	-0.73	1.41
Text	2.713	3.86	0.000	1.29	4.13
No Filler	10.620	9.07	0.000	8.26	12.98

1. Order effect sig. $p < 0.05$
2. Brand Preference not sig.

Filler Type on Valence (H3)

Full length of the wait. As seen in Table 4 bellow, users' mean valence results revealed no main effect for the GIF condition (F(1,40)=1.65, *p* < .206, SE=0.01), nor the Text condition (F(1,40)=2.81, *p* < .102, SE=0.01) as opposed to the no filler condition. We did find the mean valence for the Image condition to be slightly significant and positive (F(1,40)=3.54, *p* < .100, SE=0.01), as opposed to displaying no filler. Control variables of order effect and brand preference were not significant.

As illustrated in Table 5, standard deviation for users' valence during the *full length of the wait* revealed significant negative effects for the GIF condition (F(1,40)=6.32, *p* < .050, SE=0.03), the Image condition (F(1,40)=3.89, *p* < .100, SE=0.03), and the Text condition (F(1,40)=2.85, *p* < .100, SE= 0.03), as opposed to displaying no filler. Order effect was not significant. Control variable of brand preference for Coca-Cola versus Pepsi was significant (*p* < 0.10).

Table 4
Filler Type on Valence Mean Full Length Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	0.014	1.28	0.206	-0.01	0.03
Image	0.017	1.88	0.067	0.00	0.04
Text	0.015	1.68	0.102	0.00	0.03
No Filler	-0.260	-4.31	0.000	-0.38	-0.14

1. Order effect not sig.
2. Brand Preference not sig.

Table 5
Filler Type on Valence StDev Full Length Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.073	-2.51	0.016	-0.13	-0.01
Image	-0.062	-1.97	0.055	-0.13	0.00
Text	-0.050	-1.69	0.099	-0.11	0.01
No Filler	0.474	8.41	0.000	0.36	0.59

1. Order effect not sig.
2. Brand Preference Coca V. Pepsi sig. *p* < 0.10

First 10 seconds of the wait. As shown in Table 6, users' *mean valence* results revealed significant and positive effects of the GIF condition (F(1,40)=3.81, *p* < .100, SE=0.01), the Image condition (F(1,40)=3.44, *p* < .100, SE=0.01), and the Text condition (F(1,40)=5.96, *p* < .050, SE=0.01) on users' valence as opposed to displaying no filler. Control variables of order effect and brand preference were not significant in this analysis.

Additionally, as shown in Table 7, mean standard deviation of the Text condition (F(1,40)=3.05, *p* < .100, SE=0.09) is slightly significant and negative, as opposed to displaying no filler. Order effect was not significant. Brand preference for Coca-Cola versus Pepsi was significant ($p < 0.05$).

Table 6
Filler Type on Valence Mean First10 Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	0.025	1.95	0.058	0.00	0.05
Image	0.021	1.85	0.071	0.00	0.04
Text	0.030	2.44	0.019	0.01	0.05
No Filler	-0.269	-4.64	0.000	-0.39	-0.15

1. Order effect not sig.
2. Brand Preference not sig.

Table 7
Filler Type on Valence StDev First10 Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.142	1.39	0.172	-0.35	0.06
Image	-0.117	-1.28	0.208	-0.30	0.07
Text	-0.161	-1.75	0.088	-0.35	0.03
No Filler	1.304	8.52	0.000	0.99	1.61

1. Order effect not sig.
2. Brand Preference Coca V. Pepsi sig. $p < 0.05$

Last 10 seconds of the wait. Mean valence and standard deviation results revealed no significant differences between the displayed filler types and their effect on valence.

Overall, as summarized in table 8, results for H3a-c indicate that displaying an image, had a significant and positive effect on users' valence during the full length of the wait, as opposed to displaying no filler. For the first 10 seconds of the wait, all fillers had a significant and positive effect on users' valence as opposed to displaying no filler. Last 10 seconds of the wait revealed no significant differences between the filler types. Results thus provide enough evidence to support H3b. H3a and H3c are partially supported.

Table 8
H3 Results Summary

Hypothese No.	Hypothesis	Mesure	Results
H3	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H3a), Image (H3b), or GIF (H3c)) will experience more POSITIVE emotional valence than users exposed to filler interfaces that do not display a stimulus.	Valence	H3a Partially Supported H3b Supported H3c Partially Supported

Filler Type on Arousal (H4)

Full length of the wait. Results for users' mean arousal for full length revealed no main differences between our four conditions. However, as shown in Table 9, standard deviation results revealed a significant negative effect for the GIF condition (F(1,40)=7.14, $p < .050$, SE=0.06), as opposed to the no filler condition. Results also show significant differences between the GIF and the Image condition (F(1,40)=3.26, $p < .100$), and between the GIF and Text condition (F(1,40)=6.39, $p < .050$). This suggests that the GIF condition results are much more concentrated near the regression line than any other filler type, as well as the no filler condition. Order effect and brand preference were not significant.

Table 9
Filler Type on Arousal StDev Full Length Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.172	-2.67	0.011	-0.30	-0.04
Image	-0.077	-1.25	0.218	-0.20	0.05
Text	-0.026	-0.43	0.671	-0.15	0.10
No Filler	1.074	8.03	0.000	0.80	1.34

1. Order effect not sig.
2. Brand Preference not sig.

First 10 seconds of the wait. Results for users' mean arousal revealed no main effect between our four conditions. However, as shown in Table 10 below, standard deviation results for arousal during the first 10 seconds revealed significant negative effects for the GIF condition (F(1,40)=3.99, $p < .100$, SE=0.06) and the Image condition (F(1,40)=4.82, $p < .050$, SE=0.06) as opposed to displaying no filler. Additionally, we have found significant differences between the Image and the Text condition (F(1,40)=2.83, $p < .100$). Order effect and brand preference were not significant.

Table 10
Filler Type on Arousal StDev First10 Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.129	-2.00	0.053	-0.26	0.00
Image	-0.137	-2.19	0.034	-0.26	-0.01
Text	-0.046	-0.71	0.482	-0.18	0.09
No Filler	0.719	6.80	0.000	0.51	0.93

1. Order effect not sig.
2. Brand Preference not sig.

Last 10 seconds of the wait. Users' mean arousal results revealed no main effect between our four conditions, and control variables order effect and brand preference were not significant. However, as shown in Table 11, standard deviation results for arousal during the last 10 seconds revealed significant negative effects for the GIF condition ($F(1,40)=7.90$, $p < .010$, SE=0.05), as opposed to the no filler condition. Additional significant differences have been found between the GIF and the Image condition ($F(1,40)=2.78$, $p < .100$), between the GIF and Text condition ($F(1,40)=8.75$, $p < .010$), and between the Image and Text condition ($F(1,40)=3.16$, $p < .100$). Order effect and brand preference were not significant.

Table 11
Filler Type on Arousal StDev Last10 Regression Results [1-2]

Filler Type	Coef.	*t*	P-Value	95% Conf. Int.	
GIF	-0.143	-2.81	0.008	-0.24	-0.04
Image	-0.058	-1.21	0.234	-0.15	0.04
Text	0.040	0.77	0.445	-0.07	0.15
No Filler	0.617	7.09	0.000	0.44	0.79

1. Order effect not sig.
2. Brand Preference not sig.

All in all, as summarized in table 12, results indicate that displaying a GIF, an Image, or a Text in a filler interface has no significant differences on mean arousal, regardless of the length of the wait we examine. However, when examining the full length, as well as first and last 10 seconds of the wait, standard deviation arousal's results revealed significant and negative differences for the GIF and Image condition, as opposed to the no filler condition, suggesting that the results for GIF and Image are much more concentrated toward the regression line than it is for the no filler condition. In light of these results, we have found evidence to partially support H4b and H4c.

Table 12

H4 Results Summary

Hypothese No.	Hypothesis	Mesure	Results
H4	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H4a), Image (H4b), or GIF (H4c)) will experience GREATER emotional arousal than users exposed to filler interfaces that do not display a stimulus.	Arousal	H4a Not supported H4b Partially Supported H4c Partially Supported

3.4.3 Temporal Dissociation and Heightened Enjoyment on Perceived Waiting Time (H5-H6)

Our fifth and sixth hypotheses tested if temporal dissociation (TD) and heightened enjoyment (HE) had any effect on perceived waiting time (PWT). We expected that lower TD and higher HE would have a negative impact on PWT (H5 and H6). A repeated measures linear regression was used to make the analysis. Order effect was included in both analyses and is significant for both calculations ($p < .001$). As shown in Table 13, results suggest that an increase in TD is related to an increase in PWT (Coef. = 0.018, t = 5.95, $p < .001$, SE=0.003), thus providing support to H5 with R^2 equal to 0.143 ($p < .001$). As shown in Table 14, results also suggest that users' increased HE is related to a decrease in PWT (Coef. = -0.068, t = -5.62, $p < .001$, SE=0.01), thus providing support to H6, R^2 equal to 0.212 ($p < .001$).

Table 13

TD on PWT Regression Results [1]

Variable	Coef.	*t*	P-Value	95% Conf. Int.	
TD	0.018	5.95	0.000	0.01	0.02

1. Order effect sig. $p < 0.001$

Table 14

HE on PWT Regression Results [1]

Variable	Coef.	*t*	P-Value	95% Conf. Int.	
HE	-0.069	-5.62	0.000	-0.09	-0.04

1. Order effect sig. $p < 0.001$

3.4.4 Physiological data on PWT (H7-H8)

Our seventh and eighth hypotheses tested if valence and arousal had any effect on PWT. We expected that higher valence (H7) and higher arousal (H8) would have a negative impact on PWT. The dependent variables included in this analysis are valence and arousal. A repeated measures linear regression was used to analyse comparisons between each condition. Order effect was also in the regressions as our control variable.

For the full length of the wait, results of mean valence (Coef. = -.442, t = -1.13, p = .265, SE=0.39) and standard deviation (Coef. = -.004, t = -0.01, p = .990, SE=0.27) revealed no significant effect on PWT. We found similar results for arousal. That is, mean arousal (Coef. = .140, t = 0.08, p = .934, SE=1.69) and standard deviation (Coef. = .089, t = 0.52, p = .608, SE= 0.17) revealed no significant effect on PWT. Order effect was significant for both valence and arousal calculations ($p < .000$).

Similarly for the first 10 seconds of the wait, results of mean valence (Coef. = -.422, t = -1.13, p = .265, SE=0.37) and standard deviation (Coef. = -. 037, t = 0.39, p = .699, SE=0.09) revealed no significant effect on PWT. Along the same line, mean arousal (Coef. = 1.340, t = 1.00, p = .325, SE=1.35) and standard deviation (Coef. = . 172, t = 1.26, p = .216, SE=0.14) revealed no significant effect on PWT. Order effect was significant for both valence and arousal calculations ($p < .000$).

Lastly for the last 10 seconds of the wait, results of mean valence (Coef. = -.344, t = -.89, p = .376, SE=0.39) and standard deviation (Coef. = -.034, t = -.34, p = .734, SE=0.10) revealed no significant effect on PWT. Mean arousal (Coef. = .475, t = 0.35, p = .730, SE=1.37) and standard deviation (Coef. = -.059, t = -0.32, p = .750, SE=0.19) neither revealed significant effect on PWT. Order effect was significant for both valence and arousal calculations ($p < .000$).

Contrary to our expectations, we have not found enough evidence to support H7 and H8, regardless of the length of time we examined.

3.4.6 Effect of Perceived Waiting Time on General Impression (H9)

Our ninth hypothesis tested the effect of PWT onto GI. We expected lower PWT to be related to higher GI (H9). A repeated measures linear regression was used to analyse this comparison. Order effect was included in the regression as our control variable (not significant). Results suggest that a decrease of PWT relates to an increase in GI (Coef. = -0.41, t = -5.33, $p < .001$), thus providing support to H9. The captured variance explained by the regression for HE (R^2) is 0.203 ($p < .001$).

Table 15

Hypothesis Results Summary

Hypothese No.	Hypothesis	Mesures	Results
H1	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H1a), Image (H1b), or GIF (H1c)) will experience GREATER temporal dissociation (i.e., underestimation of the wait) than users that are exposed to filler interfaces that do not display a stimulus.	Temporal Dissociation	H1a-c Not supported
H2	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H2a), Image (H2b), or GIF (H2c)) will experience GREATER enjoyment than users exposed to filler interfaces that do not display a stimulus.	Heightened Enjoyment	H2a Supported H2b Not supported H2c Supported
H3	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H3a), Image (H3b), or GIF (H3c)) will experience more POSITIVE emotional valence than users exposed to filler interfaces that do not display a stimulus.	Valence	H3a Partially Supported H3b Supported H3c Partially Supported
H4	Users exposed to filler interfaces displaying a stimulus (i.e., Text (H4a), Image (H4b), or GIF (H4c)) will experience GREATER emotional arousal than users exposed to filler interfaces that do not display a stimulus.	Arousal	H4a Not supported H4b Partially Supported H4c Partially Supported
H5	Users reporting LOWER temporal dissociation (i.e., underestimation of the wait) due to a filler interface will report SHORTER waiting time.	Perceived Waiting Time	Supported
H6	Users experiencing GREATER enjoyment due to a filler interface will express SHORTER perceived waiting time.	Perceived Waiting Time	Supported
H7	Users experiencing more POSITIVE emotional valence will express SHORTER perceived waiting time.	Perceived Waiting Time	Not supported
H8	Users experiencing GREATER emotional arousal will express SHORTER perceived waiting time.	Perceived Waiting Time	Not supported
H9	Users experiencing SHORTER perceived waiting time will express HIGHER scores for general impression.	General Impression	Supported

3.5 Discussion and Conclusion

Using theories of resource allocation, competition for attention, and motion effect, this study examines the relationship between filler interface designs and online wait in the context of a virtual queue. Specifically, we have shown how various filler interface designs affect Cognitive absorption factors, such as temporal dissociation (TD) and heightened enjoyment (HE). We have also shown how filler interface designs affect users' valence and arousal while waiting in a virtual queue. Additionally, we analyzed how TD, HE, valence, and arousal affected perceived waiting time (PWT) online, which in turn was shown to have a large impact on the general impression (GI) of the overall wait. To our knowledge, this is the first study in an online virtual queue context to have examined the influence of filler interfaces on PWT. In this context, this study is also the first to have examined the effect of cognitive absorption factors, as well as users' valence and arousal on PWT.

Our first objective was to examine diverse filler types (i.e., text, image, GIF, or none) and their effect on cognitive absorption factors (H1 and H2). On the one hand, we found that displaying a text (H1a), an image (H1b), or a GIF (H1c) in the filler interface, rather than not displaying any of these fillers, was not associated with an increased TD. These results thus indicate that displaying visual stimuli such as texts, images, and GIFs in a filler interface is not sufficient to induce significant TD as opposed to a no-filler condition, which was unexpected. It is possible that the stimuli used in the experiment were not enough to fill users' thoughts relative to the length of the wait. Perhaps a stimulus that spans for the entire wait segment, such as a video, would be sufficient to induce TD. On the other hand, we found that displaying a text (H2a) or a GIF (H2c) in the filler interface, rather than not displaying any of these fillers, was associated with an increased HE. Specifically, displaying a GIF or a text significantly increases users' perceived enjoyment during the wait, as opposed to not displaying anything, which was expected. However, displaying an image, rather than nothing, was not associated with an increase in HE, thus rendering H2b not supported. That said, the main objective was to see if there are any differences between moving images and fixed images and by doing so, we used images that were not professionally made (i.e., images used were not aesthetically pleasing), which may have affected the results.

Our second objective was to examine diverse filler types (i.e., text, image, GIF, or none) and their effect on users' physiological reactions (H3 and H4). Results revealed that displaying a text, an image or a GIF in a filler interface has a significant and positive effect on valence as opposed to not displaying any filler. By examining the full length of the wait, we found the image condition to be the one with the highest mean valence, as opposed to any other filler type. That result is unexpected, since the Image condition did not induce significant heightened enjoyment. Perhaps the fixed image induced less stress as opposed to the text and GIF condition (i.e., things to read or flashing motions). It is also possible that the facial expression software used in the experiment interpreted people's reading segment as a negative sentiment for the text condition (i.e., eyes focusing to read, getting close to the monitor). Regarding the first 10 seconds of the wait, the text condition revealed to be the one with the highest mean valence, followed by the GIF, then image, and the no filler condition with the lowest mean valence.

Standard deviation results also revealed that displaying an image or a GIF in a filler interface has significant effect on arousal as opposed to not displaying any filler (H4). By examining the full length of the wait, we found the GIF condition to be the one with the highest mean standard deviation of arousal, as opposed to any other filler type. Additionally, for the first 10 seconds of the wait, we found the image and the GIF condition to be the ones with the highest mean standard deviation for arousal amongst all conditions. Lastly, for the last 10 seconds of the wait, we found the GIF condition to be the one with the highest mean standard deviation of arousal amongst all filler types.

Our third objective was to examine cognitive absorption factors and their effect on users' PWT (H5 and H6). We found that while in a virtual queue, users' increased TD is related to an increase in PWT (H5). Users underestimating the wait will find the wait to be shorter and users overestimating the wait will find the wait to be longer, which makes total sense. Additionally, in support of H6, we found that increased enjoyment is related to a shorter PWT. Specifically, the GIF and the text conditions were significantly more enjoyable to users than the fixed image and the no-filler conditions, which was expected and congruent with the recent literature on wait management.

Our fourth objective was to investigate the effects of users' physiological reactions on PWT. Results did not support our expectations for H7 and H8, which posit that higher valence and arousal would induce a shorter PWT.

Finally, our last objective was to examine the effect of PWT on GI (H9). We found that users' increased PWT is related to a decrease in GI, thus providing support to H9. These results are in line with the literature suggesting that people generally do not like to wait for services, which is now illustrated in the context of a virtual queue.

3.6 Theoretical Contributions

Our study makes several contributions to the online waiting management literature. By examining online wait perceptions in the context of a virtual queue, we expand knowledge of online wait research with a focus on perceived waiting time (PWT).

First, most of the current literature on online wait management measured waits of under 30 seconds. Our study went further by examining virtual queues with waiting time ranging from 45 to 55 seconds. Still, more research is needed for even longer waits. It would be interesting to investigate what is the users' sentiment towards virtual queues that last for longer than 10 minutes.

Second, our study revealed strong evidence to suggest that various filler interface designs can manipulate online users' perceived enjoyment, which in turn has important implications on users' perceived waiting time and general impression of the overall wait. Lee et al. (2012) found that moving images induced more enjoyment than fixed images in the context where users were waiting for a page to load. Our results suggest that displaying a GIF (i.e., moving images) to users in a virtual queue also led to more enjoyment than when displaying a fixed image. To our knowledge, our study is the first to examine the effects of GIFs on users' sentiment in the context of a virtual queue.

Third, we examined the relationship between physiological reactions (valence and arousal) and our main independent variables (i.e., Text, Image, and GIF). To that end, we have shown that displaying a Text, an Image or a GIF in a filler interface significantly and positively impacts valence in the first 10 seconds of the wait. To our knowledge, our study is the first to have examined filler interface designs and their effect on physiological data.

Finally, our study also reaffirmed Argawal and Karahanna's (2000) theory regarding heightened enjoyment, whereby time passes more quickly when you are having fun. Indeed, our results indicate that time really does fly when you are having fun. Additionally, we have further demonstrated that the cognitive absorption constructs, such as temporal dissociation and heightened enjoyment are relevant theoretical tools to study time perception online.

3.7 Practical Implications

Our study results allow us to provide useful and relevant practical implications for Web site managers and designers regarding filler interfaces and its impact on users' perceived waiting time. First, our findings indicate that not displaying fillers while people are waiting online is clearly inferior to displaying a filler. Whenever a wait situation is unavoidable or predictable, displaying a filler during that wait period, rather than not, is significantly more effective at managing waiting time, as it increases perceived enjoyment, which in turn reduces perceived waiting time and increases the general impression.

Second, our findings suggest that with regards to heightened enjoyment and general impression of the overall wait, displaying a GIF is significantly better than displaying a fixed image. Indeed, moving images tend to attract more attention and are more enjoyable to watch than fixed images, which translates into shorter perceived waiting time. Thus, we recommend that Web site managers and UI designers use GIFs in virtual queues as opposed to static images.

Third, our results also suggest that displaying texts as a filler works significantly better than displaying nothing or a fixed image with regards to heightened enjoyment. We recommend Web site managers and UI designers to include text into their filler interfaces. By doing this, users may spend some of the waiting time reading, thus occupying their thoughts while they wait. Possible integration includes product reviews or even a twitter feed.

Lastly, our findings suggest that shorter wait perception and enjoyment significantly increases the general impression. Thus, prior to highly marketed online events, Web site managers and UI designers are advised to spend more time on designing a filler interface that comprises features susceptible to (1) capture users' attention and (2) that fosters enjoyment, as it is a very good alternative to costly technical solutions (i.e., software, hardware, or network upgrades) (Lee et al., 2012).

3.8 Limitations, and Future Research Directions

While this study provides insights to both researchers and practitioners, we acknowledge that this study has limitations. First, our study lacks external validity. Indeed, most participants were students, and from only one university. Even if students are likely a target population in the context of this study, more research is needed with different group representation and context settings to strengthen the results. Future studies could recruit actual customers, from different cultures, which severely lacks in the present literature. Other studies could also investigate the differences amongst environmental and online context settings, such as waiting rooms in Zoom versus an online grocery store.

Second, this study only examined text, images, and GIFs as design components, which are relevant to the current use of filler interfaces, but more research is needed using different design components to further strengthen our understanding of wait perception while waiting online. Future research could examine design components such as progress indicators, wait indicators, system messages, videos, font size, or even background color. Some stimuli may be more difficult to process (i.e., video vs image vs text) (Taylor, 1994), and that is something we have not measured. Future research could examine which stimuli is more difficult to process and in which context.

Third, we did not consider other factors that may affect users' perceived waiting time, such as wait expectations, online waiting acceptance, familiarity with filler interfaces, or cultural background. Previous research suggests that familiarity with items increases time estimation (Fernandes and Garcia-Marques, 2020). Future research could thus investigate this relationship between known brands versus unknown brands. That is, participants’ sentiment could have been different at the beginning or the end of a queue because they are more excited, or not, about specific brands or products.

Fourth, in this paper, we have suggested that time flies when we are having fun. Yet, we have not measured the hedonic value of our stimuli. We suggest that future research for time estimation do measure hedonic value of every stimulus used in the experiment.

Finally, we must wonder, where do people look while they wait? A gaze analysis would be very beneficial in this study setting, as it would provide a better understanding of users’ attention.

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Chapitre 4

4.1 Conclusion

L’objectif de ce mémoire était d’étudier le comportement des utilisateurs dans un contexte de file d’attente virtuelle. En utilisant les théories d’allocation des ressources cognitive, de la compétition pour l'attention et de l'effet de mouvement, cette étude examine la relation entre différents éléments de design dans les interfaces de remplissage (i.e., image, texte, GIF, aucun filler) et de leurs impacts respectifs sur la dissociation temporelle, le plaisir perçu ainsi que sur les données physiologiques des utilisateurs. Ces métriques nous ont ensuite permis de constater s’ils avaient un impact sur la perception temporelle ainsi que l’impression générale des utilisateurs quant à l’attente en ligne. Par la manipulation de ces quatre éléments de design, nous avons validé leurs contributions respectives aux perceptions de l’attente en ligne. À notre connaissance, il s'agit de la première étude dans un contexte de file d'attente virtuelle à avoir examiné l'influence des interfaces de remplissage et de ses éléments de conception sur la perception temporelle des utilisateurs. Dans ce même contexte, cette étude est également la première à avoir examiné l'influence des facteurs d'absorption cognitive, ainsi que de la valence et de l'excitation des utilisateurs sur la perception temporelle. De ce fait, ce mémoire a permis d’enrichir nos connaissances en matière de gestion de l’attente dans un contexte de salle d’attente virtuelle.

La suite de ce chapitre consiste à faire un rappel des questions de recherche et des résultats, ainsi que les contributions, limites et avenues de recherche future qui émanent de ce mémoire.

4.2 Rappel des questions de recherche et résultats

Les résultats de ce mémoire ont permis de répondre aux questions suivantes :

Question 1 : Quelles sont les caractéristiques de conception d'une interface de remplissage qui peuvent être utilisées dans le but d’influencer la perception temporelle qu'ont les utilisateurs de l'attente en ligne ?

Question 2 : Comment pouvons-nous favoriser une évaluation positive de l’attente ?

Afin de répondre à nos questions de recherche, une expérience intra-sujet a été menée dans laquelle les participants devaient attendre dans une salle d'attente virtuelle. Avec Axure RP9, nous avons conçu ces files d’attente virtuelle, pour un total de 16 conditions différentes. Les participants devaient joindre ces files d’attente et patienter pour la durée qui était associée à cette condition. Chaque participant a été exposé à huit files d’attente virtuelle distinctes. L’expérience a accueilli 43 participants (51% femmes, 49% hommes) âgés de 19 à 63 ans (M=27,09, écart type=9,37) et la collecte de données s’est effectuée entre le 16 novembre 2020 et le 22 janvier 2021.

Notre premier objectif était d'examiner divers types de remplissage (i.e., texte, image, GIF ou aucun filler) et leur effet sur les facteurs d'absorption cognitive (H1 et H2). D'une part, nous avons constaté que l'affichage d'un texte, d'une image ou d'un GIF dans l'interface de remplissage, plutôt que de n'afficher aucun de ces éléments, n'était pas associé à une augmentation de la dissociation temporelle (H1). En d'autres termes, les utilisateurs ont sous-estimé les temps d'attente de l’ensemble des éléments de remplissage (i.e., texte, image et GIF) et ces sous-estimations ne présentaient aucune différence significative à celle dont l’interface de remplissage ne présentait aucun de ces éléments. Ces résultats indiquent donc que l'affichage de stimuli visuels tels que des textes, des images et des GIFs dans une interface de remplissage n'est pas suffisant pour induire une dissociation temporelle significative par rapport à une condition sans remplissage. En revanche, nous avons constaté que l'affichage d'un texte, d'une image ou d'un GIF dans l'interface de remplissage, plutôt que de ne pas afficher l'un de ces éléments de remplissage, est associé à une augmentation du plaisir perçu (H2). Plus précisément, l'affichage d'un GIF ou d'un texte augmente de manière significative le plaisir perçu par les utilisateurs pendant l'attente, par opposition au fait de ne rien afficher. Cependant, l'affichage d'une image, plutôt que rien, n'a pas été associé à une augmentation du plaisir perçu.

Notre deuxième objectif était d'examiner divers types de remplissage (c'est-à-dire texte, image, GIF ou aucun) et leur effet sur les réactions physiologiques des utilisateurs (H3 et H4). Pour ce faire, les réactions physiologiques des utilisateurs à ces types de remplissage ont été capturées à l'aide d'un appareil appelé Bluebox. Les résultats ont révélé que l'affichage d'un texte, d'une image ou d'un GIF, relativement à ne rien afficher, dans une interface de remplissage a un effet significatif et positif sur la valence (H3). En examinant la durée totale de l'attente, nous avons constaté que la condition de l'image était celle qui avait la valence moyenne la plus élevée, par rapport à tout autre type de remplissage. En ce qui concerne les 10 premières secondes de l'attente, la condition texte s'est révélée être celle avec la valence moyenne la plus élevée, suivie par le GIF, l'image, puis la condition sans remplissage avec la valence moyenne la plus basse. Cela dit, tous les types de remplissage tendent à s'égaliser vers les 10 dernières secondes de l'attente, car aucune différence significative n'a été constatée pour cette tranche d'observations.

Les résultats des écart-types ont également révélé que l'affichage d'une image ou d'un GIF dans une interface de remplissage a un effet significatif sur l'excitation par rapport à l'absence d'élément de design dans l'interface de remplissage (H4). En examinant la durée totale de l'attente, nous avons constaté que la condition GIF était celle qui présentait l'écart-type moyen le plus élevé en matière d'excitation, par rapport à tout autre type de remplissage. De plus, pour les 10 premières secondes de l'attente, nous avons constaté que l'image et la condition GIF étaient celles dont l'écart type moyen d'excitation était le plus élevé parmi toutes les conditions. Enfin, pour les 10 dernières secondes de l'attente, nous avons constaté que la condition GIF était celle dont l'écart type moyen de l'excitation était le plus élevé parmi tous les types de remplissage.

Notre troisième objectif était d'examiner les facteurs d'absorption cognitive et leur effet sur le temps d'attente perçu des utilisateurs (H5 et H6). Nous avons constaté que dans une file d'attente virtuelle, l'augmentation de la dissociation temporelle des utilisateurs est liée à une augmentation du temps d'attente perçu (H5), ce qui est logique dans ce contexte. Dans une file d'attente virtuelle, les utilisateurs qui surestiment l'attente perçoivent un temps d'attente plus long, tandis que les utilisateurs qui sous-estiment l'attente perçoivent un temps d'attente plus court. Ensuite, nous avons constaté que l'augmentation du plaisir perçu est liée à une perception temporelle plus courte (H6). Plus précisément, les conditions GIF et texte étaient significativement perçu comme étant plus agréables pour les utilisateurs que les conditions image et sans remplissage.

Nous avons également étudié les effets des réactions physiologiques des utilisateurs sur la perception temporelle qu'on eut les utilisateurs durant l'attente. Les résultats n'ont toutefois pas confirmé nos attentes pour H7 et H8, qui postulait qu'une valence et une excitation plus élevées induisent une perception temporelle plus courte.

Enfin, notre dernier objectif était d'examiner l'effet de la perception temporelle sur l'impression générale de l'attente (H9). Nous avons constaté que l'augmentation de la perception temporelle des utilisateurs est liée à une diminution de l'impression générale de l'attente, corroborant ainsi les résultats de recherches précédentes.

4.3 Contributions

Notre étude apporte plusieurs contributions théoriques à la littérature sur la gestion de l'attente en ligne. En examinant les réponses psychométriques et physiologiques des utilisateurs dans un contexte de salle d'attente virtuelle, nous élargissons les connaissances de la recherche sur l'attente en ligne en mettant l'accent sur la perception temporelle. Notre étude a révélé des résultats qui suggèrent que diverses conceptions d'interface de remplissage peuvent manipuler le plaisir perçu par les utilisateurs en ligne, ce qui, à son tour, a des implications importantes sur le temps d'attente perçu par les utilisateurs et l'impression générale de l'attente. Nous avons également obtenu des résultats confirmant la théorie de Lee et al. (2012) qui stipule que les images en mouvement induisent plus de plaisir que les images fixes. À notre connaissance, notre étude est la première à examiner les effets des GIFs (c'est-à-dire des images en mouvement) sur le sentiment de plaisir perçu des utilisateurs dans le contexte d'une file d'attente virtuelle. À cet égard, nos résultats suggèrent que l'affichage d'un GIF dans une file d'attente virtuelle a conduit à plus de plaisir pour les utilisateurs que l'affichage d'une image fixe. En outre, notre étude a également réaffirmé la théorie d'Argawal et Karahanna (2000) concernant le plaisir accru, et selon laquelle le temps passe plus vite lorsqu'on s'amuse. En effet, nos résultats indiquent que le temps passe significativement plus vite quand on s'amuse. Nous avons également démontré que les dimensions du construit d'absorption cognitive, telles que la dissociation temporelle et le plaisir accru, sont des outils pertinents pour étudier la prescription temporelle en ligne.

Les résultats de notre étude nous permettent également de fournir des implications pratiques aux gestionnaires et concepteurs de sites Web concernant les interfaces de remplissage et de leurs impacts sur le temps d'attente perçu par les utilisateurs. Premièrement, nos résultats indiquent que le fait de ne pas afficher d'éléments de design dans une salle d'attente virtuelle, tels qu'une image, un texte ou un GIF, est clairement inférieur à l'affichage d'un de ces éléments. Lorsqu'une situation d'attente est inévitable ou prévisible, le fait d'afficher un élément de distraction pendant cette période d'attente, plutôt que de ne pas le faire, est nettement plus efficace pour gérer le temps d'attente, car il augmente le plaisir perçu, ce qui réduit à son tour le temps d'attente perçu et augmente l'impression générale de l'attente.

Deuxièmement, nos résultats suggèrent qu'en ce qui concerne l'augmentation du plaisir et l'impression générale de l'attente, l'affichage d'un GIF est significativement meilleur que l'affichage d'une image fixe. En effet, les images en mouvement ont tendance à attirer davantage l'attention et sont plus agréables à regarder que les images fixes, ce qui se traduit par un temps d'attente perçu plus court. Nous recommandons ainsi aux gestionnaires de sites Web et aux concepteurs d'interfaces utilisateur d'utiliser des GIF dans les files d'attente virtuelles plutôt que des images fixes.

Troisièmement, en ce qui concerne l'augmentation du plaisir, nos résultats suggèrent également que l'affichage de textes comme élément de distraction fonctionne significativement mieux que l'affichage d'une image fixe ou le fait de rien n'afficher du tout. Nous recommandons aux gestionnaires de sites Web et aux concepteurs d'interfaces utilisateur d'inclure du texte dans leurs interfaces de remplissage. Ainsi, les utilisateurs peuvent consacrer une partie de leur temps d'attente à la lecture, ce qui leur permet d'occuper leurs pensées pendant qu'ils attendent. L'intégration de texte possible comprend des critiques de produits ou même un flux Twitter.

Enfin, nos résultats suggèrent que la perception d'une attente plus courte et le plaisir perçu augmentent considérablement l'impression générale. Ainsi, avant la tenue d'événements en ligne fortement publicisés, il est conseillé aux gestionnaires de sites Web et aux concepteurs d'interfaces utilisateur de consacrer plus de temps à la conception d'une interface de remplissage comprenant des caractéristiques susceptibles de (1) capter l'attention des utilisateurs et de (2) favoriser le plaisir, car il s'agit d'une très bonne alternative aux solutions techniques qui elles pourraient s’avérer être très coûteuses (i.e., mises à niveau de logiciels, de matériel ou de réseaux informatiques) (Lee et al., 2012).

4.4 Limites et recherche future

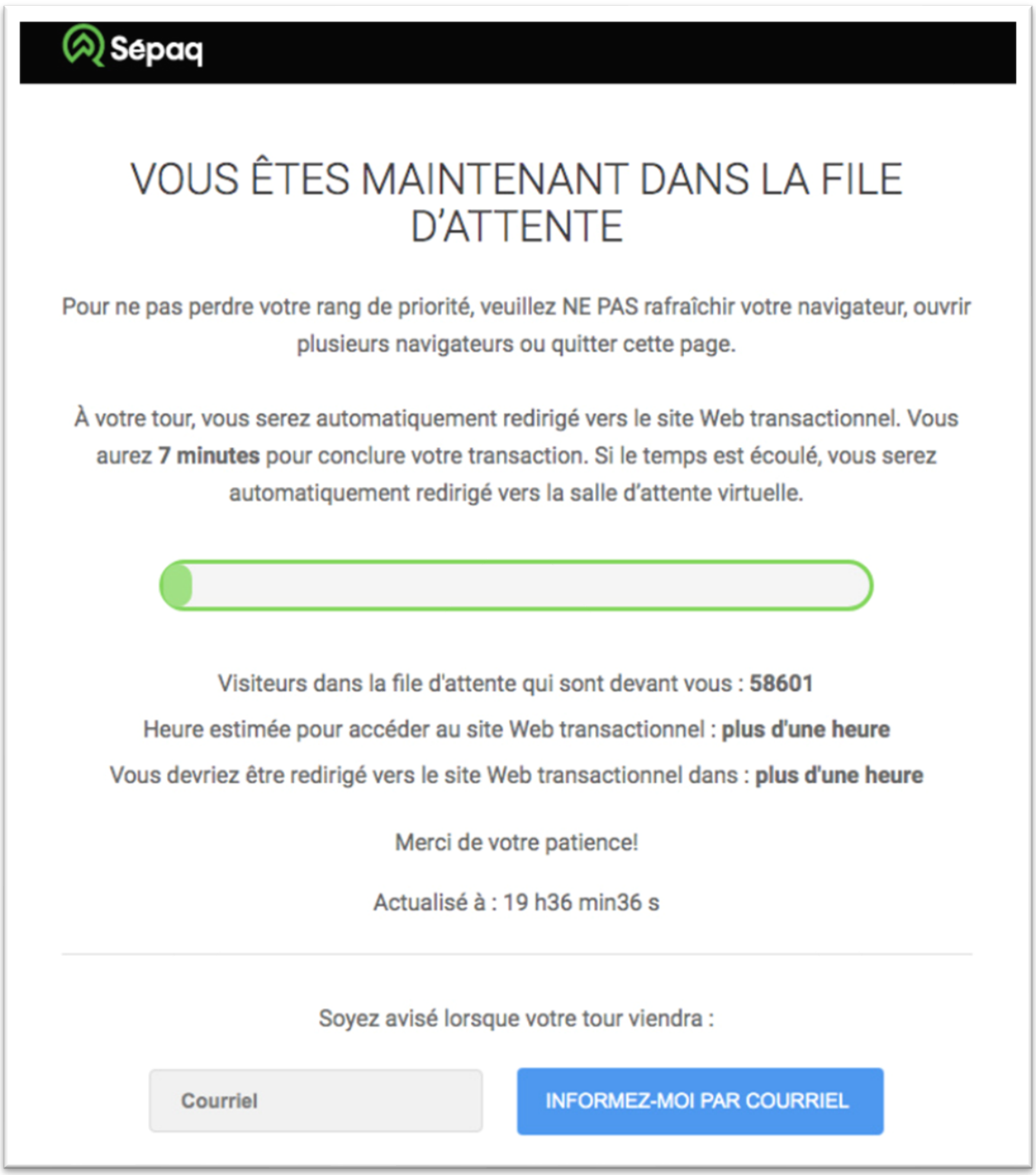
Bien que cette étude apporte des contributions aux chercheurs et aux praticiens, nous reconnaissons certaines limites. Premièrement, notre étude manque de validité externe. En effet, la plupart des participants étaient des étudiants, issus d'une seule université. Les étudiants étant une population cible dans le contexte de cette étude, il demeure que des recherches supplémentaires sont nécessaires avec une représentation de groupes et de contextes différents est nécessaires afin de renforcer les résultats. Les études futures pourraient recruter des clients réels, issus de cultures et de contextes différents, ce qui fait défaut dans la littérature actuelle. Afin d’augmenter la validité écologique, une prochaine étude pourrait réaliser l’expérience dans une réelle file d’attente virtuelle.

Deuxièmement, cette étude n'a examiné que le texte, les images et les GIF comme éléments de conception dans nos prototypes. Ceux-ci sont pertinents pour l'utilisation actuelle des interfaces de remplissage, mais d'autres recherches sont nécessaires en utilisant différents éléments de conception pour renforcer notre compréhension de la perception de l'attente en ligne. Les recherches futures pourraient porter sur des éléments de conception tels que les indicateurs de progression, les indicateurs d'attente, les messages automatisés des systèmes, les vidéos, la taille des caractères ou même différentes couleurs de fond. De plus, nous n'avons pas pris en compte d'autres facteurs susceptibles d'affecter la perception du temps d'attente par les utilisateurs, tels que l'acceptation de l'attente en ligne, la familiarité avec les interfaces de remplissage ou le contexte culturel.

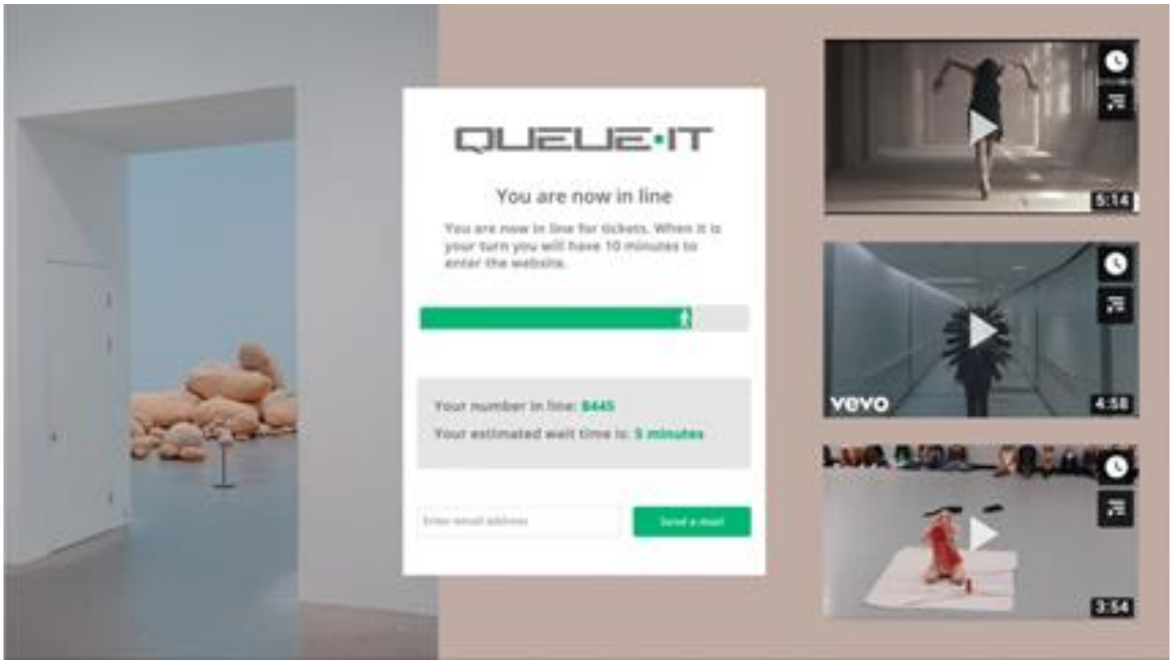
Troisièmement, la littérature actuelle sur la gestion de l'attente en ligne brosse un portrait des attentes de moins de 30 secondes. Notre étude est allée plus loin en examinant des salles d'attente virtuelles avec des temps d'attente allant de 45 à 55 secondes. Il n’en demeure pas moins que des études additionnelles sont nécessaires dans un contexte d’attentes plus longues afin d’enrichir nos connaissances en matière d’attente en ligne. Il serait intéressant d'étudier le sentiment et le comportement des utilisateurs face aux files d'attente virtuelles de plus de 10 minutes.

Annexe

1.1 File d’attente virtuelle sur le site Web de la SÉPAQ



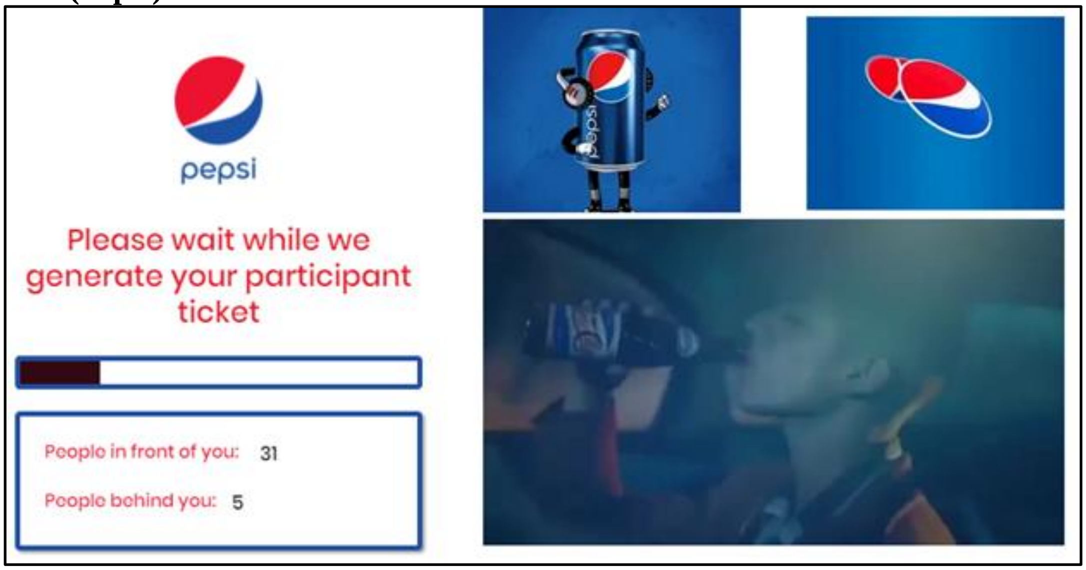
1.2 Virtual Queueing System Example: Queue-It



Queue-It, 2021, *Preview Queue-it's Waiting Room User Experience*, Youtube, video, https://www.youtube.com/watch?v=u1LpuMRsfe4&ab_channel=Queue-it

1.3 Experimental Prototypes

GIF (Pepsi)



Link: https://h64o78.axshare.com/#id=agft15&p=queue_loading&c=1

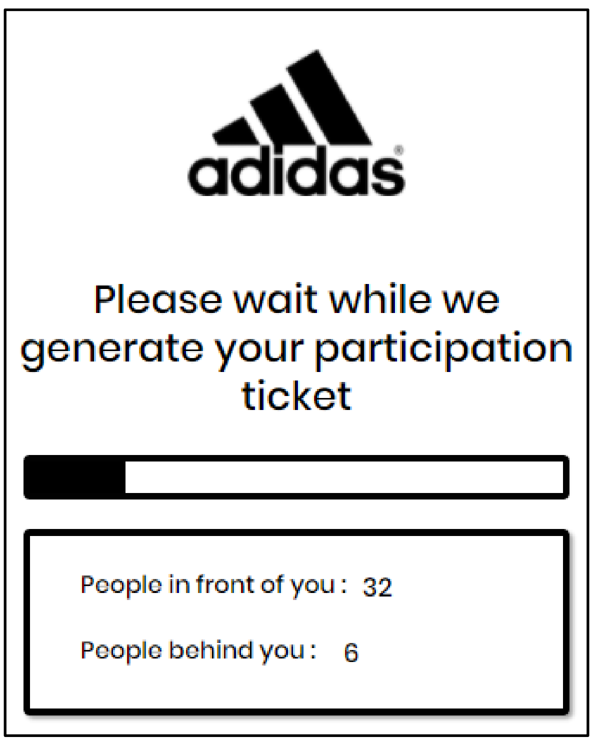
Image (Coca-Cola)

Link: https://ztomvt.axshare.com/#id=agft15&p=queue_loading&c=1

Text (Nike)

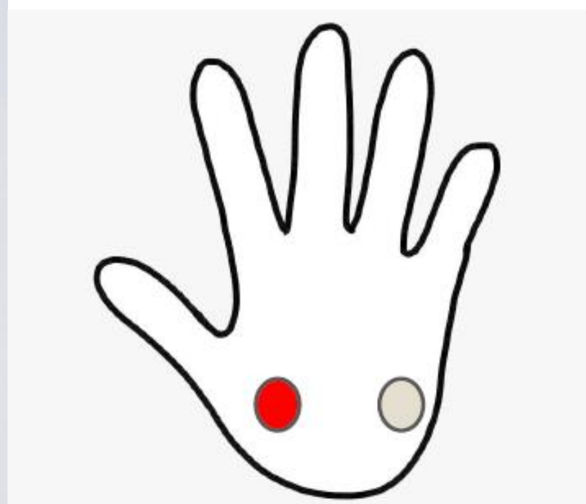
Link: https://qva77r.axshare.com/#id=agft15&p=queue_loading&c=1

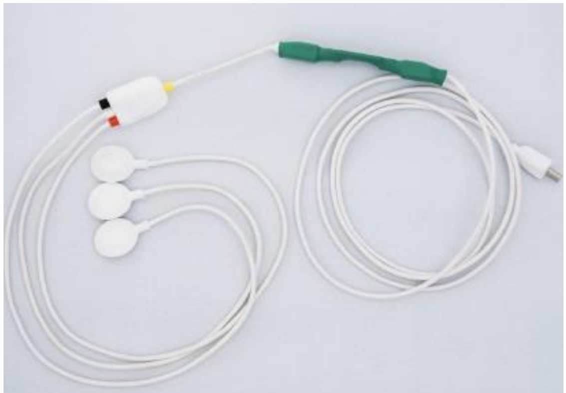
No Filler (Adidas)

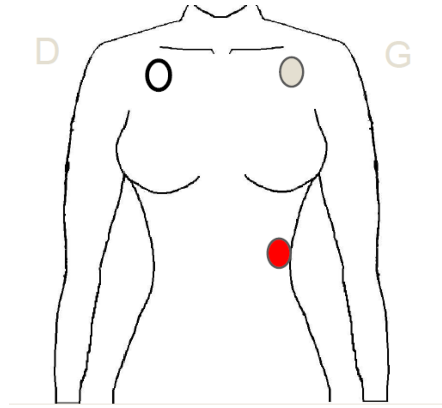


Link: https://4p7n7k.axshare.com/#id=agft15&p=queue_loading&c=1

1.4 Cobalt Box, sensors, electrodes, and their positioning






D
G