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La conception d’interface numérique accommodant une navigation partagée sur un seul écran d’ordinateur lors d’achats collaboratifs et co-localisés en ligne

par

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RENOUVELLEMENT DE L'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.

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Comité d'éthique de la recherche

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Résumé

Le **magasinage co-localisé et collaboratif en ligne**, ou *co-located collaborative online shopping* (CoLoCOS) en anglais, est une pratique où plusieurs personnes (co-acheteurs) se rassemblent autour d'un ordinateur, dans le but de magasiner en ligne accompagnées de leurs proches. Il s'agit d'une pratique populaire due entre autres à l'avancement des technologies d'information, ainsi qu'au fait que magasiner s'avère être une activité possédant une forte dimension sociale, surtout lorsque les produits et services sont de nature expérientielle comme des vacances, ou lorsqu'il s'agit d'actifs importants pour le ménage tels qu'une voiture ou une maison. Malgré sa popularité, les sites des détaillants et de commerce en ligne peinent à accommoder cette forme collaborative de magasinage puisque ceux-ci sont généralement conçus pour un seul acheteur opérant le site web de manière solitaire. Dans ce contexte, ce mémoire vise les objectifs suivants. Premièrement, il s'agit de faire l'état des connaissances sur cette pratique pour identifier des lacunes et opportunités de recherche en conduisant une revue de la littérature. Deuxièmement, cette recherche a pour but de tester l'effet de deux caractéristiques de design d'interface (paradigme de navigation, la disposition de la navigation) sur l'habileté des co-acheteurs à coordonner visuellement leur processus de recherche et d'évaluation des produits lorsqu'ils partagent un écran. Précisément, deux paradigmes de navigation (*scrolling*, *pagination*) et leur disposition (*vertical*, *horizontal*) sont évalués, l'un offrant aux utilisateurs la possibilité de consulter l'offre intégrale de produits sur une seule page web en fonction d'un défilement vertical ou horizontal, et l'autre contraignant les utilisateurs à consulter l'offre de produits de manière séquentielle, c.-à.-d. un produit suivi de l'autre, selon une disposition verticale ou horizontale. Troisièmement, ce mémoire vise à évaluer l'influence de la coordination visuelle sur l'expérience d'achats selon les réponses affectives des co-acheteurs, leur perception des conflits de comportement, leur effort dans la prise de décision, et la satisfaction des co-acheteurs avec la décision d'achats.

Un total de 28 couples (56 participants) ont participé à une expérience de magasinage en laboratoire au cours de laquelle ils ont complété quatre tâches d'achats collaboratives sur quatre interfaces combinant une disposition (vertical vs horizontal) et un paradigme (défilement vs pagination) de navigation. Les résultats démontrent que le paradigme de navigation basé sur le défilement (*scrolling*), comparé à la pagination (*pagination*), améliore la coordination visuelle des acheteurs, en particulier dans le cas d'une disposition horizontale de la navigation, mais pas dans le cas d'une disposition verticale. De plus, nous trouvons que lorsque les co-acheteurs sont en mesure de coordonner leurs interactions visuelles, cela crée une expérience d’achats en ligne plus agréable et moins exigeante sur le plan cognitif tout en améliorant la satisfaction des partenaires dans leurs choix de produits. Ces résultats suggèrent qu’une méthode de navigation davantage itérative, reproduisant ainsi la structure du paradigme de navigation basé sur la pagination, permettrait de mieux accommoder les consommateurs lorsqu’ils partagent un écran d’ordinateur pour effectuer des achats en ligne. De plus, cette recherche démontre concrètement l’influence de la coordination visuelle sur l’expérience de magasinage en ligne, soulignant ainsi sa valeur auprès des chercheurs et des acteurs impliqués dans la conception de sites de commerce en ligne tels que les designers UX.

Mots clés : Magasinage collaboratif en ligne, magasinage à deux, commerce électronique, partage d’un écran d’ordinateur, navigation partagée, collaboration en ligne, utilisation conjointe d’un système d’information, utilisation conjointe des technologies de l'information, dyade d’utilisateur, couples, expérience utilisateur, défilement, affichage partagé, oculométrie, coordination, attention conjointe, expérience en laboratoire

Méthodes de recherche : Test utilisateur en laboratoire, oculométrie, pupillométrie, mesures autodéclarées par questionnaire, test statistique

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Liste des abréviations

CFA: Confirmatory factor analysis

CGT: Common ground theory

CMA: Circumplex model of affect

COS: Collaborative online shopping

CoLoCOS: Co-located collaborative online shopping

GC: Gaze convergence

HCI: Human-computer interaction

IHM: Interaction-homme machine

INC: Intrascreen navigational uncoupling

IS: Information system

SDG: Single display groupware

SOR: Stimulus-organism-response

UX: User experience

Avant-propos

Ce mémoire, rédigé par article, à été soumis avec l'autorisation de la direction administrative du programme de M.Sc. en expérience utilisateur de HEC Montréal. Le projet de recherche a obtenu l'approbation du comité d'éthique de la recherche (CER) de HEC Montréal (Certificat #2021-4041). Finalement, tous les coauteurs des articles ont fourni leur autorisation pour que les articles soient utilisés dans le cadre de ce mémoire.

L'article 1, *Collaborative Screen-sharing for Online Shopping: A Literature Review* a été rédigé individuellement par l'étudiant. Cet article est en voie de préparation pour soumission à la *Journal of Theoretical and Applied Electronic Commerce Research*.

L'article 2, *Enhancing Co-Located Collaborative Online Shopping Through Shared Navigation Design: An Experimental Study on Visual Coordination and Co-Shoppers' Experience* a été co-écrit avec Camille Grange, Pierre-Majorique Léger, et Armel Tchanou. Cet article est en voie de préparation pour une soumission au *International Journal of Electronic Commerce*.

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La réalisation de ce mémoire ne fut possible que grâce à la précieuse contribution de plusieurs individus à qui j'aimerais accorder mes plus sincères remerciements en débutant par ma directrice et mon directeur de mémoire, Camille Grange et Pierre-Majorique Léger. Merci à vous pour votre confiance, votre écoute, vos conseils et mots d'encouragement, merci d'avoir poussé mes réflexions et contribuer à développer ma pensée critique; votre contribution fut essentielle à la réussite de ce travail. Merci à Armel Quentin Tchanou et Sylvain Sénécal d'avoir pris le temps de m'écouter et de me conseiller lors de ce parcours. Merci à mes professeurs et aux chercheurs que j'ai eu la chance de côtoyer et qui m'ont inspiré à conduire ce travail avec rigueur et conviction. Pour les travaux de recherche sur lesquels ce mémoire s'appuie, merci aux auteurs, étudiants, assistants de recherche et tout autre individu impliqués dans leurs réalisations; ce travail repose sans aucun doute sur les épaules de géants.

Cette étude n'aurait pas pu être possible sans le soutien financier de la Chaire de recherche industrielle CRSNG-Prompt en expérience utilisateur de HEC Montréal. Merci d'appuyer les esprits visionnaires, curieux et novateurs qui aspirent à réaliser des percées scientifiques et techniques au bénéfice de notre pays.

À l'équipe du Tech3Lab, particulièrement Salima, David, François, Julianne, Carl, Shang Lin et Sama, merci d'avoir partagé votre expertise et pour votre soutien dans la réalisation de ce travail. Aux étudiants et assistants de recherche du Lab qui ont été une source de confort et de camaraderie indispensable, ce fut un réel plaisir de vous avoir à mes côtés lors de ces deux années d'études.

Kat, merci de voir ce qu'il y a de mieux en moi et de croire en mes capacités quand je manque d'imagination, j'en suis infiniment reconnaissant. De par ta persévérance, bienveillance et détermination, tu as su m'inspirer à donner le meilleur de moi-même dans tout ce que j'entreprends. Ensemble, nous allons bientôt tourner la page sur ce qui fut plusieurs années d'études enrichissantes, qui nous ont mis au défi et gratifiés pour nos efforts. Je m'estime chanceux de pouvoir entamer cette prochaine étape de vie ensemble.

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Chapitre 1: Introduction

Mise en contexte du mémoire

Partager un écran d'ordinateur afin d'accomplir une tâche de manière collaborative s'avère être une pratique populaire dans plusieurs contextes, tel que lors d'une activité de magasinage en ligne (Berrada, 2011; Roten et Vanheems, 2021; Tchanou et al., 2020a), lors de la consultation de document avec un collègue au travail (Morris, 2008), ou afin de chercher de l'information en ligne avec un compagnon de classe (Amershi et Morris, 2008). Par exemple, une étude ayant sondé plus de 204 employés chez Microsoft, a dévoilé que 87,5% des participants avaient déjà regardé « par-dessus l'épaule » d'un collègue afin de chercher ensemble de l'information en ligne (Amershi et Morris, 2008). D'autres études, telles que celle conduite par Tchanou et al. (2020a) et Berrada (2011), suggèrent que cette pratique est populaire dans le contexte du magasinage collaboratif en ligne, communément appelé *collaborative online shopping* en anglais (COS). L'une de ces études a notamment observé que plus de 80% des répondants (N=325) ont déjà partagé un écran avec leurs partenaires pour magasiner en ligne (Berrada, 2011). Plus récemment, un sondage effectué auprès de 390 couples nord-américains établit que 72% des couples utilisent souvent un seul ordinateur afin de magasiner en ligne (Tchanou et al., 2020a).

Plusieurs termes ont été utilisés dans la littérature pour décrire ce phénomène (Shah, 2014). Notamment, des auteurs font usage des termes *co-located browsing*, ou *navigation côte à côte* traduit en français (Amershi et Morris, 2008; Praharaj et al., 2021; Tchanou et al., 2020b, Fontaine, 2020). D'autres termes ont également été utilisés, tel que *co-browsing*, *collaborative information seeking* (CIS) et *co-navigation*, ou, lorsque traduit en français, recherche collaborative d'informations, navigation web coopérative et co-navigation respectivement (Hoyos-Rivera et al., 2006; Shah, 2014; Yue et al., 2014). Reste à noter que ces derniers termes peuvent également désigner une collaboration à distance et asynchrone dans le cas de CIS, introduisant ainsi une certaine ambiguïté quant à la terminologie spécifique associée au partage d'un écran par un groupe d'utilisateurs. Précisément, plusieurs auteurs ajoutent le terme "co-localisé" (ou *co-located*) afin de spécifier une navigation web collaborative prenant lieu de manière synchrone et forcément dans un lieu commun aux utilisateurs (Mandryk, 2005; Amershi et Morris, 2008; Praharaj et al., 2021; Tchanou et al., 2020b, Fontaine, 2020). Ainsi, le terme *co-located collaborative online shopping* (CoLoCOS), ou magasinage co-localisé et collaboratif en ligne, réfère à une navigation web collaborative où un groupe d'utilisateur se positionne côte à côte et vis-à-vis d'un écran d'ordinateur dans le but de faire des achats en ligne. Dans ce mémoire, les termes CoLoCOS, *co-browsing* et co-navigation seront employés afin de désigner le partage d'un écran d'ordinateur à différents niveaux de précision.

Au cours des dernières décennies, des courants de recherche ont émergé dans le but de mieux comprendre les origines et les défis associés à cette pratique (e.g. Amershi et Morris, 2008; Goswami et al. 2007; Roten & Vanheems, 2021). Entre autres, des études constatent que le partage d'un écran prend parfois place dans un contexte social où il est plus plaisant d'être accompagné que d'être seul (Goswami et al. 2007; Roten & Vanheems, 2021), et autrefois par nécessité, car il est plus efficace de collaborer sur un seul écran que séparément (Kelly et Payne, 2016; Roten & Vanheems, 2021; Praharaj et al., 2021). Toutefois, des défis ont également été identifiés. Ceux-ci débutent par le constat que les ordinateurs, tels qu'ils sont généralement conçus, c.-à-d. munis d'une seule souris et clavier, ne sont pas adaptés à une dynamique d'utilisation collaborative et co-localisée (Stewart, 1999). Ainsi, lorsque la navigation de plusieurs sur un seul écran d'ordinateur est interdépendante, plusieurs défis peuvent émerger due par exemple à différentes manières de naviguer sur un site web, ou simplement au fait que l'un des utilisateurs doit forcément assumer une porte de contrôle quant à la navigation.

Ainsi, afin de remédier à cette impasse, un premier effort de recherche fut déployé afin de développer des systèmes, communément appelés *Single Display Groupware* (SDG), permettant à plusieurs utilisateurs d'interagir simultanément avec l'écran (Bier et Freeman, 1991; Stewart et al., 1999; Tse et Greenberg, 2004; Amershi et Morris, 2008). Ainsi, des applications telles que KidPad (Hourcane et Bederson, 1999) et CoSearch (Amershi et Morris, 2008) furent développées afin d'offrir un point de contrôle de l'interface à plusieurs membres du groupe d'utilisateurs. D'autres études dans le domaine du magasinage collaboratif en ligne tentent aussi de relever ces défis afin d'améliorer l'expérience de magasinage collaborative en ligne (Goswami et al., 2007; Zhu et al., 2010; Yue et al., 2014; Tchanou et al., 2020b). Toutefois, ces dernières études se concentrent sur la conception de sites web qui supportent la navigation web collaborative. Pour ce faire, plusieurs systèmes de co-navigation ont été testés et comparés en fonction du soutien qu'il apporte à la navigation web collaborative, c.-à-d. qu'ils permettent aux utilisateurs de chercher et évaluer un ensemble de produits ou services de manière efficace. Ces études démontrent que lorsque la navigation est partagée entre utilisateurs de telle façon qu'un seul utilisateur soit en contrôle de la navigation (e.i. navigation partagée ou *shared navigation*), cela permet aux collaborateurs de mieux synchroniser leur processus d'évaluation et recherches de produits comparativement à d'autres types de système de navigation ayant été testé (Zhu et al., 2010; Cheng et al., 2013; Yue et al., 2014). Ce résultat est expliqué par le fait qu'une vue partagée de la navigation permet davantage aux utilisateurs d'aligner leur processus de recherche et d'évaluation par le biais d'un espace visuel commun, tandis que d'autres systèmes de navigation encouragent une navigation séparée malgré qu'elle reste synchrone et co-localisée.

Bien que la littérature ait démontré qu'un espace visuel commun, comme établi via une navigation partagée, s'avère être bénéfique à la co-navigation, il reste que naviguer à plusieurs sur une seule interface pose toujours des défis que peu de recherches ont adressés jusqu'à maintenant. Précisément, ce défi concerne la capacité des acheteurs à coordonner leurs interactions avec l'interface et entre eux pendant l'activité de magasinage (Zhu et al., 2010 ; Yue et al., 2014 ; Roten et Vanheems, 2021). En effet, il peut s'avérer laborieux de coordonner ses interactions sur l'interface lorsque l'on tient compte des différents besoins d'information et vitesse de lecture des utilisateurs (Amershi et Morris, 2008 ; Yue et Jiang, 2013 ; Roten et Vanheems, 2021). Pour illustrer ce manque de coordination, prenons l'exemple d'un acheteur qui, partageant la navigation avec sa compagne, examine un produit spécifique affiché à l'écran lorsque sa partenaire défile rapidement et sans prévenir vers une autre section de l'interface. À ce moment, l'attention visuelle d'un utilisateur fut interrompue par celle de l'autre, de telle façon qu'il y ait une perte de coordination, un concept auquel Zhu et al. (2010) et Yue et al., (2014) réfèrent par la notion de *découplement* (*uncoupling*).

Bien que plusieurs appels à la recherche furent lancés depuis les dernières années afin d'adresser ce défi (e.g. Goswami et al., 2007, Zhu et al., 2010, Tchanou et al., 2020b), jusqu'à maintenant, peu de recherches ont été effectuées afin de fournir des lignes directrices permettant d'améliorer la coordination entre utilisateurs lors du partage de la navigation dans le contexte du magasinage co-localisé et collaboratif en ligne. Ce mémoire s'inscrit ainsi dans cet effort de recherche en approfondissant l'évaluation de système de co-navigation dans le contexte du magasinage en ligne. La prochaine section vise à clarifier cet effort afin de mieux définir notre approche et les contributions potentielles de ce mémoire.

Objectifs et contributions potentielles

L'objectif de ce mémoire est de mieux comprendre les mécanismes de co-navigation et l'incidence de ces mécanismes sur l'expérience de magasinage collaborative en ligne. Ce mémoire met donc l'emphase sur le design de système de co-navigation lors du partage d'un écran et l'expérience des utilisateurs avec ces systèmes. À partir de la littérature, nous examinons les comportements visuels des utilisateurs afin d'évaluer leur collaboration, et plus précisément leur capacité à coordonner leurs interactions visuelles sur l'interface (e.i. coordination visuelle) en fonction du design de la navigation. Il s'agit ainsi de générer des pistes de solutions afin de bonifier l'expérience de co-navigation dans la perspective d'améliorer l'expérience de magasinage collaborative en ligne.

Afin de souligner la valeur et la pertinence de cette recherche d'un point de vue pratique, il suffit de considérer l'importance grandissante pour les commerces en ligne de se distinguer de leurs compétiteurs non seulement par leur offre de produits et services, mais spécialement par l'expérience d'achats en ligne offerte à leurs clients. En effet, nous savons que l'expérience que vivent les utilisateurs sur un site Web peut avoir une influence sur l'intention des utilisateurs à revisiter un site (Alberto Castañeda et al., 2017). Ainsi, les connaissances générées par ce travail offrent l'opportunité aux entreprises et individus de s'assurer que leur commerce en ligne supporte avec succès le magasinage collaboratif dans le but d'améliorer l'expérience de magasinage collaborative. D'un point de vue théorique, cette étude répond clairement à un appel à la recherche visant à bonifier l'expérience de co-navigation dans le contexte du magasinage collaboratif en ligne (Zhu et al., 2010; Tchanou et al., 2020b). De plus, cette étude contribue plus largement aux connaissances sur l'utilisation collaborative et conjointe des technologies d'informations. L'application potentielle de ces connaissances va au-delà du magasinage collaboratif en ligne pour s'inscrire dans d'autres contextes tels que celui des jeux vidéo multi-joueurs. Ainsi, ce mémoire est d'une pertinence d'autant pratique que théorique.

Questions de recherche et introduction des articles

Afin d'atteindre les objectifs illustrés précédemment, une revue de littérature est conduite afin de fournir un aperçu de l'état actuel des connaissances et des lacunes de recherche sur le partage d'écran dans le contexte du magasinage en ligne. Cette revue de littérature répond aux questions de recherche suivantes:

> **Q1** : Quels sont les avantages et les défis associés au magasinage co-localisé et collaboratif en ligne lors du partage d'un écran?
>
> **Q2** : Quelles sont les lignes directrices en matière de conception d'interface permettant de mieux accommoder le magasinage en ligne co-localisée et collaboratif?

Dans le but de combler les lacunes de recherches ayant été identifiées dans le chapitre de revue de littérature, nous posons trois questions de recherches présentées ci-bas. Les deux premières questions adressent deux caractéristiques de design de co-navigation: **paradigme de navigation** et **disposition de la navigation**; et la mesure dans lequel ceux-ci soutiennent la collaboration en ligne. Afin d'évaluer la collaboration en ligne des *co-acheteurs*, e.i., acheteurs partageant un écran d'ordinateur afin de magasiner en ligne, l'emphase est mise sur leur habileté à coordonner leur processus d'évaluation et de recherche de produit tel que mesurer par leur **coordination visuelle** lors de l'activité de magasinage. De plus, l'effet de la coordination visuelle sur la qualité de l'expérience de magasinage est évalué. Pour ce faire, nous considérons deux dimensions d'une expérience de magasinage collaborative déjà bien établies, à savoir, l'expérience de navigation partagée (la valence et l'intensité des réponses affectives des co-acheteurs, leur perception des conflits de comportement et leur effort dans la prise de décision) et le résultat de la navigation partagée (la satisfaction des co-acheteurs avec la décision d'achats) (Fontaine, 2020, Tchanou et al., 2020b).

> **Q3** : Dans quelle mesure le paradigme de navigation (*navigation paradigm*) influence la coordination visuelle des co-acheteurs ?
>
> **Q4** : Dans quelle mesure la disposition de la navigation (*navigation layout*) modère-t-elle l'effet du paradigme de navigation sur la coordination visuelle ?

Q5 : Dans quelle mesure la coordination visuelle influence l'expérience de navigation partagée des co-acheteurs ?

Afin de répondre à ces questions de recherche, nous conduisons une expérimentation en laboratoire basée sur l'installation expérimentale développée par Tchanou et al. (2020b), et poursuivant un design expérimental intra-groupe 2x2 avec deux caractéristiques de design de co-navigation comme facteurs intra-groupe: le paradigme de navigation (*navigation paradigm*) et la disposition de la navigation (*navigation layout*). Le paradigme de navigation est défini comme le type de structure d'information permettant la découverte du contenu (par ex., le contenu peut être rendu accessible en faisant défiler une page ou en cliquant pour afficher le contenu de manière séquentielle). La disposition de la navigation est définie comme l'axe (par ex. horizontal et vertical) selon lequel le contenu est révélé lors de la navigation de l'utilisateur. Un site de commerce en ligne fictif a été développé afin d'incorporer les quatre combinaisons de la disposition et du paradigme de navigation (voir Annexe C). 28 couples ont été invités en laboratoire afin d'effectuer quatre tâches de magasinage collaboratif en ligne sur quatre interfaces distinctes. Lors des tâches, les couples ont magasiné pour de véritables expériences Airbnb offertes dans la région de Montréal (Airbnb, Inc., San Francisco, CA, U.S.A.).

Contributions de l'étudiant au projet de recherche

Le tableau présenté ci-bas présente les contributions de l'étudiant à ce mémoire sous forme de pourcentage pour chaque étape du projet de recherche réalisé en collaboration avec le Tech3lab de HEC Montréal.

Table 1. Contributions et responsabilités personnelles

Étape du projet	**Contribution**
Revue de la littérature	Examiner la littérature existante pour identifier les constructions et les théories en lien avec le partage d'un écran d'ordinateur dans le contexte de du magasinage en ligne collaboratif, puis rédiger une synthèse : **100%**.
Formulation des questions de recherche	Identifier les questions de recherche en rapport avec le sujet choisi, pouvant être répondu avec le matériel : **85%**.

	- Mes codirecteurs de recherche ont contribué à la formulation des questions de recherche.
Conception du design expérimental	Compléter la demande au CER ainsi que les formulaires de modification de projet : **90%**. - Un membre de l'équipe d'opération du Tech3Lab s'est assuré que la demande était complète et bien remplie. Élaborer et rédiger le protocole de l'étude empirique : **90%**. - Les membres de l'équipe d'opération du Tech3Lab ont fourni un protocole de base sur lequel je me suis appuyé pour concevoir le protocole expérimental de la collecte de données. Définir et proposer les outils de mesure à utiliser selon les construits et théories choisies : **85%**. - Armel Quentin Tchanou, Pierre-Majorique Léger, et Camille Grange, co-auteures de l'article au chapitre trois, ont contribué à la définition des outils de mesure utilisés. Assurer la mise en fonction des outils de mesures Tobii Nano, l'écosystème COBALT, et les logiciels Tobii Pro Lab et Media Recorder : **80%**. - Salima Tazi, Xavier Côté et d'autres membres de l'équipe de recherche du Tech3Lab, ont contribué à l'installation, à la préparation et aux tests du matériel et outils de mesure dans la salle de collecte. Créer trois questionnaires administrés avant, pendant et après l'expérience : **90%**. - Les questionnaires ont été construits en partie à partir du modèle de recherche développé par Armel Quentin Tchanou.
Recrutement et compensations des	Recruter et gérer les participants : **90%**.

participants	- Julianne Chénier de l'équipe de recherche du Tech3Lab a confirmé la présence des participants un jour avant leur participation. Administrer les compensations : **50%**. - Les compensations ont été administrées par un membre de l'équipe de recherche du Tech3Lab. - L'étudiant à effectuer le suivi des compensations: **100%**.
Collecte des données	Effectuer les collectes des données : **100%**. - Sama Gholami, étudiante au doctorat, a contribué à la collecte en assistant dans l'administration des questionnaires, l'opération des outils de mesures, la préparation de la salle de collecte et la gestion des participants lors de l'expérience.
Extraction des données	Extraire et mettre en forme les données oculométriques : **90**%. - Salima Tazi de l'équipe de recherche du Tech3Lab a offert un soutien technique dans l'extraction des données oculométriques du logiciel Tobii Pro Lab et la synchronisation des données. - Armel Tchanou a offert un soutien pratique dans le calcul du *gaze convergence index* à partir des données oculométriques. Extraire et mettre en forme les données des questionnaires : **70**%. - Sama Gholami, étudiante au doctorat, a contribué à la transcription des données des questionnaires dans la base de données.
Analyse des données	Effectuer les analyses statistiques de l'article : **90%**. - L'étudiante a reçu l'aide du statisticien de l'équipe de recherche et le soutien des coauteurs.

Rédaction	Rédaction des articles : **100%**. - Les articles ont été révisés et bonifiés à la suite des commentaires des coauteurs tout au long de la rédaction. Écriture du mémoire : **100%**.

Structure du mémoire

Ce mémoire est composé de 4 chapitres incluant deux articles (chapitres deux et trois) rédigés en anglais en vue d'une éventuelle publication dans le *Journal of Theoretical and Applied Electronic Commerce Research* pour l'article présenté au chapitre deux, ainsi que dans le *International Journal of Electronic Commerce* pour l'article présenté au chapitre trois. Le premier chapitre, où cette section prend place, constitue une introduction aux sujets abordés dans ce mémoire. Le deuxième chapitre constitue une revue de littérature visant à faire le point sur les connaissances et les lacunes actuelles en matière de partage d'écran dans le contexte du magasinage collaboratif en ligne. Le troisième chapitre présente l'étude empirique pour laquelle nous avons obtenu l'approbation du comité d'éthique de la recherche (CER) de HEC Montréal (Certificat #2021-4041). Une discussion détaillée des résultats de la revue de littérature et de l'étude empirique, ainsi que des limites de l'étude et des orientations futures de recherche, est présentée dans le chapitre quatre.

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Chapitre 2: Collaborative Screen-sharing for Online Shopping: A Literature Review[1]

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Abstract

Co-located collaborative online shopping (CoLoCOS) is becoming more common, as consumers increasingly shop online with their romantic partners, friends, and relatives. This narrative literature review addresses the important, but seldom studied, practice of sharing a computer screen to collaboratively shop online by investigating its benefits and challenges, as well as existing design recommendations to resolve these challenges. The aim is to provide an overview of the current state of knowledge on screen-sharing in the context of online shopping, and to highlight research gaps that present valuable research opportunities for researchers and practical recommendations for the design of online shopping websites. We extract 40+ research papers from five databases by using search queries from a list of relevant keywords, and based on exclusion and inclusion criterias. From our findings we draw a general picture of the benefits and challenges consumers face when sharing a screen, and the design challenges e-commerce websites must surmount to best support collaborative online shopping. We conclude by identifying potential research avenues that aim to address the gaps in the literature, and set the table for future research.

Keywords: screen-sharing, shared displayed, shared attention, visual coordination, co-located collaborative online shopping, navigation support systems, shared navigation

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2.1 Introduction: Collaborative online shopping

Shopping is an activity that is often considered to be solitary, and often studied as such (Lim & Beatty, 2011; Roten & Vanheems, 2021). However, in reality, shopping can often be a collaborative activity (Goswami et al. 2007; Lim & Beatty, 2011; Baghdadi, 2013; Gao et al., 2017; Izadi et al., 2021; Roten & Vanheems, 2021). Indeed, shopping can take on a social dimension when the cost of a purchase is shared between a group of people, such as in the case of a vacation or house (Lim & Beatty, 2011). It can also be the case when shoppers find it more pleasurable to shop accompanied then alone (Lim & Beatty, 2011). Thus, shopping is not simply a solitary activity, but also a social one.

For several years now, a growing portion of retail sales are being made online. For instance, in 2015, e-commerce accounted for less than 9% of worldwide retail sales (Coppola, 2021). In 2021, this number rose above 18% and is expected to continue rising. For collaborative shoppers, this entails that a growing portion of collaborative shopping will be done online. This transition from in-person shopping to online shopping is giving rise to the practice of **collaborative online shopping** (COS) defined as the activity in which a consumer shops at an online store concurrently with one or more partners (Zhu et al., 2010; Yue et al., 2014; Izadi et al., 2021). In numbers, it is estimated that COS accounted for $23.3 billion in sales in 2021, up 20% from 2019 (Droesch, 2020).

While shopping partners can collaborate asynchronously and remotely, studies looking at couples' online shopping habits show us that shopping partners commonly share a computer or smartphone to collaboratively shop online (Berrada, 2011; Tchanou et al., 2020a; Wei et al., 2022). For instance, a 2011 study that surveyed couples on their online shopping habits showed that 83.2% of the 325 respondents declared having shared a screen to shop online at least once with their partner (Berrada, 2011). More recent studies on couples' online shopping habits found that the joint use of a computer or a smartphone to shop online is a particularly widespread practice among couples (Tchanou et al., 2020a; Wei et al., 2022). When inquiring further into couples online shopping habits Tchanou et al. (2020a) discovered that more than 90% of couples occasionally use a single computer side by side to shop online and in nearly 82% of cases, a single smartphone. Thus, to consider screen-sharing between co-located partners to jointly shop online, the COS definition can be expanded to refer to the practice as **co-located collaborative**

online shopping (CoLoCOS) (Fontaine, 2020). Moreover, partners' who's shopping activity takes place in such a setting will be referred to in this paper as **co-shoppers**.

As CoLoCOS becomes an increasingly widespread phenomenon among online shoppers with the advent of electronic commerce, it is important to better understand the practice. Gaining further insight into CoLoCOS will help craft design guidelines for screen-sharing experiences in the context of online shopping and more broadly enrich the literature on collaborative screen-sharing practices.

2.1.1 Aim and scope

The aim of this literature review will be to 1) provide an overview of the current state of knowledge on screen-sharing in the context of online shopping and to 2) highlight research gaps that present valuable research opportunities for researchers and user experience practitioners alike. The questions that will guide our exploration of the extent literature on screen-sharing practices in the context of co-located collaborative online shopping are as follow:

> **Q1**: What are the benefits and challenges associated with sharing a screen during a co-located collaborative online shopping activity?
>
> **Q2**: What are the interface design guidelines to better accommodate co-located and collaborative online shopping?

2.1.2 Methodology

To achieve the aforementioned aim of the literature review, we followed the method detailed below. More specifically, we elaborate on the databases and keywords used to search the literature, as well as the inclusion and exclusion criterias employed to select relevant search results. We also report on the application of the method and the overall procedure.

Databases

As it is recommended to use multiple databases to search the literature (Bramer et al., 2017), we used Google Scholar and Web of Science to do an initial scan of the literature, followed by more focused databases accessible via our institution, namely ACM Digital Library, AIS eLibrary, IEEE Xplore. These databases were selected based on the relevance of their respective research domain as presented in Table 1.

Table 1. Research domain by databases

Database	Research domain
Google Scholar	Multiple disciplines
Web of Science	Science, social sciences, arts, and humanities
ACM Digital Library	Computer science
AIS eLibrary	Information systems and management
IEEE Xplore	Computer science, electrical engineering, and electronics

Keywords and search queries

A set of keywords were initially identified for each section of the literature (see Table 2.A.1 *Keywords* in Appendix A). As multiple keywords can be used to represent distinct aspects of the phenomenon covered in each section, a set of analogous keywords were identified to cover encompassing aspects of the phenomenon of interest. For example, the group aspect relating to screen-sharing uses the following set of keywords: couple, collaborative, group, multi-user. Then, a mix of keywords (e.g. [spatial aspect] + [group aspect] + [activity]) are joined to form a search query (e.g. co-located collaborative online shopping). The subsequent sections (section 2.3 and 2.4) used a similar method such that multiple keywords could be associated with a specific aspect of the phenomenon. More details on the queries that were formed from the set of keywords are presented in Appendix A (see Table 1.A.2).

Inclusion and exclusion criteria

Table 2 below provides an overview of the inclusion and exclusion criterias that were established to select the articles from the search.

Table 2. Inclusion and exclusion criteria by section

Article section	**2.2 The benefits and challenges of sharing a screen to shop together online**	**2.3 Navigation support systems: enhancing coordination performance through system design**	**2.4 Shared attention: a mechanism for joint system use interactions**
Inclusion criterias	Deals with challenges/benefits of screen-sharing or co-located multi-user computer interactions; Addresses co-located collaborative online shopping	Deals with navigation support systems; Includes coordination as a measure of shopping performance	Deals with antecedents and consequences of shared attention; Includes empirical findings
Exclusion criterias	Deals with asynchronous and remote collaboration; Non-english	Non-english	Non-english

Procedure

To get acquainted with the volume of search results produced with our queries, an initial search was done on Google Scholar, Web of Science and ACM Digital Library. As going through the volume of results (see Table 1.A.2 in Appendix A) would require more time and human resources than readily accessible for the purpose of this research, more precise search queries were used (e.g. co-located collaborative online shopping + screen-sharing). However, using this technique either narrowed the search results to an overly excessive extent or did not sufficiently reduce the volume of results depending on the database.

As a solution, the first relevant results from each database were used to produce a first sample of the literature. This first sample was used to source further articles on its respective topic. Using this snowballing technique, a sufficient extent of the literature was covered in order to produce a narrative literature review on collaborative screen-sharing for online shopping (Paré et al., 2015).

2.2 The benefits and challenges of sharing a screen to shop together online

To better understand how screen-sharing contributes positively to the partners' shopping experience, we first cover the benefits associated with CoLoCOS. Additionally, we also cover the challenges to help us in identifying which aspects of the user experience could be improved on. The following section will therefore focus on screen-sharing practices in the context of collaborative online shopping.

2.2.1 The benefits of screen-sharing when shopping online

Drawing from the literature on screen-sharing practices and qualitative work on CoLoCOS, there are three common benefits to screen-sharing when shopping together, namely efficient collective decision-making, pleasurable social interactions, as well as visual control and transparency (Zhu et al., 2010; Lim et Beatty, 2011; Kim et al., 2013; Roten and Vanheems, 2021).

Efficient collective decision-making

An often-stated benefit of screen-sharing is that it provides shopping partners with the ability to think through the shopping task together, particularly because of the shared visual context afforded by screen-sharing (Amershi and Morris, 2008; Zhu et al., 2010; Roten and Vanheems, 2021; Wei et al., 2022). Additionally, this proximity between partners allows them to instantaneously share opinions and discuss their findings together without any delay in their partner's response as it would be the case in other forms of collaborative shopping. Thus, the shared context induced by screen-sharing makes communication between the shopping partners more efficient by streamlining the flow of information between collaborators. This can facilitate decision-making by easing the process of establishing a common ground upon which they can discuss and exchange opinions (Olsen and Olsen, 2000). Improved decision-making efficiency via screen-sharing can also be understood through the lens of shared cognition theory, which states that more shared understanding between collaborators allows for greater harmony between how people approach tasks (Razzouk and Johnson, 2012). Co-shoppers can therefore benefit from the shared visual context and improved communication by sharing a screen when online shopping.

Pleasurable social interactions

Many studies on co-browsing in an online shopping context have looked at the social value of COS (Goswami et al. 2007; Zhu et al., 2010; Kim et al., 2013; Wei et al., 2017; Wei et al., 2022). Indeed, pleasurable social interactions are a desired aspect of screen-sharing because of the afforded physical proximity between shoppers (Zhu et al., 2010; Roten and Vanheems, 2021;

Izadi et al., 2021; Wei et al., 2022). Similarly, to the enjoyment and closeness perceived when gathering around a television with a group of friends or relatives, sharing a screen to shop online provides a sense of togetherness and closeness difficult to obtain in a remote setting. Even in a remote online collaborative shopping setting, the perception of being together in shared online space, e.i. co-presence, has been positively associated with shopping enjoyment (Kim et al., 2013). Thus, screen-sharing can also be seen as a form of hedonic-socialization where the experience is perceived as pleasurable while enabling social interactions that can enhance the partners relationship (Roten and Vanheems, 2021; Wei et al., 2022).

Transparency and trust

Finally, screen-sharing provides partners with a sense of control over the shopping experience because they can easily visualize the shopping process and easily access information simultaneously, thus making the decision process more transparent (Roten and Vanheems, 2021). Since shared experiences further the development of trust between collaborators (Lewis and Weigert, 1985; Mayer et al., 1995; Olsen and Olsen, 2000), this added layer of transparency over the decision process promotes trust between shopping partners. Accordingly, Lim et Beatty (2011) suggests that couples' motivation to shop together increases as the financial risk associated with the purchase increases. In line with this finding, Tchanou et al. (2020a) found that couples shop together online more often for cars as well as travel and tourism compared to other product categories such as leisure activities, art and shows, and groceries (Tchanou et al., 2020a). Therefore, transparency and trust are important aspects of COS and screen-sharing seems to encourage trust between shopping partners by making the shopping process more transparent.

From the literature covered here, we find that shopping partners can benefit from screen-sharing largely because of the shared context it provides them and the possibility to communicate face-to-face, which facilitates communication. This form of co-located collaboration results in more efficient collective decision-making, allows for pleasurable social interactions during the shopping activity and promotes trust between shopping partners. The following section will cover the challenges associated with the COS practice of screen-sharing.

2.2.2 The challenges of screen-sharing when shopping online

The literature on CoLoCOS and other forms of screen-sharing practices identifies three common challenges with screen-sharing, namely social tensions, lack of control and coordination problems (Amershi and Morris, 2008; Zhu et al., 2010; Roten and Vanheems, 2021).

Social tension around the screen

While co-located shoppers acknowledge the togetherness and social proximity as beneficial aspects of sharing a screen (Kim et al., 2013; Roten and Vanheems, 2021), there are also social tensions that can arise. These tensions originate from the ‘battle for attention’ that exists between the screen and their respective partner such that the visual and verbal cues inherent face-to-face communication are undermined by the spatial dynamic of screen-sharing (Amershi and Morris, 2008; Roten and Vanheems, 2021). Indeed, it is difficult to determine when and how much attention should be allocated to the screen and to their partner. Thus, when a partner's attention is misplaced, the partner can feel isolated and not listened to, such that the shopping experience can become frustrating and unpleasant (Roten and Vanheems, 2021). The spatial dynamic of screen-sharing can therefore put a strain on the partners communication by altering the visual and verbal cues indispensable to face-to-face communication. Although collaborative tools, such as CoSearch (Amershi and Morris, 2008), have been developed to address this challenge by offering better support for co-located online collaboration, oftentimes by offering multi-cursor functionalities, there have currently been no practical way of integrating such capabilities in existing shopping websites.

Lack of control

Commonly, when partners share a screen to shop online, only one user can be in control of the mouse and keyboard at a time. Although some solutions have emerged, such as sharing control of the peripherals (Fontaine, 2020), or allowing multiple users to be in control of the computer, mainly in experimental contexts through the development of Single Display Groupware (SDG) (Stewart et al., 1998; Amershi and Morris, 2008; Steinert et al., 2009), there are currently no easy and practical ways for co-located shopping partners to do so while sharing a screen. Thus, this asymmetry in the control of peripherals entails that one partner is in control while the other can only observe and communicate. This demands that the partner not in control of the peripherals must lose some independence and freedom in their shopping activity (Roten and Vanheems, 2021) while feeling less cognitively involved in the shopping task (Liu & Shrum, 2002; Fontaine, 2020). In return, this lack of control can be the cause of friction and discomfort, especially when one does not fully accept their loss of agency over the shopping activity (Roten and Vanheems, 2021). In addressing this problem, recent study has suggested that partners could benefit from sharing control of the peripherals as sharing has been associated with (Fontaine, 2020).

Coordination problems

We previously saw that co-located shopping partners benefit from the shared context and subsequent gains in decision-making efficiency that screen-sharing provides (Zhu et al., 2010; Roten and Vanheems, 2021). However, sharing a screen exacerbates the differences between shopping partners' search paths and their browsing pace, in particular due to the contrast between shoppers' reading speed, product preferences and information needs (Amershi and Morris, 2008; Yue et Jiang, 2013; Roten and Vanheems, 2021). This can complicate collaborative browsing since the decisions of the partner in control of the navigation does not always align with the other partner's desired navigation. For example, one partner might want to gain more information on a certain product while the other partner would prefer to continue exploring other options. Resolving such incidents can be done by communicating their desired navigational choices. However, doing so requires an added effort, which can complicate the browsing and reduce decision-making efficiency (Zhu et al., 2010; Yue et Jiang, 2013; Roten and Vanheems, 2021). Such a challenge has been framed in the COS literature as a coordination problem between shopping partners (Zhu et al., 2010; Yue et al., 2014). In this sense, better coordination could reduce frictions between partners (Zhu et al., 2010). Yet, little is known about how to enhance coordination when sharing a screen with one's shopping partners (Zhu et al., 2010; Yue et al., 2014).

We can conclude from the literature covered here that despite the previously illustrated benefits associated with sharing a screen to shop online, there are still many challenges to be addressed. Namely, the social tensions arising from the complicated spatial dynamic of screen-sharing, the loss of agency experienced by the partner not in control of the navigation, and the coordination problems arising from natural differences between shopping partners. From the screen-sharing challenges reviewed above, the literature has dedicated substantial resources to study the problem of coordination through navigation support systems (Zhu et al., 2010; Cheng et al., 2013; Yue et al., 2014). The following section will therefore detail how COS research has explored system design alternatives to alleviate the coordination challenges posed by screen-sharing.

2.3 Navigation support systems: enhancing coordination performance through system design

The coordination performance of shopping partners, defined as the partners ability to "coordinate their product search and evaluation process" (Zhu et al., 2010), is an important topic in the COS literature (Zhu et al., 2010; Cheng et al., 2013; Yue et Jiang, 2013; Yue et al., 2014; Tchanou et al., 2020b). This is mainly due to the importance of coordination for effective collaboration between shopping partners (Zhu et al., 2010; Yue et al., 2014). As a result of coordination's important role in COS, studies have looked at how collaborative online shopping tools and more broadly ecommerce websites could be designed to enhance the coordination performance of shopping partners (Zhu et al., 2010; Cheng et al., 2013; Yue et al., 2014; Tchanou et al., 2020b). Particularly, navigation support has been the main focus of researchers in terms of enhancing coordination performance via better system design. The following sections will therefore present different types of navigation support systems and how they comparatively impact co-shoppers' coordination performance. The later half of the following sections will focus on shared navigation, a specific type of navigation support system, which presents some interesting challenges for future CoLoCOS research on coordination performance.

2.3.1 Navigation support systems and coordination performance

Four types of navigation support systems have been proposed in the literature to investigate their impact on coordination performance, namely, **shared navigation**, **separate navigation**, **separate navigation with location cue**, and **split screen navigation** (see exemple in Appendix B). Shared navigation, also referred to as tightly-bound shared navigation (Yue et Jiang, 2013) ties shopping partners' navigation to a single browser such that they both have a shared view of their browsing while only one user is in control of the navigation (Zhu et al., 2010; Yue et Jiang, 2013). On the other hand, separate navigation allows each user to navigate on their own, thus allowing for a wider search scope while reducing the perception of togetherness inherent to COS (Zhu et al., 2010). Similarly, separate navigation with location cue allows each user to navigate separately while providing each shopping partner with a location cue indicating in real-time their partner’s browsing location. In practice, this can be done by displaying in a small portion of the interface a clickable link that allows the partners to navigate directly to their partners web location (Yue et Jiang, 2013; Cheng et al., 2013; Yue et al., 2014). Finally, split screen navigation provides a personal view where the shopper can navigate freely while the other half of the screen is used to display the other partner's navigation. Thus, both partners always have a concrete view of their partners navigation while being able to navigate independently (Yue et Jiang, 2013; Cheng et al., 2013; Yue et al., 2014). In this sense, split screen could be thought of as a middle ground between shared navigation and separate navigation with location cue.

From all of these navigation support systems, the literature suggests that shared navigation is superior to other forms of navigation support systems in terms of enhancing coordination performance, which can be understand as co-shoppers’ ability to maintain a common referential context throughout the shopping activity (Zhu et al., 2010; Cheng et al., 2013; Yue et al., 2014). For instance, Yue et al. (2014) found shared navigation to be superior to previously mentioned navigation support systems by measuring coordination performance through the conversation-gaze alignment of co-shoppers. More specifically, the results showed that when using shared navigation, co-shoppers were more often visually engaged with the same information in moments where they initiated a discussion about a certain product. In other words, what shoppers said and what they saw were more aligned when using shared navigation than with other forms of navigation support systems. It was therefore easier for co-shoppers to establish and maintain a shared context in the shared navigation setting since partners were already visually engaged with the information discussed. Similarly, Zhu et al. (2010) found coordination performance to be superior in shared navigation than in separate navigation. However, despite this result, the findings also revealed that shared navigation was not better than other forms of navigation support in reducing instances of intrascreen navigational uncoupling (e.i. when a shopper’s action affects his companion’s product examination such that they lose coordination). This was explained by the fact that shopping partners’ navigation is much more interdependent in shared navigation than in other forms of navigation support (Zhu et al., 2010).

In this sense, despite the increased shared context provided by shared navigation, it remains difficult for shopping partners to coordinate their interactions on the interface (Zhu et al., 2010).

Yihong (2012) provides a comprehensive summary (see Table 3) of how navigation support systems compare with regards to relevant aspects of coordination performance (i.e. common ground, uncoupling occurrence), as well as other associated dimensions of collaborative online shopping (e.i. co-presence, information search scope).

Table 3. Summary of navigation support levels

Navigation support type	**Navigation support levels**			
	Common ground	Uncoupling occurrence	Co-presence	Information search scope
Shared navigation	High	High	High	Low
Split screen	Moderate	Moderate	High	Moderate
Separate navigation with location cue	Moderate	Low	Moderate	High
Separate navigation	Low	Low	Low	High

Note. Taken from *The Effects Of Navigation Support And Group Structure On Collaborative Online Shopping Performance* by Yihong, 2012, National University of Singapore (https://core.ac.uk/download/pdf/48656916.pdf). Copyright by Yihong 2012.

Overall, the literature indicates that shared navigation is the most advantageous option in terms of enhancing coordination performance, which is explained by the shared view it provides to shopping partners (Zhu et al., 2010; Yue et Jiang, 2013). Contrarily, in the case of split screen navigation and separate navigation (with or without location cue), shared views are not a given, thus, users must communicate to gain a shared context and generally demands more effort to coordinate. Nevertheless, there are still coordination challenges associated with shared navigation. Indeed, better coordination performance does not mean good coordination. The following section will therefore focus on the particular coordination challenges associated with shared navigation.

2.3.2 Navigation support in shared navigation

As we have previously seen, shared navigation provides a shared view to co-shoppers such that shopping partners browse together on the same webpage (Zhu et al., 2010; Yue et Jiang, 2013). Whereas partners benefit from this shared context, coordinating their actions on the screen can be particularly difficult given the shopping partners' asymmetry in control over the navigation (Zhu et al., 2010; Yue et Jiang, 2013) and their differences in browsing rhythms, information needs and reading speed (Amershi and Morris, 2008; Yue et Jiang, 2013; Roten and Vanheems, 2021). This can often lead to disjointed interactions (i.e. uncoupling incidents) such that the actions on the screen of the partner in control of the navigation can often be contrary to the preferred navigation of the passive partner, that is, the partner who does not have control over the navigation. For instance, this could be the case when the attention of the passive partner is drawn to a certain product while the partner in control browses without notice to another section of the webpage (Yue et Jiang, 2013; Tchanou et al., 2020b). In this case, the passive partner could communicate with the active partner in order to go back to the product of their interest. However, such communication exchanges add a coordination cost to the shopping experience, thus requiring partners to exert more effort than if they were initially coordinated (Clark and Brennan 1991; Yue et al., 2014).

Reducing uncoupling and the cost of coordination in shared navigation has been proposed as an important research avenue in COS (Zhu et al., 2010). However, to the best of our knowledge, only Tchanou et al. (2020c) has set forth research to understand how to enhance coordination in a shared navigation context. Their research investigated the role of user interface features, particularly scrolling, on shopping partners' ability to coordinate their gaze when sharing a screen to shop online. The results suggest that, compared to a static webpage where products are always at a fixed position on the screen, using vertical scrolling to browse through a series of products diminished co-shoppers' ability to coordinate their gaze on the screen (Tchanou et al., 2020b). This was explained by the reduced interaction cost afforded by scrolling which further encourages serendipitous product exploration compared to a webpage where users have to click to see further content (Loranger, 2014). Thus, reducing the pace at which co-shoppers navigate could improve the passive partner's ability to visually follow the actions on the screen of the active partner. It would therefore be beneficial for future COS research to investigate the extent to which scrolling actually impacts the partners' coordination performance compared to other shared navigation design features (Tchanou et al., 2020b). Yet, researchers should be aware that reducing the speed at which co-shoppers explore products in shared navigation could also widen the gap in information search scope between shared navigation and other navigation support systems (Yihong, 2012).

From the COS literature reviewed in this section, we see that shared navigation is superior to other forms of navigation support systems in supporting coordination between co-located shopping partners. This is mainly because of the shared visual context it provides to co-shoppers through screen-sharing (Zhu et al., 2010; Yue et Jiang, 2013). However, shared navigation still poses some challenges in terms of coordination, in particular regarding the ability for shopping partners to align their actions on the screen (Zhu et al., 2010; Yue et Jiang, 2013; Roten and Vanheems, 2021). Further investigation into shared navigation support features leads us to believe that doing away with scrolling could be beneficial for co-shoppers' coordination performance (Tchanou et al., 2020b). Thus, considering alternatives to interface scrolling should be the next step in exploring how to support shared navigation in CoLoCOS settings. Moreover, gaze seems to play a central role in how co-shoppers can coordinate their product search and evaluation process. In particular, co-shoppers' ability to coordinate their gaze seems to be associated with better coordination performance (Zhu et al., 2010; Yue et al., 2014). For this reason, the following section will explore the literature on shared attention, defined as the state in which a group of people are visually co-attending to a common aspect of their environment (Shteynberg, 2015). Specifically, we will be looking at the role of shared attention in coordinating action and communication, as well as how shared attention could potentially play a larger role in the overall shopping experience of co-located users.

2.4 Shared attention: a mechanism for joint system use interactions

COS researchers have explored how different navigation support systems could be used to improve the shopping partners' coordination performance such that they could 1) engage in synchronous conversation to jointly evaluate products and 2) coordinate their interactions on the interface when searching for products side-by-side (Zhu et al., 2010; Goswami et al., 2007; Tchanou et al., 2020b). To improve coordination in these two interconnected shopping processes, a substantive share of previous COS studies on navigation support considered co-shoppers' gaze behavior; at times by looking at the alignment between participants' gaze and utterances (Yue et al., 2014), and otherwise by simply looking at their gaze coordination (Tchanou et al., 2020b). The following sections will therefore take a broader look at the function of shared visual attention in collaborative activities. The aim is to clarify the role of gaze in shopping partners' ability to coordinate verbal and visual interactions as well as to explore the broader role of shared visual attention in joint action.

2.4.1 Shared attention and coordination

"What do you think about the first vacation package we saw on the first page?" one shopping partner might ask the other partner. The other partner could reply "I think it is a good option" or "which vacation package?". Whether the partner needs more information or can answer directly is dependent on the information they have in common. This simple example adapted from Richardson et al. (2009) illustrates the importance for co-shoppers to have a shared context in order to efficiently communicate when evaluating products together. The process through which two individuals update their common ground (e.i. shared context) in order to communicate effectively has been defined as *grounding in communication* by Clark and Brennan (1991). In the case of CoLoCOS, *grounding* is progressively built over the course of the shopping activity through the different products that they see on the screen and the ensuing discussions. Thus, shopping partners' ability to effectively communicate is largely dependent on the extent to which they can attend to the same visual information (e.i. visually coordinate), which serves in establishing common ground (Shockley et al., 2009; Richardson et al., 2009; Kawase, 2014).

In fact, it is believed that people's ability to communicate effectively is closely linked to the knowledge interlocutors share among themselves (Shockley et al., 2009; Richardson et al., 2009; Kawase, 2014). Accordingly, shared knowledge is often associated with the degree to which visual attention is 'shared' between interlocutors (Shteynberg, 2015). For instance, Dale and Richardson (2005) recorded people's gaze and speech while watching a TV sitcom. The recorded speech was later played to another set of participants while they were listening to the same sitcom, such that they could hear the speaker's recorded description of the scenes and characters. The second set of participants (e.i. the "listeners") were later asked a series of questions relating to the events and characters in the episode they had watched. The results showed that the listeners performed better on comprehension questions about the show when their gaze was aligned with the speakers' gaze, thus suggesting that shared visual attention is associated with better speech comprehension (Dale and Richardson, 2005; Shockley et al., 2009). While this study did not look at real-time interactions between conversants, a later study considered the gaze alignment of two interlocutors during a spontaneous conversation regarding a painting (Richardson et al., 2007). The researchers manipulated the knowledge conversants shared about the painting in question before engaging in conversation. The findings revealed that conversants' gaze alignment was greater when dyads were provided with the same information prior to the gazing, compared to when they were provided with different information (Richardson et al., 2007). Thus, it would seem that establishing a shared understanding of a given context could contribute to aligning partners' visual interactions on a common visual scene (Richardson et al., 2007; Shockley et al., 2009).

The presented literature suggests that shared visual attention could play an important role in coordinating conversations and actions (Shockley et al., 2009; Shteynberg, 2015; Shteynberg, 2018). In the COS context, such findings support the claim that shared attention could be an important screen-sharing mechanism for co-shoppers, such that it could help co-shoppers coordinate their interactions on the screen and in conversation. However, if a shared-attention mechanism for joint interactions ought to be investigated in the interest of supporting shared navigation, it would be beneficial to also look into the broader role of shared attention beyond that of coordination. The following section will therefore aim to explore the role of shared attention in joint action.

2.4.2 Shared attention and acting together

We have seen that shared visual attention could function as an important mechanism to improve a group's coordination in conversation and visual interactions. Yet, shared visual attention has implications beyond that of establishing a shared visual context (Shteynberg, 2015; Shteynberg, 2018).

In that sense, Shteynberg (2015) put forward a theory of shared attention suggesting that co-attending to a common object could have implications for memory, motivation, judgment, emotion, and behavior. This can be explained by the fact that shared attention presupposes that both co-attendants are aware of each other's attentional state, such that when one person is paying attention to an object, the other person is aware of this, and vice versa (Shteynberg, 2015). However, contrarily to joint attention where participants must look at one another while looking at the object to confirm their joint attention state (Emery, 2000), shared attention considers that attendants make assumptions about the other co-attendants' attentional state based on the given context (Shteynberg, 2015; Stephenson et al., 2021). Thus, shared attention does not presuppose that attendants can confirm whether they are in fact jointly attending to a common object, but rather posits that they believe they are attending together.

This perception that they are attending together entails that co-attendants are dedicating greater cognitive resources to the object of shared attention (Shteynberg, 2015). In consequence, collectively dedicating cognitive resources to a common object is believed to play a role in the emergence of shared attitudes and beliefs (Shteynberg, 2018). This can be the case when considering memory. For example, it has been found that when a group of participants believed that they were co-attending to a set of words, they had a better recall memory for those words (Eskenazi, 2013). These results were reflected by He et al. (2014) in a similar experiment. It can also be the case for emotions since deeper cognitive involvement with valenced information would increase the positive or negative feelings towards the co-attended object (Shteynberg, 2018). This has been validated in experimental settings by looking at the intensity of individuals' emotional responses when exposed to happy or sad images in groups and alone (Shteynberg, Hirsh, Apfelbaum, et al., 2014; Shteynberg, 2015). Moreover, the effect of shared attention on judgment and motivation can be understood similarly to what is observed for emotions and memory. For instance, co-attending to an object will produce a more extreme judgment of the object (Shteynberg, 2015). Likewise, if the given object is a goal or a task, then more cognitive resources allocated to the object will increase goal persistence and goal completion such that motivation is amplified (Shteynberg, 2015). The same principle applies to behavior, such that attending together to an action entails greater adoption of the co-attended action (Shteynberg, 2015). From these results, it is believed that shared attention could act as an important mechanism for joint action. This is based on the notion that shared attention diverts individuals' cognition and effect towards the valenced object due to the perception of co-attendance while attenuating group differences by the same token.

However, it is not clear how well such findings apply to the context of collaborative screen-sharing. For instance, could shared attention modulate the cognitive and emotional experience of shopping partners when sharing a screen to shop online? Moreover, it could also be believed that when co-shoppers engage in synchronous conversations they are also revealing their attentional focus to their shopping partner. This could moderate the impact of shared attention by indicating whether or not they are in fact co-attending. More research remains to be done in order to properly understand how the shared attention mechanism modulates the shopping experience of co-located shopping partners.

The reviewed research reveals that coordinating gaze plays an important role in conversation and joint action. In this regard, shared visual attention is essential for establishing and maintaining common ground between individuals, but also has implications for heightening cognition and amplifying emotions. While this is explained by the perspective that individuals' attentional focus will increase when attending together, it remains unclear whether coordinated gaze could have a similar impact, regardless of co-attends beliefs about each other's attentional state. For instance, could there be a relationship between shared gaze and shopping partners' attitude towards a given product? Exploring such relationships could have important implications for collaborative online shopping. Indeed, gaze has already been an important aspect of COS research (Zhu et al., 2010; Yue et al., 2014; Tchanou et al., 2020b), yet, its role outside of its impact on coordination remains unclear.

2.5 Conclusion

Regarding Q1, this literature review initially set out, for one, to identify the benefits and challenges associated with the common practice of sharing a screen during a collaborative online shopping activity. The following three benefits of CoLoCOS have been mentioned in the literature: (i) improved decision-making efficiency (Amershi and Morris, 2008; Zhu et al., 2010; Roten and Vanheems, 2021; Wei et al., 2022), (ii) enhanced social interactions (Zhu et al., 2010; Izadi et al., 2021; Roten and Vanheems, 2021; Wei et al., 2022), and (ii) increased transparency in the shopping process resulting in more trust between co-shoppers (Roten and Vanheems, 2021). There are also three challenges associated with CoLoCOS that have been pointed out: (i) social tensions that arise from the complicated spatial dynamic of sharing a screen (Amershi and Morris, 2008; Roten and Vanheems, 2021), (ii) loss of agency experienced by the partner not in control of the navigation (Liu & Shrum, 2002; Fontaine, 2020), (iii) coordination problems stemming from differences in reading speed, information need, and product preferences between co-shoppers (Zhu et al., 2010; Yue et Jiang, 2013; Yue et al., 2014; Roten and Vanheems, 2021).

In response to Q2, guidelines, particularly with respect to interface design, have been proposed in the literature to address the challenges associated with sharing a screen during a co-located collaborative online shopping activity while preserving the benefits of sharing a screen. For one, multi-cursor functionalities offered via single display groupware (SDG) have been stated as a promising way to better support screen-sharing practices (Stewart et al., 1998; Amershi and Morris, 2008). Other solutions have been proposed, such as sharing the control of the peripherals to attenuate the loss of agency experienced by the partner not in control of the navigation, and conducting separate searches prior to co-browsing to improve decision-making efficiency when sharing the same screen (Fontaine, 2020; Roten and Vanheems, 2021). Additionally, research has indicated that shared navigation may be the most effective approach for addressing coordination issues since it allows co-shoppers to have a shared view of the navigation. More recently, researchers have begun to examine how shared navigation design features (e.g. scrolling and pagination) might impact co-shoppers' visual coordination performance by using the synchronous gaze-tracking method developed by Tchanou et al. (2020c). In exploring the role of gaze in collaborative activities, studies have suggested that shared visual attention is associated with heightening cognitive and affective experiences of co-attending individuals, and to play a central role in facilitating collaboration and synchronization among individuals during collaborative activities (Shteynberg, Hirsh, Apfelbaum, et al., 2014; Shteynberg, 2015; Tchanou et al., 2020c).

Despite current efforts to facilitate screen-sharing, especially in the co-located collaborative online shopping context, there remain areas of research that have still not been explored. For one, to the best of our knowledge, no research has examined the benefits of single display groupware (SDG) functionalities in an online shopping context, and perhaps more importantly, found practical ways of successfully implementing such functionality in current e-commerce websites. Moreover, creative solutions to easily implement peripherals sharing and allowing shifts between individual and shared browsing modes have yet to emerge. Finally, in spite of emerging dual eye-tracking methods (Tchanou et al., 2020c), the antecedents of shared visual attention in shared navigation, and of its influence on collaborative screen-sharing experiences in CoLoCOS remains unclear.

These gaps in the literature offer several opportunities for future research. First, more research on multi-cursors functionalities could have the potential to demonstrate its relevance, practicality, and benefits in the CoLoCOS context, and thus provide new ways for online retailers to accommodate co-shoppers. Second, additional research is necessary in order to assess scrolling alternatives that could better support coordination in shared navigation, and that offer practical recommendations for the design of e-commerce websites. Finally, with the proven effectiveness of the synchronous gaze-tracking method developed by Tchanou et al. (2020c) in measuring shared visual attention during collaborative use of a shared system interface, there are now proven and effective ways to better understand the role of co-shoppers gaze during CoLoCOS.

To conclude, the aim of this literature review was to give an overview of the benefits, challenges and design guidelines associated with screen-sharing in co-located collaborative online shopping, as well as to identify areas where further research can be conducted, which presents research opportunities for researchers and can lead to design guidelines for e-commerce website designers. The hope is that this review will serve as a foundation for future research initiatives, leading to practical design recommendations that improve support for co-located collaborative online shopping.

Table 4. Summary of findings

	Benefits of screen-sharing			Challenges of screen-sharing			Design guidelines for screen-sharing			
	Efficient collective decision-making	Pleasurable social interactions	Transparency and trust	Social tension around the screen	Lack of control	Coordination problem	Introduce multi-cursor functionalities to better support collaborative screen-sharing	Enhance shared navigation design to better support collaborative screen-sharing	Conduct separate search before screen-sharing	Share control of the peripherals during screen-sharing
Amershi and Morris, 2008	X			X			X			
Zhu et al., 2010	X	X				X		X		
Roten and Vanheems, 2021	X		X	X	X	X			X	
Wei et al., 2022	X	X								
Goswami et al. 2007		X								
Kim et al., 2013		X								
Wei et al., 2017		X								
Liu & Shrum, 2002					X					

Note. Table continues on the next page.

Table 4. Summary of findings (continued)

	Benefits of screen-sharing			Challenges of screen-sharing			Design guidelines for screen-sharing			
	Efficient collective decision-making	Pleasurable social interactions	Transparency and trust	Social tension around the screen	Lack of control	Coordination problem	Introduce multi-cursor functionalities to better support collaborative screen-sharing	Enhance shared navigation design to better support collaborative screen-sharing	Conduct separate search before screen-sharing	Exchange control of the peripherals during screen-sharing
Fontaine, 2020					X					X
Zhu et al., 2010										
Yue et Jiang, 2013						X				
Stewart et al., 1998							X			
Cheng et al., 2013								X		
Steinert et al., 2009							X			
Yue et al., 2014						X		X		
Tchanou, 2021						X	X	X		

Note. The **X** symbol indicates articles that have mentioned the benefits, challenges or design recommendations stated above.

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Chapitre 3: Enhancing Co-Located Collaborative Online Shopping Through Shared Navigation Design: An Experimental Study on Visual Coordination and Co-Shoppers' Experience[2]

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Abstract: Shopping is often a social and collaborative activity that people enjoy and benefit from doing with close ones. Technology advances have introduced a new form of shopping: co-located collaborative online shopping (CoLoCOS), in which consumers find themselves sharing a single computer screen to shop online. However, e-commerce website designs have yet to successfully accommodate and support such a practice. In this paper, we build upon common ground theory to test the effect of two shared navigation support features (navigation paradigm and navigation layout) on shoppers' ability to visually coordinate their product search and evaluation process when sharing a screen. We also draw upon flow theory and Stimulus-organism-response (SOR) framework to investigate the effect of visual coordination on shoppers' experience as measured by their affective responses, their perception of behavioral conflicts, their decision-making effort, and their satisfaction. By conducting an experiment with 28 real-life couples, we find that: (i) Scrolling, compared to pagination, enhances dyadic visual coordination performance, especially in the case of a horizontal navigation layout, but not as significantly when using a vertical navigation layout; (ii) When co-shoppers are able to synchronize their visual interactions, it creates a more enjoyable, less cognitively demanding shared navigation experience, and enhances the satisfaction of partners in their product choices. These results show that visual coordination performance can be significantly enhanced via shared navigation design and contributes positively to co-shoppers shopping experience.

Keywords: co-located collaborative online shopping, joint system use, scrolling, shared navigation, shared display, synchronized dual eye-tracking, visual coordination, shared attention, user dyad, laboratory experiment, couples, user experience

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3.1 Introduction

Shopping is often a social activity where friends and close ones come together to exchange opinions and enjoy each other's presence (Zhu et al, 2010; Lim & Beatty, 2011; Tchanou et al., 2020a). In recent years, collaborative shopping has been transposed into a digital context in which consumers shop at an online store together with one or more partners (Zhu et al., 2010; Yue et al., 2014; Izadi et al., 2021). While **collaborative online shopping** (COS) can involve asynchronous and remote collaboration, there is mounting evidence that shopping partners commonly share a computer or smartphone to collaboratively shop online (Berrada, 2011; Tchanou et al., 2020a; Wei et al., 2022). This practice is particularly widespread among couples (Tchanou et al., 2020a; Wei et al., 2022). For instance, a decade ago, 83.2% of a study respondents (N=325) reported having shared a screen to shop online at least once with their partner (Berrada, 2011), and more recently, Tchanou et al. (2020a) found that 90% of couples use a single computer side by side to shop online. Thus, to account for screen-sharing between co-located partners in a joint online shopping activity, the COS definition can be expanded to refer to the practice as **co-located collaborative online shopping** (CoLoCOS) (Fontaine, 2020). Moreover, the term **co-shoppers** will also be referred to in this paper to indicate partners' whose shopping activity takes place in such a setting.

To explain the advent of CoLoCOS, three common benefits of screen-sharing have been identified. For one, it allows for pleasurable social interactions similar to in person collaborative shopping (Zhu et al., 2010; Roten and Vanheems, 2021; Izadi et al., 2021; Wei et al., 2022). Moreover, screen-sharing builds trust between shopping partners by making the shopping process more transparent via the provided shared context (Roten and Vanheems, 2021). Lastly, shopping side by side is an efficient way of making collective decisions as the needed information is easily accessible to co-shoppers (Zhu et al., 2010; Roten and Vanheems, 2021, Wei et al., 2022). While these benefits drive partners' decisions to share a screen to jointly shop online, there remain challenges to be addressed.

An important challenge concerning CoLoCOS relates to shoppers’ ability to **coordinate** their interactions with the interface and between themselves during the shopping activity (Zhu et al., 2010; Yue et al., 2014; Roten and Vanheems, 2021). Indeed, coordinating their interactions, especially with the interface, can be laborious when accounting for natural differences between co-shoppers' intended search paths and browsing pace, in particular due to the contrast between shoppers' product preferences, information needs and reading speed (Amershi and Morris, 2008; Yue et Jiang, 2013; Roten and Vanheems, 2021). To illustrate such lack of coordination, consider one shopper who might be scanning information on a specific product while their partner swiftly scrolls to another section of the interface without notifying their partner. In those cases, communicating their desired navigation can help curb such lack of coordination. However, the effort required in verbally coordinating their interactions at all times can complicate the browsing and hinder decision-making efficiency (Zhu et al., 2010; Yue et Jiang, 2013; Roten and Vanheems, 2021). Such a challenge has been framed in the COS literature as a problem of coordination between shopping partners (Zhu et al., 2010; Yue et al., 2014). Accordingly, the term *uncoupling* has been introduced to refer to the state in which shopping partners lose coordination (Zhu et al., 2010). Such instances of coordination loss, or uncoupling, can affect two particular COS processes (Zhu et al., 2010; Goswami et al., 2007).

The first process relates to the shoppers' ability to coordinate through conversation, that is, when they engage in synchronous conversation (Zhu et al., 2010). Uncoupling through conversation may occur when a partner refers to an item on the interface that their partner is not promptly aware of. Previous COS research aimed to evaluate shoppers' coordination in conversation across different navigation support designs (see Chapter 1 section 1.3.1 for details on the different navigation support designs) (Zhu et al, 2010; Yue et Jiang, 2013; Cheng et al., 2013; Yue et al., 2014). The findings establish shared navigation as superior to other forms of navigation designs in supporting coordination in conversation between partners (Zhu et al., 2010; Yue et Jiang, 2013). This was explained by the shared view it provides to shopping partners contrary to other navigation settings where partners follow independent product search paths (Zhu et al., 2010; Yue et Jiang, 2013).

The second process affected by uncoupling deals with partners' ability to coordinate through visual interactions on the screen, or visual coordination performance as it will be referred to here (Zhu et al., 2010; Tchanou et al., 2020b). Visual coordination performance is defined as the extent to which co-located users can coordinate their visual attention on the screen. Hence, when users' gazes are aligned, there is a greater degree of visual coordination. In practice, poor visual coordination performance can appear when users' visual attention are in conflict, and then materializes as divergent navigational interactions between the user in control of the navigation and the passive user (e.g. one user is looking at product images while the other is scrolling through reviews). Conversely, good visual coordination performance can be imagined as a near-perfect alignment between co-shoppers' visual interactions with the interface such that the actions of the user in control of the navigation align with the desired navigation of the noncontrolling user. Failing to coordinate their interactions on the screen has been labeled as *intrascreen navigational uncoupling* (INC) by Zhu et al. (2010). As such, users' visual coordination is particularly relevant in a shared navigation setting since users' product searches are interdependent and closely tied together as there is only one user in control of the navigation. However, in previously tested co-located navigation designs where users' conduct independent product searches with separate screens (e.g. separate navigation), partners' ability to align their visual attention is much less applicable (Zhu et al., 2010, Cheng et al., 2013). As a result, visual coordination was commonly overlooked in previous COS studies aiming to compare different navigation support designs. Thus, little is known about the navigation system related antecedents of visual coordination, and especially in shared navigation, despite evidence that shared navigation is optimal for coordination through conversation. This lack of investigation into visual coordination in shared navigation design has introduced a gap in the literature that only recent studies have begun to explore, thus leaving room for further research.

To that effect, an important finding from recent studies suggests that two attributes of a shared navigation system ought to be investigated with respect to their ability to enhance visual coordination performance between co-located online shoppers (Tchanou et al., 2020b). **Navigation paradigm** refers to the type of information structure supporting the discovery of content (e.g., content can be made accessible by *scrolling* within a page or by *clicking* to display content bit by bit). **Navigation layout** refers to the axis along which content is revealed upon user navigation (e.g. vertical or horizontal). Based on this classification, we aim to address the current gap in the literature by investigating the impact of such shared navigation design features on visual coordination performance. Therefore, we ask:

> **Q1a**: To what extent does the navigation paradigm influence co-shoppers' visual coordination performance?

Q1b: To what extent does the navigation layout moderate the effect of the navigation paradigm on visual coordination performance?

Moreover, as it is established that enhancing visual coordination performance is a key objective in improving the shared navigation experience, we ought to better understand **how** better visual coordination impacts user shopping experience. Therefore we ask:

Q2: What is the influence of visual coordination performance on co-shoppers' shared navigation experience?

Thus, this research aims to explore how to enhance visual coordination when co-located users shop together using a shared display. It also aims to evaluate how visual coordination performance modulates partners' shopping experience. Moreover, this study contributes directly to the extant COS literature, and more broadly to the HCI and IS research community by investigating further into the information system related antecedents of visual coordination and its impact on user experience. From a theoretical perspective, we contribute to the literature on the role of shared attention and coordination in collaborative online shopping by providing further evidence of the role of gaze in joint actions. Moreover, considering the growing importance of COS for consumers and online retailers (Droesch, 2020), the insights presented here provide a valuable opportunity for shaping shared navigation design guidelines for UX practitioners and business decision makers alike.

In the following section, we develop the research model and related hypotheses in response to our research questions and present the key concepts studied in this paper. We then describe the research methodology, which involves a within-subjects experimental design using couples as participants. Finally, we present the results, and discuss the study's implications, its limitations and the avenues for future research.

3.2 Research model & hypothesis development

The proposed research model is presented in Figure 1. Our hypotheses address two research questions about (1) the influence of the navigation paradigm and the moderating effect of navigation layout on visual coordination performance, and (2) the impact of visual coordination performance on two well-established dimensions of successful collaborative shopping experiences, namely, the shared navigation experience (the perceived valence and intensity of partners' **affective** responses, their perception of behavioral **conflicts**, and their decision-making **effort**) and the shared navigation outcome (partners' **satisfaction**) (Fontaine, 2020, Tchanou et al., 2020b).

The following sections will draw upon existing theories of flow and common ground, as well as the Stimulus-organism-response (SOR) framework to develop hypotheses related to our research questions.

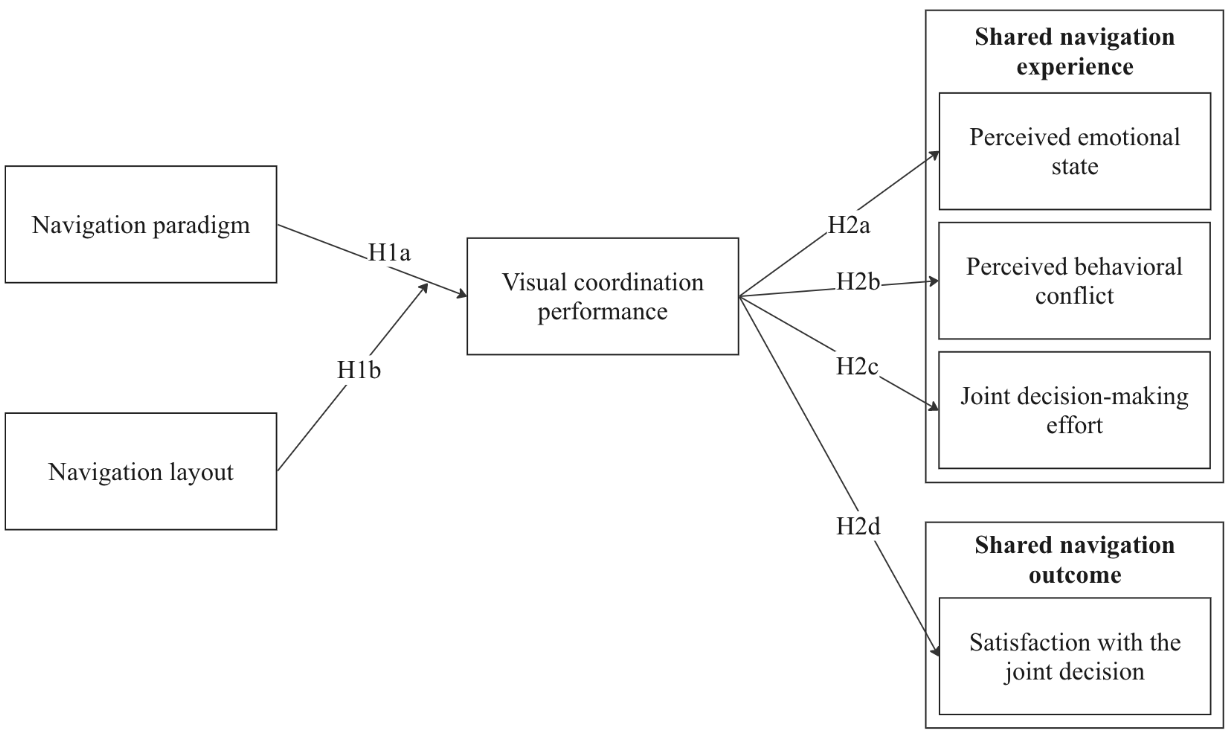

Figure 1. Research model

3.2.1 Enhancing visual coordination performance through shared navigation support

To supplement previous findings on shared navigation support, we evaluate the impact of the navigation paradigm and layout on co-shoppers' visual coordination performance. We build upon common ground theory (CGT) to develop two hypotheses about the effect of each navigation design feature on visual coordination (Clark and Brennan, 1991). We begin by providing an overview of the main concepts presented in common ground theory. We then adapt and detail those concepts to the shared navigation context by describing the underlying mechanisms through which users establish a shared visual context.

Common ground theory: Shared navigation technique and costs

Common ground theory introduces the concept of *grounding*, that is, the process through which individuals establish and maintain a common referential context that they can use to effectively communicate (Clark and Brennan, 1991). In order to easily establish common ground, CGT suggests that conversants choose a medium of communication, or more broadly a ***grounding*** **technique** of exchanging information, according to the cost induced by the technique (Clark and Brennan, 1991). In accordance with the least collaborative effort principle assumed in CGT, conversants tend to choose a technique that minimizes the grounding **effort** (the cost) required to establish common ground, i.e., to communicate.

In applying this framework to CoLoCOS, we adapt the notion of *grounding* technique and cost to the shared navigation context. In doing so, we consider the manner in which users establish and maintain a shared visual context via the user interface during the shopping activity, which we define as the **shared navigation technique**. Put simply, the shared navigation technique is the way users *ground* their shared navigation. In this paper, we identify two ways in which the shared navigation technique can vary. First, is the extent to which users employ verbal exchanges to agree on the navigation action that will be undertaken by the user in control, which we refer to as **navigational consensus building**. Second, is the extent to which users attentional focus converges towards interacting with the system as opposed to other forms of interactions (e.g. verbal exchanges), which we refer to as **system-oriented interactions**.

Because different grounding techniques require different levels of effort, we identify three *grounding* costs in shared navigation: (i) first, the **communication cost** of issuing utterances (e.i. establishing a shared context via communication) (Clark and Brennan, 1991); (ii) second, the **interaction cost** relating to the navigation itself (Loranger, 2014), and (iii) lastly, the **adaptability cost** which accounts for users' effort in getting familiar with the navigation system (Wilson and Rutherford, 1989). In our context, communication cost captures the level of effort users invest into establishing a shared context via face-to-face communication (Clark and Brennan, 1991). It is perceived when users must form and produce utterances to realign the navigation between the controlling and noncontrolling user. Interaction cost refers to the level of effort users invest into interacting with the supportive digital interface (Budiu, 2013). In this paper, interaction cost is specifically viewed as the effort deployed by users to *navigate* through the online shopping website. Finally, adaptability cost is the effort deployed by a user to become familiar with a system interface in order to reach a goal. It is incurred when users are faced with a navigation system that does not easily fit within their mental model of how the system should behave (Wilson and Rutherford, 1989).

Table 1. Summary of expected shared navigation technique based on navigational cost

Shared navigation design attributes (nav. paradigm and nav. layout)				
Navigation paradigm	Scrolling	Scrolling	Pagination	Pagination
Navigation layout	Vertical	Horizontal	Vertical	Horizontal
Combination of navigation paradigm and layout	Vertical scrolling	Horizontal scrolling	Vertical pagination	Horizontal pagination
Expected shared navigation technique [a] based on interaction cost [b]				
Interaction cost	Low	Low	High	High
Shared Navigation technique	Low navigational consensus [c]	Low navigational consensus	High navigational consensus	High navigational consensus
Expected shared navigation technique based on adaptability cost [d]				
Adaptability cost	Low	High	High	Low
Shared navigation technique	Low system-oriented interactions [e]	High system-oriented interactions	High system-oriented interactions	Low system-oriented interactions
Combined effect of interaction and adaptability cost on shared navigation technique				
Shared navigation technique	Low navigational consensus and system-oriented interactions	Low navigational consensus and high system-oriented interactions	High navigational consensus and system-oriented interactions	High navigational consensus and low system-oriented interactions
Effect of shared navigation technique on visual coordination performance				
Visual coordination performance	Poor	Worst	Moderate	Good

Notes for Table 1.

[a] **Shared navigation technique** refers to the manner in which users' establish a shared context during the shopping activity.

[b] **Interaction cost** refers to the effort deployed by the users to navigate on the online shopping website.

[c] **Navigational consensus** refers to an agreement between co-shoppers as to the subsequent undertaken navigational action in order to establish a shared visual context during the shopping activity.

[d] **Adaptability cost** refers to the effort deployed by a user when adapting to an unfamiliar system interface in order to reach a goal.

[e] **System-oriented interactions** refers to users' heightened attentional focus on navigation system related interactions.

The following two sections will elaborate on the influence of the navigation paradigms and layouts on visual coordination performance according to CGT and the least collaborative effort principle assumed in CGT. In doing so, we detail how navigational costs might influence the shared navigation technique, and subsequently, the visual coordination performance as summarized in Table 1.

Navigation paradigm (scrolling vs pagination) and visual coordination performance

There are two dominant types of information structures on the Web, e.i., navigation paradigms that can support the discovery of content on a website (Loranger, 2014; Sharma and Murano, 2020). The first structure displays information on a single webpage through which users must *scroll* to access content. In this paradigm, scrolling is generally performed with a mouse, often with a built-in scroll wheel on a desktop computer and a touchpad on a laptop computer (Sharma and Murano, 2020). The second structure groups information in a series of webpages or sections such that users must retrieve content via *clicking* (Sharma and Murano, 2020). This paradigm allows users to click the 'next' or 'previous' button to display more information.

When comparing these navigation paradigms in terms of interaction cost, we anticipate, based on the tendency for scrolling to encourage serendipitous content exploration (Loranger, 2014), that the interaction cost will be greater in the pagination navigation paradigm compared to the scrolling navigation paradigm. Indeed, scrolling is much less costly in interaction cost than clicking through a series of webpages as in the case of pagination. It is for this reason that infinite scrolling is often used to encourage serendipitous content exploration or product exploration in the case of shopping (Loranger, 2014).

In considering interaction cost's role in shaping the shared navigation technique, we expect that high interaction cost will result in further navigation consensus building. Precisely, we anticipate that if the navigation paradigm induces high interaction cost, then, when uncoupling occurs, partners will perceive a higher cost to realigning, that is, to resolving uncoupling. As such, we foresee that under high interaction cost, the user controlling the navigation device will tend to further employ verbal exchanges to arrive at an agreement concerning the navigation action that will be undertaken by the user in control. Thus, building navigational consensus could be perceived as the most cost efficient strategy since performing unprompted navigational actions will likely generate additional interaction cost as uncoordinated actions are prone to initiate uncoupling. Put differently, when the interaction is high, partners will favor incurring the additional cost of verbal exchanges in order to coordinate their navigation rather than the cost of interacting with the system. In return, favoring communication should reduce instances of intrascreen navigational uncoupling (INC), and by the same token improve their visual coordination as a result of enhanced common ground between shoppers.

Conversely, low interaction cost will result in less navigational consensus building. Specifically, if the navigation paradigm induces low interaction cost, then we expect partners to perceive a lower cost to resolving unprompted navigational actions that lead to uncoupling incidents. As a result, partners will be less prone to communicate in order to coordinate their interactions. This can be expected due to the interaction cost of realigning the navigation being perceived as lesser than the communication cost associated with establishing consensus prior to navigating. Accordingly, partners will be less prone to communicate in order to coordinate their interactions since the interaction cost of realigning the navigation can be perceived as minimal compared to the communication cost associated with establishing consensus prior to navigating.

Therefore, in scenarios where interaction cost is low, we assume that INC will increase as establishing visual common ground via conversation will be less favored. Consequently, we expect that when the navigation paradigm renders more interaction cost, visual coordination will improve as users will benefit from coordinating their interactions prior to navigating. Thus, we posit:

> **H1a**: Navigation paradigm influences visual coordination performance with *scrolling* weakening visual coordination performance (compared to *pagination*).

Navigation layout (horizontal vs vertical) and visual coordination performance

Two navigation paradigms were discussed thus far: scrolling and pagination. Different navigation layouts can also be used in conjunction with the navigation paradigm, for instance, vertical and horizontal scrolling (Tchanou et al., 2020b; Sharma et al., 2020). We consider in this paper two types of navigation layout: horizontal and vertical.

Based on the layout used to enable each navigation paradigms, we believe that horizontal scrolling will render more adaptability cost than vertical scrolling. We anticipate this to be the case because vertical scrolling is most commonly used, as opposed to horizontal scrolling, to display a series of products in an ecommerce website. Thus, since horizontal scrolling is much less commonly used for such interactions, users' perceived adaptability cost will be greater when using horizontal scrolling than vertical scrolling.

Conversely, clicking to browse through a series of contents is more commonly done via horizontal layout where users are clicking to browse leftward and rightward. Such horizontal layout may be used to replicate the experience of turning pages in a book (Kim et al., 2016). For instance, navigation controls in carousels are typically positioned at the bottom of the carousel and occasionally at the left and right edges (Pernice, 2013), thus suggesting to the user that the content is laid out horizontally. Therefore, we expect that users' adaptability cost when navigating through a series of pages will be greater for a vertical layout than a horizontal layout.

To consider the role of adaptability cost in shaping the shared navigation technique, we think of how users might interact with an unfamiliar navigation system. Hence, we foresee that when the adaptability cost is high, *system-oriented interactions* will increase as the controlling user's attentional focus will converge towards adapting to the system. Such system-oriented interactions ought to impede on building navigational consensus, as users' cognitive resources will be diverted to interacting with the system as opposed to coordinating with their shopping partners. Consequently, users will benefit from increased visual coordination performance in a pagination laid out horizontally where adaptability cost is lower than for a vertical pagination layout. Similarly, when using vertical scrolling, users' visual coordination will improve as horizontal scrolling generates higher adaptability cost. Therefore we posit:

> **H1b**: The effect of the navigation paradigm on visual coordination performance (h1a) is stronger when the navigation layout is *horizontal* (compared to *vertical*).

3.2.2 Influence of visual coordination performance on co-shoppers' experience

To examine how visual coordination might impact co-shoppers' experience and the quality of their joint decision (e.i., the outcome), we consider measures of co-shoppers' experience that have been assessed in previous COS studies (Fontaine, 2020; Tchanou et al., 2020b). Namely, we consider partners' emotional experience (valence and arousal), perceived and cognitive effort associated with reaching a consensus over the decision, the perception of behavioral conflict, and regarding the shopping outcome, partners' satisfaction with the joint decision. To theorize on the relationship between visual coordination performance and aforementioned measures of the shared navigation experience and outcome, we build upon Flow theory (Csikszentmihalyi, 1990) and frame our investigation of the outcome via the Stimulus-organism-response (SOR) framework (Mehrabian & Russell, 1974; Donovan and Rossiter, 1984; Mosteller et al., 2014).

Shopping experience: emotions, effort and perceived behavioral conflict

Flow theory introduces the concept of *flow*: a state where an individual is intrinsically motivated to engage in a goal-driven activity in which the challenge and required skills reach an optimal equilibrium (Csikszentmihalyi 1990; Nakamura and Csikszentmihalyi, 2014; Mahnke et al., 2015; van den Hout et al., 2018). Flow, commonly regarded as an optimal experience state, is characterized as desirable, particularly because it presupposes a sense of enjoyment, exhilaration and immersion in an activity, as well as a sense of control over the course and outcome of the activity (Csikszentmihalyi, 1990; Mahnke et al., 2015).

While flow is commonly conceptualized at the individual level, studies have explored flow experiences at group level (e.g. Walker, 2010; Mahnke et al., 2015; van den Hout et al., 2018). Such conceptualization of team flow has been defined as "a shared experience of flow derived from an optimized team dynamic during the execution of interdependent personal tasks" (van den Hout et al., 2018). It is important to note that team flow is experienced individually but is derived from the group dynamic. As such, the quality of interactions between team members are essential in shaping the *flow* of each individual within the group (Walker, 2010; van den Hout et al., 2018). For instance, such group level conceptualization applies well in team sports where team dynamics, and precisely interactions between team players are highly influential features in regulating the team's ability to attain team and individual flow (Jackson and Eklund, 2004; Jackson, Kimiecik, Ford, and Marsh, 1998; Jackson and Csikszentmihalyi, 1999; Russell, 2001 as cited in van den Hout et al., 2018).

In the case of co-located collaborative online shopping, visual coordination performance can be considered as a vector of team flow because visual coordination is an important mechanism for joint action (Shockley et al., 2009; Shteynberg, 2015; Shteynberg, 2018); in other words, visual coordination should enable smooth interactions between co-shoppers. As a result, it is when partners are visually coordinated that they are best positioned to achieve team flow and by the same token, individual flow. Thus, when shopping partners converge towards a flow state, we expect such state to be reflected in their emotional response, the exerted effort to conduct the shopping activity, as well as the perceived quality of their interactions, that is, whether the interactions are constructive rather than obstructive.

Regarding emotions, we start from a notable conceptualization of emotional responses: the circumplex model of affect (CMA) (Posner et al. 2005). This model classifies emotional states according to two dimensions: arousal and valence, where arousal refers to the intensity of the emotion while valence relates to the dimension of pleasure associated with emotions (Posner et al. 2005). Relating CMA to the experience of flow, we consider flows' positive association with enjoyable and exhilarating experiences (Nakamura and Csikszentmihalyi, 2014) to posit that partners' emotional state will improve when shoppers are visually coordinated, such that they experience more pleasurable and intense emotions during the shopping activity. Therefore, we propose the following hypotheses:

> **H2a**: Visual coordination performance is positively associated with each partner's perceived emotional state.

Concerning partners' interactions during the shopping activity, particularly relating to their interactions on the screen, we consider the possibility that such interactions may be unsupportive and interfere with each other's action (Ma et al., 2017). Correspondingly with Ma et al.'s typology of conflict (2017), we refer to this construct as behavioral conflict. Such a construct aims to account for uncoupling incidents (and their resolvement) as they involve some form of interference between partners actions. The notion that team flow presupposes a sense of control over the outcome but also over the activity itself (Nakamura and Csikszentmihalyi, 2014; van den Hout et al., 2018) as it is characterized by optimized group dynamics (van den Hout et al., 2018), allows us to infer that when partners experience team flow based on improved visual coordination performance, behavioral conflict should lessen. Therefore, we propose H3:

> **H2b**: Visual coordination performance is negatively associated with each partner's perceived behavioral conflict.

Regarding partners' effort at reaching a consensus over the purchase decision during the shopping task (Tchanou et al., 2020b), we turn to the notion of challenge associated with flow theory. In this sense, we rely on the premise that challenges presuppose that some level of effort will be incurred when pursuing a flow inducing activity. Yet, such effort can be perceived as necessary to the pursuit of the activity's goal, and as such, is sustained voluntarily to some extent (Csikszentmihalyi 1990). However, the exerted effort can only be perceived as fitting for as long as the challenge met by the individuals during the activity is well adjusted to their ability to carry out the task, and specifically to visually coordinate their interactions on the screen. When such ability (or skill) is not sufficient to conduct the activity successfully, the effort is much less likely to be incurred voluntarily, rather, it ought to be a source of discomfort that inevitably prevents from maintaining *flow*. Thus, partners' visual coordination performance is likely to be an important factor in shaping how effort is perceived and experienced during CoLoCOS. In this sense, we expect that when visual coordination performance is high, such that their abilities are well-adjusted to the shopping task, partners will converge towards a team flow state where the effort to make a joint decision will decrease. Therefore, we propose H4:

> **H2c**: Visual coordination performance is negatively associated with each partner's effort for joint decision-making.

Shopping outcome: satisfaction with the joint decision

In addition to co-shoppers' navigation experience, we also consider their attitude towards the shopping outcome. Thus, we define partners' satisfaction with their joint decision as, the extent to which co-shoppers are satisfied with the product choice they jointly made (Tchanou et al., 2020b). To examine how visual coordination might impact partners' satisfaction with their joint decision, we leverage the Stimulus-organism-response (SOR) framework. The SOR framework posits that the inner workings of an organism drive its attitudinal and behavioral responses to a given stimulus (Mehrabian & Russell, 1974; Donovan and Rossiter, 1984; Mosteller et al., 2014). For instance, such a framework has been useful in evaluating shoppers' choice satisfaction as a response to a website's hedonic characteristics (Mosteller et al., 2014), and in describing consumer decision-making process in retail settings (Donovan and Rossiter, 1984).

Accordingly with SOR, we consider co-shoppers (the *organism*) internal attributes as the driver of co-shoppers' joint decision satisfaction (*attitudinal response*), to the shared navigation support features (the *stimulus*). In specifying group level attributes that might shape shoppers' joint decision satisfaction, we consider the quality of partners' product evaluation process. This is in line with previous research showing that the perceived quality of a decision during a shopping process relies substantially on the shoppers ability to effectively process and evaluate a set of information and decide accordingly (Angela and Kukar-Kinney, 2011; Zha et al., 2013). Hence, we propose that shared navigation support features will drive shopping partners' attitudinal responses based on the quality of their evaluation process. More specifically, we expect that the quality of such evaluation process will be influenced by the partners' visual coordination performance, e.i. their ability to visually coordinate their interactions on the screen, and that their satisfaction with the decision will ensue accordingly (Zhu et al., 2010; Tchanou et al., 2020b). Therefore:

> **H2d**: Visual coordination performance is positively associated with each partner's satisfaction with the joint product choice.

3.3 Methodology

To test our hypotheses, we conducted a controlled experiment in a laboratory setting. The study was approved by our institution's Ethics Research Committee (Certificate #2021-4041). It involved 28 couples who shopped together online for Airbnb Experiences on a shared display, where shopping partners viewed the same webpage on their respective screens. We implemented a 2x2 within subjects design with navigation paradigm and navigation layout as the two within-group factors (summarized in Table 2). The following sections will provide more details on the participants, the experimental design and stimulus, the materials, the procedure, and the measures as well as the statistical analysis.

Table 2. Experimental design - 2x2 within-subject

<table>
<tr><td></td><td></td><td colspan="2">Navigation paradigm</td></tr>
<tr><td></td><td></td><td>Scrolling</td><td>Pagination (no scrolling)</td></tr>
<tr><td rowspan="2">Navigation layout</td><td>Vertical</td><td>Vertical scrolling</td><td>Vertical pagination</td></tr>
<tr><td>Horizontal</td><td>Horizontal scrolling</td><td>Horizontal pagination</td></tr>
</table>

3.3.1 Experimental design

In our experiment, participants were exposed to all four experimental conditions. To avoid confounding variables and order effects, experimental conditions were counterbalanced using a 4x4 balanced Latin Square (Lewis, 1989). By using this method, four different treatment orders were established in which each condition only appeared once in the same position of the treatment order. Dyads were randomly assigned to one of the four treatment orders during the experiment.

3.3.2 Sample

28 real-life couples (56 participants) were recruited to participate in the experiment. Participants were recruited primarily through our institution's pool of participants, as well as through major digital social networks and word-of-mouth. All participants were between the ages of 18 to 65, with the majority (48 participants) being younger than 35 years old, and 39 of which were between the ages of 18 to 29. Couples were dichotomous in self-declared gender such that the sample comprised 28 men and 28 women. Participants' perceived interpersonal closeness score revealed that partners felt close and connected with each other with an average score of 5.36 on a 7-point Likert scale where a high score indicates that they feel close and connected with their

partner (Aron et al., 1992). Differences between each partners' score within the couple (mean = 1.12 and SD = 0.93) also showed little contrast in perceived interpersonal closeness between partners. Moreover, the product categories most frequently shopped for by the participants over the last year were furniture and accessories, leisure, and art and entertainment (see Table 3 for all categories).

Table 3. Participants' shopping habits

Product category	Mean*	Standard deviation
Groceries	2.02	1.23
Travel and tourism	2.98	1.36
Newspapers or magazines	1.13	0.58
Furniture and accessories	**3.29**	1.02
Real Estate	2.13	1.44
Cars	1.44	1.06
Clothing and fashion	2.75	1.15
Computers and electronics	2.67	1.42
Leisure	**3.24**	0.92
Art and Entertainment	**3.15**	1.05

Note. Values in **bold** are the three most frequently online shopped for product categories in the past year by our participants.

*Mean values follow an ordinal scale where 1 = Never; 2 = A few times a year, 3 = A few times a month; 4 = A few times a week;

3.3.3 Experimental stimulus

A fictitious online shopping website was developed specifically for our experiment. Based on the navigation paradigm and layout, one webpage was created for each experimental condition (see Appendix C). As for the products jointly shopped for on the website, we chose experience products to stimulate collaboration during the shopping experience (Zhu et al., 2010; Gao et al., 2017) and to remain faithful to product categories that are often shopped for collaboratively by couples (Tchanou et al., 2020a). Thus, we selected 40 of the most popular Airbnb Experiences in the city where the experiment was conducted. Airbnb Experiences are activities that tourists or locals can book to take part in a unique activity created and hosted by Airbnb hosts (Airbnb, Inc., San Francisco, CA, U.S.A.). From the information provided on Airbnb's website, 40 Airbnb product cards were designed using Figma software (Figma, Inc., San Francisco, CA, U.S.A.). Each product card provided a title, product description, price, product rating, duration of the activity, and a maximum number of participants in the activity. For each webpage, a mutually exclusive set of 10 randomly selected Airbnb product cards were laid out on the webpage accordingly with the navigation paradigm and layout. Therefore, each webpage contained a different set of Airbnb Experiences and presented via a different shared navigation support system.

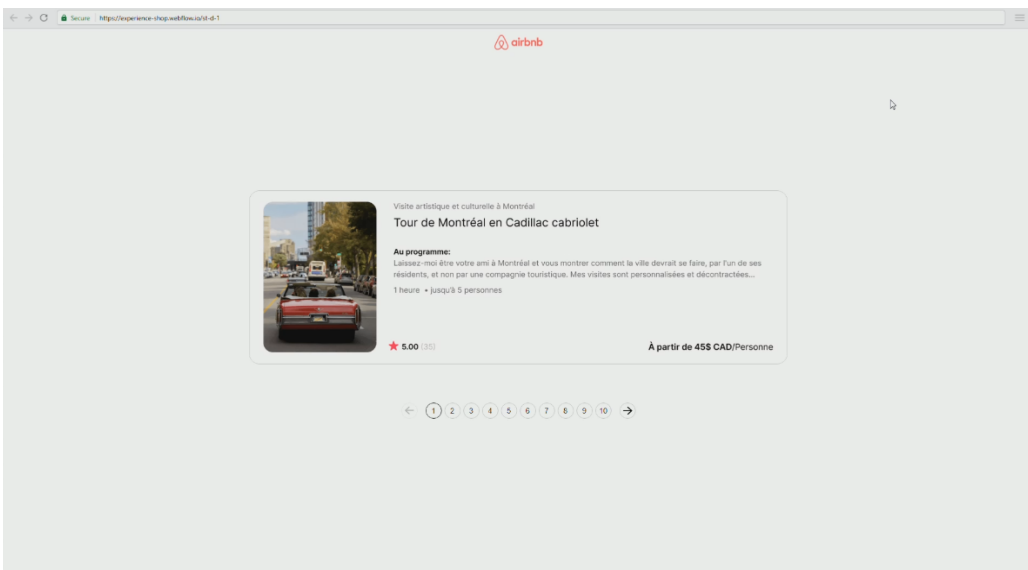

Figure 2. Webpage with horizontal pagination

3.3.4 Material & apparatus

We reproduced the experimental setup developed in Tchanou et al. (2020c) as illustrated in Figure 3. Correspondingly, each participant had their own computer screen but saw the same stimuli on the screen by mirroring the interface display. Only one participant was provided with a keyboard and a mouse while the noncontrolling participant could communicate with their partner to direct the navigation. Participants were allowed to discuss during the shopping tasks. A cardboard wall was installed between the participants to make sure participants would direct their gaze at the screen and not at each other. This was done to ensure better tracking of their gaze behavior by the eye-trackers.

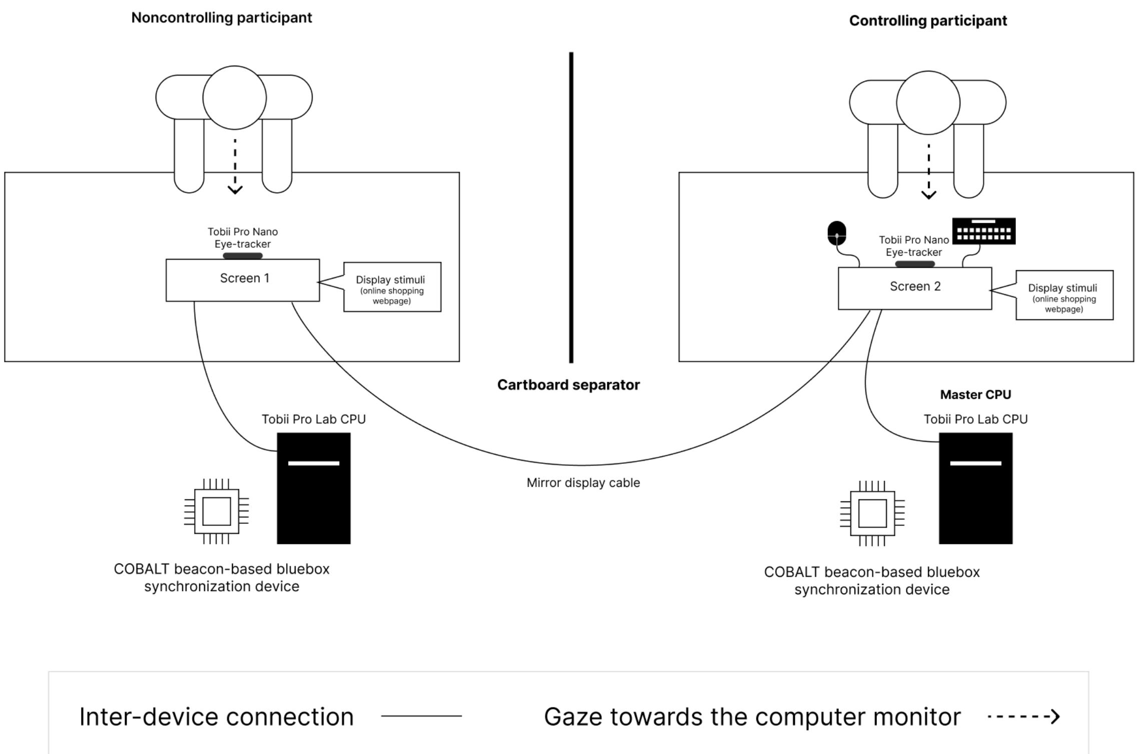

Figure 3. Dual-eye-tracking experimental setup

To record the gaze behavior of the participants, we used two Tobii Nano Pro eye-trackers (Tobii Technology, Inc., Reston, VA, U.S.A.). The eye-trackers were attached to the bottom edge of the computer screen. Tobii Pro Lab software was used to manage the Tobii Nano Pro hardware, such as in the calibration of the eye-trackers. Tobii Pro Lab was also used to administer the stimuli and some task related instructions during the experiment, as well as participants' screen recording. We used two COBALT - Bluebox synchronization devices (Tech3Lab, HEC Montréal, Montreal, Québec, Canada) as a real-time synchronization means of users' gaze data (Léger et al., 2019; Courtemanche et al., 2022a; Courtemanche et al., 2022b). One of the two devices automatically dispatched regular synchronization markers to all computers collecting gaze data. To assess participants' experience, self-reported scales were administered via paper-form questionnaires (see Appendix D for administered questionnaires Q_1, Q_2, Q_3).

3.3.5 Experimental procedure

Prior to the participants' arrival, all the tools and equipment were set up for the experiment. After welcoming the participants, shopping partners were assigned a seat which specified whether they would be in control or without control of the peripherals (control was alternated between men and women after each trial). Therefore, only one partner acted as the controlling user throughout the experiment.

Before the participants were provided with the consent form, we introduced the general purpose of the study and the tools used during the experiment. We also informed the participants that they would each be compensated via an *Interac* e-transfer payment of $50 following their participation, as well as a chance to win, based on a random draw, one of the four Airbnb activities that they would jointly choose during the shopping tasks. The latter was done to increase the realism of the shopping tasks by incentivising the partners to select activities in which they would like to participate in real life.

Once the consent form was signed by the participants and researcher, a pre-experiment paper-form questionnaire (Q_1) was administered individually to gather information on their shopping habits and their previous experience with Airbnb. We then proceeded with the calibration of the eye-trackers. To ensure the best capture of their gaze behavior by the eye-trackers, the participants' seats had limited room for lateral and longitudinal movements.

The experiment consisted of four collaborative shopping tasks on the fictitious Airbnb website, each followed by a post-task questionnaire (Q_2). Participants were advised that they would only have a maximum of five minutes per task to examine all 10 products displayed on the webpage and make a joint decision. Once a decision was made, the participants had to indicate aloud the chosen Airbnb Experience so that we could take note of the chosen product. We determined beforehand that five minutes would offer ample time for the participants to view and discuss the products while limiting the participants from lingering on their decision. The administration of the stimuli and instructions was managed by the researcher via Tobii Pro Lab software, such that it was necessary to manually start the task when participants confirmed being ready, and end the tasks when participants specified the chosen product. After completing all the tasks, a post-experience questionnaire (Q_3) was administered. Finally, we conducted interview sessions to gather feedback on their experience.

3.3.6 Measures

Visual coordination performance

We conceptualized visual coordination performance at dyad level via a construct named *gaze convergence*, that is, the extent to which a group of users look at a common location of the interface (Tchanou et al., 2020c). Precisely, dyad gaze convergence is measured using the Gaze convergence index (GC index), which results from the Euclidean distance between the two users' gaze locations on the screen throughout an experimental task (Tchanou et al., 2020c). We obtained the GC index by leveraging the synchronized dual eye-tracking technique which assesses two co-located users' gaze behavior relative to each other (Tchanou et al., 2020c).

Cognitive load

To assess participants' cognitive effort during the shopping tasks, we measured cognitive load through pupillary dilation based on pupillary diameter data provided by Tobii Pro Nano eye-tracker (Riedl and Léger, 2016; van der Wel et al., 2018). The fictitious online shopping website was also developed to reduce variation of light intensity across experimental conditions in order to minimize the confounding effect of changing light intensity on pupillary dilation (Karran et al., 2022).

Self-reported measures of user experience and shopping outcome

In assessing participants' shared navigation experience and the quality of their joint decision, we used self-reported scales administered after each task via paper questionnaires (see Table 4 for a list of measurement scales). To measure perceived emotional state, we used affective sliders covering both dimensions of emotional response: valence and arousal (Betella & Verschure, 2016). The sliders were adapted to paper form such that participants' indicated their level of arousal and pleasure (valence) by tracing a horizontal line on the scale. The extent to which two parties experience non constructive or destructive interactions such as being unsupportive and interfering with each other's action, that is, *perceived behavioral conflict*, was measured via three items adapted from Ma et al. (2017). Co-shoppers' reported on how much effort they perceived it took to reach consensus over decisions during tasks, a construct called perceived effort for *joint decision-making* (Tchanou et al., 2020b). The extent to which a participant was satisfied with the final product choice jointly made with their partner, that is, the *satisfaction with the joint product choice*, was measured via Tchanou et al. (2020b)'s scale.

3.3.6 Data analysis

Reliability and validity of self-reported measures

We assessed the self-reported measurement scales' convergent and discriminant validity via a confirmatory factor analysis (CFA). The goodness of fit measures (see Table 2.E.2. presented in Appendix E) of the CFA show that it is an appropriate model to verify validity of our measures ($\chi^2 = 15.620$ with df = 11; p=0.156; χ^2 / df = 1.420 < 3; Bentler-Bonett ≥ 0.9; CFI, EFI, GFI, AGFI ≥ 0.9; RMSEA ≤ 0.8) (Hair et al., 2010). To verify discriminant validity we used an approach based on Fornell-Larcker (1981) (see Table 2.E.3. presented in Appendix E for details). Unidimensionality and convergent validity was also verified (see Table 2.E.1. presented in Appendix E for details). For the reliability of self-reported measures, Cronbach alphas are superior to 0.7 as presented for each self-reported measure in the Table 4.

Transformation of non-normally distributed variables

For all dependent variables, we assessed whether they were normally distributed. We found that satisfaction, perceived effort, behavioral conflict and gaze convergence were not normally distributed based on skewness and kurtosis values exceeding the generally acceptable range of +/-2 (George & Mallery, 2010) (see Table 3.F.1 presented in Appendix F for details). To account for non-normally distributed variables of self-reported scales (satisfaction, effort, behavioral conflict), we transformed them each into a binary variable by using their median as a split point (Iacobucci et al., 2015). As for the gaze convergence variable, we performed a transformation by taking the reciprocal of the Gaze convergence (GC) variable as presented in Figure 6.F.1 of Appendix F.

Table 4. Items formulation, factor loadings, and construct reliability

Construct	Items #	Item	Factor Loading*	Cronbach Alpha	Source
Perceived emotional valence	P_EM_V	Please draw a line on the scale below to indicate your level of enjoyment felt while searching for an Airbnb experience with your partner.	NA	NA	(Betella & Verschure, 2016)
Perceived emotional arousal	P_EM_A	Please draw a line on the scale below to indicate your level of excitement felt while searching for an Airbnb experience with your partner.	NA	NA	(Betella & Verschure, 2016)
Perceived behavioral conflict	To what extent do you agree with the following statements?			0.85	(Ma et al., 2017)
	P_B_CON_1	During the online shopping activity, my partner and I would often obstruct or interfere with each other's actions.	0.655		
	P_B_CON_2	During the online shopping activity, my partner or I would often be uncooperative.	0.918		
	P_B_CON_3	During the online shopping activity, my partner would often be unsupportive of my actions, or I would often be unsupportive of his/hers.	0.873		
Perceived effort for joint decision-making	To what extent do you agree with the following statements?			0.9	(Tchanou et al., 2020b)
	P_EF_1	It was very hard to reach a consensus together on the final buying decision.	0.895		
	P_EF_1	It took a lot of effort to agree on the final buying decision.	0.925		
Satisfaction with joint product choice	To what extent do you agree with the following statements?			0.91	(Tchanou et al., 2020b)
	SAT_P_1	I am totally satisfied with the choice we made.	0.918		
	SAT_P_2	The choice made is a good one for me.	0.918		

Note. NA is attributed to single item measures. Abbreviations: P_EM_V = Perceived emotional valence; P_EM_A = Perceived emotional arousal; SAT_P = Perceived satisfaction; P_EF = Perceived effort; P_B_CON = Perceived behavioral conflict.

* Factor loading assessed with confirmatory factor analysis (CFA) method.

Hypotheses testing

A mixed model regression with repeated measures was used to test H1a and H1b. Moreover, as we also wanted to compare different combinations of navigation paradigms and layouts, we used the Sidak method to adjust for multiple comparisons. To test H2, we ran a mixed model regression analysis with repeated measures for variables that were normally distributed. Thus H2a and H2c (cognitive effort) were tested accordingly. Conversely, to test the remaining H2 hypotheses (H2b, H2c (perceived effort), H2d) in which the dependent variable did not follow a normal distribution, we ran a generalized logistic regression with random intercepts and repeated measure modeling the probability that the dependent variables reach a higher value than their median, that is, a value of "1". Random intercept method was used to account for repeated measures within the logistic regression analysis (Baltagi, 2021). Fit statistics with respect to each model are presented in Appendix G.

Control variables

Based on previous findings (Fontaine, 2020), we accounted for the potential effect of device control, that is, whether the partner was in control of the navigation device, on co-shoppers' navigation experience. We found no significant effect of device control, thus indicating that the role of visual coordination on the user experience was not moderated by whether the participants were in control of the navigation device.

3.4 Results

Table 5. Descriptive statistics for construct measures

Construct name	Values	Mean (Std. Dev)
Perceived emotional valence	1-100	77.46 (19.42)
Perceived emotional arousal	1-100	70.42 (23.39)
Perceived behavioral conflict	1-7	1.85 (1.05)
Perceived effort for joint decision-making	1-7	2.09 (1.35)
Satisfaction with joint product choice	1-7	6.12 (1.08)
Cognitive load	2-5	3.41 (0.62)
Gaze convergence	0-1000*	377 (69.02)

*Values of gaze convergence closer to 0 indicate high gaze convergence, while larger values indicate low gaze convergence. Maximum value for gaze convergence can exceed the indicated upper bound range to the furthest possible distance between users' gaze locations on the screen.

Descriptive statistics for construct measures are detailed in Table 5 above. Figure 4 below also provides more details regarding participants gaze convergence per shared navigation designs. In the following sections we present our results with respect to H1 and H2.

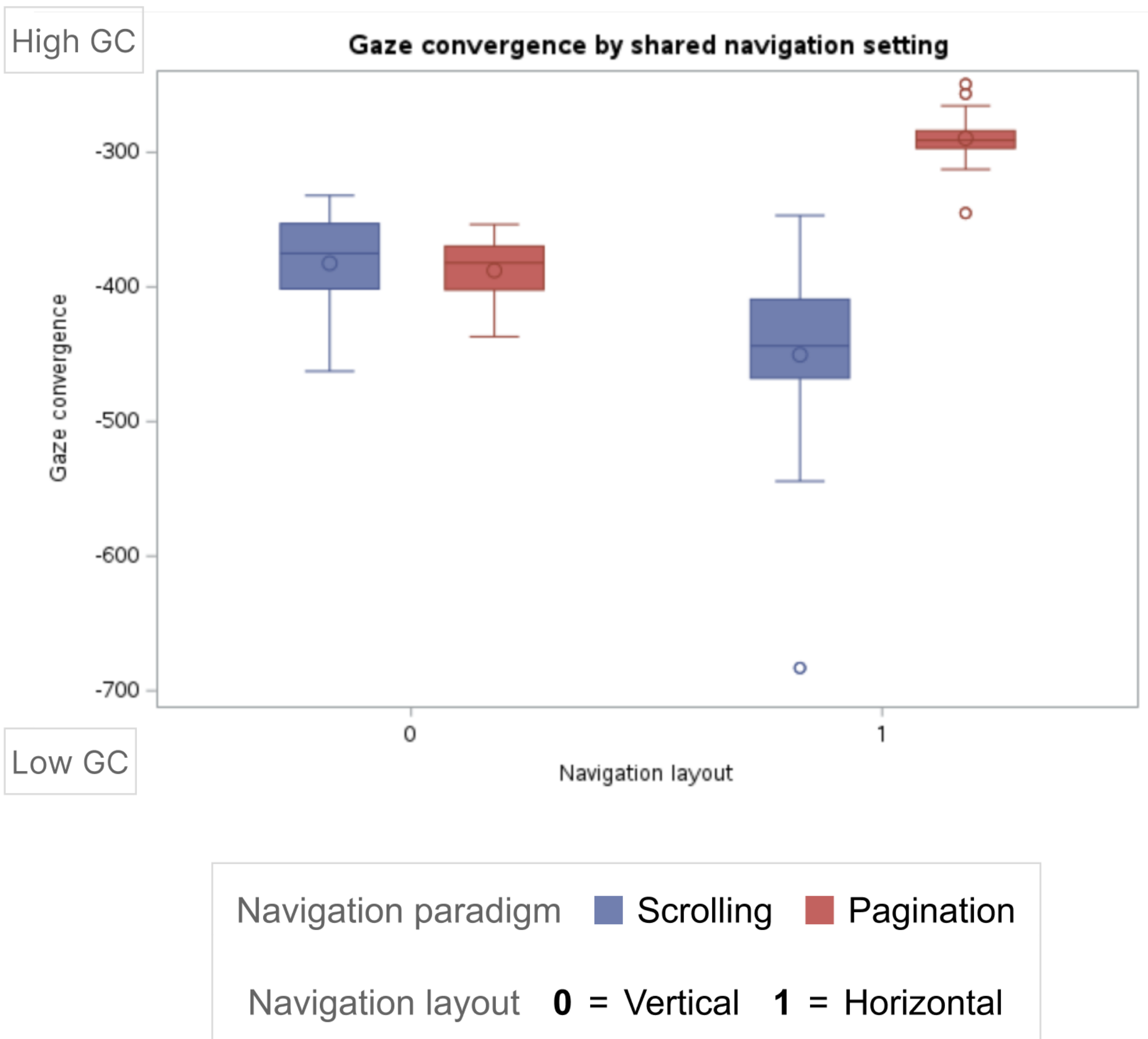

Figure 4. Gaze convergence by shared navigation support setting

Note for Figure 4. Larger values of gaze convergence closer to 0 indicate high gaze convergence, while smaller values indicate low gaze convergence

3.4.1 Results for H1: Role of shared navigation support features on visual coordination performance

We found that the shared navigation support features have an influence on co-shoppers' visual coordination performance as inferred from the dyad gaze convergence index. Precisely, the navigation paradigm (scrolling vs. pagination) was found to have a significant effect on visual coordination ($F(1, 24) = 204.08$; $p < 0.0001$), with the scrolling navigation paradigm weakening visual coordination performance compared to the pagination navigation paradigm, thus supporting H1a.

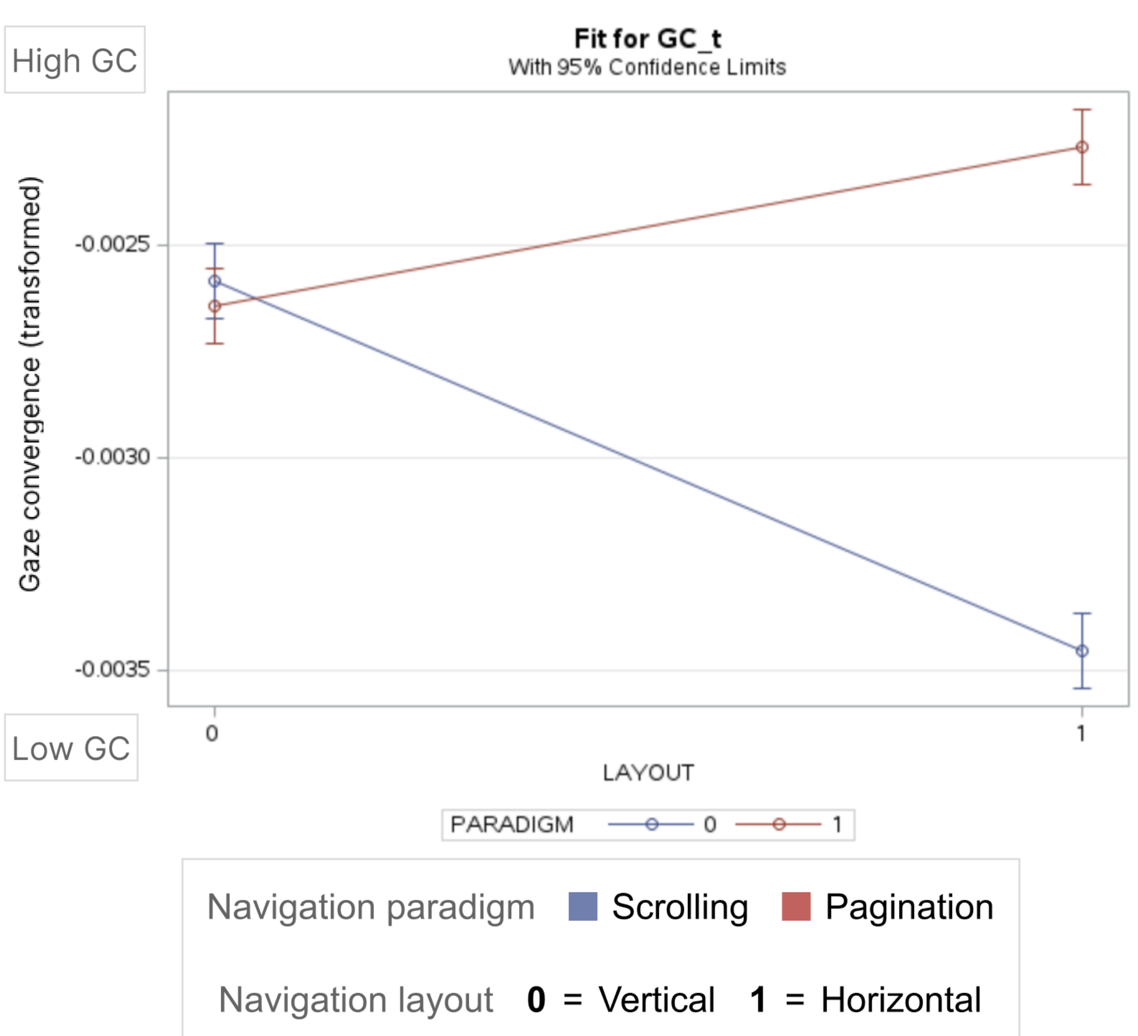

Figure 5. Interaction effect between navigation paradigm and layout

Notes for Figure 5. Values on the Y-axis represent the transformed gaze convergence values (see Appendix F for details). Larger values of gaze convergence closer to 0 indicate high gaze convergence, while smaller values indicate low gaze convergence.

Moreover, the navigation layout had a significant moderating effect on the relationship between navigation paradigm and visual coordination ($F(1, 24) = 249.81$; $p < 0.0001$), hence providing support for H1b. Specifically, the horizontal layout was found to amplify the effect of the navigation paradigm specified in H1a. In other words, the horizontal layout significantly worsened visual coordination when using scrolling ($t = 6.73$; $p < 0.0001$), while it significantly improved visual coordination in pagination ($t = -15.62$; $p < 0.0001$). Conversely, no significant difference was observed in visual coordination when considering the vertical layout ($t = -1.07$; $p = 0.8754$). Finally, post-hoc analysis showed a significant direct effect of navigation layout on visual coordination performance ($F(1, 24) = 39.46$; $p < 0.0001$), with vertical layout weakening visual coordination performance compared to the horizontal navigation layout.

3.4.2 Results for H2: Role of visual coordination on user shopping experience and outcome

We now consider how visual coordination performance impacts partners' shopping experience and its outcome. We found that partners reported significantly higher emotional pleasure (valence) as visual coordination improved ($F(1, 148) = 9.43$; $p = 0.0025$). However, there was no significant effect of visual coordination on perceived emotional arousal ($F(1, 148) = 2.03$; $p = 0.1567$). Moreover, we did not find any significant effect of visual coordination on behavioral conflict ($F(1, 148) = 0.01$; $p = 0.9032$). When considering how visual coordination influences the effort for joint decision-making, we found that there was no significant effect on perceived effort ($F(1, 148) = 0.73$; $p = 0.3938$), but found a significant effect on cognitive effort via the cognitive load measures ($F(1, 148) = 5.24$; $p = 0.0235$). Finally, we found that when visual coordination was enhanced, partners reported significantly more satisfaction with their chosen product ($F(1, 148) = 9.05$; $p = 0.0031$).

Table 6. Summary of Results

Hypotheses	Result
H1a: **Navigation paradigm** influences visual coordination performance with *scrolling* weakening **visual coordination performance** (compared to *pagination*).	Supported ($p<0.0001$)
H1b: The effect of the **navigation paradigm** on **visual coordination performance** (h1a) is stronger when the **navigation layout** is *horizontal* (compared to *vertical*).	Supported ($p<0.0001$)
H2a: **Visual coordination performance** is positively associated with each partner's **perceived emotional state**.	Partially supported Emotional pleasure: supported ($p=0.0025$); Emotional arousal: not supported ($p=0.5665$)
H2b: **Visual coordination performance** is negatively associated with each partner's **perceived behavioral conflict**.	Not supported ($p=0.9032$)
H2c: **Visual coordination performance** is negatively associated with each partner's **effort for joint decision-making**.	Partially supported Perceived effort: not supported ($p=0.3938$); Cognitive effort: supported ($p=0.0235$)
H2d: **Visual coordination performance** is positively associated with each partner's **satisfaction with the joint product choice**.	Supported ($p=0.0031$)

3.5 Discussion

This study initially sought, for one, to clarify the navigation system related antecedents of visual coordination, and secondly, to evaluate the impact of coordinated visual attention on the shopping experience and its outcome. In the following sections, we discuss the results of this study and its contributions to the extant literature as well as to industry professionals. We conclude with the studies limitation and an outlook on future research initiatives.

3.5.1 Discussion of results

Impact of shared navigation support features on visual coordination

An important objective of this research was to understand how navigation systems could enhance users' ability to coordinate their visual interactions on a shared display when conducting a joint shopping activity. Our findings clearly show the impact of the navigation paradigm on visual coordination performance, and specifically that pagination is more effective than scrolling in supporting visual coordination performance. This is in line with prior research in suggesting that scrolling hinders co-shoppers' ability to coordinate their gaze on the screen when compared to a static webpage where products are always at a fixed position on the interface as in the case of the pagination navigation paradigm (Tchanou et al., 2020b). As such, this study, along with previous findings, point to common evidence: in shared navigation design, scrolling is suboptimal for visual coordination performance compared to information structures where content is displayed bit by bit via user clicks.

Based on previous research (Tchanou et al, 2020c; Sharma and Murano, 2020; Kim et al., 2016), our study featured vertical and horizontal orientations for each navigation paradigms such that both forms of scrolling and pagination layouts were taken into account. As a result, we found that the effectiveness of the navigation paradigm in enabling or diminishing visual coordination largely depends on the navigation layout. For instance, we observed that the horizontal layout amplified the effect of the navigation paradigm on visual coordination while there were very little differences in visual coordination performance between navigation paradigms in the vertical layout. Such results indicate that the navigation paradigm should not be assumed to be equivalent across layouts, especially when accounting for co-shoppers' visual coordination performance. Moreover, post-hoc analysis showed that the navigation layout had a direct effect on visual coordination, with horizontal navigation layout enhancing visual coordination performance compared to the vertical layout. This result suggests that the navigation layout might not only moderate the effect of the navigation paradigm on visual coordination performance, but could also be an important individual factor in influencing partners' ability to coordinate their visual attention.

Interestingly, the findings suggest that introducing some *friction* in users' navigation may help users coordinate their visual interaction on the interface. This is due to the fact that we actually observed better visual coordination performance in navigation paradigms that induce the most interaction cost, thus implying that navigation-related interaction costs could contribute to enhancing visual coordination performance. Moreover, we also note that this navigation-cost mechanism might be less effective when users are unfamiliar with the interface. Thus, for visual coordination to be supported, it is better when users have acquainted themselves with the system. More broadly, we show that, in a shared navigation context, shared navigation strategies could be enticed by manipulating navigation-related costs, e.i. the effort required by users to navigate. These results support the previously established premise that partners will employ a navigation technique (a way of *grounding* their navigation) that minimizes the overall effort in their shopping activity. This premise is consistent with common ground theory (CGT), and with the underlying least collaborative effort principle, as the theory supports the notion that individuals will favor a strategy for exchanging information that minimizes the effort required to effectively communicate (Clark and Brennan, 1991). The use of such a theoretical framework has also been useful in previous COS studies when explaining the relationship between system related features and coordination performance in communication (Zhu et al. 2010; Yue et al., 2014). Thus, our findings supplement the applicability of common ground theory in studying co-browsing activities, especially in the context of collaborative online shopping. Furthermore, we find supporting evidence of the proposed visual grounding mechanism with respect to the navigation (detailed in Table 1), and as such, we lay a base for future exploration of system design features on co-browsing activities.

Role of visual coordination on shared navigation experience and outcome

Understanding the shopping experience and outcome related impacts of visual coordination was a key feature of this study. As such, we expected based on flow theory that enhancing visual coordination performance would give rise to team flow, and ensuingly to individual flow (van den Hout et al., 2018; Walker, 2010; Csikszentmihalyi, 1990). As flow is often associated with a sense of enjoyment, exhilaration and immersion in an activity, as well as a sense of control over the course and outcome of the activity, we expected participants' user experience measures to be reflected in the extent to which they actually experienced *flow*.

Indeed, our results show that visual coordination performance is associated with a more pleasurable shopping experience; to the extent perceived by the participants, but not necessarily a more exhilarating experience. Moreover, as expected based on flow theory, we found that visual coordination leads to lower cognitive effort as assessed via participants' cognitive load. However, this was not reflected in participants' self-reported measure of perceived effort. Similarly, we did not find any significant effect of visual coordination performance on perceived behavioral conflict.

Since flow theory only allows us to explain part of these findings, we turn to an alternative explanation for non-significant results relating to partners' perceived arousal, effort with the joint decision-making and behavioral conflict. Broadly, these results seem to indicate that despite differences in visual coordination performance, partners' joint decision-making was generally easy and void of any significant frictions in partners' interactions. Surely, the relatively low observed levels of self-reported effort and high levels of satisfaction with the joint decision point in this direction. As such, we envision the possibility that our experiment did not sufficiently challenge participants' in their product evaluation process due to the limited number of products to be assessed (ten products) in the time (five minutes) allocated to make a joint decision. Indeed, as the number of options to evaluate (in a decision-making process) decreases, and the time to assess all options increases, it becomes less challenging to make an optimal joint shopping decision (Bossaerts & Murawski, 2017). Based on such observations, we anticipate that introducing more complexity, with respect to the product evaluation and decision-making process, as it would be the case in a real shopping experience, might generate further insights regarding perceived arousal, effort and behavioral conflict. We later discuss possible research avenues which ought to alleviate current ambiguity regarding these results.

Moreover, regarding satisfaction with the chosen product as a dimension of shopping outcome, we found satisfaction to be positively associated with visual coordination performance. We anticipated this result based on the Stimulus-organism-response (SOR) framework (Mehrabian & Russell, 1974; Donovan and Rossiter, 1984; Mosteller et al., 2014). Precisely, we expected that the quality of partners' product evaluation process, as dependent on their visual coordination performance, will influence their attitudinal responses. As such, positive attitudinal responses would emerge from productive and effective group dynamics, thus resulting in an enhanced decision-making process and ensuingly higher satisfaction with the joint decision. Hence, we find evidence that the SOR framework supports this result.

3.5.2 Contributions

Since Goswami et al. (2007) proposed an initial framework for investigating the website features that could help support collaborative online shopping, researchers have provided additional insights with the ultimate aim of making collaborative online shopping a success. This study joins such effort as it provides practical and theoretical contributions to the extant COS literature, and more broadly to the field of HCI with respect to co-navigation practices, as well as to user experience practitioners and web designers.

Our first contribution deals with supporting visual coordination performance via shared navigation design. As such, we provide an initial categorization of shared navigation design features (layout and paradigm) through which we establish the benefits of pagination over scrolling with respect to visual coordination performance. Moreover, in an attempt to detail the underlying mechanism through which users establish visual common ground, we present a tentative framework that illustrates users' shared navigation techniques with respect to navigation-related interaction costs. Thus, we apply an interaction cost analysis perspective to classify shared navigation strategies that might influence visual coordination performance. In doing so, we introduce further evidence of common ground theory's applicability in examining the effects of shared navigation design on visual coordination performance. In practice, we show that UX and web designers ought to consider more sequential and structured ways for co-shoppers to navigate when designing e-commerce websites, thus emulating the structure offered via the pagination navigation paradigm. This will be especially important for e-commerce websites offering social products, such as travel and tourism websites (Tchanou et al., 2020a). This contribution not only applies in the context of COS, but extends to broader co-navigation practices such as in the workplace (Amershi and Morris, 2008, 2009) and beyond (Kelly and Payne, 2014; Sharma et al., 2020).

While assessing users' gaze during co-navigation is not new (e.g. Yue et al., 2014), the dual eye-tracking technique performed in this study has been seldom employed in previous COS studies to assess joint system use (Tchanou et al., 2020c). As such, our study contributes methodologically to the study of co-navigation systems via user gaze behavior by providing evidence of its applicability in experiments such as ours, and thus consolidating the use of the gaze convergence index (GC index) in assessing two co-located users' gaze behavior relative to each other during joint system use.

Lastly, this research is among the few COS studies on coordination performance to extend its scope to user experience dimensions of affect (pleasure and arousal), joint decision-making effort (perceived and cognitive) and perceived behavioral conflict. In doing so, we establish that visual coordination performance is associated with measures of affect and cognitive effort in a shared navigation context. Similarly, our research shows a positive association between visual coordination performance and joint decision satisfaction as a measure of shopping outcome. These findings offer a novel and promising outlook on the role of visual coordination performance in enhancing co-shoppers' shared navigation experience and outcome, while supplementing previous findings on CoLoCOS user experience (Tchanou et al., 2020b).

3.5.3 Limitations and future research

This study is subject to many limitations. The first limitation pertains to the external validity of the findings. For one, our experiment might not have sufficiently challenged participants similarly to how a real-life shopping activity would. This is especially due to the fact that our experiment was conducted in a laboratory setting (Berkowitz and Donnerstein, 1982), and could be further attributed to the time limit given to the participants as well as the limited number of products (ten in total) to be assessed in the alloted time. Moreover, it is important to note that our sample consisted of a predominantly younger population, such that the participants might not be representative of the general population. Previous studies have found that system experience and age can be a determinant factor in system use (Dingus et al., 1997). Future research would therefore benefit from exploring whether similar results can be obtained by conducting a more realistic shopping experience with a more diverse sample across different age groups.

Additionally, the classification of shared navigation techniques based on navigation-related costs has yet to be duly verified, despite being well founded in common ground theory. As such, it is difficult to establish the extent to which those techniques accurately depict actual co-browsing strategies, and the degree to which they stem from the shared navigation paradigm. To improve the current classification of shared navigation techniques, future research could account for other confounding strategies, such as search strategies (Gao et al., 2017), and theorize based on information foraging theory. This theory suggests that individuals with a specific information need will adopt a search strategy based on the value of the information and the cost of obtaining it (Pirolli & Card, 1999), thus providing a potential framework for understanding and classifying navigation behavior in a more nuanced way. Besides, most important is the challenge of determining the influence of those strategies on visual coordination performance, and perhaps coordination in communication as well. Ultimately, more precise depictions of co-browsing strategies ought to be established to better translate the effects of shared navigation design features on coordination performance.

Moreover, our study did not directly account for participants' verbal communication as we were primarily focused on partners' ability to coordinate their visual interactions. Considering that coordination via communication plays an important role in co-shoppers' overall coordination performance (Yue et al., 2014; Zhu et al., 2010), we believe future studies ought to distinguish between visual coordination and verbal coordination; and account for possible interacting effects between both coordination mechanisms.

Finally, this study's findings with respect to emotional valence and arousal might also be limited by the exclusive use of self-reported measures. Indeed, the use of implicit measures to infer shoppers' emotional response is a well-established practice and could provide a more accurate assessment of participants' emotions (de Guinea et al., 2014), thus allowing for a richer and more reliable assessment of participants' shopping experience.

3.6 Conclusion

This study evaluates the impact of shared navigation paradigms on visual coordination performance based on common ground theory. In doing so, we establish that scrolling, compared to pagination, is suboptimal for dyadic visual coordination performance. Most importantly, our research goes beyond establishing the antecedents of visual coordination performance by assessing its impact on shopping partners' shared navigation experience and outcome. As such, users' ability to coordinate their visual interactions is conducive to pleasurable and less cognitively demanding shared navigation experience, while improving partners' product choice satisfaction. In the future, we believe more effort should be dedicated to clarifying the underlying mechanism through which system design can enhance coordination performance.

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Chapitre 4: Conclusion

L'objectif de ce mémoire était de mieux comprendre les mécanismes de co-navigation et l'incidence de ces mécanismes sur l'expérience de magasinage collaborative en ligne. Ce mémoire examine ainsi deux caractéristiques de design de système de co-navigation: le paradigme de navigation (*navigation paradigm*) et la disposition de la navigation (*navigation layout*); ainsi que la mesure dans laquelle elles peuvent soutenir une vue partagée de la navigation lors d'une activité de magasinage collaborative en ligne. Le support d'une vue partagée de la navigation est évalué en fonction de l'habileté des co-acteurs à coordonner leur processus d'évaluation et de recherche de produit tel que mesuré par leur coordination visuelle lors de l'activité de magasinage. Dans le but d'établir l'impact de la coordination visuelle des co-acheteurs, notre recherche prend en compte l'expérience de navigation partagée (la valence et l'intensité des réponses affectives des co-acheteurs, leur perception des conflits de comportement et leur effort dans la prise de décision) et le résultat de la navigation partagée (la satisfaction des co-acheteurs avec la décision d'achats) (Fontaine, 2020, Tchanou et al., 2020a).

Afin de mettre en œuvre cet effort de recherche, nous avons effectué une revue de littérature sur le partage d'un écran d'ordinateur en portant une attention particulière à cette pratique dans le contexte du magasinage co-localisé et collaboratif en ligne. De plus, nous avons conduit une expérimentation en laboratoire basée sur l'installation expérimentale développée par Tchanou et al. (2020a). Lors de cette expérience, 28 participants accompagnés de leur partenaire de couple ont été invités à magasiner en ligne pour des expériences Airbnb en partageant un seul écran d'ordinateur. Une méthode de capture, de synchronisation et d'analyse du comportement visuel des partenaires (Tchanou et al., 2020b), ainsi que des questionnaires ont été utilisés afin d'évaluer l'expérience de navigation partagée des co-acheteurs lors de quatre tâches présentant chacune un type de design de navigation partagé.

Ce chapitre présente les questions de recherche abordées dans les deux articles de ce mémoire ainsi que les résultats qui s'y rattachent. Nous abordons aussi les contributions de ce travail de recherche, ainsi que les limites et les futures avenues de recherche.

4.1 Rappel des questions de recherche et résultats

Dans le deuxième chapitre de ce mémoire, un article de revue de littérature sur les pratiques de partage d'écran, particulièrement dans le contexte du magasinage en ligne, est introduit. Cette revue de littérature, visant ultimement à identifier des lacunes de recherche sur le partage d'écran dans le contexte du magasinage en ligne, nous permet de répondre aux deux questions de recherche suivantes:

> **Q1** : Quels sont les avantages et les défis associés associés au partage d'un écran lors d'une activité co-localisée et collaborative de magasinage en ligne?
>
> **Q2** : Quelles sont les lignes directrices en matière de conception d'interface permettant de mieux accommoder le magasinage en ligne co-localisée et collaboratif?

En réponse à la première question, il a été identifié qu'un premier bénéfice du partage d'un écran lors d'une activité de magasinage collaboratif en ligne est associé à la dimension sociale et hédonique du magasinage collaboratif, c.-à-d. qu'il est parfois plus plaisant de magasiner en ligne accompagné que seul (Zhu et al., 2010; Roten and Vanheems, 2021; Izadi et al., 2021; Wei et al., 2022). Le partage d'un espace visuel résultant du partage d'un écran est aussi perçu comme une façon plus efficace de collaborer lors d'achat en ligne, de plus que cela rend le processus d'achat transparent aux collaborateurs, ce qui renforce les liens de confiance entre co-acheteurs (Roten and Vanheems, 2021). Pour ce qui est des défis, il a été trouvé qu'il est parfois compliqué de bien diriger son attention lorsque l'attention des co-acheteurs est partagée entre l'écran et leurs partenaires (Roten and Vanheems, 2021). En effet, mal orienter son attention peut être une source de tensions et de frustration. D'autres défis ont lieu en conséquence du fait qu'un seul acheteur est en contrôle de la souris et du clavier, et par conséquent, de la navigation. Ainsi, il a été trouvé que ne pas être en contrôle de la navigation peut générer un sentiment de perte d'autonomie et de liberté, jusqu'à un désengagement envers l'activité de magasinage (Roten and Vanheems, 2021). Un autre défi, que ce mémoire aborde, concerne la capacité des co-acheteurs à coordonner leurs interactions avec l'interface et entre eux pendant l'activité de shopping (Zhu et al., 2010 ; Yue et al., 2014 ; Roten et Vanheems, 2021).

En réponse à la deuxième question, quelques lignes directrices, particulièrement en matière de conception d'interface, ont été suggérées afin d'adresser les défis associés à une activité co-localisée et collaborative de magasinage en ligne. Entre autres se trouve les fonctionnalités multi-curseurs offertes par des plateformes de type *single display groupware* (SDG) qui ont été présentées comme un moyen prometteur de mieux soutenir les pratiques de partage d'écran (Stewart et al., 1998; Amershi et Morris, 2008). D'autres solutions ont été proposées, telles que le partage du contrôle des périphériques pour atténuer la perte d'autonomie et liberté subie par le partenaire qui ne contrôle pas la navigation, ainsi que de conduire des recherches séparément avant la co-navigation pour améliorer l'efficacité de la prise de décision lors du partage d'écran (Fontaine, 2020 ; Roten et Vanheems, 2021). Dans une autre lignée, des études établissent qu'une navigation partagée s'avère être la meilleure option afin de mieux supporter le partage d'un écran en permettant davantage aux co-acheteurs de maintenir un contexte partagé (*shared context*) (Zhu et al., 2010; Cheng et al., 2013; Yue et al., 2014). Plus récemment, d'autres recherches explorant différents types de structure d'information (paradigme de navigation) lors d'une navigation partagée proposent que le défilement (*scrolling*) pourrait nuire à l'habileté des co-acheteurs à coordonner leurs interactions visuelles à l'écran (Tchanou et al., 2020a). Dans d'autre contexte que celui du magasinage collaboratif, il a été proposé que l'attention conjointe pourrait jouer un rôle important dans l'habileté de deux partenaires à coordonner leurs interactions visuelle et verbale, permettant ainsi une meilleure collaboration et synchronisation entre individus et suggérant que l'attention conjointe pourrait permettre une meilleure expérience de navigation partagée (Shockley et al., 2009; Shteynberg, 2015 ; Shteynberg, 2018).

Au terme de la revue de littérature, des lacunes de recherches ont été identifiées telles que l'absence d'étude en lien avec les fonctionnalités multi-curseurs dans le contexte du magasinage co-localisé et collaboratif en ligne, le manque de recherche établissant des alternatives au défilement (*scrolling*) afin de mieux accommoder une navigation partagée, ainsi que le manque de connaissance sur l'influence de la coordination visuelle sur l'expérience de navigation partagée. C'est au chapitre suivant, soit le chapitre trois de ce mémoire, que certaines de ces lacunes de recherche sont abordées.

Le troisième chapitre adresse trois questions de recherche. Les deux premières questions de recherche abordent l'impact du design d'une navigation partagée sur la coordination visuelle (e.i. l'attention conjointe). Précisément, deux caractéristiques de design d'interfaces lors d'une navigation partagée (le **paradigme de navigation** et la **disposition de la navigation**) sont évaluées en fonction de la coordination visuelle y étant associée. La troisième question concerne l'effet de la coordination visuelle sur la valence et l'intensité des réponses affectives des co-acheteurs, leur perception des conflits de comportement, leur effort dans la prise de décision et la satisfaction des co-acheteurs avec la décision d'achats.

Q3 : Dans quelle mesure le paradigme de navigation (*navigation paradigm*) influence la coordination visuelle des co-acheteurs ?

Q4 : Dans quelle mesure la disposition de la navigation (navigation layout) modère-t-elle l'effet du paradigme de navigation sur la coordination visuelle ?

Q5 : Dans quelle mesure la coordination visuelle influence l'expérience de navigation partagée des co-acheteurs ?

En réponse à la troisième question de recherche, nos résultats confirment le lien significatif entre le paradigme de navigation et la coordination visuelle des co-acheteurs. Précisément, il a été trouvé que le défilement (*scrolling*) génère significativement moins de coordination visuelle qu'une pagination où le contenu est disposé sur une série de pages (*pagination*) telle que l'utilisateur se doit de cliquer afin de révéler du contenu. Ce résultat démontre que l'attention conjointe (coordination visuelle) des partenaires était plus élevée pour la *pagination* comparée au *scrolling*. En d'autres termes, il s'avère que la structure d'information permettant la découverte de contenu sur un site de commerce en ligne a un effet sur l'habileté des partenaires à coordonner visuellement leur processus d'évaluation et de recherche de produit lors de l'activité de magasinage.

L'hypothèse en lien avec la quatrième question de recherche est aussi supporté. Ainsi, nous trouvons que la disposition de la navigation (l'axe sur lequel le contenu est révélé) modère la relation entre le paradigme de navigation et la coordination visuelle. Plus précisément, il a été constaté que la disposition horizontale amplifie l'effet du paradigme de navigation. En d'autres termes, la disposition horizontale a détérioré de manière significative la coordination visuelle des co-acheteurs lors de l'utilisation du défilement, alors qu'elle a amélioré de manière significative la coordination visuelle pour la pagination. À l'inverse, aucune différence significative n'a été observée quant à la coordination visuelle lorsque l'on considère la disposition verticale.

Notre cinquième question de recherche se penche sur la manière dont la coordination visuelle influence l'expérience d'achat des partenaires et son résultat. Pour ce faire, nous avons pris en compte deux dimensions de l'expérience d'achat collaborative déjà bien établi, à savoir, l'expérience de navigation partagée (la valence et l'intensité des réponses affectives des co-acheteurs, leur perception des conflits de comportement et leur effort dans la prise de décision) et le résultat de la navigation partagée (la satisfaction des co-acheteurs avec la décision d'achats). En lien avec la dimension affective de l'expérience, il a été constaté que les partenaires ont rapporté une valence émotionnelle significativement plus élevée lorsque la coordination visuelle s'améliorait. Cependant, aucun effet significatif de la coordination visuelle sur l'excitation émotionnelle et le conflit comportemental n'a été constaté. En examinant la manière dont la coordination visuelle influence l'effort pour la prise de décision conjointe, il a été constaté qu'il n'y avait pas d'effet significatif sur l'effort perçu, mais nous avons trouvé un effet significatif sur l'effort cognitif via les mesures de la charge cognitive. Enfin, nous trouvons que lorsque la coordination visuelle s'améliorait, les partenaires se disaient être significativement plus satisfaits du produit qu'ils avaient choisi ensemble. En somme, ces résultats démontrent que plus la coordination visuelle des participants était élevée, plus ils ou elles percevaient des émotions positives et moins d'effort cognitif lors du magasinage, ainsi qu'une meilleure satisfaction avec leur décision d'achat.

4.2 Contributions

Ce mémoire contribue autant théoriquement que pratiquement à l'étude des systèmes de co-navigation et l'incidence de ces mécanismes sur l'expérience de magasinage collaborative en ligne. Les connaissances générées par ce travail en lien avec le design de système de co-navigation sont d'une valeur importante pour la littérature existante sur le magasinage collaboratif en ligne, et de façon plus générale, pour le domaine de l'interaction homme-machine (IHM) ainsi que de l'expérience utilisateur (UX). Ces contributions sont présentées en détail ci-bas.

Premièrement, la revue de littérature présentée au chapitre deux permet d'établir que bien qu'une vue partagée de la navigation permet davantage aux co-acheteurs de coordonner visuellement leur processus d'évaluation et de recherche de produit, il y reste des problèmes de coordination que la littérature à peine à adresser (Zhu et al., 2010; Tchanou et al., 2020a). Ces lacunes de recherche, ainsi que des études récentes établissant une base afin d'adresser ces lacunes (voir Tchanou et al., 2020a; 2020b), constituent une base de connaissance appuyant notre travail de recherche subséquente. L'espoir est tel que ce travail contribue également à enrichir les futures recherches étant concernées par cette pratique.

Deuxièmement, il a été établi grâce à l'étude présentée au chapitre trois, qu'un paradigme de navigation offrant une structure d'information de nature itérative, telle que dans le cas d'une pagination (*pagination navigation paradigm*), amènerait les co-acheteurs partageant une seule interface à mieux coordonner leurs interactions visuelles à l'écran. De plus, en surcroît des études suggérant le bénéfice d'une coordination visuelle afin d'*œuvrer en concert* (Shockley et al., 2009; Shteynberg, 2015; Shteynberg, 2018), nous montrons les effets bénéfiques de la coordination visuelle sur les émotions et l'effort cognitif des co-acheteurs, ainsi que sur la qualité de leur décision d'achat en termes de satisfaction. De ce fait, il devient intéressant pour les concepteurs de sites web de commerce en ligne et les designers UX d'émuler les caractéristiques de design présenté par une pagination, c.-à-d. une navigation itérative et séquentielle amenant les partenaires à synchroniser davantage leurs interactions lors de l'activité d'achat. Cela s'avère spécialement important dans le cas de sites de commerce en ligne offrant des produits sujet au magasinage collaboratif tel que dans le cas du voyages et tourismes (Tchanou, Léger, Senecal, et al., 2020b).

Finalement, ce mémoire contribue méthodologiquement à l'étude des systèmes de co-navigation via l'évaluation du regard des utilisateurs en appliquant la méthode développée par Tchanou et al. (2020c). Cette méthode permet de calculer l'index de convergence du regard (*gaze convergence index*), qui fournit une mesure de la coordination visuelle de deux utilisateurs partageant un écran, consolidant ainsi l'application de cette approche pour évaluer les pratiques de partage d'écran d'ordinateur.

4.3 Limite et recherche future

Il est important d'interpréter les conclusions de ce mémoire selon ses limitations. Ainsi, une première limite à considérer relève du fait que notre étude ne prend pas en compte les échanges verbaux entre participants. En effet, certaines études évaluent la performance de coordination à travers différent système de co-navigation (e.g. navigation séparée) en fonction de la capacité des partenaires à établir et maintenir un contexte de référence commun dans de leurs conversations lors d'une activité de magasinage (Zhu et al., 2010; Yue et al., 2014). Puisque notre étude se concentre sur la coordination visuelle des partenaires, il serait pertinent de combiner ces approches afin d'avoir une vision plus complète de la coordination entre co-acheteurs. Ainsi, nos résultats démontrant l'apport d'une pagination afin de bonifier la coordination visuelle pourraient être enrichis en démontrant aussi son apport en termes de coordination verbale, choses n'ayant pas été établies jusqu'à maintenant.

Deuxièmement, notre étude associe le paradigme de navigation à la coordination visuelle en démontrant l'apport d'une pagination afin d'amener les co-acheteurs à coordonner visuellement leur processus d'achats. Nous proposons aussi au chapitre trois un cadre théorique basé sur common ground theory (Clark and Brennan, 1991) afin d'expliquer l'effet du paradigme de navigation et de la disposition de la navigation sur la coordination visuelle. Bien que le cadre soit conforme à la théorie et que nos résultats y démontrent sa juste application, les mécanismes sous-jacents à l'apport de la pagination sur la coordination visuelle restent flous et mal compris. Étudier ces mécanismes, en identifiant et vérifiant par exemple les caractéristiques d'une pagination en opposition au défilement, permettrait ainsi de concevoir des systèmes de co-navigation (et spécialement de navigation partagée) de façon plus élémentaire. Pour ce faire, il serait aussi intéressant d'étudier la coordination selon d'autres paradigmes de navigation. Par exemple, il pourrait être envisagé de combiner au sein d'une seule interface les paradigmes évalués dans ce mémoire: défilement et la pagination. Cela pourrait être effectué grâce à une interface regroupant par page Web un nombre limité de contenus pouvant être révélés via défilement au sein du regroupement.

Une troisième limite concerne la validité externe des résultats. D'une part, il est possible que notre expérience n'ait pas suffisamment mis les participants au défi comme le ferait une véritable activité d'achat. Ceci est particulièrement dû au fait que notre expérience a été menée en laboratoire (Berkowitz et Donnerstein, 1982), et particulièrement attribuée à la limite de temps accordée aux participants ainsi qu'au faible nombre de produits (dix au total) à évaluer dans le temps imparti. De plus, il est important de noter que notre échantillon était composé d'une population majoritairement jeune, de sorte que les participants pourraient ne pas être représentatifs de la population générale. En effet, des recherches antérieures ont démontré que l'âge et l'expérience avec un système peuvent influencer l'utilisation de ce dernier (Dingus et al., 1997). Dans cette optique, les recherches futures gagneraient à explorer si des résultats similaires peuvent être obtenus en menant une expérience d'achat plus réaliste avec un échantillon plus diversifié selon différents groupes d'âge.

Pour conclure, bien que notre étude examine l'effet de la coordination visuelle sur des dimensions déjà bien établi du magasinage collaboratif en ligne (réponses affectives, effort dans la prise de décision, etc.), d'autres dimensions se doivent également d'être considérées afin d'avoir une vue complète de l'effet de la coordination visuel sur l'expérience d'achat. De futures recherches gagneraient ainsi à examiner l'effet de la coordination visuelle sur l'engagement (co-présence) (Kim et al., 2013; Wei et al., 2017) et l'intention de refaire l'expérience de magasinage (Kim et al., 2013; Yue et Jiang, 2013; Fontaine, 2020) afin de consolider le rôle que joue le regard des co-acheteurs dans la réussite d'une activité de magasinage collaborative en ligne.

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Annexes

Annexe A

Table 1.A.1. Keywords used to search the literature by article section

Section 2.2 The benefits and challenges of sharing a screen to shop together online	
Group aspect [a]	**Artifact** [b]
Couple, collaborative, group, multi-user	user interface, computer system, information system, computer, screen
Section 2.3 Navigation support systems: enhancing coordination performance through system design	
Activity [c]	**Quality** [d]
collaborative online shopping, co-located screen-sharing, co-browsing, shared navigation	Coordination performance
Section 1.4 Coordination performance: shared attention as a grounding in communication mechanism	
Mechanism [e]	**Quality**
Shared attention, shared visual attention, joint attention, gaze coordination	Coordination

[a] **Group aspect** refers to the social dimension of screen-sharing.

[b] **Artifact** refers to the employed system to conduct the activity.

[c] **Activity** refers to the social and collaborative dimensions of online shopping.

[d] **Quality** refers to a desirable dimension of collaborative online shopping.

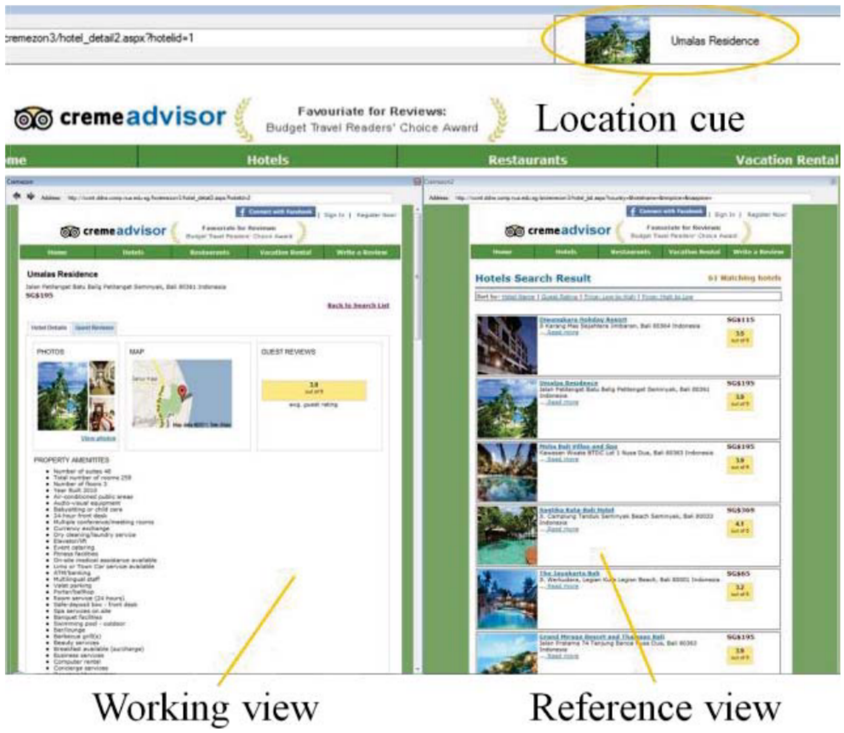
[e] **Mechanism** refers to the underlying process enabling the coordination between shopping partners.

Table 1.A.2. Number of search results from each databases

Search queries	Number of results		
	Google Scholar	Web of Science	ACM Library
Section 2.2 The benefits and challenges of sharing a screen to shop together online			
Co-located collaborative online shopping	20,800	243	434,664
Online shopping screen-sharing	2,590	3	390,422
Co-located collaborative web navigation	22,300	0	452,117
Shared navigation collaborative online shopping	135	1	399,262
Multi-user shared computer navigation	30,300	9	653,672
Section 2.3 Navigation support systems: enhancing coordination performance through system design			
Coordination performance in shared navigation	404,000	25	567,868
Coordination performance in shared navigation + collaborative online shopping	26,500	2	229,135
Section 2.4 Shared attention: a mechanism for joint system use interactions			
Shared attention	8,300,000	37,066	380,154
Shared visual attention	5,150,000	2,798	424,693
Joint attention	5,510,000	44,059	265,928
Gaze coordination	399,000	1,630	152,057

Annexe B

Figure 1.B.1. Location cue (top) and split screen (bottom) navigation support



Source: Yue et al., 2014

Annexe C

Figure 2.C.1. Webpage using vertical scrolling

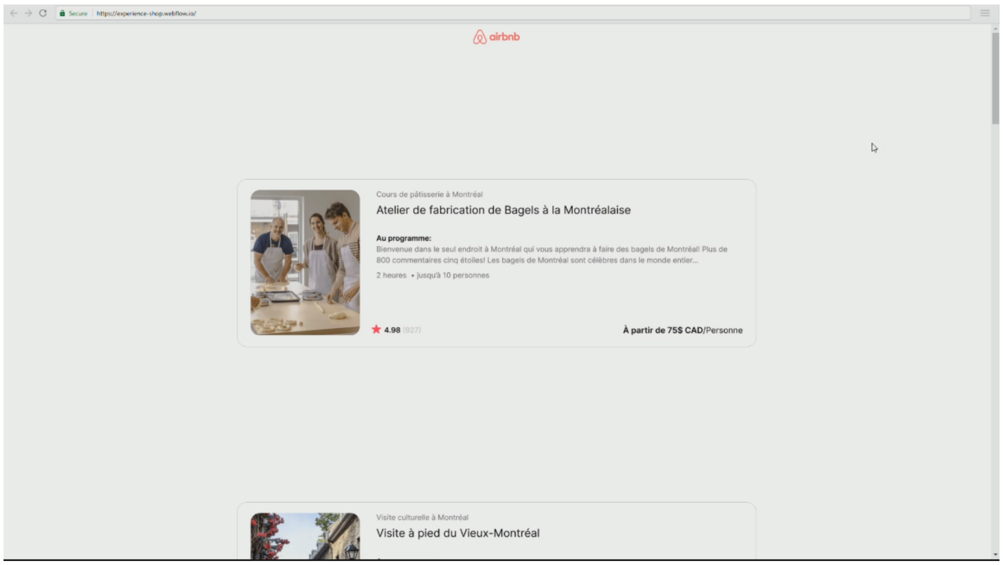


Figure 3.C.2. Webpage using horizontal scrolling

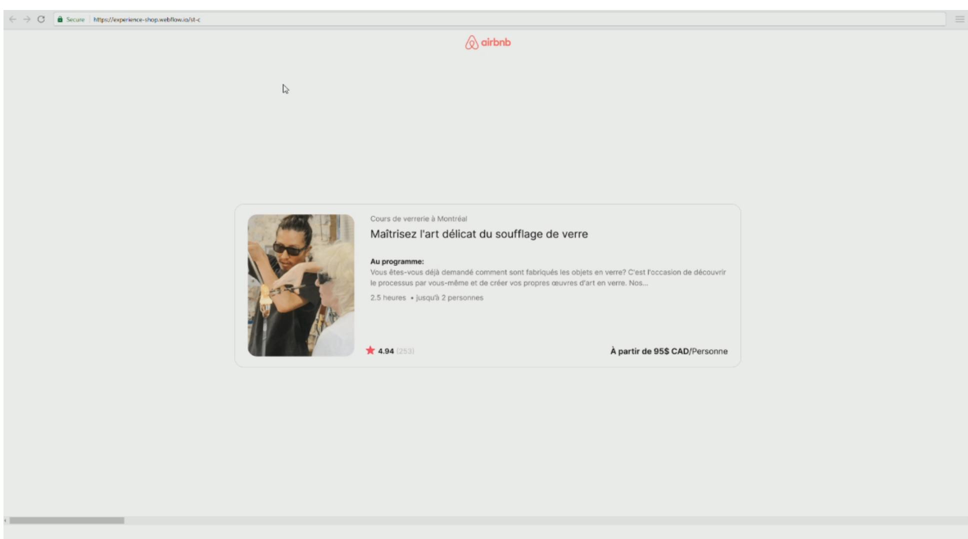


Figure 4.C.3. Webpage using vertical pagination

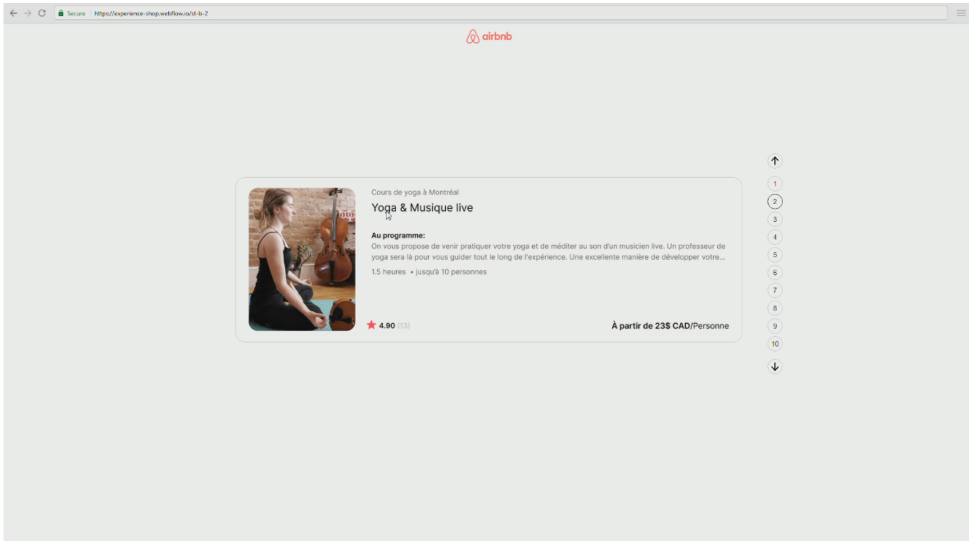
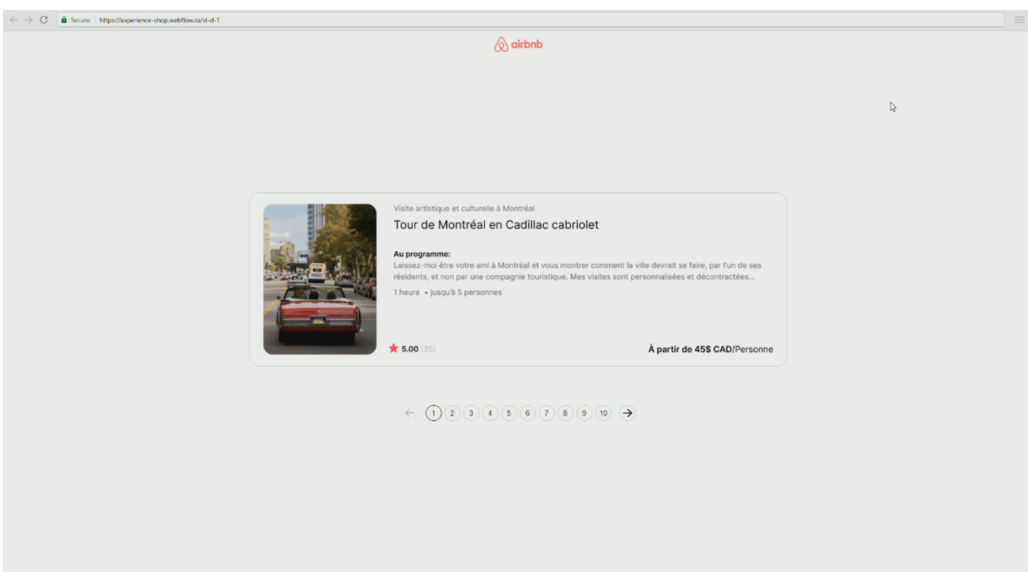


Figure 5.C.4. Webpage using horizontal pagination



Annexe D

Q_1: Questionnaire pré-tâche

Questionnaire pré-tâche

Veuillez inscrire votre numéro de participant.

____

Les <u>expériences Airbnb</u>, qu'est-ce que c'est?

Airbnb s'est d'abord fait connaître comme la plus grande plateforme de réservation de locations à court terme. L'entreprise a depuis élargi son offre avec une plateforme appelée Airbnb Experiences. Lancé en 2016, ce programme apporte une saveur locale aux voyageurs qui utilisent Airbnb. Plus précisément, les Airbnb Experiences sont des activités que les clients peuvent réserver pendant leur séjour quelque part. Des hôtes locaux dirigent ces activités dans chaque région. Elles sont plus que des visites guidées ou des cours traditionnels. Toute personne ayant une passion ou un hobby créatif peut s'inscrire pour participer au programme et offrir des activités locales.

Dans la dernière année, veuillez indiquer le nombre d'expériences Airbnb auquel vous avez participé.

- ○ Aucune
- ○ 1 à 2 fois
- ○ 3 à 5 fois
- ○ Plus que 5 fois

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Si vous avez déjà participé à une expérience Airbnb, dans quelle mesure êtes-vous d'accord avec les affirmations suivantes. Si vous n'avez jamais participé à une expérience Airbnb, vous pouvez sauter cette question et passer à la prochaine question.

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
J'aime acheter des expériences Airbnb.	○	○	○	○	○	○	○
Il n'est pas nécessaire que ce soit une occasion spéciale pour acheter une expérience Airbnb.	○	○	○	○	○	○	○
J'ai un intérêt marqué pour les expériences Airbnb.	○	○	○	○	○	○	○
Je me sens concerné par l'expérience Airbnb que j'achète.	○	○	○	○	○	○	○

À quelle fréquence magasinez-vous en ligne avec votre partenaire pour les catégories de produits suivants.

	Jamais	Quelques fois par semaine	Quelques fois par mois	Quelques fois par année
Épicerie	○	○	○	○
Voyages et tourisme	○	○	○	○
Journaux ou magazines	○	○	○	○
Meubles et accessoires	○	○	○	○
Immobilier	○	○	○	○
Voitures	○	○	○	○
Vêtements et mode	○	○	○	○
Ordinateurs et électronique	○	○	○	○
Loisirs	○	○	○	○
Art et spectacles	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes.

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
De manière générale, j'aime magasiner en ligne avec mon/ma partenaire.	○	○	○	○	○	○	○
De manière générale, j'ai l'habitude de magasiner en ligne avec mon/ma partenaire.	○	○	○	○	○	○	○
De manière générale, c'est amusant de magasiner en ligne avec mon/ma partenaire.	○	○	○	○	○	○	○

Q_2: Questionnaire post-tâche

Questionnaire post-tâche

Veuillez inscrire votre numéro de participant.

____

Veuillez tracer une ligne sur l'échelle ci-dessous afin d'indiquer votre niveau de plaisir ressenti lors de votre recherche d'expérience Airbnb avec votre partenaire.

0 50 100

Niveau de plaisir |____|

Veuillez tracer une ligne sur l'échelle ci-dessous afin d'indiquer votre niveau d'excitation ressenti lors de votre recherche d'expérience Airbnb avec votre partenaire.

0 50 100

Niveau d'excitation |____|

Dans quelle mesure êtes-vous d’accord avec les affirmations suivantes.

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
Comparativement à mes expériences passées de magasinage en ligne avec mon/ma partenaire, il a été très difficile de parvenir à un consensus sur un choix d’expérience Airbnb.	○	○	○	○	○	○	○
Comparativement à mes expériences passées de magasinage en ligne avec mon/ma partenaire, il a fallu beaucoup d'efforts pour se mettre d'accord sur un choix d’expérience Airbnb.	○	○	○	○	○	○	○
Je suis totalement satisfait du choix d'expérience Airbnb que nous avons fait.	○	○	○	○	○	○	○
Le choix d'expérience Airbnb fait est un bon choix pour moi.	○	○	○	○	○	○	○
Durant la recherche d’expérience Airbnb, mon/ma partenaire et moi avons souvent fait obstruction l’un(e) à l’autre ou avons souvent interféré avec les actions de l’autre.	○	○	○	○	○	○	○
Durant la recherche d’expérience Airbnb, mon/ma partenaire ou moi-même étions souvent peu coopératifs.	○	○	○	○	○	○	○
Durant la recherche d’expérience Airbnb, mon/ma partenaire ne me soutenait pas souvent dans mes actions, ou je ne le soutenais pas non plus.	○	○	○	○	○	○	○

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
La tâche que je viens d'accomplir avec mon/ma partenaire sur ce site web m'a permis de découvrir des expériences Airbnb intéressantes que je n'aurais pas anticipées.	○	○	○	○	○	○	○
La recherche d'expérience Airbnb que je viens de faire avec mon/ma partenaire a donné lieu à des résultats inattendus mais pertinents.	○	○	○	○	○	○	○
Durant la tâche que je viens d'accomplir avec mon/ma partenaire, j'ai découvert de manière inattendue plusieurs expériences Airbnb intéressantes.	○	○	○	○	○	○	○
L'utilisation que je viens de faire du site web avec mon/ma partenaire m'a permis de considérer des expériences Airbnb surprenantes mais intéressantes.	○	○	○	○	○	○	○
L'utilisation que je viens de faire du site web avec mon/ma partenaire m'a aidé à rechercher et à comparer systématiquement et efficacement de nombreuses expériences Airbnb différentes afin de trouver celles nous convenant le mieux.	○	○	○	○	○	○	○
L'utilisation que je viens de faire du site web avec mon/ma partenaire m'a donné la possibilité de rechercher et d'évaluer de nombreuses expériences Airbnb de manière systématique et efficace.	○	○	○	○	○	○	○

Page 3 of 4

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
L'utilisation que je viens de faire du site web avec mon/ma partenaire m'a permis d'obtenir rapidement une bonne compréhension des principales caractéristiques des expériences Airbnb disponibles.	○	○	○	○	○	○	○
J'ai senti que j'étais en contrôle de la navigation du site web.	○	○	○	○	○	○	○
J'ai senti que je pouvais naviguer librement à travers le site web.	○	○	○	○	○	○	○
J'ai senti que j'avais de l'influence sur notre recherche d'expériences Airbnb.	○	○	○	○	○	○	○
J'ai senti que le système de navigation du site web a limité notre capacité à explorer les expériences Airbnb.	○	○	○	○	○	○	○
J'ai senti que le système de navigation du site web a restreint notre habilité à parcourir les expériences Airbnb.	○	○	○	○	○	○	○
En termes de support pour naviguer à travers les différentes expériences Airbnb, j'ai trouvé le site web rigide.	○	○	○	○	○	○	○

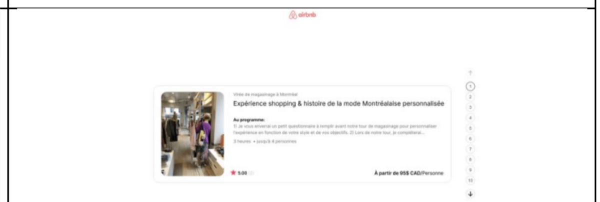
Q$_3$: Questionnaire post-expérience

Questionnaire post-expérience

Veuillez inscrire votre numéro de participant.

____

Voici les 4 interfaces avec lesquels vous avez magasiné pour des expériences Airbnb.
Veuillez classer <u>en ordre de préférence</u> les interfaces que vous avez utilisées en inscrivant un <u>1</u> au-dessus de l'interface que vous avez préféré le plus, puis un 2 pour la deuxième interface préférée, ainsi de suite jusqu'à 4.

<table>
<tr><th>Interface A</th><th>Interface B</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

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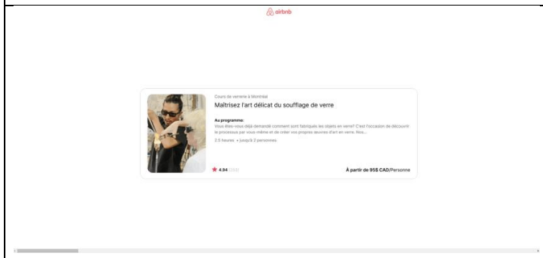
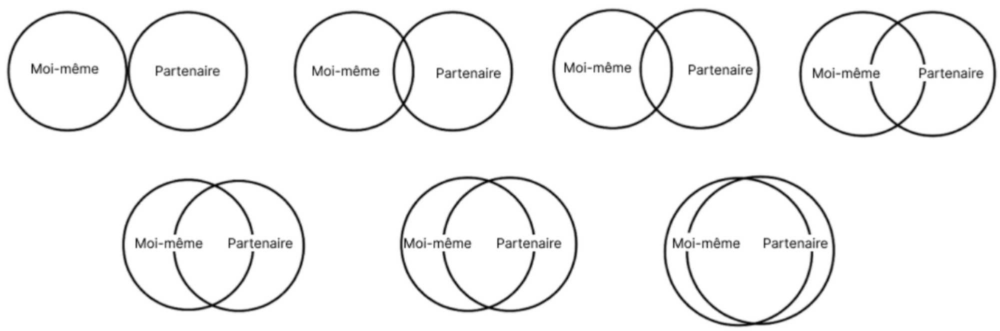
Interface C	Interface D
	

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes.

	Pas du tout d'accord	En désaccord	Plutôt en désaccord	Ni d'accord, ni en désaccord	Plutôt d'accord	D'accord	Tout à fait d'accord
De manière générale, lorsque mon/ma partenaire et magasinons en ligne ensemble, je suis en contrôle de la navigation.	○	○	○	○	○	○	○
De manière générale, lorsque mon/ma partenaire et magasinons en ligne ensemble, j'effectue la recherche du produit ou service.	○	○	○	○	○	○	○
De manière générale, lorsque mon/ma partenaire et magasinons en ligne ensemble, je prends la décision finale.	○	○	○	○	○	○	○
De manière générale, lorsque mon/ma partenaire et moi faisons des achats en ligne, je fais l'achat du produit ou service.	○	○	○	○	○	○	○

Veuillez encercler l'image ci-dessous qui décrit le mieux, de manière générale, votre relation avec votre partenaire.



Annexe E

Table 2.E.1. Unidimensionality and Convergent Validity

	Satisfaction (F1)		**Effort** (F2)		**Conflict** (F3)	
Items #	λ	t-value	λ	t-value	λ	t-value
SAT_P_1	0,918****	14.866				
SAT_P_2	0,918****	14.862				
P_EF_1			0,895****	15.359		
P_EF_2			0,925****	16.139		
P_B_CON_1					0,655****	10.021
P_B_CON_2					0,918****	16.045
P_B_CON_3					0,873****	14.874
AVE	0.843		0.829		0.678	
Cronbach Alpha	0.915		0.906		0.851	

Note. SAT_P = Perceived satisfaction; P_EF = Perceived effort; P_B_CON = Perceived behavioral conflict.

* p <= 0,10; ** p<=0,05; ***p<=0,01; ****p<=0,001

Table 2.E.2. Fit indices for confirmatory factor analysis

Goodness of fit measures	**Value**
X^2	15.620
df	11
p	0.15582
X^2 /df	1.420
Bentler-Bonett	0.984
CFI	0.995
IFI	0.995
GFI	0.979
AGFI	0.947
RMSEA	0.0460

Table 2.E.3. Inter-construct Correlations and discriminant validity.

	Satisfaction (F1)		**Effort** (F2)		**Conflict** (F3)	
Construct	Phi	t-value	Phi	t-value	Phi	t-value
Satisfaction (F1)	**0.918**					
Effort (F2)	-0,573****	-10.445	**0.910**			
Conflict (F3)	-0,466****	-7.427	0,722****	17.146	**0.823**	

Note. Diagonal elements in bold are square roots of the Average Variance Explained (AVE).

Annexe F

Table 3.F.1. Skewness and Kurtosis values for dependant variables

Variable	Skewness	Kurtosis	Distribution
Perceived emotional valence	-1.22	1.44	Normal
Perceived emotional arousal	-0.79	-0.17	Normal
Perceived effort for joint decision-making	1.50	1.83	Skewed to the left
Satisfaction with joint product choice	-1.67	3.21	Skewed to the right
Perceived behavioral conflict	1.77	3.30	Skewed to the left
Gaze convergence	-0.82	2.59	Skewed to the right
Cognitive load	0.35	-0.15	Normal

Note. skewness and kurtosis values between -2 to +2 is acceptable to verify normal distribution (George & Mallery, 2010)

Figure 6.F.1. Formula used to transform gaze convergence variable

$$GCtransformed(GC) = \frac{1}{|GC|}$$

Annexe G

Table 4.G.1. Fit statistics of mixed model regression with repeated measures for H1

Model	-2 Log like
Model with constant only	-1326.76072174
Complete model	-1333.25275215

df	Pr > χ2
1	0.0108

Table 4.G.2. Fit statistics of mixed model regression with repeated measures for H2a (emotional pleasure)

Model	-2 Log like
Model with constant only	1699.81311357
Complete model	1623.31339196

df	Pr > χ2
1	<0.0001

Table 4.G.3. Fit statistics of mixed model regression with repeated measures for H2a (emotional arousal)

Model	-2 Log like
Model with constant only	1780.19719988
Complete model	1701.68070522

df	Pr > χ2
1	<0.0001

Table 4.G.4. Fit statistics of generalized logistic regression with random intercepts and repeated measures for H2b

-2 Log Pseudo-Likelihood	Generalized $\chi 2$	$\chi 2$ / df
900.26	125.72	0.64

Table 4.G.5. Fit statistics of generalized logistic regression with random intercepts and repeated measures for H2c (self-reported effort)

-2 Log Pseudo-Likelihood	Generalized $\chi 2$	$\chi 2$ / df
882.99	137.87	0.70

Table 4.G.6. Fit statistics of mixed model regression with repeated measures for H2c (cognitive effort)

Model	-2 Log like
Model with constant only	257.37848541
Complete model	-226.99649549

df	Pr > $\chi 2$
1	<0.0001

Table 4.G.7. Fit statistics of generalized logistic regression with random intercepts and repeated measures for H2d

-2 Log Pseudo-Likelihood	Generalized $\chi 2$	$\chi 2$ / df
849.99	166.41	0.85