

**T.C. İSTANBUL KÜLTÜR UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**

**AUGMENTED REALITY IN E-
COMMERCE: A COMPARATIVE
ANALYSIS OF XR, ONLINE AND
PHYSICAL SHOPPING EXPERIENCES**

MASTER OF BUSINESS ADMINISTRATION

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Department: Business Administration
Program: Business Administration (English)

Thesis Supervisor: Asist. Prof. Dr. Didem Kayalidereden

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List of Abbreviations

Abbreviation	Definition
ANOVA	Analysis of Variance
AR	Augmented Reality
ATU	Attitude Toward Use
BIU	Behavioural Intention to Use
CX	Customer Experience
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TAM	Technology Acceptance Model
UX	User Experience
VR	Virtual Reality

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ÖZET

Yousef Lyas

Bu tez, tüketicilerin gözlük alışverişi deneyimlerini üç farklı kanal üzerinden incelemektedir: fiziksel mağaza, çevrimiçi (online) alışveriş ve artırılmış gerçeklik (AR). Sürükleyici ve dijital teknolojilerin gelişmesiyle birlikte perakendeciler, her alışveriş yönteminin kullanıcıların kolaylık, etkileşim ve bilinçli karar verme beklentilerini nasıl karşıladığını giderek daha fazla araştırmaktadır. Teknoloji Kabul Modeli (TAM) ve Müşteri Deneyimi (CX) teorisine dayanan bu çalışma, anketler, görüşmeler, gözlemler ve göz izleme gibi yöntemleri bir araya getiren karma yöntemli bir yaklaşım benimseyerek kapsamlı bir karşılaştırmalı analiz sunmaktadır.

Üç alışveriş yöntemiyle veri toplamak üzere 100 katılımcıdan nicel veriler toplanmış; bunların 30 kişilik bir alt grubu, AR ve çevrimiçi alışverişe yönelik doğrulanmış TAM anketlerini tamamlamıştır. Dijital ortamlarda görsel dikkat desenlerini incelemek için göz izleme teknolojisi kullanılmış, fiziksel perakende ortamlarında ise gerçek davranışları yakalamak için gözlemsel teknikler uygulanmıştır.

Bulgular, fiziksel mağaza alışverişinin hâlâ en güvenilir ve etkileşimli kanal olduğunu; duyuşsal ve sosyal faydalar sunduğunu ortaya koymaktadır. Çevrimiçi alışveriş pratikliği açısından tercih edilmekle birlikte, dokunsal geri bildirim eksikliği ve düşük satın alma güveni ile sınırlanmaktadır. AR alışverişi ürün görselleştirmesini ve etkileşimi artırsa da, kullanım kolaylığı ve güven açısından sınırlamalarla karşı karşıyadır.

Genç katılımcılar AR'ye daha açık olsa da, yaş tercihler üzerinde istatistiksel olarak anlamlı bir etken değildir. Genel olarak, hiçbir kanal tüm deneyim boyutlarında üstünlük sağlamamakta; bu da perakendecilerin her yöntemin kendine özgü güçlü yönlerini stratejik olarak kullanmaları gerektiğini göstermektedir. Çok kanallı gözlük perakendeciliğini geliştirmek için pratik öneriler sunulmaktadır.

Anahtar Kelimeler: Gözlük Alışverişi, Mağaza İçi Alışverişi, Çevrimiçi Alışverişi, Artırılmış Gerçeklik (AR), Karma Yöntem Araştırması, Müşteri Deneyimi (CX), Teknoloji Kabul Modeli (TAM)



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Abstract

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This thesis investigates consumer experiences with eyewear shopping across three distinct channels: in-store, online, and augmented reality (AR). As immersive and digital technologies evolve, retailers are increasingly exploring how each modality meets user expectations for convenience, engagement, and informed decision-making. Grounded in the Technology Acceptance Model (TAM) and Customer Experience (CX) theory, this study adopts a mixed-methods approach, combining surveys, interviews, observations, and eye-tracking to offer a comprehensive comparative analysis.

Quantitative data were collected from 100 participants using the three shopping methods, including a subgroup of 30 who completed validated TAM questionnaires for AR and online shopping. Eye-tracking was employed to examine visual attention patterns in digital environments, while observational techniques captured real-world behaviour in physical retail settings.

Findings reveal that in-store shopping remains the most trusted and engaging channel, offering distinct sensory and social benefits. Online shopping is valued for its convenience but lacks tactile feedback and shows lower purchase confidence. AR shopping enhances product visualisation and immersion but faces limitations in usability and consumer trust.

Although younger participants showed more openness to AR, age was not a statistically significant predictor of preference. Overall, the study finds that no single

channel excels across all experience dimensions, suggesting that retailers should strategically leverage the unique strengths of each modality. Practical recommendations are provided for enhancing multichannel eyewear retail experiences.

Keywords: Eyewear Shopping, In-Store Shopping, Online Shopping, Augmented Reality (AR), Mixed-Methods Research, Customer Experience (CX), Technology Acceptance Model (TAM).



Chapter 1: Introduction

1. Background and Rationale

The retail industry has undergone a significant transformation with the rise of digital and immersive technologies, providing consumers with a variety of shopping options beyond traditional in-store experiences. Today, shoppers can explore products and make purchases through online platforms, augmented reality (AR) applications, virtual reality (VR) environments, and physical stores. These diverse shopping channels, each offering unique advantages in convenience, engagement, and sensory interaction, raise questions about how effectively they meet consumer needs and shape the overall shopping experience.

With Extended Reality (XR) technologies such as AR and VR rapidly gaining traction in the retail sector, brands are exploring innovative ways to engage customers, offering virtual try-ons, in-home visualizations, and 3D product interactions. At the same time, online shopping remains highly popular for its convenience, while in-store shopping continues to provide sensory and social engagement that digital channels cannot fully replicate. Given the range of experiences these channels provide, a critical question emerges: Which shopping channel delivers the best overall user experience for consumers? Understanding how consumers perceive and respond to these shopping methods will provide valuable insights for retailers seeking to optimize consumer satisfaction and engagement across multiple platforms.

2. Research Question and Sub-Research Questions

To guide this inquiry, the primary research question and sub-research questions are formulated as follows:

2.1 Primary Research Question:

Which shopping method - XR (e.g., AR), online, or in-store - provides the most effective user experience for consumers?

This question addresses the overarching goal of determining the comparative effectiveness of XR, online, and in-store shopping experiences in meeting consumer needs and expectations. To further explore this question, several sub-research questions are identified as shown below.

2.2 Sub-Research Questions:

1. What unique characteristics do XR, online, and in-store shopping channels contribute to the consumer experience?
2. How do engagement, convenience, immersion, and ease of use vary among XR, online, and in-store shopping channels?
3. How does each shopping channel (XR, online, and in-store) impact consumer satisfaction, perceived value, and decision-making?

3. Research Hypotheses:

In line with the research questions, the following hypotheses are proposed to test specific aspects of the consumer experience across XR (AR), online, and in-store shopping channels when shopping for eyewear:

H1: In-store eyewear shopping has a significantly more positive effect on consumer satisfaction than online and XR (AR) shopping methods.

Rationale: In-store shopping allows users to physically try on glasses, feel frame materials, and receive face-to-face guidance from opticians. Offering sensory and social engagement that contributes to higher satisfaction.

H2: XR (AR) eyewear try-on experiences have a significantly greater positive effect on consumer engagement and immersion than online or in-store shopping experiences.

Rationale: AR enables users to virtually try on multiple frame styles in real time using their own face, enhancing emotional engagement and immersion by visualizing fit, style, and appearance from anywhere.

H3: Perceived ease of use is significantly higher for online eyewear platforms than for XR (AR) tools. Perceived usefulness is significantly higher for XR (AR) tools than for online eyewear platforms when selecting suitable frames.

Rationale: Online platforms are widely used and perceived as simple to navigate (high PEOU), whereas XR adds unique usefulness (PU) by enabling virtual try-ons that assist with personalized style decisions.

H4: XR (AR) eyewear try-on experiences have a significantly stronger positive effect on consumers' purchase intentions than online or in-store shopping methods.

Rationale: AR facilitates visualizing how glasses look on the user's face, building confidence in appearance and fit (two critical factors in purchasing higher-end eyewear).

H5: Perceived convenience has a significantly greater influence on consumer preference for online eyewear shopping compared to XR and in-store methods.

Rationale: Some online eyewear retailers offer fast frame browsing, home delivery, and return options, which is ideal for routine purchases and repeat buyers seeking convenience.

H6: XR (AR) eyewear try-on tools have a significantly greater positive effect on perceived value compared to standard online eyewear platforms.

Rationale: By allowing personalized, interactive product previews, AR reduces uncertainty about aesthetics and fit, enhancing perceived value in eyewear selection.

H7: In-store eyewear shopping has a significantly greater positive effect on social engagement than online and XR (AR) shopping methods.

Rationale: In-store shopping engages touch and interpersonal interaction, especially for users exploring style and identity through glasses.

H8: Consumers aged 18–34 show a significantly stronger preference for XR (AR) eyewear shopping than older consumers (35 and above), who prefer in-store or online shopping methods.

Rationale: Younger users are more comfortable with mobile AR tech and more likely to engage in experimental, style-driven frame selection, while older users may value familiarity and professional guidance.

These hypotheses form the basis for examining the comparative strengths and limitations of each shopping channel. By testing these hypotheses, the study aims to provide a good understanding of how XR, online, and in-store shopping experiences impact consumer satisfaction, engagement, and decision-making. Ultimately, the findings of this study will offer valuable insights for retailers and technology developers as they seek to enhance customer experiences across diverse shopping platforms.



Chapter 2: Literature Review

1. Introduction to Modern Shopping Experiences

The retail landscape has undergone significant transformation with the rise of digital and immersive technologies, resulting in a variety of shopping experiences. Traditional in-store shopping, while still prevalent, now coexists with online shopping and Extended Reality (XR) platforms, which encompass Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR). Each of these channels offers unique advantages and challenges that shape consumer perceptions and behaviours, redefining how shoppers engage with products.

1.1 Overview of Consumer Shopping Experience

The concept of the "shopping experience" includes a multi-dimensional range of factors such as convenience, sensory engagement, emotional satisfaction, social interaction, and usability (Puccinelli et al., 2009). Researchers note that consumer satisfaction in retail settings is influenced by perceived value, convenience, trust, and the ability to interact with products in ways that support informed decision-making (Childers et al., 2001). These factors make it essential to assess each shopping channel's contribution to consumer satisfaction, providing insights into their impact on shopping behaviours.

In today's retail environment, consumers can interact with products through diverse channels, each fulfilling specific needs for convenience, engagement, and personalization:

- Augmented Reality (AR): Overlays digital information onto the real world, enabling users to visualize products within their physical surroundings.
- Virtual Reality (VR): Fully immerses users in a virtual environment, often requiring headsets, to simulate real-world shopping interactions.

- Mixed Reality (MR): Combines AR and VR, blending digital and physical environments for real-time interactions with both virtual and tangible elements.
- Websites: Enable online shopping, allowing users to browse, evaluate, and purchase products via e-commerce platforms.
- In-store shopping: Offers a traditional retail experience, where customers physically interact with products and engage with the store environment.

Each channel possesses unique characteristics that influence consumer behaviour and satisfaction, which are explored in the following sections.

1.2 XR Technology and Shopping Experience

Extended Reality (XR), encompassing AR, VR, and MR, has introduced a new era in retail defined by immersive, interactive experiences. This technology allows users to engage with products in simulated or augmented environments, closely replicating in-store experiences in ways that traditional online shopping cannot achieve.

Augmented Reality (AR): AR enhances the shopping experience by overlaying digital images of products onto real-world settings. For instance, IKEA's Place app allows users to visualize furniture in their home environment, which helps to reduce uncertainties about fit and style (Hilken et al., 2017). Similarly, brands like Gucci and Nike use AR for virtual try-ons, enabling customers to preview products on themselves before purchase, thereby bridging the gap between online and in-store shopping (Poushneh & Vasquez-Parraga, 2017).

Virtual Reality (VR): VR creates fully immersive virtual shopping environments, transporting users to 3D spaces where they can explore products as though they were physically present. This technology is particularly valuable for high-involvement purchases in industries like automotive and luxury fashion. For example, Audi's VR showrooms let customers explore vehicle features in detail, creating an interactive, sensory-rich experience that enhances engagement and decision-making (Flavián et al., 2019).

Mixed Reality (MR): MR merges AR and VR elements, enabling users to interact with digital content in a real-world context. Lowe's Holoroom is a notable example, allowing customers to visualize home improvement projects by placing virtual items

in physical spaces, supporting informed and confident purchasing decisions (Poushneh & Vasquez-Parraga, 2017). While MR provides high interactivity, its cost and technical complexity currently restrict its widespread use in mainstream retail.

By providing enhanced engagement and product interaction, XR channels offer an immersive shopping experience that rivals traditional in-store shopping, though they face limitations in accessibility and complexity that may impact adoption.

1.3 Online Shopping Experience (Websites and Apps)

Online shopping, facilitated through websites and apps, is among the most accessible and widely adopted shopping channels, driven by its inherent convenience and efficiency. E-commerce platforms prioritize user-centric features such as personalized recommendations, broad product selections, and customer reviews, all of which contribute to a streamlined shopping experience (Rose et al., 2012).

Websites like Amazon and Zara set the standard for online shopping, using sophisticated recommendation engines to tailor the shopping experience and increase relevance for each user (Koufaris, 2002). Online shopping's primary strength is its convenience, allowing users to shop from anywhere and at any time. However, this channel lacks the physical engagement found in XR or in-store experiences, which can be especially significant for high-involvement purchases like fashion and home decor that often require tactile evaluation (Choi & Lee, 2003). For these products, the inability to physically examine items online may reduce customer satisfaction and increase return rates (Pappas et al., 2014).

1.4 Physical Shopping Experience (In-Store)

Despite the shift toward digital shopping, the in-store experience remains crucial in retail, particularly for brands aiming to deliver sensory engagement and social interaction. In-store shopping allows consumers to engage with products physically, benefiting from tactile feedback and the immediate ability to assess quality and suitability, especially in categories like eyewear and furniture.

Physical stores also provide emotional and social engagement through face-to-face interactions with sales associates who offer personalized recommendations. For instance, Whole Foods markets itself as a community space, fostering a sense of

belonging that contributes to customer loyalty (Puccinelli et al., 2009). Although physical stores offer high levels of engagement, they require greater effort in terms of travel and time, which can limit convenience - an important consideration for low - involvement purchases (Verhoef et al., 2009).

2. Theoretical Framework

This literature review applies two theoretical lenses: the Technology Acceptance Model (TAM) and Customer Experience (CX) Theory. TAM assesses ease of use, perceived usefulness, and user adoption rates of XR and online shopping platforms (Davis, 1989). Meanwhile, CX Theory evaluates the holistic experiences that consumers encounter across shopping channels, focusing on emotional, cognitive, and sensory engagement (Verhoef et al., 2009). Together, these frameworks provide a basis for comparing the channels' unique characteristics in meeting consumer needs.

2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), first introduced by Fred Davis in 1989, is a foundational theory in understanding how users come to accept and use new technologies. TAM was developed to predict user behaviour concerning technology adoption by focusing on two primary determinants: Perceived Ease of Use and Perceived Usefulness (Davis, 1989). These constructs allow researchers to examine why individuals accept or reject specific technologies, making TAM one of the most widely applied models in information systems and technology studies.

Key Constructs of TAM

1. Perceived Ease of Use (PEOU): This construct refers to “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989). If a technology is perceived as easy to use, individuals are more likely to adopt it. In a retail context, ease of use can determine how quickly and effectively customers can interact with technologies like AR apps, VR systems, or online shopping platforms. For instance, the simplicity of an AR app interface may enhance its perceived ease of use, encouraging more customers to try it.

2. Perceived Usefulness (PU): Perceived usefulness is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989). In a consumer setting, perceived usefulness refers to the extent to which the technology improves the shopping experience, facilitates decision-making, or provides added value. For instance, if an online shopping app effectively streamlines product selection, provides recommendations, and simplifies the purchasing process, users will likely find it useful and thus be more inclined to adopt it (Gefen et al., 2003).

TAM Extensions and Relevance in Modern Retail

While the original TAM focuses on PEOU and PU, subsequent research has introduced additional constructs, such as Attitude Toward Using Technology, Behavioural Intention to Use, and Social Influence. These expanded versions, such as TAM2 and TAM3, consider factors like subjective norms, experience, and voluntariness, which further shape users’ intentions and behaviours concerning technology adoption (Venkatesh & Davis, 2000).

In retail, TAM is particularly relevant for understanding how consumers interact with and accept emerging technologies like XR, mobile apps, and self-service kiosks. For instance, studies have applied TAM to explore how ease of use influences AR app adoption among shoppers in furniture and apparel retail (Poushneh & Vasquez-Parraga, 2017). The perceived usefulness of technology is also crucial; if consumers believe an app adds value by enabling virtual product try-ons or recommending products based on preferences, they are more likely to adopt and repeatedly use that technology (McLean & Wilson, 2019).

Applications of TAM in Shopping Channels

TAM provides a framework for comparing different shopping experiences. For example:

- Extended Reality (XR): XR applications, including AR and VR, are likely to be adopted if they are user-friendly and offer significant benefits, such as product visualization or customization (Hilken et al., 2017).

- Online Shopping (Websites and Apps): The ease of navigation and perceived usefulness of online platforms directly impact consumer adoption. Online retail giants like Amazon leverage streamlined interfaces and features like personalized recommendations to enhance perceived usefulness and ease of use (Koufaris, 2002).
- In-Store Shopping with Technology: As in-store environments increasingly adopt digital elements like mobile apps and digital kiosks, TAM explains how the ease of use and perceived value of these tools impact customer interaction and shopping experience.

In sum, TAM serves as a powerful model for understanding technology acceptance in retail, revealing how ease of use and usefulness drive consumer adoption across various shopping channels. By applying TAM, retailers can enhance consumer engagement with emerging technologies, improving the overall shopping experience.

2.2 Customer Experience (CX) Theory

Customer Experience (CX) Theory has gained prominence as companies increasingly prioritize customer satisfaction, loyalty, and engagement. CX theory seeks to understand the holistic, multi-dimensional experience customers encounter across all touchpoints with a brand. Unlike models focused solely on transactional outcomes, CX theory emphasizes the emotional, sensory, cognitive, and social dimensions of the customer journey (Verhoef et al., 2009).

Core Dimensions of Customer Experience

1. Sensory Engagement: Sensory elements include any physical interactions or sensory stimuli that enhance the consumer's experience with a product or environment. For instance, in a physical store, sensory engagement may involve tactile interactions, such as feeling fabrics or testing products. In XR shopping, VR provides sensory engagement by simulating realistic environments, allowing consumers to explore products in 3D, which enhances experiential satisfaction (Flavián et al., 2019).
2. Emotional Engagement: Emotional factors pertain to the feelings a customer experiences when interacting with a brand. Positive emotional engagement can drive customer loyalty and influence purchasing decisions. For example,

physical stores often create emotional connections through in-store interactions with staff, while online platforms may use personalization and convenience to evoke positive emotions. According to CX theory, emotional engagement is a critical aspect of building long-term customer relationships (Puccinelli et al., 2009).

3. **Cognitive Engagement:** Cognitive engagement includes how consumers process information and make purchasing decisions. In online shopping, cognitive engagement may be influenced by factors like product descriptions, customer reviews, and navigation simplicity. In XR environments, cognitive engagement could involve evaluating products in a virtual setting, which provides a deeper understanding of product features and suitability (Pappas et al., 2014).
4. **Social Engagement:** Social interaction plays a significant role in customer experience, particularly in in-store settings where interactions with staff and other shoppers contribute to a sense of community and trust. In contrast, online and XR shopping experiences often lack direct social engagement. However, some online platforms foster a sense of community through customer reviews and forums, which can partially satisfy the social aspect of CX (Pantano & Vannucci, 2019).

CX Theory's Relevance in Multi-Channel Retail

CX theory's comprehensive approach makes it particularly valuable for analysing different retail channels, each of which contributes uniquely to customer satisfaction and loyalty.

- **Extended Reality (XR):** In XR, CX theory highlights the significance of sensory and emotional engagement. VR and AR can create memorable experiences by immersing consumers in a virtual environment or allowing them to see products in real-world contexts (Hilken et al., 2017). Although XR typically lacks social interaction, it compensates with high levels of personalization and sensory engagement.
- **Online Shopping:** In online shopping, CX theory emphasizes convenience and personalization as key components of emotional and cognitive engagement. Features like product recommendations, personalized offers, and convenient

checkout processes improve customer satisfaction, although the lack of physical interaction may reduce sensory engagement (Rose et al., 2012).

- In-Store Shopping: CX theory is especially applicable to in-store shopping, where all four dimensions - sensory, emotional, cognitive, and social - can be fully engaged. Physical stores enable tactile interactions, face-to-face customer service, and a curated atmosphere that fosters positive emotions and cognitive processing. Studies show that sensory engagement in stores leads to higher customer satisfaction and loyalty, especially for high-involvement products like apparel and furniture.

Applications of CX Theory in Retail

Comparing shopping channels through CX theory provides a structured approach to evaluating consumer experience:

- XR: Sensory and emotional engagement are the primary drivers, as these technologies enable consumers to experience products in ways that simulate physical presence.
- Online Shopping: Cognitive and emotional engagement are the main factors, as online shopping provides convenience and personalization that support informed decision-making.
- In-Store Shopping: In-store shopping fully leverages all CX dimensions, making it the preferred model for consumers who value direct sensory interaction and social engagement.

In conclusion, CX theory offers a holistic framework for understanding customer experience across shopping channels. By focusing on sensory, emotional, cognitive, and social elements, retailers can design customer experiences that enhance satisfaction and foster loyalty across XR, online, and in-store settings.

2.3 XR Shopping Experience Through TAM and CX Theory

2.3.1 *Technology Acceptance Model (TAM)*

TAM is especially relevant to XR shopping, given XR's novelty and technical complexity. According to TAM, perceived ease of use and perceived usefulness are critical for user adoption (Davis, 1989).

1. **Perceived Ease of Use:** AR apps like IKEA's Place offer intuitive interfaces for visualizing furniture, while VR typically requires additional equipment, such as headsets, that can complicate usability. Research suggests that such usability concerns can reduce adoption, particularly among less tech-savvy demographics (McLean et al., 2020).
2. **Perceived Usefulness:** XR's capacity for realistic product visualization offers an advantage in providing an experience that traditional online shopping lacks. Studies show that XR's simulation of real-world interactions increases perceived usefulness, especially for high-involvement purchases like furniture or cars (Hilken et al., 2017).

2.3.2 *Customer Experience (CX) Theory*

CX theory emphasizes the experiential strengths of XR shopping, particularly in providing sensory and emotional engagement.

1. **Sensory and Emotional Engagement:** VR's immersive environments and AR's real-world visualization capabilities enhance sensory engagement, leading to greater customer satisfaction and brand loyalty (Flavián et al., 2019). Audi's VR showroom, for instance, allows customers to experience vehicle interiors, fostering an emotional connection that supports purchase intent.
2. **Convenience and Social Interaction:** While XR offers an immersive experience, its accessibility is limited by physical and technical requirements (Pantano & Vannucci, 2019). Furthermore, XR's typically solitary use may lack the social engagement found in in-store shopping (Hilken et al., 2017).

2.4 Online Shopping Experience Through TAM and CX Theory

2.4.1 *Technology Acceptance Model (TAM)*

TAM's emphasis on ease of use and perceived usefulness aligns closely with online shopping.

1. **Ease of Use:** E-commerce platforms prioritize user-friendly interfaces and seamless navigation. Sites like Amazon and Zara set benchmarks in ease of use, appealing to both novice and experienced users (Koufaris, 2002).
2. **Perceived Usefulness:** Online shopping provides convenience, accessible anywhere, and enriched by product recommendations, reviews, and comparisons that support informed decision-making (Gefen et al., 2003).

2.4.2 *Customer Experience (CX) Theory*

1. **Convenience and Personalization:** Online shopping is highly convenient, minimizing effort and supporting CX theory's low-effort shopping ideal, increasing satisfaction (Rose et al., 2012). Platforms like Amazon personalize the experience by recommending products, and fostering engagement (Koufaris, 2002).
2. **Limitations in Sensory Engagement:** While convenient, online shopping lacks tactile engagement, reducing satisfaction in contexts requiring physical inspection (Choi & Lee, 2003).

2.5 In-Store Shopping Experience Through TAM and CX Theory

2.5.1 *Technology Acceptance Model (TAM)*

While TAM traditionally applies to technology, its principles can assess in-store technology, such as self-checkouts and digital kiosks, which improve convenience and usability (Pantano, Priporas, & Dennis, 2018).

2.5.2 *Customer Experience (CX) Theory*

1. **Sensory and Emotional Engagement:** Physical stores allow for tactile interaction, enhancing decision-making and reducing purchase regret.

2. Social Interaction and Brand Loyalty: Face-to-face interactions in stores strengthen emotional bonds, creating brand loyalty difficult to replicate online or in XR (Puccinelli et al., 2009).

3. Summary

Each shopping channel demonstrates unique strengths and limitations. XR offers immersive, personalized experiences but is limited by technical requirements. Online shopping is convenient and widely accessible but lacks sensory engagement. In-store shopping delivers sensory and social interaction, ideal for high-involvement purchases, though it requires greater effort. Together, TAM and CX theory show that each channel effectively meets specific consumer needs, suggesting they serve distinct roles within the retail ecosystem.

4. Comparative Studies on Consumer Experience Across Shopping Models

A growing body of research has focused on comparing consumer experiences across XR, online, and in-store shopping models, analysing how each model performs in terms of engagement, convenience, sensory satisfaction, and emotional connection. Comparative studies offer valuable insights into the unique advantages and challenges of each channel, helping retailers understand how different shopping models align with consumer preferences and expectations.

4.1 Engagement and Immersion

Studies consistently find that Extended Reality (XR), especially Virtual Reality (VR), excels in delivering immersive and highly engaging experiences. Flavián et al. (2019) demonstrate that VR in particular offers a level of sensory and emotional engagement that surpasses traditional online and in-store experiences, primarily due to its ability to simulate real-world settings. VR's strength in immersion can drive brand loyalty and enhance consumer satisfaction for high-involvement products like cars and real estate, where detailed exploration and visualization significantly impact purchasing decisions.

However, while XR provides immersive engagement, it faces practical barriers to adoption, including technological accessibility and usability concerns, as noted by McLean et al. (2020). In contrast, in-store shopping provides natural sensory engagement through physical interaction, allowing consumers to touch and test products. Research indicates that this tactile aspect is irreplaceable, especially for categories like fashion and home furnishings, where physical interaction enhances decision-making.

4.2 Convenience and Accessibility

In terms of convenience, online shopping via websites and apps consistently outperforms other models. Studies by Rose et al. (2012) and Koufaris (2002) highlight online shopping's advantage in providing 24/7 access, product variety, and home delivery options, which align with consumer preferences for minimal-effort purchasing. Gefen et al. (2003) emphasize that the ease of navigation and searchability in online shopping platforms significantly enhances perceived ease of use, an essential component for adoption according to the Technology Acceptance Model (TAM).

Comparatively, in-store shopping requires greater effort, including travel and time, which can be a limiting factor for routine or low-involvement purchases (Verhoef et al., 2009). XR, while offering enhanced product interaction, remains less accessible due to the requirement for specialized devices like VR headsets, limiting its practical convenience for many consumers.

4.3 Sensory Satisfaction and Tactile Interaction

The in-store shopping experience is unmatched in providing sensory satisfaction, allowing consumers to physically interact with products. Puccinelli et al. (2009) argue that tactile interaction contributes significantly to consumer confidence and satisfaction, particularly for high-involvement purchases. For instance, in clothing and furniture retail, the ability to touch and feel products enhances perceived quality and suitability, reducing the likelihood of post-purchase regret.

Although AR within the XR model attempts to mimic this sensory experience by allowing virtual visualisation of products in real-world settings, studies by Hilken et

al. (2017) show that AR does not fully substitute the tactile feedback that in-store shopping provides. Online shopping falls short in this aspect, as the lack of sensory engagement is a known limitation, particularly for products where texture and fit are essential considerations (Choi & Lee, 2003).

4.4 Emotional and Social Connection

The emotional and social aspects of the in-store experience are another area where physical retail outshines both XR and online shopping. Research by Pantano and Vannucci (2019) and Puccinelli et al. (2009) shows that face-to-face interactions with sales staff in physical stores foster emotional connections, trust, and a sense of community. This social element enhances customer satisfaction and loyalty, particularly in settings like grocery stores or boutique retail environments where personalized service contributes to a positive shopping experience.

Comparatively, XR offers personalized and interactive experiences through AR and VR, but these interactions are often solitary, lacking the interpersonal connection found in-store (Hilken et al., 2017). Online shopping, while convenient, also struggles to replicate the emotional engagement of in-store experiences. However, platforms like Amazon attempt to address this gap by offering customer reviews and product recommendations, which help to build a sense of community and trust within the digital environment (Koufaris, 2002).

4.5 Consumer Preferences and Channel Suitability

Overall, studies indicate that consumer preferences for shopping channels vary depending on the type of product, level of involvement, and individual needs. XR technologies are highly valued for high-involvement purchases that benefit from visual and spatial engagement, such as automotive and home improvement. In contrast, online shopping is preferred for routine, low-involvement purchases due to its convenience and accessibility (Pappas et al., 2014). In-store shopping is favoured when physical interaction and immediate gratification are essential, often appealing to consumers seeking sensory engagement and personal interaction.

5. Contextualizing the Shopping Experience of Eyewear Across In-Store, Online, and XR Channels

This study focuses on comparing the shopping experience of glasses using these three methods, analysing how each channel impacts consumer perceptions, satisfaction, and decision-making. This contextualization builds on existing research and theoretical models discussed above, namely, the Technology Acceptance Model (TAM) (Davis, 1989) and Customer Experience (CX) Theory (Verhoef et al., 2009), which provide a structured framework to evaluate shopping experiences across digital and physical environments.

5.1 Shopping Experience Across Different Channels

In-Store Shopping

In-store shopping remains a dominant retail model, particularly for high-involvement purchases like eyewear, where consumers seek tactile engagement, product testing, and professional assistance. Research by Puccinelli et al. (2009) highlights that in-store shopping provides a multi-sensory experience, fostering consumer confidence through direct product interaction. The ability to try on glasses, assess fit and comfort, and receive personalized guidance from sales representatives enhances consumer trust



Figure 2.1: Figure 1: In-store shopping experience (images are from <https://www.pexels.com/>)

and satisfaction. Many eyewear brands, such as Warby Parker¹, Ray-ban², Specsavers³ and Oakley⁴, leverage their physical stores to provide hands-on experiences, personalized fittings, and eye exams, reinforcing the value of in-store shopping (See Figure 1). However, in-store shopping requires physical effort and time investment, which may deter some consumers seeking convenience (Verhoef et al., 2009).

Online Shopping

Online shopping offers unparalleled convenience and accessibility, enabling consumers to browse and purchase products from anywhere. Websites and e-commerce platforms leverage personalization algorithms, and customer reviews to enhance the shopping experience (Rose et al., 2012). For eyewear, digital tools allow consumers to compare frame styles and access detailed specifications, but the inability to physically try on glasses can be a limitation (Pappas et al., 2014). Brands like Warby Parker have tackled this challenge by offering home try-on services, where customers can select multiple frames, have them shipped to their homes, and decide before purchasing (See Figure 2). The Technology Acceptance Model (TAM) explains online shopping adoption by emphasizing ease of use and perceived usefulness; platforms that streamline navigation, provide clear product information, and facilitate secure transactions are more likely to be embraced by consumers (Gefen et al., 2003).

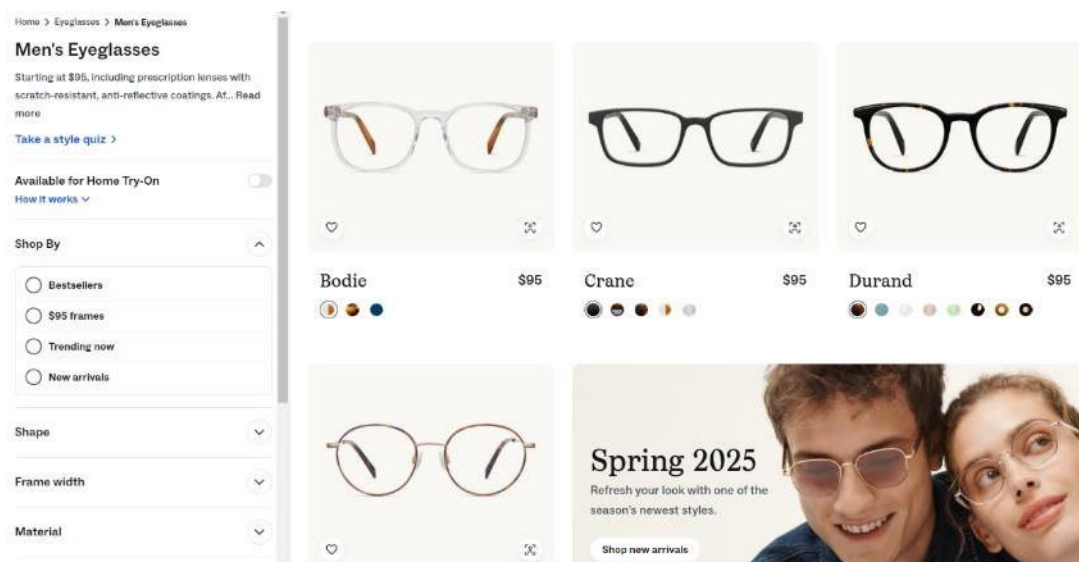


Figure 2.2: A screenshot from Warby Parker website

¹ <https://www.warbyparker.com/>

² <https://www.ray-ban.com/row>

³ <https://www.specsavers.co.uk/>

⁴ <https://www.oakley.com/en-gb>

Augmented Reality (AR) Shopping

AR bridges the gap between online and in-store experiences by allowing consumers to visualize products in real-world contexts. Studies show that AR enhances consumer engagement, reducing uncertainty in purchase decisions (Hilken et al., 2017). Retailers like Ray-Ban, Specsavers, Warby Parker, and Oakley have integrated AR-powered virtual try-ons, enabling customers to see how different frames look on their faces in real-time (See Figure 3). This feature increases perceived usefulness and emotional engagement, two key determinants of technology adoption according to TAM (McLean & Wilson, 2019). Warby Parker's AR try-on, for example, has become a widely used feature in their mobile app, allowing customers to see frame designs on their faces before making a purchase. However, while AR offers immersive visualization, it lacks the physical interaction and tactile feedback available in-store (Flavián et al., 2019).

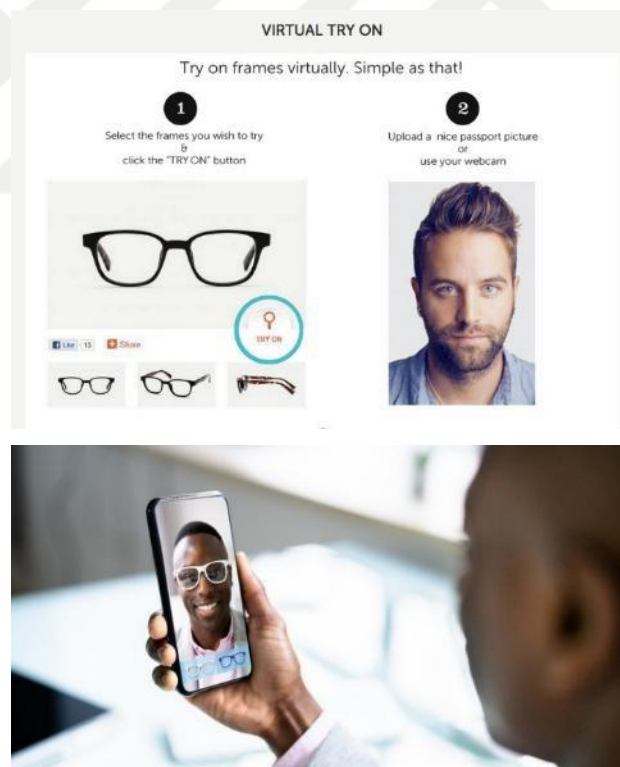


Figure 2.3: Examples of the AR-powered virtual try-ons feature

Chapter 3: Methodology

1. Introduction

This chapter discusses the methodological framework and approach used in the research on exploring people's buying experiences across in-person shopping, online shopping, and augmented reality shopping. It explains the distinctions between qualitative and quantitative data, the concepts of primary and secondary data, and reviews various data collection methods. In addition, I justify the use of a mixed research method to capture both the depth and breadth of user experiences across different shopping modalities.

1.1 Qualitative and Quantitative Data

Data can be broadly classified into qualitative and quantitative types, each serving distinct purposes in research. Qualitative data refers to non-numeric data that provides in-depth insights into participants' experiences, perceptions, and behaviours (Creswell & Creswell, 2017). In the context of shopping experiences, qual data may involve open-ended survey responses, or interview transcripts detailing participants' feelings and preferences toward different shopping environments.

In contrast, quantitative data is numeric and focuses on measuring aspects that can be counted, allowing for statistical analysis to identify patterns, trends, or correlations (Bryman, 2016). For instance, quantitative data in this study could involve metrics such as the frequency of online shopping or the time spent exploring products in an augmented reality environment.

1.2 Primary and Secondary Data

Data collection involves primary and secondary sources, each contributing uniquely to research.

1. Primary data refers to original data gathered directly from the study's participants or through observational research, which in this case, includes interviews, surveys, and possibly eye-tracking analyses to gauge user engagement with different shopping platforms.
2. Secondary data consists of information collected from existing sources, such as prior research studies, online consumer reports, or meta-analyses on shopping behaviours. These sources provide a comparative baseline and contextual background (Saunders, Lewis, & Thornhill, 2019).

In this research, primary data was prioritised to capture firsthand insights into individual shopping experiences, while secondary data was reviewed to provide context and background on consumer behaviour patterns in diverse shopping environments.

1.3 Data Collection Methods

The following section reviews various data collection methods, their respective advantages and disadvantages, and their relevance to studying user shopping experiences.

1.3.1 Surveys and Questionnaires

Surveys and questionnaires are widely used data collection tools that allow researchers to gather large volumes of data efficiently. These instruments are typically structured, featuring closed-ended questions for quantitative data and open-ended questions to capture qualitative insights. Surveys are particularly suitable for research that requires the systematic collection of opinions, preferences, or behaviours across a diverse participant group (Robson & McCartan, 2016). In this study, surveys and questionnaires will be utilized to evaluate consumer preferences and satisfaction across in-store, online, and augmented reality (AR) shopping modalities.

Advantages of Surveys and Questionnaires

One of the primary advantages of surveys and questionnaires is their cost-effectiveness. These tools enable researchers to reach a large sample of participants at a relatively low cost, especially when administered digitally. Online platforms, such as Google

Forms or Qualtrics, streamline the distribution process, allowing for rapid data collection and broad geographic coverage (Creswell & Creswell, 2017).

Another significant benefit is their standardization, which ensures that all participants respond to the same set of questions. This uniformity facilitates comparative analysis across different participant groups, making it easier to identify patterns and trends in the data (Bryman, 2016). Standardization is especially valuable in this study, where consumer experiences across three distinct shopping modalities are being compared.

Surveys are also highly time-efficient. Participants can complete them at their convenience, reducing the burden on both the researcher and the respondent. This flexibility increases response rates and enhances participant engagement, particularly for online surveys (Saunders, Lewis, & Thornhill, 2019).

Lastly, surveys provide data that is easy to quantify and analyse, especially when closed-ended questions with pre-defined answer options are used. Statistical analysis tools such as SPSS or Excel can quickly process this data, enabling researchers to identify significant differences or correlations between variables (Robson & McCartan, 2016).

Disadvantages of Surveys and Questionnaires

Despite their advantages, surveys and questionnaires have notable limitations. A key disadvantage is their limited depth. Closed-ended questions, while easy to analyse, may not capture the nuanced perspectives or complex decision-making processes of participants (Bryman, 2016). This limitation is particularly relevant in this research, where understanding the subjective aspects of consumer experiences is crucial.

Another challenge is the potential for response bias. Participants may provide socially desirable answers rather than truthful responses, particularly when questions touch on personal preferences or behaviours. This bias can distort findings and reduce the validity of the results (Robson & McCartan, 2016).

Furthermore, surveys rely on self-reported data, which may not always align with actual behaviours. Participants may overestimate or underestimate their engagement with certain shopping modalities, leading to inaccuracies in the data (Creswell & Creswell, 2017).

Finally, designing effective surveys can be a complex task. Questions must be clear, concise, and free from ambiguity to avoid misinterpretation. Poorly designed surveys can confuse participants or lead to incomplete responses, compromising the reliability of the data (Saunders, Lewis, & Thornhill, 2019).

1.3.2 Interviews

Interviews are a qualitative data collection method that allows researchers to gain deep insights into participants' experiences, perceptions, and motivations. Unlike surveys, interviews provide an opportunity for open-ended, exploratory dialogue, enabling researchers to probe for detailed information and clarify responses in real time (Patton, 2015). In this study, interviews will be employed to understand the subjective dimensions of consumer experiences across in-store, online, and AR shopping environments.

Advantages of Interviews

A significant advantage of interviews is their ability to provide rich, detailed data. The conversational nature of interviews allows participants to elaborate on their experiences, revealing insights that might not emerge through structured surveys or questionnaires (Creswell & Creswell, 2017). This depth of understanding is particularly valuable for exploring complex or emotional aspects of consumer behaviour.

Interviews also allow for flexibility. Researchers can adapt their questions based on participant responses, delving deeper into areas of interest or clarifying ambiguous answers. This adaptability enhances the quality of the data and ensures that key topics are thoroughly explored (Patton, 2015).

Another strength of interviews is their capacity to build rapport with participants. Establishing a comfortable, trusting environment encourages participants to share candidly, leading to more authentic and meaningful data (Saunders, Lewis, & Thornhill, 2019).

Lastly, interviews are well-suited for exploring diverse perspectives. By engaging with participants from various demographic or experiential backgrounds, researchers can

gain a comprehensive understanding of how different factors influence shopping experiences across modalities (Bryman, 2016).

Disadvantages of Interviews

Interviews also come with challenges. A major drawback is their time-intensive nature. Conducting, transcribing, and analysing interviews requires significant time and resources, particularly in studies involving large samples (Patton, 2015). This limitation may constrain the number of participants that can be realistically included.

Interviews are also susceptible to interviewer bias. The researcher's tone, phrasing, or body language may inadvertently influence participant responses, compromising the neutrality of the data (Creswell & Creswell, 2017). Ensuring interviewer consistency and minimizing bias requires careful training and preparation.

Another limitation is the subjectivity of qualitative data analysis. Unlike surveys, where numerical data can be easily quantified, interview responses require thematic analysis, which is inherently interpretative. This process can introduce variability, making it essential to employ rigorous analytical frameworks to ensure reliability (Bryman, 2016).

Finally, interviews may encounter participant reluctance. Some individuals may feel uncomfortable discussing personal preferences or experiences, leading to incomplete or guarded responses. Establishing rapport and ensuring confidentiality are critical to addressing this issue (Saunders, Lewis, & Thornhill, 2019).

1.3.3 Observational Methods

Observational methods involve the systematic recording of participants' behaviours in naturalistic settings. This approach allows researchers to study real-world interactions as they occur, without relying on self-reported data. Observational methods are particularly useful for understanding how consumers engage with products or environments, making them highly relevant to this study on shopping modalities (Cohen, Manion, & Morrison, 2018).

Observational methods were used in the in-store shopping context to capture naturalistic consumer behaviours, including physical interaction with frames,

movement patterns, and social exchanges. This approach compensated for the inability to use eye-tracking glasses, which were excluded due to cost and practical limitations. Observation offered a viable alternative for collecting behavioural data without relying on self-reports. Recent studies support this approach: Nguyen et al. (2023) demonstrated how in-store behaviour analysis can reveal valuable insights into consumer movement and engagement, while Pletcher (2023) highlighted the importance of ethical and practical considerations when using observational tools in retail environments.

Advantages of Observational Methods

A key advantage of observational methods is their ability to capture authentic behaviours. Unlike surveys or interviews, which rely on participant recollection, observations provide direct evidence of how individuals interact with their environment in real time (Cohen et al., 2018). This objectivity enhances the validity of the data.

Observational methods are also valuable for identifying non-verbal cues. Behaviours such as eye movements, gestures, or time spent examining a product can reveal important insights about consumer engagement that might not be explicitly communicated (Saunders, Lewis, & Thornhill, 2019).

Another strength is their applicability in natural settings. Observing participants in real-world environments, such as physical stores or AR interfaces, allows researchers to understand contextual factors that influence behaviour, providing a holistic view of the consumer experience (Robson & McCartan, 2016).

Finally, observational methods can complement other data collection techniques. By combining observations with interviews or surveys, researchers can triangulate findings, enhancing the reliability and depth of the study (Creswell & Creswell, 2017).

Disadvantages of Observational Methods

Observational methods also have limitations. A significant challenge is the potential for observer bias. Researchers may unintentionally interpret behaviours through a subjective lens, leading to skewed findings. Implementing standardized observation protocols is essential to mitigate this risk (Cohen et al., 2018).

Another drawback is the method's inability to capture internal states. While observations can reveal what participants do, they cannot explain why those behaviours occur. Supplementary methods, such as interviews, are often needed to provide this context (Saunders, Lewis, & Thornhill, 2019).

Observational studies can also be time-consuming and resource-intensive, particularly in dynamic environments where behaviours are complex and multifaceted. Recording, coding, and analysing observational data requires specialized skills and significant effort (Robson & McCartan, 2016).

Lastly, participant awareness of being observed may influence behaviour. Known as the Hawthorne effect, this phenomenon can lead individuals to alter their actions, potentially distorting the data. Ensuring unobtrusive observation techniques is critical to minimizing this effect (Cohen et al., 2018).

1.3.4 Eye Tracking

Eye-tracking technology is an advanced method for measuring visual attention, providing detailed insights into how users interact with visual stimuli in various contexts. This technique involves the precise recording of eye movements, including fixations - where the gaze remains stationary - and saccades, which are rapid shifts between points of focus. By analysing these patterns, researchers can infer cognitive processes, engagement levels, and user behaviours, offering a window into the subconscious elements of decision-making (Duchowski, 2017).

Eye-tracking technology was employed in this study to objectively measure visual attention and user engagement during the online and AR eyewear shopping experiences. This method provides precise, real-time insights into how consumers navigate digital interfaces, including where their gaze lingers, how long they examine key product areas, and which elements capture their attention first. Recent research reinforces the relevance of eye-tracking in immersive retail settings. For example, Jang (2023) used eye-tracking to analyse consumer behaviour in a virtual reality fashion store, revealing that gaze distribution and fixation duration varied based on participants' involvement levels and product categories. Similarly, Xu et al. (2022) developed ARShopping, an in-store decision-support system that integrates eye-tracking and augmented reality to deliver detailed product information based on what the user is

looking at. These findings highlight the value of eye-tracking in identifying cognitive effort, visual interest, and usability issues in retail technologies. In the context of this study, eye-tracking was essential for comparing how consumers visually interact with eyewear options across AR and online modalities, offering objective data that complements self-reported survey responses and qualitative insights.

Advantages of Eye-Tracking

Eye-tracking offers several significant advantages as a data collection method. Firstly, it provides objective and precise data on user engagement. Unlike self-reported data, which can be subject to bias or inaccuracies, eye-tracking offers a direct and quantifiable measure of visual attention, capturing real-time behaviour (Duchowski, 2017). This is particularly advantageous when studying digital interfaces or physical layouts, where subtle differences in design can have profound impacts on user behaviour.

Another key benefit is the ability to generate detailed usability insights. Eye-tracking can pinpoint which elements of an interface or environment capture attention, and which are overlooked. For instance, in online shopping, it can identify whether users focus on product images or bypass critical sections like descriptions or reviews. Similarly, in AR, it can reveal how users navigate virtual spaces, providing data on areas of engagement and potential confusion (Hilken et al., 2017).

Eye-tracking also contributes to a comprehensive understanding of user behaviour. By mapping visual attention, it is possible to deduce user preferences, levels of cognitive load, and decision-making processes. For example, prolonged fixations on certain products or interface elements might indicate interest or difficulty, providing actionable insights for design improvements (Flavián et al., 2019).

Finally, eye-tracking facilitates cross-channel comparisons, which are integral to this study. The ability to directly compare visual attention patterns across in-store, online, and AR shopping environments enables a robust evaluation of how different channels engage users. This is crucial for understanding the relative strengths and limitations of each modality in delivering an effective consumer experience.

Disadvantages of Eye-Tracking

Despite its advantages, eye-tracking also presents several challenges. A primary limitation is its high cost and the need for specialized equipment. The technology requires sophisticated devices such as eye-tracking glasses or fixed screens, alongside analytical software capable of processing large datasets. This can significantly increase research costs, particularly in studies requiring a large sample size (Duchowski, 2017).

Furthermore, while eye-tracking provides precise data on where users look, it offers limited insights into why users focus on certain elements. For instance, a prolonged fixation on a product might indicate interest, confusion, or dissatisfaction, but additional methods, such as interviews or surveys, are needed to contextualize these observations (Creswell & Creswell, 2017).

Lastly, the complexity of data analysis can be a barrier. Eye-tracking generates large volumes of data that require specialized skills and software to interpret effectively. Identifying meaningful patterns and correlating them with broader research findings can be time-intensive and requires careful methodological rigor (Patton, 2015).

Application of Eye-Tracking in the Research Context

In the context of this research project, eye-tracking could be applied to evaluate and compare user interactions within in-store, online, and AR shopping channels. Each modality presents unique opportunities for eye-tracking analysis.

In in-store shopping, eye-tracking can measure how consumers interact with physical layouts, product displays, and promotional materials. For instance, it can assess whether promotional signage effectively captures attention or if certain product placements are overlooked. These insights are critical for understanding sensory engagement, a key component of the in-store shopping experience (Puccinelli et al., 2009).

In online shopping, eye-tracking can be used to analyse user interactions with e-commerce platforms. Specific metrics include time spent on product images, navigation pathways, and the effectiveness of call-to-action elements such as “add to cart” buttons. These data will provide valuable insights into the usability and efficiency of online shopping interfaces (Koufaris, 2002).

In AR environments, eye-tracking can evaluate how users explore virtual products or spaces. For example, it can reveal whether users focus on specific features of a virtual product or struggle with interface navigation. These findings are particularly relevant for assessing the immersive and interactive qualities of AR, which are central to its perceived value in high-involvement purchases (Hilken et al., 2017).

Challenges and Adaptations in Data Collection for In-Store Experiences

During the planning phase of this research, eye-tracking glasses were identified as an ideal tool for capturing visual engagement during the in-store shopping experience. However, practical challenges, including the high cost of equipment and logistical complexities, prevented their use. As a result, data collection using eye-tracking glasses in-store was cancelled. To overcome the lack of behavioural in the in-store method and to ensure broader coverage of in-store behaviours, observational techniques were employed with participants. This approach provided valuable data on consumer interactions within the store environment while addressing the lack of using eye-tracking with this shopping method.

Key Observations in the In-Store Experience:

When using observational methods, the following aspects were recorded to analyse consumer behaviour:

- Time Spent: Duration of time spent in different sections of the store.
- Product Interaction: Frequency and type of physical interactions with products (e.g., picking up, examining).
- Movement Patterns: Pathways taken within the store, including areas of congestion or avoidance.
- Engagement with Displays: Attention to promotional materials, signage, or displays.
- Decision-Making behaviours: Indicators of decision-making, such as hesitation, comparison of products, or consultation with others.
- Social Interactions: Conversations with staff or other shoppers and their influence on shopping decisions.
- Checkout Behaviour: Actions at the checkout counter, such as evaluating last-minute purchase options.

These observations provided rich behavioural data, contributing to a comprehensive understanding of the in-store shopping experience.

1.4 Mixed Research Method

A mixed research method integrates both qualitative and quantitative data collection to leverage the strengths of each approach (Tashakkori & Teddlie, 2003). This approach provides a comprehensive understanding of user experiences by capturing statistical data on shopping behaviours and deeper insights into consumer perceptions and emotional responses.

For this study on shopping experiences, a mixed-method approach was selected to combine numerical data from surveys with rich narrative data from interviews (See Figure 4). This blend allows for a more holistic analysis, capturing the complexity of user preferences across physical, online, and augmented reality environments. By applying both qualitative and quantitative analyses, this approach helps to uncover not only what people prefer in a shopping experience but also why they prefer it.

Eye-tracking will complement the mixed-methods approach adopted in this research, which combines quantitative data from surveys with qualitative insights from interviews. For example, eye-tracking metrics such as fixation duration or heatmaps can be correlated with survey responses on user satisfaction or engagement. This integration enables a more detailed analysis, linking behavioural data with reported experiences.

In addition, qualitative methods such as interviews will contextualize eye-tracking findings. For example, if participants display prolonged attention on a particular AR feature, follow-up interviews can clarify whether this reflects interest, confusion, or another factor. This triangulation enhances the validity and depth of the findings, addressing the limitations of relying on a single data source (Tashakkori & Teddlie, 2003).

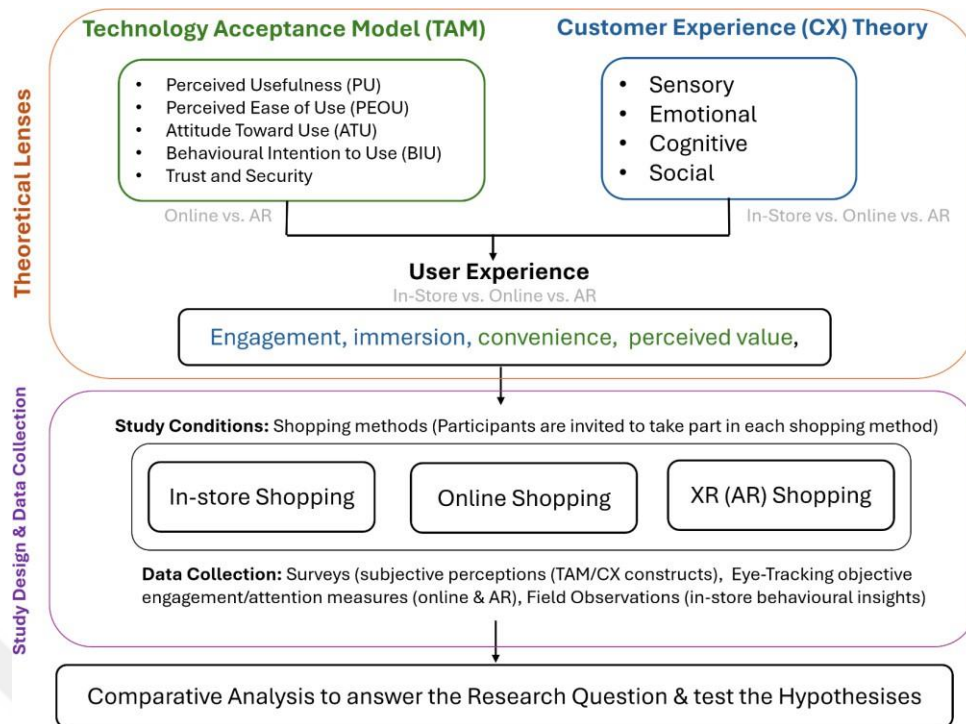


Figure 3.4: Research Theoretical Framework & Data Collection Method

Figure 5 presents the conceptual framework developed for this study, integrating the Technology Acceptance Model (TAM) with additional constructs derived from Customer Experience (CX) theory. The model illustrates the hypothesized relationships among key factors influencing consumer attitudes and purchase intentions across in-store, online, and XR eyewear shopping. Constructs such as perceived ease of use, usefulness, trust, and engagement interact to shape attitudes toward use and behavioural intention, ultimately leading to purchase decisions.

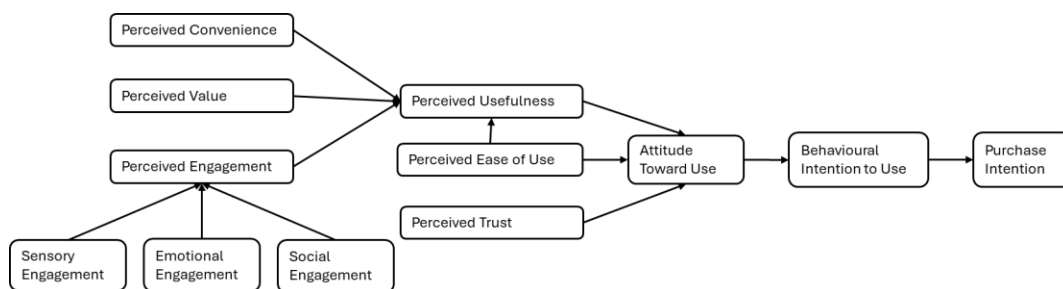


Figure 3.5: Conceptual Framework Integrating TAM and CX Constructs

1.5 Recruitment Strategy

This study employed a snowball sampling technique, leveraging personal and professional networks to recruit participants who had experience with one or more

eyewear shopping modalities, namely, in-store, online, and augmented reality (AR). The recruitment process began by inviting an initial group of eligible participants to take part in the study. These participants were then encouraged to share the study invitation with their own contacts, helping to organically expand the participant pool through peer referral.

To maximize reach and diversity, the study invitation and survey links were also distributed via social media platforms, mainly WhatsApp. This approach enabled the recruitment of participants from a range of backgrounds, age groups, and levels of familiarity with digital technologies, aligning with the study's goal of capturing a broad spectrum of consumer experiences.

The recruitment process yielded participation across three distinct data collection methods:

Quantitative Survey: 100 participants completed the three surveys about the in-store, online, and AR shopping experience, providing comparative data on satisfaction, engagement, usability, and purchase intentions across shopping channels (See 1.6 Material section). This ensured manageable data collection while enabling meaningful trend analysis and statistical reliability (Bryman, 2016; Saunders, Lewis, & Thornhill, 2019).

A total of 30 participants completed the Technology Acceptance Model (TAM) validated questionnaire (See 1.6 Materials) with both the online and AR shopping methods. Although the original TAM items were developed for general technology systems, this study adapts these items to the AR/online shopping context, following the approach of similar studies (e.g., Poushneh & Vasquez-Parraga, 2017; Yim et al., 2017), which modified TAM constructs to suit the AR retail environment. The adapted items reflect the unique affordances of AR, such as enhanced product visualization and interactivity, which are central to consumer decision-making in digital retail.

Eye-Tracking Data: 40 participants engaged in eye-tracking tasks in both the online and AR shopping method. This component, provided detailed insights into visual engagement and attention patterns across the two shopping modalities (Cohen et al., 2018).

Qualitative Observation and Interviews: A smaller group of 15 participants took part in observational sessions and semi-structured interviews (See 1.6 Materials), allowing for deeper exploration of behaviours, preferences, and contextual factors influencing eyewear shopping experiences. This subset allowed for the collection of rich, qualitative data that complemented the broader quantitative findings (Patton, 2015).

Inclusion and Exclusion Criteria

The sampling process adhered to the following criteria to ensure the relevance and reliability of the data:

- **Inclusion Criteria:**

- Participants must be at least 18 years old.
- Must have prior experience with one or more of the shopping methods under study (in-store, online, or AR).
- Willingness to provide informed consent and participate in one or more data collection methods, including surveys, eye-tracking, interviews, or observations.

- **Exclusion Criteria:**

- Participants with no prior experience in any of the shopping modalities under investigation.

1.6 Materials:

The following table (1) maps each survey question from the first questionnaire of the three shopping methods (in-store, online, and AR) to the relevant theoretical constructs and literature. This mapping demonstrates the alignment of each item with established frameworks, including the Technology Acceptance Model (TAM) and Customer Experience (CX) theory, as well as supporting references from the literature review.

Table 3.1: Mapping Consumer Experience Survey Questions to Theoretical Background and Literature

Survey Question	Construct / Theme	Theory & References
To what extent did the [online/in-store/AR] method provide useful product information?	Information Quality / Usefulness	TAM (Davis, 1989; Gefen et al., 2003)
How valuable was the [online/in-store/AR] shopping method in helping you evaluate the product before purchase?	Perceived Value	TAM; CX (Davis, 1989; Hilken et al., 2017; Puccinelli et al., 2009)
How well did the [online/in-store/AR] shopping method allow you to experience the product's physical qualities?	Sensory Experience / Product Fit	CX (Hilken et al., 2017; Flavián et al., 2019; Puccinelli et al., 2009)
How easy was it to use the [online/in-store/AR] shopping method to find the product you were looking for?	Ease of Use	TAM (Davis, 1989; Koufaris, 2002)
How convenient was the method compared to others?	Convenience	CX (Rose et al., 2012; Koufaris, 2002)
How much time was needed?	Time Efficiency	CX (Rose et al., 2012)
How satisfied were you with the time it took to complete your shopping experience?	Time Satisfaction	CX (Rose et al., 2012)
How likely are you to purchase online in the future?	Behavioural Intention	TAM (Davis, 1989; Venkatesh & Davis, 2000)
How enjoyable did you find the [online/in-store/AR] shopping method?	Enjoyment	CX (Flavián et al., 2019; McLean & Wilson, 2019)
Do you feel the [online/in-store/AR] shopping method provided a good product representation?	Product Representation	CX (Hilken et al., 2017; Flavián et al., 2019)
How well did the [online/in-store/AR] shopping method allow you to experience the product's physical qualities?	Sensory Experience / Product Fit	CX (Hilken et al., 2017; Flavián et al., 2019; Puccinelli et al., 2009)
Did the [online/in-store/AR] shopping experience feel immersive (i.e., engaged your senses and attention)?	Immersion / Sensory Engagement	CX (Flavián et al., 2019; Hilken et al., 2017)
Did the [online/in-store/AR] shopping method influence your confidence in making a purchase decision?	Decision Confidence / Trust	TAM; CX (Gefen et al., 2003; Poushneh & Vasquez-Parraga, 2017)
How engaged did you feel during the [online/in-store/AR] shopping experience?	Engagement	CX (Flavián et al., 2019; Pantano & Vannucci, 2019)

Did you feel socially engaged/connected? (e.g., interactions with staff/customers)	Social Engagement	CX (Puccinelli et al., 2009; Pantano & Vannucci, 2019)
How satisfied are you with your recent shopping experience [online/in-store/AR]?	Overall Satisfaction	CX (Puccinelli et al., 2009; Rose et al., 2012)
How satisfied were you with the time it took to complete your shopping experience with [online/in-store/AR]?	Time Satisfaction	CX (Rose et al., 2012)
Was the [online/in-store/AR] shopping experience available at times that were convenient for you?	Accessibility / Convenience	CX (Rose et al., 2012; Verhoef et al., 2009)
Was the [online/in-store/AR] shopping experience available at locations that were convenient for you?	Accessibility / Convenience	CX (Rose et al., 2012; Verhoef et al., 2009)

The following table (2) maps each item from the Technology Acceptance Model (TAM) survey used in this study to key theoretical constructs and supporting literature. This mapping demonstrates the theoretical basis and relevance of each survey question in assessing user acceptance of both AR and online shopping experiences.

Table 3.2: Mapping TAM Survey Questions to Relevant Literature

Section/Construct	Survey Question	Item Code	Relevant Literature/Theoretical Background
Perceived Usefulness (PU)	Using [online shopping/AR shopping] would enable me to accomplish shopping tasks more quickly.	PU1	Davis (1989); Gefen et al. (2003); Rose et al. (2012)
	Using [online shopping/AR shopping] would improve my shopping performance.	PU2	Davis (1989); Gefen et al. (2003); Hilken et al. (2017)
	Using [online shopping/AR shopping] would increase my productivity when shopping.	PU3	Davis (1989); Rose et al. (2012); McLean & Wilson (2019)
	Using [online shopping/AR shopping] would enhance my effectiveness as a shopper.	PU4	Davis (1989); Hilken et al. (2017); Flavián et al. (2019)

	Using [online shopping/AR shopping] would make it easier to complete my shopping.	PU5	Davis (1989); Koufaris (2002); Rose et al. (2012)
	I would find [online shopping/AR shopping] useful for my needs.	PU6	Davis (1989); Gefen et al. (2003); Poushneh & Vasquez-Parraga (2017)
Perceived Ease of Use (PEOU)	Learning to use [online shopping/AR shopping] would be easy for me.	PEOU1	Davis (1989); Koufaris (2002); McLean et al. (2020); Rose et al. (2012)
	I would find it easy to get [online shopping/AR shopping] to do what I want it to do.	PEOU2	Davis (1989); Koufaris (2002); Hilken et al. (2017)
	My interaction with [online shopping/AR shopping] would be clear and understandable.	PEOU3	Davis (1989); Koufaris (2002); Hilken et al. (2017); McLean et al. (2020)
	I would find [online shopping/AR shopping] easy to use.	PEOU4	Davis (1989); Koufaris (2002); Hilken et al. (2017); Rose et al. (2012)
	It would be easy for me to become skillful at [online shopping/AR shopping].	PEOU5	Davis (1989); Koufaris (2002); Hilken et al. (2017)
	I would find [online shopping/AR shopping] easy to use overall.	PEOU6	Davis (1989); Koufaris (2002); Rose et al. (2012)
Attitude Toward Use (ATU)	I enjoy using [AR/online] for shopping.	ATU1	Venkatesh & Davis (2000); Flavián et al. (2019); McLean & Wilson (2019)
	Using [AR/online] shopping is a good idea.	ATU2	Venkatesh & Davis (2000); Flavián et al. (2019)
	I find [AR/online] shopping fun and engaging.	ATU3	Flavián et al. (2019); Pantano & Vannucci (2019)
Behavioural Intention to Use (BIU)	I intend to use [AR/online] shopping in the future.	BIU1	Davis (1989); Venkatesh & Davis (2000); McLean & Wilson (2019)
	I will frequently use [AR/online] shopping if it is available.	BIU2	Davis (1989); Venkatesh & Davis (2000)
	I would recommend [AR/online] shopping to others.	BIU3	Davis (1989); Venkatesh & Davis (2000); McLean & Wilson (2019)

Trust and Security	I trust the information provided through [AR/online] shopping.	TS1	Gefen et al. (2003); Poushneh & Vasquez-Parraga (2017); Rose et al. (2012)
	I feel secure using [AR/online] shopping systems.	TS2	Gefen et al. (2003); Rose et al. (2012)

The following interview questions were designed to explore participants' experiences and perceptions across online, in-store, and augmented reality (AR) shopping methods. These open-ended questions aim to gain deeper insights into factors influencing engagement, perceived usefulness, ease of use, convenience, and overall value within each shopping channel.

1. Can you describe aspects of the [online/in-store/AR] experience that made it more (or less) engaging?
2. What specific features did you find most useful in the [online/in-store/AR] shopping experience?
3. Were there any aspects of the [online/in-store/AR] method that made it difficult or confusing to use?
4. What about the [online/in-store/AR] experience influenced your likelihood to purchase?
5. What factors made the [online/in-store/AR] shopping method convenient or inconvenient?
6. Can you explain how the [online/in-store/AR] shopping experience influenced your view of the product's value?

1.7 Data Analysis Techniques

Both qualitative and quantitative data will be analysed to achieve a comprehensive understanding of consumer experiences.

Quantitative Data Analysis

Quantitative data from surveys will be analysed using descriptive and inferential statistical methods:

- Descriptive Statistics: Measures of central tendency (mean, median) and distribution (standard deviation) will summarize consumer preferences and behaviours.
- Inferential Statistics: Statistical tests, such as t-tests, will identify any significant differences between shopping experiences across modalities.

Qualitative Data Analysis

Qualitative data from interviews and open-ended survey responses will undergo thematic analysis, following Braun and Clarke's (2006) six-step process:

1. Familiarization: Immersing in the data by reading and re-reading transcripts and notes.
2. Generating Initial Codes: Systematically coding segments of data relevant to the research questions.
3. Searching for Themes: Grouping codes into potential themes that capture key patterns.
4. Reviewing Themes: Ensuring themes accurately represent the data and align with the research questions.
5. Defining and Naming Themes: Refining themes for clarity and coherence.
6. Writing the Report: Integrating themes into the final analysis, providing representative quotes and interpretations.

2. Reliability and Validity

Ensuring the reliability and validity of the data is critical to maintaining the integrity of the research findings.

- Reliability: The survey will be pilot-tested to ensure questions are clear and produce consistent results.
- Validity: To ensure validity, both the survey and interview questions will be based on existing literature on consumer behaviour. Triangulation of data from multiple sources (surveys, interviews, observations) will further enhance the validity by providing a more nuanced understanding of consumer experiences.

3. Obtain Brand Approval, Process and Challenges

Initially, a store was approached, and the researcher spoke with the staff to explain the research objectives and study design. The store employees were highly enthusiastic about the project; however, they were unable to provide guidance on how to obtain official approval. Instead, they provided a customer service contact number for further inquiries regarding research permissions.

Following this lead, I contacted the customer service department and managed to speak with a representative. The team member followed up on our conversation by sending an email with details about the approval process (A copy of the email can be found in Appendix A), including a relevant form that needed to be completed. However, during the call and in the follow-up email, it was clearly stated that due to high volumes of requests, the company would only respond to research inquiries if they had an interest in collaborative research.

Unfortunately, despite submitting the necessary forms and waiting for a response, the company did not follow up on my inquiry. As a result, the brand name will not be explicitly mentioned in this thesis, and any images included that feature the brand will have the name blurred to maintain anonymity. This challenge highlights the difficulty of securing official partnerships with established retail brands, particularly when their internal research policies prioritize selective collaborations

4. Pilot Study

Before launching the full-scale study, a pilot study was conducted to assess the clarity, wording, and structure of the survey questions. This preliminary step aimed to identify any ambiguities or issues in question phrasing, as well as to refine the overall flow and logical order of the questionnaire. In addition, the pilot study provided an opportunity to test the Participant Information Sheet (PIS) and Consent Form (See Appendix B & C), ensuring that they were clear, comprehensive, and aligned with ethical requirements.

The primary objectives of the pilot study were:

1. To test the clarity and wording of the survey questions.

2. To assess the logical flow and order of the questions.
3. To ensure the PIS and Consent Form were easily understandable and met ethical standards.
4. To identify any technical or procedural issues that could arise during the main data collection phase.

The pilot study was conducted with three participants, who were selected to represent the target demographic of the main study. These participants were asked to complete the survey and provide feedback on:

1. Question clarity: Were the questions easy to understand?
2. Wording precision: Did any questions require rewording for better comprehension?
3. Question order: Did the order of the questions flow logically?
4. PIS and Consent Form clarity: Were the documents clear and informative?

Participants were also encouraged to share any general observations or difficulties they encountered while completing the survey. Following an iterative process, I made adjustments after each participant's feedback and tested the new version with the next participant. For example, one participant was unsure about the meaning of the term "immersive". Based on their suggestion, I added an explanation in the question to clarify that it refers to how engaging the experience is for the senses and attention. Another participant was unclear about the term "socially engaged," so I included a brief explanation stating that it refers to interactions with staff or other customers. These changes aimed to improve clarity and ensure that all participants interpreted the questions in a consistent way. In addition, questions about practical convenience factors (such as time and location) were moved to the end of the survey, after the main shopping experience questions, to create a smoother logical flow. The expected time to complete the full study was also included in the Participant Information Sheet (PIS), based on participants' feedback, to help manage expectations and ensure transparency. Some technical issues, such as ensuring that the survey link was anonymous and accessible to all potential participants without requiring an email login, were also resolved during this phase.

The pilot study proved to be a valuable step in refining the research instruments. By identifying and addressing potential issues early on, the study ensured that the final

survey was clear, well-structured, and user-friendly. These improvements helped enhance the overall reliability and validity of the data collection process for the main study.

5. Procedure

In-Store Shopping Data Collection

Fifteen participants were observed as they shopped in the store to buy a pair of glasses. During these sessions, the researcher noted their behaviours, interactions, and decision-making processes. At the end of their shopping experience, these participants were asked to complete the in-store survey to evaluate their experience. The remaining participants were given the flexibility to visit the store in their own time to shop and then complete the in-store survey afterward. If they had already shopped for glasses in the last six months, they were instructed to answer the survey based on their most recent in-store shopping experience.

Online Shopping Data Collection

For the online shopping experience, 40 face-to-face sessions were conducted where participants were asked to shop for a pair of glasses using an online platform. During these sessions, eye-tracking technology was employed to capture participants' gaze patterns, browsing behaviours, and decision-making processes. After completing their online shopping session, participants filled out a survey assessing their online shopping experience. The remaining participants were instructed remotely to browse the retailer's website for a pair of glasses and then complete the online shopping survey.

Augmented Reality (AR) Shopping Data Collection

The same procedure used for online shopping was applied to the AR shopping experience. Forty participants engaged in face-to-face sessions where they used AR tools to try on glasses virtually. Eye-tracking was used to analyse their interactions with the AR interface, including how they viewed and selected frames. After completing their AR shopping session, participants were asked to complete the relevant survey. The remaining participants were instructed remotely to browse the AR shopping experience on their own and complete the AR shopping survey afterward.

6. Mapping Hypotheses to Data Collection Methods

To ensure methodological coherence and strengthen the study’s validity, each hypothesis was explicitly aligned with one or more data collection methods. The table below presents a mapping of the research hypotheses (H1–H8) to the corresponding methods used in this study (surveys, interviews, observations, and eye-tracking) along with a brief justification for each pairing. This alignment clarifies how the mixed-methods approach supported the testing of both descriptive and causal relationships.

Table 3.3: Mapping of the research hypotheses to the corresponding methods used in this study

Hypothesis	Data Collection Method(s)	Justification
H1: In-store satisfaction > others	Survey, Interview	Satisfaction scores collected via Likert-scale items; interviews probed reasons for preference.
H2: AR engagement > others	Survey, Interview, Eye-tracking	Engagement assessed via self-report and AR visual attention (fixation, heatmaps).
H3: Online easiest, AR most useful	Survey	TAM constructs measured with validated items (PEOU, PU).
H4: AR impact on premium intent	Survey, Eye-tracking	Survey measured purchase intent; eye-tracking assessed attention to premium features.
H5: Online preferred for convenience	Survey	Survey captured convenience perception using structured items.
H6: AR delivers higher perceived value	Survey	value-based survey items measured consumer perceptions.
H7: In-store = sensory/social; AR = immersive	Interview, Observation, survey	Observations noted tactile/social cues; interviews captured emotional reactions.
H8: Younger prefer AR	Survey	Age demographics cross-analysed with TAM/engagement responses.

7. Summary

This chapter outlined the methodology used in the study, including the definitions of qualitative and quantitative data, primary and secondary data sources, and reviews of

various data collection methods. By adopting a mixed research method, this study aims to provide both depth and breadth in understanding how consumers navigate different shopping environments. This approach is essential to address the nature of consumer experiences in an increasingly digital and immersive shopping landscape.



Chapter 4: Ethical Considerations in Data Collection

1. Introduction

This study, conducted as part of an MBA degree at Kültür University in Turkey. The ethical approach followed aligns with Turkish legal frameworks and cultural sensitivities to protect participant rights and well-being. Ethical approval has been obtained from the ethical committee.

The following ethical considerations guided this research:

1. Informed Consent

- All participants received a clear, detailed information sheet that outlines the study's purpose, procedures, potential risks, and benefits.
- This information includes an overview of the study's aim to understand shopping experiences across AR, online, and in-store channels, as well as the methods used for data collection (e.g., surveys, interviews).
- Participants were informed of their right to withdraw from the study at any time, without any consequence, and must provide written consent before participation.

2. Privacy and Confidentiality

- This study complies with Turkey's Personal Data Protection Law (KVKK), ensuring that all personal data collected, stored, and processed is legally protected.
- Whenever possible, data were anonymized to prevent it from being linked to participants' personal identities.
- Data will be securely stored, with access limited to authorized personnel only, preserving the integrity and confidentiality of participant information.

3. Avoiding Deception and Harm

- Participants who attended the face to face sessions were monitored for signs of distress and allowed to pause or withdraw at any point.

4. Data Ethics

- The study Participants Information Sheet specified data intended uses.

5. Participant Autonomy

- Participants were free to withdraw from the study at any time without repercussions.
- Recruitment materials and processes emphasised voluntary participation to avoid implicit pressure on potential participants.

2. Conclusion

These ethical considerations are essential to ensure that the research is conducted responsibly, and transparently. By adhering to ethical best practices, and ensuring research transparency, this study aims to contribute valuable insights into the research field while upholding participant trust and rights.

Chapter 5: Results and Discussion

Comparative Analysis of Shopping Experiences: In-Store, Online, and AR

1. Introduction

As discussed in previous chapters the retail landscape has evolved significantly with the introduction of AR technologies, supplementing traditional in-store and online shopping experiences. As consumer shopping behaviour shifts, it was crucial to understand how different shopping modalities impact user experience. This chapter presents the key findings of this research project, which examined consumer experiences across in-store, online, and augmented reality (AR) eyewear shopping channels. Drawing on survey responses, eye-tracking data, and qualitative feedback, the chapter explores differences in satisfaction, engagement, and purchase confidence. The results are discussed in relation to the study's research questions and theoretical framework, offering insights into the comparative strengths and limitations of each shopping method.

2. Data Analysis

Since the data did not follow a normal distribution, non-parametric tests were employed for the analysis to ensure statistical validity and robustness of the results. The study utilized descriptive statistics, Friedman's test, Kruskal-Wallis's test, and Wilcoxon signed-rank tests to compare differences across shopping methods.

In this study, several key consumer experience dimensions (such as satisfaction, engagement, usefulness, and ease of use) in the first survey were measured using single-item questions rather than multi-item scales. This approach was chosen to reduce participant burden and align with the exploratory nature of the research, which compares three distinct shopping modalities (in-store, online, and AR) (Castro, et al.,

2023). Single-item measures are commonly used in consumer experience and technology adoption research when constructs are straightforward and easily understood, such as satisfaction or likelihood of future use (Bergkvist & Rossiter, 2007). As each item was analysed independently, internal consistency measures such as Cronbach's alpha were not applied across all survey items. Instead, individual item responses were examined to compare perceptions across modalities, supported by descriptive and inferential statistics. While this approach limits the ability to assess internal scale reliability, it is suitable for early-stage, comparative research where brevity and clarity are important for participant engagement (Fuchs & Diamantopoulos, 2009).

In addition to the custom survey items used for exploring the overall shopping experience, a validated version of the Technology Acceptance Model (TAM) questionnaire was employed to assess constructs such as Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Toward Use (ATU), Behavioural Intention to Use (BIU), and Trust. This TAM questionnaire has been widely used in information systems and retail technology research and was adapted in this study to specifically evaluate the AR and online eyewear shopping experiences. The items were based on validated scales developed by Davis (1989) and extended by Venkatesh and Davis (2000), with adaptations guided by recent studies that applied TAM to AR retail settings (e.g., Poushneh & Vasquez-Parraga, 2017; McLean & Wilson, 2019). The use of a validated instrument strengthens the reliability and comparability of findings related to consumer technology adoption behaviours. Cronbach's alpha was calculated for all survey scales to assess internal consistency. All subscales achieved $\alpha > 0.70$, indicating acceptable reliability.

Both interview and observational notes were analysed using Braun and Clarke's (2006) six-phase thematic analysis approach. This method provided a structured and flexible way to identify meaningful patterns across qualitative data. After transcribing the interviews and organizing observation notes, familiarisation with the data was followed by initial coding focused on shopping behaviours, sensory engagement, and social interaction. Codes were then grouped into broader themes such as decision hesitation, confidence-building interactions, display engagement, and barriers to convenience. These themes were reviewed and refined to ensure consistency and relevance. By combining interview insights with real-world behavioural observations,

this approach enabled a deeper understanding of how consumers experienced and navigated each shopping environment.

3. Results & Discussion

3.1 Descriptive Statistics

The descriptive analysis revealed clear differences in consumer perceptions of each shopping method. Satisfaction scores as shown in Figure 5 were highest for in-store shopping (M = 3.87, SD = 1.07), followed by AR shopping (M = 3.77, SD = 1.14), while online shopping received the lowest scores (M = 3.44, SD = 1.21).

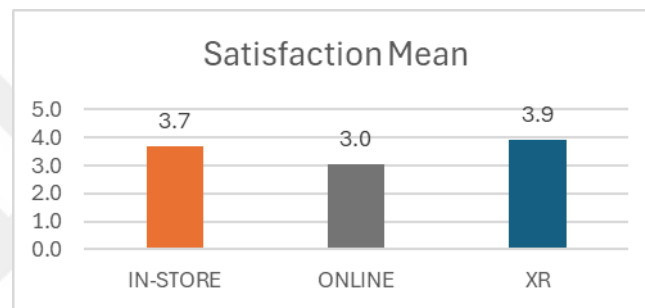


Figure 5.6: Participants' Satisfaction Ratings for in-store, online and AR shopping methods

The Figure 6 shows a comparison of whether different shopping methods, in-store, online, and AR, met consumer expectations. The results are fairly balanced across all three methods, with a slightly higher percentage of respondents indicating that their experience did not fully meet expectations.

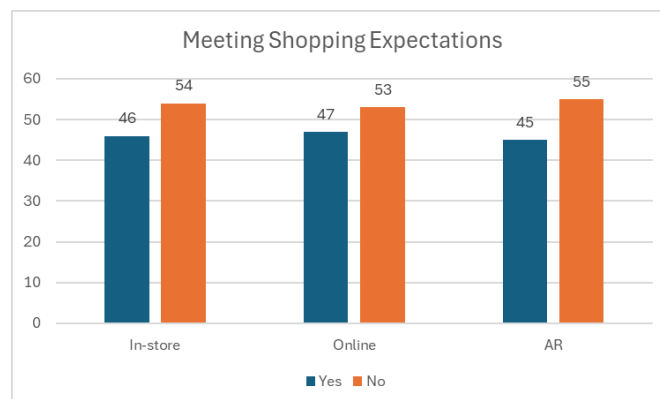


Figure 5.7: Participants' Ratings for in-store, online and AR shopping methods meeting shopping expectations

Specifically, 54% of in-store shoppers, 53% of online shoppers, and 55% of AR shoppers reported that their expectations were not entirely met, while 46%, 47%, and

45%, respectively, felt that their expectations were met. While there are small differences, the overall trend suggests that consumer expectations vary across shopping methods, with none standing out as significantly more or less satisfactory than the others.

Engagement levels as shown in Figure 7 were significantly different across the shopping methods, with in-store shopping ($M = 3.57$, $SD = 1.08$) and AR shopping ($M = 3.63$, $SD = 1.09$) yielding higher engagement than online shopping ($M = 3.44$, $SD = 1.21$).

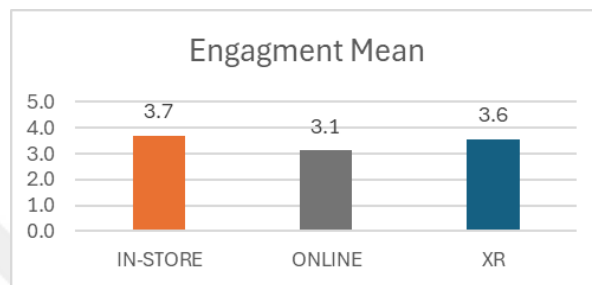


Figure 5.8: Participants' Engagement Ratings for in-store, online and AR shopping methods

The most engaging aspects of in-store shopping as noted in the interviews included "talking to store staff", "trying products in real-time", and "interactive store environment". Some participants also noted that a "busy environment reduced engagement". In the online shopping experience engagement was mostly tied to "easy navigation", "reading customer reviews", and "clear product information". However, some users described the experience as "standard" or "lacking personal interaction". Consumers found AR shopping engaging due to "fun interaction", "smooth tracking", and "realistic visuals".

The Figure 8 illustrates whether consumers found their in-store, online, and AR shopping experiences immersive, meaning they engaged their senses and attention. The results show a close balance between those who felt immersed and those who did not across all three shopping methods. In-store and online shopping both received a 52% "Yes" response, indicating a similar level of perceived immersion, while AR shopping had a slightly lower "Yes" response at 47%. Conversely, 48% of in-store and online shoppers and 53% of AR shoppers reported that their experiences did not feel immersive. These findings suggest that traditional and online shopping are perceived as slightly more immersive than AR, though the differences are relatively small, highlighting varied consumer experiences across shopping formats.

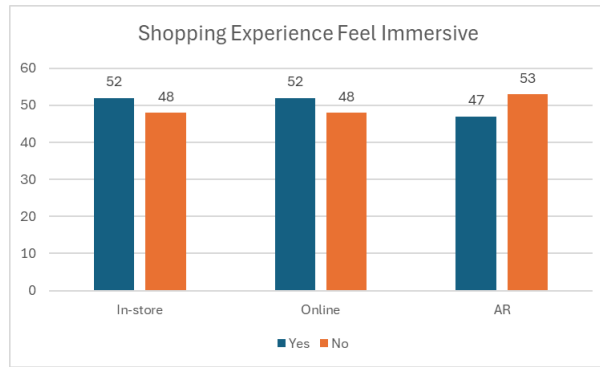


Figure 5.9: Participants' Immersions Ratings for in-store, online and AR shopping methods

The mean enjoyment ratings for in-store, online, and XR shopping experiences are shown in Figure 9. In-store shopping received the highest enjoyment score ($M = 3.8$), followed closely by XR shopping ($M = 3.7$), indicating that consumers found these two shopping methods relatively enjoyable. In contrast, online shopping had the lowest enjoyment rating ($M = 3.1$), suggesting that it may offer a less engaging or fulfilling experience compared to the other two methods. These findings imply that while digital shopping methods like XR can approach the enjoyment levels of traditional in-store shopping, online shopping still lags behind in providing an engaging and enjoyable experience.

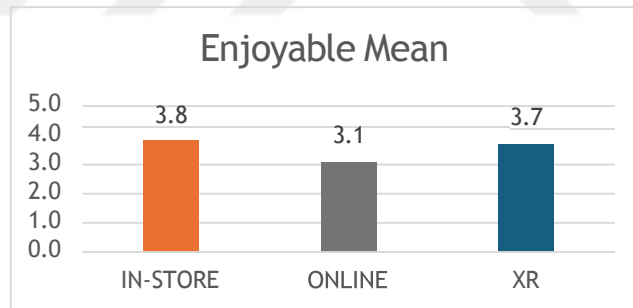


Figure 5.10: Participants' Enjoyment Ratings for in-store, online and AR shopping methods

Ease of use to find the products as shown in Figure 10 was rated highest for online shopping ($M = 3.77$, $SD = 1.14$), which was significantly higher than AR shopping ($M = 3.44$, $SD = 1.21$) and in-store shopping ($M = 3.61$, $SD = 1.18$).

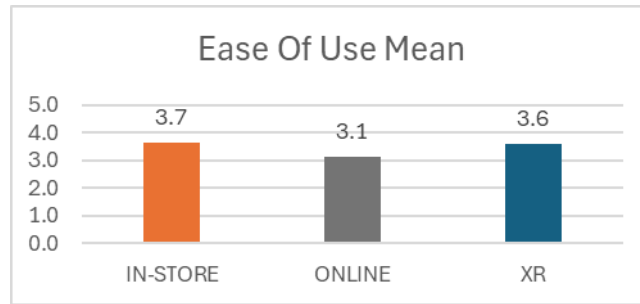


Figure 5.11: Participants' Ratings of Ease of Use for in-store, online and AR shopping methods

The Figure 11 presents the mean usefulness ratings for in-store, online, and AR shopping methods in providing product information. AR shopping received the highest usefulness score ($M = 3.8$), followed closely by in-store shopping ($M = 3.7$), indicating that both methods were perceived as valuable sources of product information. In contrast, online shopping had the lowest usefulness rating ($M = 3.0$), suggesting that consumers found it less informative compared to in-store and AR experiences. These results highlight the strength of interactive and immersive shopping methods (in-store and AR) in conveying useful product details, while online shopping may lack the depth of information needed for confident purchase decisions.

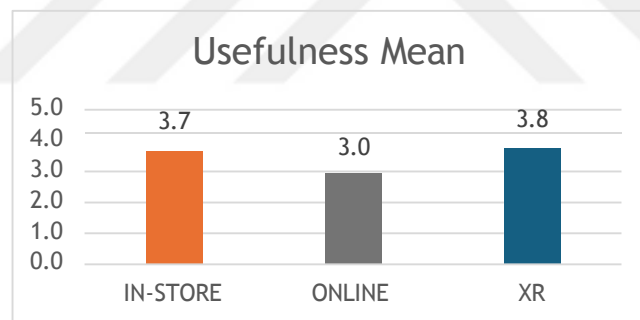


Figure 5.12: Participants' Usefulness Ratings for in-store, online and AR shopping methods

The interviews suggested that the most useful features varied across in-store, online, and AR shopping experiences, highlighting the unique strengths of each shopping method. For in-store shopping, participants highly valued seeing real colours and textures, trying different sizes, and checking how glasses fit under different lighting conditions. In addition, interacting with knowledgeable staff and receiving immediate feedback were frequently mentioned as beneficial aspects of the in-store experience. These findings suggest that the tactile, real-world interaction and personalized assistance offered by physical stores play a crucial role in enhancing product evaluation and decision-making.

In the online shopping experience, participants found customer reviews, detailed product specifications, and high-quality product images to be the most useful features. Live chat support and price comparison tools were also frequently mentioned, indicating that online shoppers rely heavily on external information and customer feedback to make informed purchasing decisions. The importance of these digital tools highlights the role of transparency and accessibility of information in bridging the gap created by the lack of physical interaction with products.

For AR shopping, the most useful features revolved around enhanced visualization and interactivity. Participants particularly appreciated colour selection tools, comparison views, face tracking, and lighting effects, which helped simulate real-world conditions. Try-on accuracy was another key factor, suggesting that participants value AR's ability to provide a realistic preview of products before purchase. These findings highlight AR's potential to improve confidence in online shopping by offering a more interactive and immersive experience.

Overall, the results indicate that in-store shopping excels in physical interaction and expert guidance, online shopping relies on information accessibility and user feedback, while AR enhances visualization and interactivity to support product evaluation. Each shopping method has distinct advantages, reinforcing the need for retailers to optimize their platforms based on consumer preferences.

The eye-tracking data provides insights into participants attention patterns during online shopping, highlighting the importance of product information and pricing in decision-making.

The gaze plot (Figure 12) illustrates how users navigated the page, with a strong concentration of fixations on the product images, pricing details, and promotional pop-ups. This suggests that consumers actively seek pricing and promotional information before making purchase decisions. Additionally, fixations on product descriptions and specifications indicate a desire for detailed information to support decision-making.

The heatmap visualization (Figure 12) reinforces these findings, showing intense areas of focus on product images, pricing, and discount offers. High engagement with these elements suggests that price transparency and product visuals are crucial factors in capturing consumer interest. The relatively lower attention on additional product

details suggests that while specifications are important, consumers prioritize visual assessment and pricing when evaluating options.

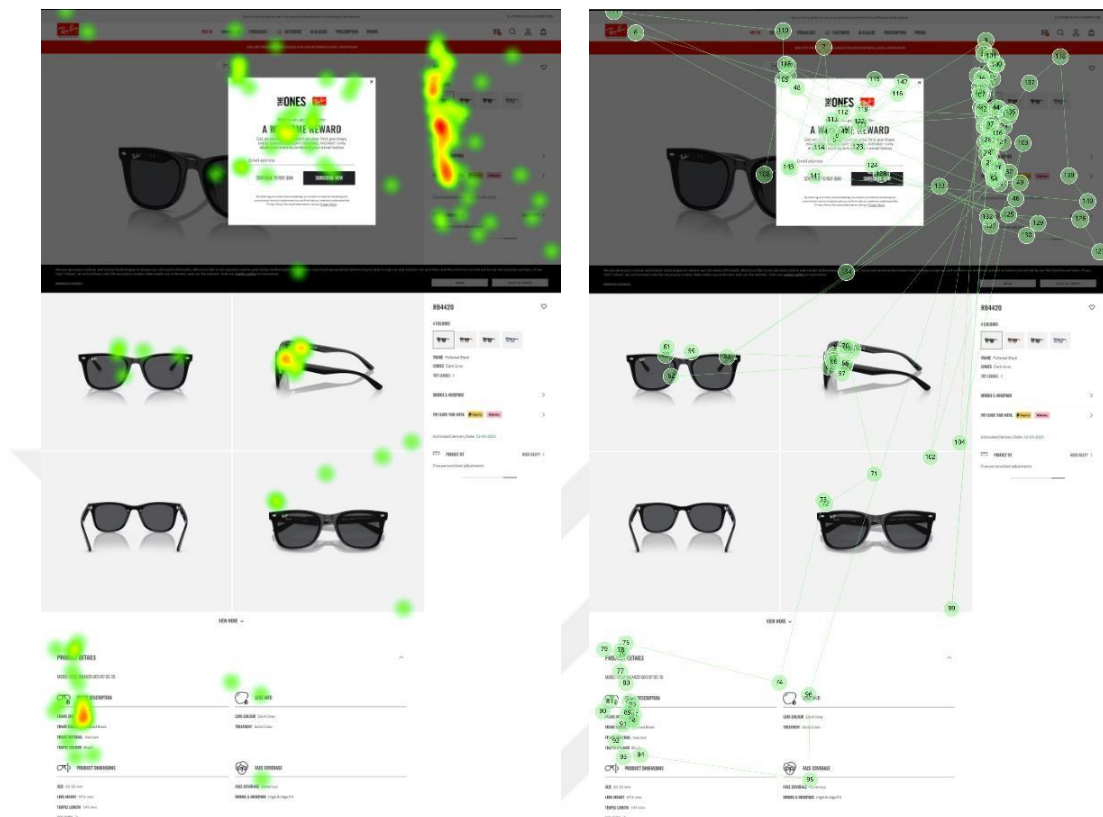


Figure 5.13: Heatmap and Gaze Plot of Participants Interaction with website in the online method

Overall, these findings emphasize the critical role of clear and accessible pricing, high-quality product visuals, and strategic placement of promotional content in enhancing the online shopping experience. Retailers can leverage these insights to optimize their digital storefronts by ensuring pricing information is easily visible, images are high resolution, and product descriptions are both concise and informative.

The Figure 13 illustrates whether different shopping methods, in-store, online, and AR, made it easier for consumers to make a purchase decision. In-store shopping had the highest percentage of participants (52%) indicating that it helped them make a purchase decision, with only 48% saying otherwise. In contrast, online shopping had the lowest percentage (47%) finding it easy to decide, while 53% reported difficulty in making a purchase decision. The responses for AR shopping were evenly split at 50%, suggesting that while some consumers found AR helpful in decision-making, others still experienced uncertainty. These results indicate that in-store shopping

remains the most effective in facilitating purchase decisions, while online shopping presents the most challenges, with AR falling in between.

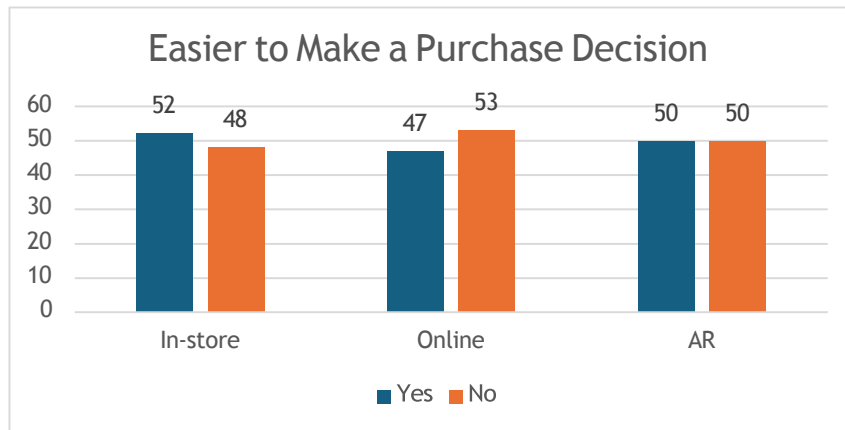


Figure 5.14: Participants' Ratings on the Ease of Making a Purchase Decision Using the In-store, online and AR methods

In the In-store shopping experience, many participants in the interviews mentioned that "seeing a product in real life increased trust", while others felt that it "matched expectations" or "felt less premium than expected". When shopping online, some participants noted that they "felt unsure about the product until receiving it", indicating a lack of trust in product representation. Others stated that online shopping "felt more expensive than it seemed". Responses were mixed with AR shopping experience. Some found AR experiences "confirmed their purchase choice", while others expressed "neutral influence" or "raised doubts" about product accuracy.

The confidence in making a purchase decision as shown in Figure 14 was found to be the highest score for in-store ($M=3.8$), suggesting that consumers feel the most assured when making purchasing decisions in physical stores. AR shopping followed closely with a score of 3.6, indicating that immersive technologies help boost consumer confidence. Online shopping had the lowest confidence score ($M = 3.3$), suggesting that consumers may feel less certain about their purchases when shopping online compared to in-store and AR experiences. These results indicate that while traditional shopping remains the most confidence-inspiring, AR has the potential to bridge the gap by offering interactive and engaging product exploration.

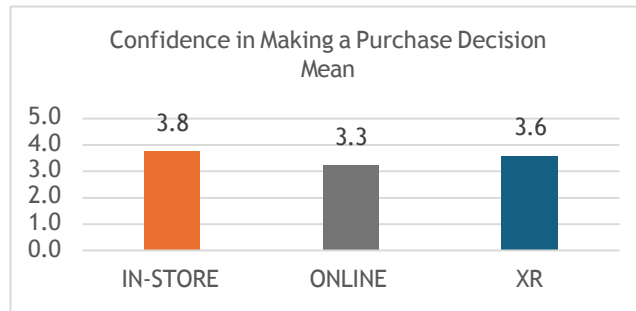


Figure 5.15: Participants Ratings on their confidence in making a purchase decision

Further analysis (See Figures 15, 16, & 17) of participants responses on relative confidence levels across the three shopping methods supports this trend. Many participants reported being more confident in in-store shopping compared to both online and AR, reinforcing the idea that physical interaction with products and real-time assistance play a crucial role in purchase decision-making. A substantial number of respondents felt more confident in AR shopping than online shopping but less confident than in-store shopping, indicating that AR offers a more immersive and reliable product evaluation than online shopping, though it does not yet fully replace the tangible benefits of in-store experiences.

Online shopping was generally perceived as the least confidence-inducing, with many respondents reporting lower confidence when making purchase decisions through online channels. However, a subset of participants expressed equal confidence across all shopping methods, suggesting that for certain consumers, the shopping format may not significantly impact their confidence levels.

Overall, these findings reinforce the notion that in-store shopping continues to be the most trusted method for confident purchasing, while AR is emerging as a viable alternative that enhances product evaluation compared to traditional online shopping. To further bridge the confidence gap, retailers may benefit from enhancing AR features and improving online product presentation, making digital shopping experiences more interactive and engaging.

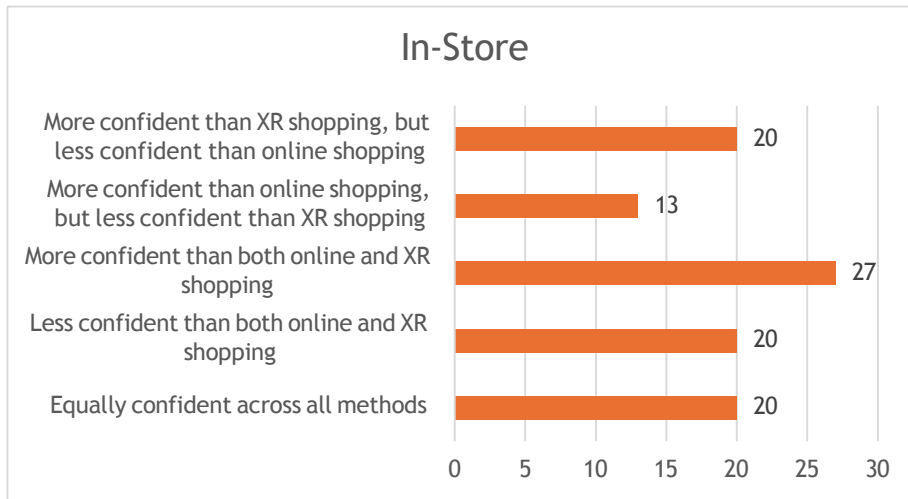


Figure 5.16: Participants' confidence levels in in-store shopping method

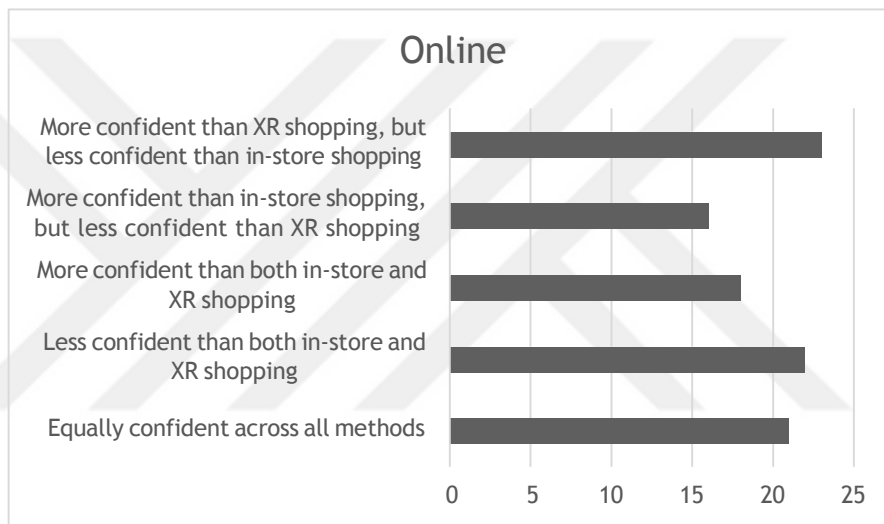


Figure 5.17: Participants' confidence levels in online shopping method

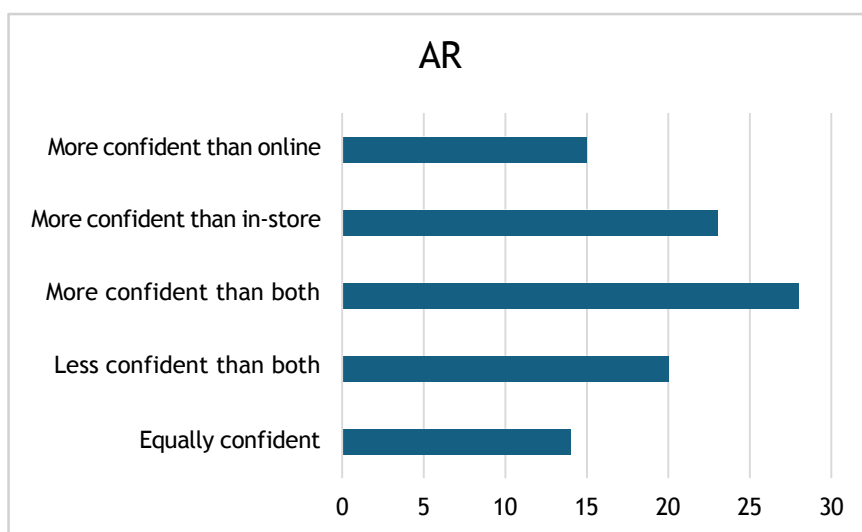


Figure 5.18: Participants' confidence levels in AR shopping method

The factors influencing purchase likelihood as participants noted varied across in-store, online, and AR shopping experiences, highlighting the distinct advantages and limitations of each method. For in-store shopping, the most commonly cited influences were good customer service, immediate availability of products, comfort and fit in real-time, and physical product verification. Participants valued the ability to interact with staff, try on products in person, and assess factors such as colour and texture under different lighting conditions. However, some noted that limited stock availability made them hesitate before purchasing.

In the online shopping experience, the convenience of shopping from home, easy price comparisons, return policy reassurance, and trust in brand reputation played a crucial role in purchase decisions. Consumers appreciated the ability to compare prices quickly and rely on brand reputation or return policies to mitigate the risk of purchasing without physically seeing the product. The ability to compare prices quickly was further supported by eye-tracking data. Heatmaps (See Figure 18) revealed that participants' attention was primarily focused on viewing both the product and its price, indicating that price comparison played a significant role in their decision-making process. This suggests that consumers rely heavily on price visibility when shopping online, reinforcing the importance of clear and competitive pricing strategies for retailers. However, uncertainty about product quality was a recurring concern that negatively impacted purchase confidence.

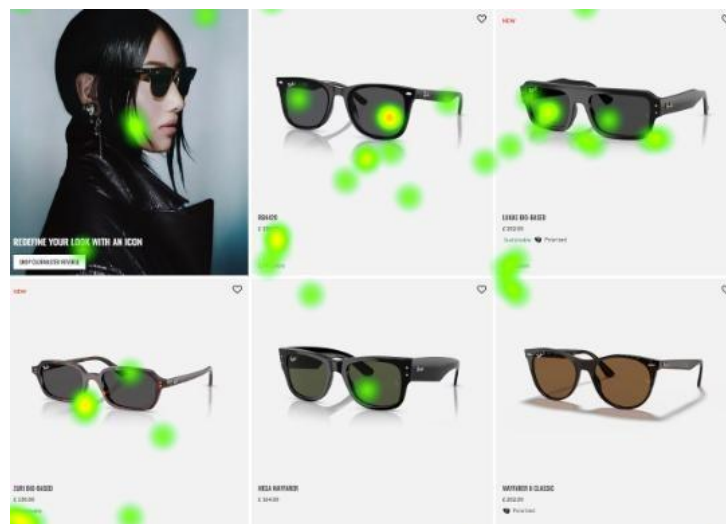


Figure 5.19: Heatmap of participants' attention on the product and the price

For AR shopping, factors influencing purchase likelihood centred around fun and immersive experiences, accurate representation of products, and good visualization

features. Participants found AR helpful for trying on products virtually, assessing colour accuracy, and comparing different options in real-time. However, some participants remained uncertain about product accuracy, indicating that while AR improves visualization, it does not completely eliminate hesitation in purchasing.

Overall, the results suggest that in-store shopping remains the most reliable for immediate purchase confidence, online shopping excels in convenience and price transparency, and AR enhances engagement but still faces challenges in fully reassuring consumers about product accuracy. Retailers can leverage these insights by optimizing features such as real-time AR improvements, more robust product information for online shoppers, and better stock availability for physical stores.

Future purchase likelihood as shown in Figure 19 was found to be highest for AR ($M = 3.77$, $SD = 1.14$) and in-store shopping ($M = 3.87$, $SD = 1.07$), while online shopping was lower ($M = 3.44$, $SD = 1.21$). These results suggest that while digital shopping methods are evolving, the in-store experience remains the most trusted for repeat purchases, with XR showing potential for future adoption.

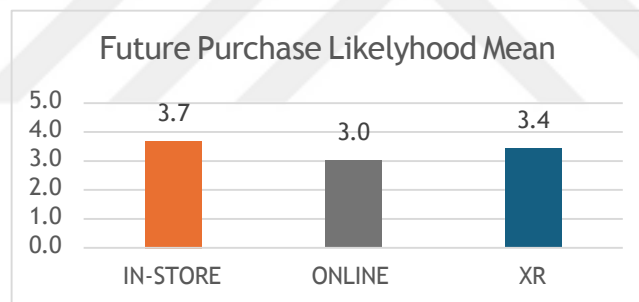


Figure 5.20: Participants' Mean Ratings on the Likelihood of Future Purchase by In-store, online, and AR

The in-store shopping experience convenience as participants explained was influenced by "store proximity", "store hours flexibility", and "crowded shopping areas". Some users mentioned having to "travel far" as a disadvantage. Online convenience in the other hand was influenced by factors including "no need to commute", "24/7 availability", and "easy comparison of multiple options". While some participants found AR "user-friendly", others highlighted "limited compatibility", and "need for fast internet", as barriers to convenience.

Challenges in in-store shopping included "limited stock", "waiting time for assistance", and "unclear pricing on some items". In the online experience the most

commonly reported difficulties were "hard to judge product size and fit", "limited customization options", and "uncertainty about product quality".

In the in-store shopping environment, observational methods were employed to analyse participants behaviour across multiple dimensions. Time spent varied significantly, with participants who are frequent shopper of the brand were able to make quick decisions, while new shoppers often took longer to make a decision. Product interaction was frequent, with participants trying on multiple frames, adjusting them in front of mirrors, and assessing fit and comfort by tilting their heads or checking reflections from different angles. Movement patterns indicated that most participants followed a structured path, first browsing display walls before moving to interactive areas with mirrors and consultation desks, while some avoided crowded sections. Engagement with displays was highest near promotional selection (with discount offers), with participants pausing to read details on frame materials and lens features. Decision-making behaviours included repeatedly switching between two or three options, taking photos for external opinions, and occasionally seeking reassurance from companions or sales staff before finalizing a choice. Social interactions played a crucial role, as participant frequently consulted store associates for advice on fit and style recommendations.

The Figure 20 illustrates participants' perceptions of how long shopping took compared to their expectations across three channels: in-store, online, and augmented reality (AR). A notable number of participants reported that in-store and AR shopping took about the time they expected (25 participants each), while fewer felt this way about online shopping (18). Online shopping was most commonly perceived as "slightly longer than expected" (24), while AR followed closely with 23. Interestingly, AR had the fewest participants who felt it was "much faster than expected" (12), compared to in-store (18) and online (17). Overall, online and AR shopping showed more variability in perceived duration, suggesting more unpredictable experiences compared to the relatively consistent in-store experience.

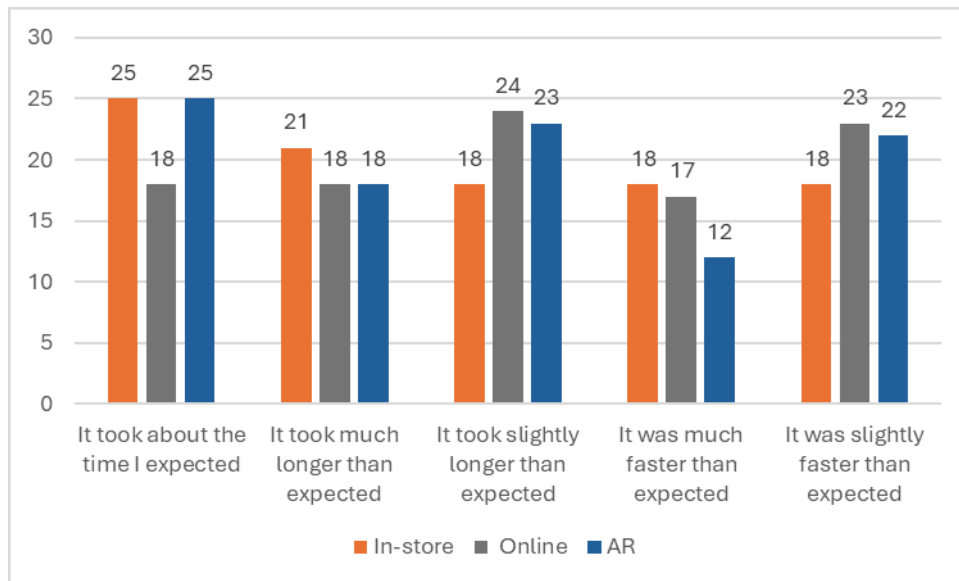


Figure 5.21: Participants' perceptions of how long shopping took compared to their expectations across the three channels

As shown in Figure 21, online shopping ratings were very close, with 49 participants finding it time-convenient and 51 not. This reflects its well-established reputation for convenience, as supported in the literature (e.g., Rose et al., 2012), where online channels are praised for 24/7 availability, quick access to product information, and the ability to shop from anywhere. However, the fact that nearly half did not find it convenient may point to issues such as: Over choice and decision fatigue, where users may spend excessive time browsing and comparing options. Information overload, which can increase cognitive effort, diminishing the perceived convenience.

Interestingly, 47 participants viewed in-store shopping as time convenient, nearly matching online, despite requiring physical presence, travel, and potential queuing. This is somewhat surprising given the known time demands of physical retail. However, in-store shopping may still feel efficient in specific contexts, such as, when the customer knows exactly what they want. Moreover, CX theory emphasizes cognitive and sensory engagement in physical spaces (Verhoef et al., 2009), which can make the time feel more “worth it,” even if objectively longer. This highlights the idea that perceived time convenience is influenced not just by duration, but by satisfaction and outcome quality.

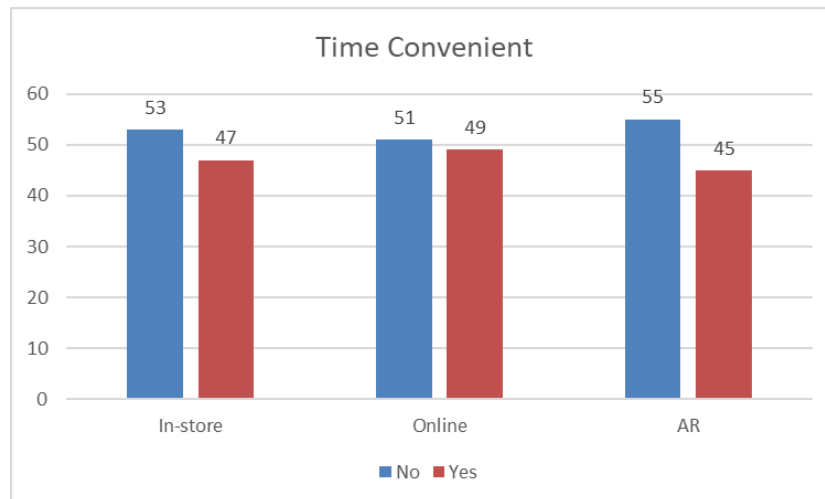


Figure 5.22: Participants' Ratings on time convenient across the three channels

AR received the lowest rating for time convenience, with only 45 participants saying it was convenient versus 55 who disagreed. This aligns with findings in the literature (e.g., McLean & Wilson, 2019; Pantano & Vannucci, 2019), where technical complexity, device compatibility, and learning curves are cited as barriers. Several factors may contribute to this perception, for example, performance issues, especially on less powerful devices. These findings suggest that while AR offers immersive benefits (as noted by Hilken et al., 2017), its current stage of development may hinder perceptions of convenience. Its novelty may still position it as a “nice-to-have” rather than a time-saving utility.

The Figure 22, examining perceived location convenience across in-store, online, and AR shopping methods offers interesting insights. While one might expect online and AR platforms to score significantly higher due to their inherently digital, location-independent nature, the results tell a more nuanced story.

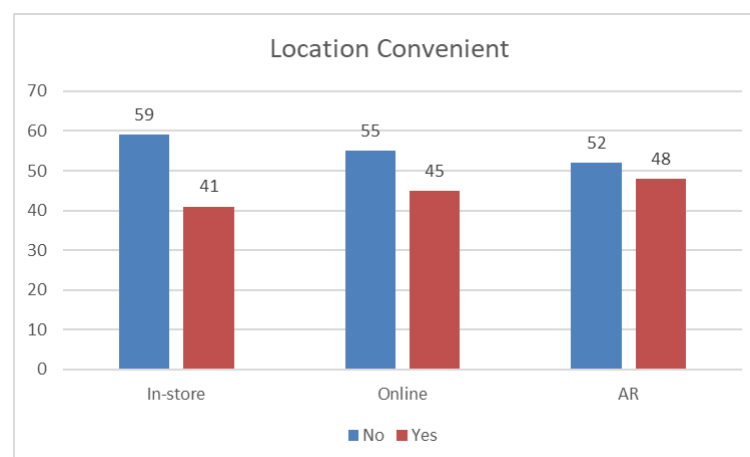


Figure 5.23: Participants' Ratings on location convenient across the three channels

With only 41 participants finding in-store shopping location convenient and 59 disagreeing, this result confirms longstanding critiques about physical retail's dependence on proximity and mobility. This aligns with existing literature (Verhoef et al., 2009), which identifies travel time, parking, and store accessibility as common barriers. However, the relatively high number of "Yes" responses (41%) suggests that, some users live near shopping centres, making in-store shopping relatively convenient for them; or in-store may still feel more trustworthy or familiar, outweighing location inconvenience for certain demographics.

Surprisingly, online shopping did not dominate in location convenience. While 45 participants agreed it was convenient, 55 did not. This result appears to conflict with its unlimited access in much of the literature (e.g., Rose et al., 2012; Koufaris, 2002). However, several critical factors may explain this, for example, delivery location limitations: Some users may live in areas with limited delivery services or longer shipping times.

AR received the most balanced results, 48 participants considered it location convenient, while 52 did not. This suggests AR may be more flexible than in-store, but still not as seamless as assumed. Several factors may contribute, for example, lack of technical proficiency or setup complexity can affect where and how AR is used.

3.2 Inferential Statistical Findings

To further investigate the observed differences, a repeated-measures ANOVA was initially planned. However, the Shapiro-Wilk test for normality indicated that the data were not normally distributed across all variables, necessitating the use of Friedman's test as a non-parametric alternative. The Friedman test results showed significant differences in satisfaction, engagement, enjoyment, ease of use, information usefulness, future purchase likelihood, perceived value, and physical experience (See Tables below).

Following the Friedman test, Wilcoxon signed-rank tests were conducted to determine specific pairwise differences between shopping methods. As shown in the Tables below, satisfaction was significantly higher for in-store shopping compared to online shopping, and AR shopping was rated significantly higher than online shopping. However, no significant difference was observed between in-store and AR shopping.

Engagement levels showed that AR was significantly more engaging than online shopping, while in-store was more engaging than online. Ease of use was significantly higher for online shopping compared to both AR and in-store. Information usefulness was significantly greater in both in-store and AR shopping compared to online shopping ($p < 0.001$). Similarly, future purchase intention was higher for in-store and AR shopping compared to online shopping. The analysis also revealed that in-store shopping provided significantly better sensory engagement and social interaction than online shopping, while AR shopping significantly outperformed online shopping in these areas. To control for Type I error across multiple Wilcoxon comparisons, a Bonferroni correction was applied, adjusting the significance threshold accordingly.

Table 5.4: Results of the Friedman Test for Participants' Satisfaction Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of Satisfaction_in_store, Satisfaction_Online and Satisfaction_AR are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	28.399
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

Table 5.5: Pairwise Comparisons of Participants' Satisfaction Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Satisfaction_Online-Satisfaction_in_store	.510	.141	3.606	<.001	.001
Satisfaction_Online-Satisfaction_AR	-.645	.141	-4.561	<.001	.000
Satisfaction_in_store-Satisfaction_AR	-.135	.141	-.955	.340	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.6: Results of the Friedman Test for Participants' Enjoyment Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of Enjoyable_Online, Enjoyable_in_store and Enjoyable_AR are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	24.080
Degree Of Freedom	2
Asymptotic Sig. (2-sided test)	<.001

Table 5.7: Pairwise Comparisons of Participants' Enjoyment Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons						
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a	
Enjoyable_Online-Enjoyable_AR	-.515	.141	-3.642	<.001	.001	
Enjoyable_Online-Enjoyable_in_store	-.565	.141	-3.995	<.001	.000	
Enjoyable_AR-Enjoyable_in_store	.050	.141	.354	.724	1.000	

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.8: Results of the Friedman Test for Participants' Engagement Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of Engagement_AR, Engagement_in_store and Engagement_Online are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	15.796
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

Table 5.9: Pairwise Comparisons of Participants' Engagement Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
Engagement_Online-Engagement_AR	.405	.141	2.864	.004	.013
Engagement_Online-Engagement_in_store	.465	.141	3.288	.001	.003
Engagement_AR-Engagement_in_store	-.060	.141	-.424	.671	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.10: Results of the Friedman Test for Participants' Ease of Use Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of EaseOfUse_AR, EaseOfUse_in_store and EaseOfUse_Online are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	.026	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	7.319
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.026

Table 5.11: Pairwise Comparisons of Participants' Ease of Use Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
EaseOfUse_Online-EaseOfUse_AR	.265	.141	1.874	.061	.183
EaseOfUse_Online-EaseOfUse_in_store	.320	.141	2.263	.024	.071
EaseOfUse_AR-EaseOfUse_in_store	-.055	.141	-.389	.697	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.12: Results of the Friedman Test for Participants' Information Usefulness Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of InfoUsefulness_AR, InfoUsefulness_in_store and InfoUsefulness_Online are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	22.060
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

Table 5.13: Pairwise Comparisons of Participants' Information Usefulness Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
InfoUsefulness_Online-InfoUsefulness_in_store	.510	.141	3.606	<.001	.001
InfoUsefulness_Online-InfoUsefulness_AR	.540	.141	3.818	<.001	.000
InfoUsefulness_in_store-InfoUsefulness_AR	.030	.141	.212	.832	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.14: Results of the Friedman Test for Participants' Likelihood of Future Purchase Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of FuturePurchaseLikely_AR, FuturePurchaseLikely_in_store and FuturePurchaseLikely_Online are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	13.958
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

Table 5.15: Pairwise Comparisons of Participants' Likelihood of Future Purchase Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
FuturePurchaseLikely_Online- FuturePurchaseLikely_AR	.300	.141	2.121	.034	.102
FuturePurchaseLikely_Online- FuturePurchaseLikely_in_store	.480	.141	3.394	<.001	.002
FuturePurchaseLikely_AR- FuturePurchaseLikely_in_store	-.180	.141	-1.273	.203	.609

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.16: Results of the Friedman Test for Participants' Physical Experience Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of PhysicalExperience_AR, PhysicalExperience_in_store and PhysicalExperience_Online are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	16.497
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

Table 5.13: Pairwise Comparisons of Participants' Physical Experience Ratings Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
PhysicalExperience_Online- PhysicalExperience_AR	.370	.141	2.616	.009	.027
PhysicalExperience_Online- PhysicalExperience_in_store	.515	.141	3.642	<.001	.001
PhysicalExperience_AR- PhysicalExperience_in_store	-.145	.141	-1.025	.305	.916

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5.14: Results of the Friedman Test for Participants' Perceived Value Ratings Across In-Store, Online, and AR Conditions

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The distributions of ValueHelp_in_store, ValueHelp_Online and ValueInEvaluation_AR are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	100
Test Statistic	15.602
Degree Of Freedom	2
Asymptotic Sig. (2-sided test)	<.001

Table 5.15: Pairwise Comparisons of Participants' Perceived Value Using Wilcoxon Signed-Rank Tests Between In-Store, Online, and AR Conditions

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. ^a
ValueHelp_Online-ValueInEvaluation_AR	-.280	.141	-1.980	.048	.143
ValueHelp_Online-ValueHelp_in_store	.500	.141	3.536	<.001	.001
ValueInEvaluation_AR-ValueHelp_in_store	.220	.141	1.556	.120	.359

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

As shown in Table 20 regression analysis was conducted to examine whether age predicts participants' satisfaction with the online shopping experience. The results indicate that age is not a significant predictor. Although the relationship between age and satisfaction was positive, it was weak and not statistically significant. The model explained only 2.3% of the variance in satisfaction, suggesting that age has minimal influence on how participants rate their online shopping satisfaction.

Table 5.16: Results of Linear Regression Analysis Examining the Effect of Age on Online Shopping Satisfaction

Variables Entered			
Model	Variables Entered	Variables Removed	Method
1	Age		Enter

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.151 ^a	.023	.013	1.143

a. Predictors: (Constant), Age

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.977	1	2.977	2.281	.134 ^b
	Residual	127.933	98	1.305		
	Total	130.910	99			

a. Dependent Variable: Satisfaction_Online

b. Predictors: (Constant), Age

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.634	.286		9.219	<.001
	Age	.130	.086	.151	1.510	.134

a. Dependent Variable: Satisfaction_Online

Another regression analysis was conducted to examine whether age predicts participants' satisfaction with the augmented reality (AR) shopping experience. As shown in Table 21 the results show that age is not a significant predictor. The relationship between age and satisfaction was weak and statistically non-significant. The model explained only 1.2% of the variance in satisfaction, indicating that age has little to no influence on participants' ratings of AR shopping satisfaction.

Table 5.17: Results of Linear Regression Analysis Examining the Effect of Age on AR Shopping Satisfaction

Variables Entered			
Model	Variables Entered	Variables Removed	Method
1	Age	.	Enter

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.110 ^a	.012	.002	1.069

a. Predictors: (Constant), Age

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.370	1	1.370	1.199	.276 ^b
	Residual	111.940	98	1.142		
	Total	113.310	99			

a. Dependent Variable: Satisfaction_AR

b. Predictors: (Constant), Age

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.602	.267		13.474	<.001
	Age	.088	.081	.110	1.095	.276

a. Dependent Variable: Satisfaction_AR

A final regression analysis was conducted to assess whether age predicts participants' satisfaction with the in-store shopping experience. The results as shown in Table 22 indicate no significant relationship between age and in-store satisfaction. The correlation was negligible and the model did not reach statistical significance. The model explained virtually none of the variance in satisfaction scores, suggesting that age has no meaningful impact on participants' ratings of their in-store shopping experience.

Table 5.18: Results of Linear Regression Analysis Examining the Effect of Age on In-store Shopping Satisfaction

Variables Entered			
Model	Variables Entered	Variables Removed	Method
1	Age	.	Enter

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.013 ^a	.000	-.010	1.037

a. Predictors: (Constant), Age

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.018	1	.018	.016	.898 ^b
	Residual	105.372	98	1.075		
	Total	105.390	99			

a. Dependent Variable: Satisfaction_in_store

b. Predictors: (Constant), Age

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.720	.259		14.345	<.001
	Age	-.010	.078	-.013	-.128	.898

a. Dependent Variable: Satisfaction_in_store

Cochran's Q test was conducted to evaluate differences in social engagement across the three shopping modes, based on binary engagement classifications. As shown in Table 23, the test yielded a statistically significant result, indicating that at least one platform differs from the others in perceived social engagement. Follow-up pairwise McNemar tests showed that AR was significantly more engaging than Online, while differences between In-store and the other platforms were not statistically significant (See Table 24).

Table 5.19: Cochran's Q Test of Social Engagement Across Shopping Methods

Frequencies			Test Statistics	
	Value		N	
	1	2		
Social_Engagement_in_store	41	59	100	
Social_Engagement_AR_	52	48	Cochran's Q	7.818 ^a
Social_Engagement_Online_	32	68	df	2
			Asymp. Sig.	.020

a. 1 is treated as a success.

Table 5.20: McNemar Test Results for Pairwise Social Engagement Comparisons

Test Statistics ^a			
	Social_Engagement_in_store & Social_Engagement_AR_	Social_Engagement_in_store & Social_Engagement_Online_	Social_Engagement_AR_ & Social_Engagement_Online_
N	100	100	100
Chi-Square ^b	1.695	1.488	6.942
Asymp. Sig.	.193	.222	.008

a. McNemar Test
b. Continuity Corrected

To explore dimensions of perceived convenience, Cochran's Q tests were conducted for both time-based and location-based convenience across In-store, Online, and AR shopping modes. The results showed no significant differences for time convenience or location convenience (See Tables 25 & 26).

Table 5.21: Cochran's Q Test of Time-Based Convenience Across Shopping Methods

Frequencies			Test Statistics	
	Value		N	
	1	2		
Convenient_Time_In_store	47	53	100	
Convenient_Time_Online	49	51	Cochran's Q	.296 ^a
Convenient_Time_AR	45	55	df	2
			Asymp. Sig.	.862

a. 1 is treated as a success.

Table 5.22: Cochran's Q Test of Location-Based Convenience Across Shopping Methods

Frequencies			Test Statistics	
	Value		N	
	1	2		
Convenient_Location_in_Store	41	59	100	
Convenient_Location_Online	45	55	Cochran's Q	1.014 ^a
Convenient_Location_AR	48	52	df	2
			Asymp. Sig.	.602

a. 1 is treated as a success.

3.3 Comparative Analysis of AR and Online Eyewear Shopping Using TAM

This section presents a comparative analysis of consumer responses to Augmented Reality (AR) shopping and online shopping experiences for eyewear, using the Technology Acceptance Model (TAM) framework. The analysis incorporates survey data from 30 participants for each shopping modality and compares the results with the findings of the larger set of data collected for this project (100 participants). The TAM constructs assessed include Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Toward Use (ATU), Behavioural Intention to Use (BIU), and Trust and Security.

The mean scores across TAM (See Figure 23) constructs indicate that both AR and online eyewear shopping are generally perceived as useful and easy to use. However, differences emerge in behavioural intention and trust. AR shopping was rated highly in terms of usefulness ($M = 6.07$), ease of use ($M = 6.04$), and attitude ($M = 6.08$), with a moderate score in behavioural intention ($M = 5.01$) and trust ($M = 4.93$). In contrast, online eyewear shopping also scored highly in usefulness ($M = 6.03$), ease of use ($M = 6.03$), and attitude ($M = 6.09$), but behavioural intention was lower ($M = 4.90$) despite a higher trust score ($M = 5.77$).

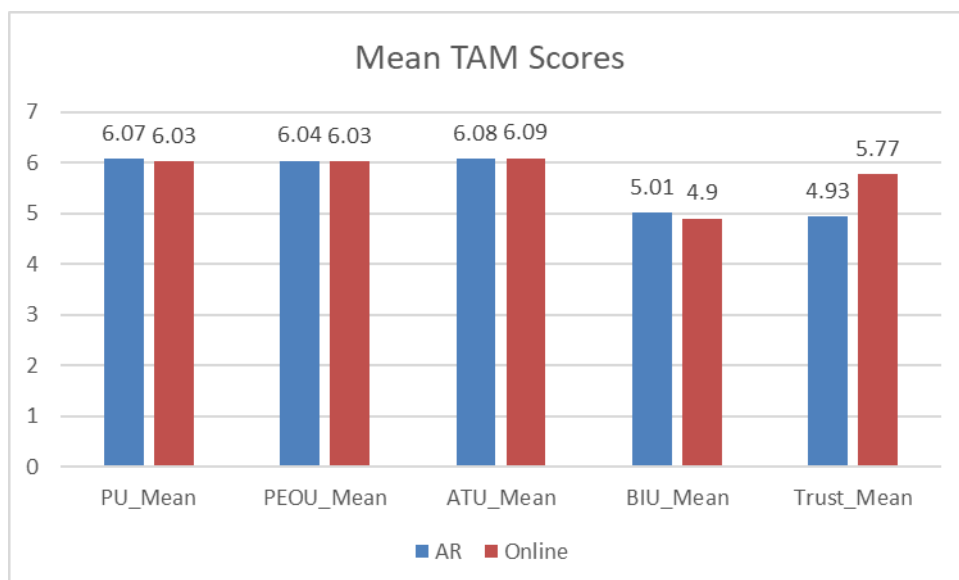


Figure 5.24: The Mean Scores of the TAM Questionnaire

A Wilcoxon signed-rank test was conducted to compare participants' perceptions of AR and online eyewear shopping experiences across the main TAM constructs:

Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Toward Use (ATU), Behavioural Intention to Use (BIU), and Trust. The analysis as shown the Tables below revealed no statistically significant differences between AR and online shopping for PU, PEOU, ATU, or BIU (all $p > 0.05$), indicating that participants viewed both shopping modalities as similarly useful, easy to use, and positive overall.

Table 5.23: Results of Wilcoxon Signed-Rank Test Comparing Attitudes Toward Using AR and Online Shopping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between ATU_AR and ATU_Online equals 0.	Related-Samples Wilcoxon Signed Rank Test	.848	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	30
Test Statistic	169.500
Standard Error	36.473
Standardized Test Statistic	.192
Asymptotic Sig.(2-sided test)	.848

Table 5.24: Results of Wilcoxon Signed-Rank Test Comparing Perceived Ease of Use of AR and Online Shopping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between PEOU_AR and PEOU_Online equals 0.	Related-Samples Wilcoxon Signed Rank Test	.971	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	30
Test Statistic	187.500
Standard Error	40.992
Standardized Test Statistic	-.037
Asymptotic Sig.(2-sided test)	.971

Table 5.25: Results of Wilcoxon Signed-Rank Test Comparing Behavioral Intention to Use AR and Online Shopping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between BIU_AR and BIU_Online equals 0.	Related-Samples Wilcoxon Signed Rank Test	.169	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	30
Test Statistic	154.000
Standard Error	46.118
Standardized Test Statistic	-1.377
Asymptotic Sig.(2-sided test)	.169

Table 5.26: Results of Wilcoxon Signed-Rank Test Comparing Perceived Usefulness of AR and Online Shopping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between PU_AR and PU_Online equals 0.	Related-Samples Wilcoxon Signed Rank Test	.681	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	30
Test Statistic	172.000
Standard Error	41.413
Standardized Test Statistic	-.411
Asymptotic Sig.(2-sided test)	.681

However, Trust was rated significantly higher for online shopping than for AR, suggesting that even when the same individuals engage with both formats, established online platforms are perceived as more secure and trustworthy for eyewear purchases. These findings highlight that while AR technology matches online shopping in perceived value and usability, it still faces a notable trust barrier among consumers, a critical consideration for retailers aiming to increase adoption of immersive digital experiences.

Table 5.27: Results of Wilcoxon Signed-Rank Test Comparing Trust on AR and Online Shopping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Trust_AR and Trust_Online equals 0.	Related-Samples Wilcoxon Signed Rank Test	.002	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	30
Test Statistic	295.000
Standard Error	39.131
Standardized Test Statistic	3.054
Asymptotic Sig.(2-sided test)	.002

When analysed by experience levels (See Figures 24 & 25), results show that participants with high familiarity with AR or online shopping consistently reported higher PU, ATU, and BIU scores. Notably, BIU was lowest among those with lower experience in both AR and online contexts, suggesting a learning curve related to less familiar technology.



Figure 5.25: The Mean Scores of the TAM Questionnaire for the Online shopping method based on experience buying online

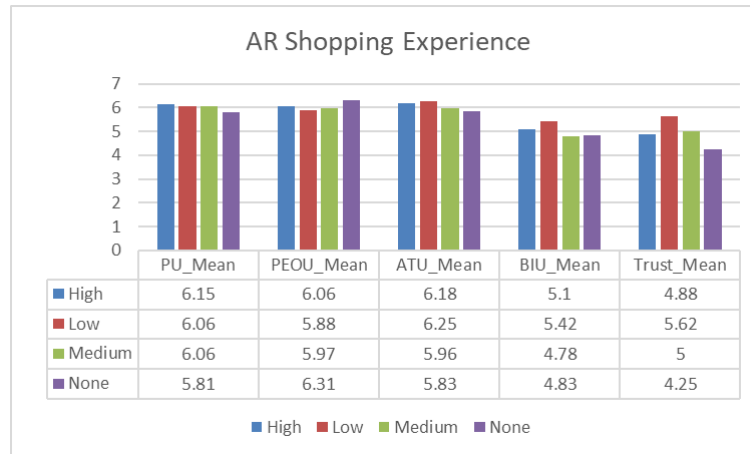


Figure 5.26: The Mean Scores of the TAM Questionnaire for the AR shopping method based on experience buying using AR

Participants with higher levels of prior experience with AR reported more favourable responses across all five TAM dimensions. In particular, experienced users scored higher on PU and BIU, suggesting that familiarity with the technology may lead to greater appreciation of its utility and a stronger intention to continue using it. On the contrary, those with limited or no prior AR experience demonstrated lower levels of trust and a weaker inclination toward future use.

However, Kruskal-Wallis tests were conducted to determine if experience with AR or online shopping influenced participants' TAM construct scores for each respective modality. The results in the Tables below showed no statistically significant differences in Perceived Usefulness, Perceived Ease of Use, Attitude Toward Use, Behavioural Intention to Use, or Trust across different experience levels for either AR shopping (all $p > 0.05$) or online shopping (all $p > 0.05$). This suggests that, within this sample, prior experience with AR or online shopping did not substantially impact participants' perceptions or intentions regarding the use of these shopping methods.

Table 5.28: Results of Kruskal-Wallis H Test Examining Differences in Perceived Usefulness of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	Online_Shopping_Experience	N	Mean Rank	PU_Online	
PU_Online	Low	2	4.50	Kruskal-Wallis H	3.443
	Medium	15	16.27		
	High	13	16.31		
	Total	30			
				df	2
				Asymp. Sig.	.179

Table 5.29: Results of Kruskal-Wallis H Test Examining Differences in Perceived Ease of Use of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	Online_Shopping_Experience	N	Mean Rank	PEOU_Online	
PEOU_Online	Low	2	7.25	Kruskal-Wallis H	2.116
	Medium	15	15.43	df	2
	High	13	16.85	Asymp. Sig.	.347
	Total	30			

Table 5.30: Results of Kruskal-Wallis H Test Examining Differences in Attitude Toward Use of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	Online_Shopping_Experience	N	Mean Rank	ATU_Online	
ATU_Online	Low	2	23.00	Kruskal-Wallis H	4.747
	Medium	15	12.30	df	2
	High	13	18.04	Asymp. Sig.	.093
	Total	30			

Table 5.31: Results of Kruskal-Wallis H Test Examining Differences in Behavioral Intention to Use of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	Online_Shopping_Experience	N	Mean Rank	BIU_Online	
BIU_Online	Low	2	10.00	Kruskal-Wallis H	4.110
	Medium	15	13.17	df	2
	High	13	19.04	Asymp. Sig.	.128
	Total	30			

Table 5.32: Results of Kruskal-Wallis H Test Examining Differences in Trust of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics^{ab}	
	Online_Shopping_Experience	N	Mean Rank	Trust_Online	
Trust_Online	Low	2	15.00	Kruskal-Wallis H	1.501
	Medium	15	17.40	df	2
	High	13	13.38	Asymp. Sig.	.472
	Total	30			

Table 5.33: Results of Kruskal-Wallis H Test Examining Differences in Perceived Usefulness of AR Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	AR_Experience	N	Mean Rank	PU_AR	
PU_AR	Low	4	11.75	Kruskal-Wallis H	.558
	Medium	9	12.78	df	2
	High	13	14.54	Asymp. Sig.	.756
	Total	26			

Table 5.34: Results of Kruskal-Wallis H Test Examining Differences in Perceived Ease of Use of AR Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	AR_Experience	N	Mean Rank	PEOU_AR	
PEOU_AR	Low	4	10.88	Kruskal-Wallis H	.747
	Medium	9	13.22	df	2
	High	13	14.50	Asymp. Sig.	.688
	Total	26			

Table 5.35: Results of Kruskal-Wallis H Test Examining Differences in Attitude Toward Use of Online Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
	AR_Experience	N	Mean Rank	ATU_AR	
ATU_AR	Low	4	15.88	Kruskal-Wallis H	1.407
	Medium	9	11.22	df	2
	High	13	14.35	Asymp. Sig.	.495
	Total	26			

Table 5.36: Results of Kruskal-Wallis H Test Examining Differences in Behavioral Intention to Use of Online Shopping Across Levels of AR Shopping Experience

Ranks				Test Statistics	
	AR_Experience	N	Mean Rank	BIU_AR	
BIU_AR	Low	4	15.75	Kruskal-Wallis H	.498
	Medium	9	12.61	df	2
	High	13	13.42	Asymp. Sig.	.780
	Total	26			

Table 5.37: Results of Kruskal-Wallis H Test Examining Differences in Trust of AR Shopping Across Levels of Online Shopping Experience

Ranks				Test Statistics	
Trust_AR	AR_Experience	N	Mean Rank	Trust_AR	
	Low	4	18.63	Kruskal-Wallis H	2.194
	Medium	9	12.78	df	2
	High	13	12.42	Asymp. Sig.	.334
	Total	26			

As Shown in Figures 26 & 27, age-based comparisons also revealed notable trends. Participants aged 18-35 generally rated both AR and online shopping higher across all TAM constructs compared to those aged 36-65. In the online eyewear shopping context, older users expressed slightly less behavioural intention and trust. This trend suggests younger users are more open to digital and immersive retail experiences.

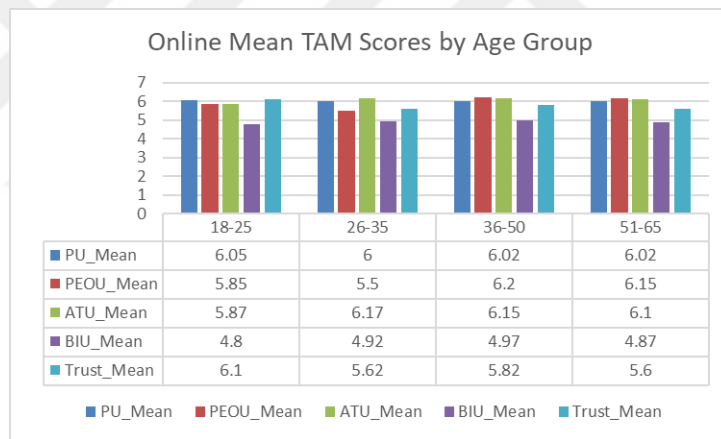


Figure 5.27: The Mean Scores of the TAM Questionnaire for the Online shopping method based on Age group

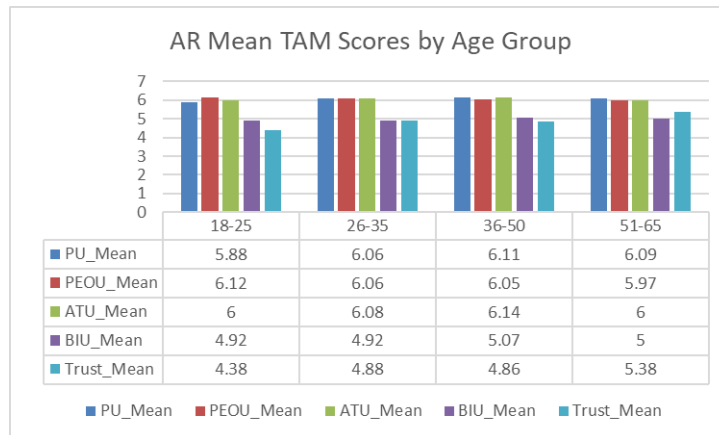


Figure 5.28: The Mean Scores of the TAM Questionnaire for the AR shopping method based on age group

Kruskal-Wallis tests were performed to explore whether age group affected TAM scores for AR and online eyewear shopping. Participants were grouped as Younger Age Group (18-25), Young-Mid Adults (26-35), Middle-Aged Group (36-50) and Older Age Group (51-65). The analysis found no statistically significant differences in Perceived Usefulness, Perceived Ease of Use, Attitude Toward Use, Behavioural Intention to Use, or Trust among different age groups for either AR or online shopping (all $p > 0.05$). This suggests that, in this sample, age did not meaningfully influence participants' perceptions or intentions related to either AR or online shopping for eyewear.

Table 5.38: Results of Kruskal-Wallis H Test Examining Differences in Perceived Usefulness of AR Shopping Across Age Groups

Ranks				Test Statistics	
	Age_Group_AR_	N	Mean Rank	PU_AR	
PU_AR	Younger Age Group	4	11.75	Kruskal-Wallis H	.962
	Young-Mid Adults	4	15.25	df	3
	Middle-Aged Group	14	16.54	Asymp. Sig.	.810
	Older Age Group	8	15.69		
	Total	30			

Table 5.43: Results of Kruskal-Wallis H Test Examining Differences in Attitude Toward Use of AR Shopping Across Age Groups

Ranks				Test Statistics	
	Age_Group_AR_	N	Mean Rank	ATU_AR	
PEOU_AR	Younger Age Group	4	17.25	Kruskal-Wallis H	.544
	Young-Mid Adults	4	15.13	df	3
	Middle-Aged Group	14	15.68	Asymp. Sig.	.909
	Older Age Group	8	14.50		
	Total	30			

Table 5.44: Results of Kruskal-Wallis H Test Examining Differences in Perceived Ease of Use of AR Shopping Across Age Groups

Ranks				Test Statistics	
	Age_Group_AR_	N	Mean Rank	PEOU_AR	
ATU_AR	Younger Age Group	4	14.75	Kruskal-Wallis H	.290
	Young-Mid Adults	4	15.13	df	3
	Middle-Aged Group	14	16.68	Asymp. Sig.	.962
	Older Age Group	8	14.00		
	Total	30			

Table 5.45: Results of Kruskal-Wallis H Test Examining Differences in Behavioral Intention to Use of AR Shopping Across Age Groups

Ranks				Test Statistics	
	Age_Group_AR_	N	Mean Rank	BIU_AR	
BIU_AR	Younger Age Group	4	15.00	Kruskal-Wallis H	.310
	Young-Mid Adults	4	14.38		
	Middle-Aged Group	14	15.18		
	Older Age Group	8	16.88	df	3
	Total	30		Asymp. Sig.	.958

Table 5.46: Results of Kruskal-Wallis H Test Examining Differences in Trust of AR Shopping Across Age Groups

Ranks				Test Statistics	
	Age_Group_AR_	N	Mean Rank	Trust_AR	
Trust_AR	Younger Age Group	4	10.38	Kruskal-Wallis H	3.131
	Young-Mid Adults	4	15.00		
	Middle-Aged Group	14	14.86		
	Older Age Group	8	19.44	df	3
	Total	30		Asymp. Sig.	.372

Table 5.39: Results of Kruskal-Wallis H Test Examining Differences in Perceived Usefulness of Online Shopping Across Age Groups

Ranks				Test Statistics	
	Age_group_online_	N	Mean Rank	PU_Online	
PU_Online	Younger Age Group	5	17.00	Kruskal-Wallis H	.355
	Young-Mid Adults	3	17.00		
	Middle-Aged Group	12	14.67		
	Older Age Group	10	15.30	df	3
	Total	30		Asymp. Sig.	.949

Table 5.40: Results of Kruskal-Wallis H Test Examining Differences in Perceived Ease of Use of Online Shopping Across Age Groups

Ranks				Test Statistics	
	Age_group_online_	N	Mean Rank	PEOU_Online	
PEOU_Online	Younger Age Group	5	11.90	Kruskal-Wallis H	5.030
	Young-Mid Adults	3	6.83		
	Middle-Aged Group	12	17.25		
	Older Age Group	10	17.80	df	3
	Total	30		Asymp. Sig.	.170

Table 5.41: Results of Kruskal-Wallis H Test Examining Differences in Attitude Toward Use of Online Shopping Across Age Groups

Ranks				Test Statistics	
	Age_group_online_	N	Mean Rank	ATU_Online	
ATU_Online	Younger Age Group	5	12.30	Kruskal-Wallis H	1.310
	Young-Mid Adults	3	14.00	df	3
	Middle-Aged Group	12	17.29	Asymp. Sig.	.727
	Older Age Group	10	15.40		
	Total	30			

Table 5.42: Results of Kruskal-Wallis H Test Examining Differences in Behavioral Intention to Use of Online Shopping Across Age Groups

Ranks				Test Statistics	
	Age_group_online_	N	Mean Rank	BIU_Online	
BIU_Online	Younger Age Group	5	13.90	Kruskal-Wallis H	.207
	Young-Mid Adults	3	15.83	df	3
	Middle-Aged Group	12	15.83	Asymp. Sig.	.976
	Older Age Group	10	15.80		
	Total	30			

Table 5.43: Results of Kruskal-Wallis H Test Examining Differences in Trust of Online Shopping Across Age Groups

Ranks				Test Statistics	
	Age_group_online_	N	Mean Rank	Trust_Online	
Trust_Online	Younger Age Group	5	18.90	Kruskal-Wallis H	1.502
	Young-Mid Adults	3	17.67	df	3
	Middle-Aged Group	12	15.21	Asymp. Sig.	.682
	Older Age Group	10	13.50		
	Total	30			

3.4 Interpretation of Findings in Relation to Hypotheses (H1-H8):

This study evaluated eight hypotheses (H1–H8) to understand consumer experiences across in-store, online, and AR-based eyewear shopping. The findings reflect a nuanced performance of each channel, with some hypotheses partially validated, and others not confirmed statistically.

H1 (Satisfaction: In-Store > Online & AR): Partially Supported.

In-store eyewear shopping resulted in the highest satisfaction, significantly outperforming online shopping. However, no significant difference was found between in-store and AR. This suggests that while physical try-ons, staff interaction, and real-world fit verification enhance satisfaction, AR's realistic visualization makes it a compelling alternative, particularly for style-conscious or tech-savvy shoppers.

Test used	P-value	Test Results	Null Hypothesis	Comments
Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 28.399, p < .001$; In-store > Online	Rejected	In-Store > Online: Statistically significant. In-Store vs AR: Not statistically significant

Reason for Partial Support:

While In-Store is significantly better than Online, there is no statistical evidence it is better than AR. Thus, only half of the hypothesis is statistically confirmed, leading to a "Partially Supported" classification. The interviews result suggests that in-store benefits such as staff interaction and physical trials contribute to satisfaction. However, AR tools, while not statistically inferior, were well-received for their ability to offer realistic visual previews. Interviews supported AR's visual strengths but emphasized a lack of tactile feedback and human interaction.

H2 (Engagement: AR > In-Store & Online): Partially Supported.

AR shopping showed significantly greater engagement than online shopping but did not surpass in-store experiences. Physical trials and staff consultation in-store remain strong engagement drivers, while AR's interactive and fun elements (e.g., virtual try-ons with real-time lighting simulation) created substantial emotional engagement.

Test used	P-value	Test Results	Null Hypothesis	Comments
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Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 15.796, p < .001$; AR > Online, AR \approx In-store	Rejected	AR > Online: Statistically significant (p = .004). AR vs In-Store: Not significant
Eye-tracking	N/A	Higher fixation duration in AR	N/A	Supports emotional engagement

Reason for Partial Support:

The hypothesis claims AR engagement exceeds both Online and In-Store. Only AR > Online is statistically validated, while AR is not significantly better than In-Store. Therefore, the hypothesis is only partially supported. Participants described AR try-ons as “fun” and “playful,” though in-store experiences benefited from social interactions and tactile involvement that AR could not fully replicate.

H3 (Ease of Use: Online > AR, AR More Useful for High-Involvement: Not Confirmed.

Online eyewear platforms were rated as easiest to use due to familiar navigation and efficient browsing. However, AR was perceived as more useful than online for high-involvement purchases like prescription frames, where visual fit and style matter, confirming TAM's emphasis on the interplay between ease of use and perceived usefulness.

Test used	P-value	Test Results	Null Hypothesis	Comments
Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 7.319, p = .026$; Online > others (marginal)	Rejected	Online > AR: Weak statistical evidence, borderline significant.
Wilcoxon signed-rank	.681	Z \approx 0.41	Rejected	No significant difference in Perceived Usefulness AR vs Online
Wilcoxon signed-rank	.971	Z \approx 0.04	Rejected	No significant difference in Perceived Ease of Use Online vs AR

Reason for Partial Support:

While the Online > AR aspect is weakly supported, the current AR try-on offers neither greater ease-of-use nor higher perceived usefulness than conventional online shopping.

H4 (Purchase Intentions: AR > In-Store & Online for High-Involvement): Not Confirmed.

AR outperformed online shopping in purchase intention but did not significantly exceed in-store experiences. AR helped boost purchase confidence through accurate face tracking and visualization, though technical issues and perceived complexity tempered its effectiveness for some users.

Test used	P-value	Test Results	Null Hypothesis	Comments
Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 13.958$, $p < .001$; AR > Online, AR \approx In-store	Rejected	AR > Online: Suggested, but adjusted p-value not significant. AR vs In-Store: Not significant.
Wilcoxon signed-rank	<.001	Wilcoxon AR vs Online $p = .01$; In-store vs Online $p = .0013$; AR vs In-store $p = .47$	Rejected	AR > Online, but AR \approx In-store

Reason for not confirmed:

Despite qualitative suggestions that AR builds confidence in frame selection, the Wilcoxon test on behavioural intention showed no statistically significant difference between AR and online. The Friedman's test similarly did not confirm AR's superiority over in-store purchase intention.

H5 (Convenience: Online > AR & In-Store): Partially Supported.

Online eyewear shopping was perceived as most convenient due to accessibility, 24/7 availability, and fast comparison tools. However, some participants experienced decision fatigue and information overload. AR and in-store shopping were rated lower in convenience but were valued for clarity in product evaluation.

Test used	P-value	Test Results	Null Hypothesis	Comments
Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 16.497, p < .001$; Online > AR & In-store	Rejected	Online > AR & In-Store: Supported qualitatively and with some statistical difference.
Cochran Q	<.001	(Time) $\chi^2(2)=1.69, p=.43$; (Location) $\chi^2(2)=0.48, p=.79$	Rejected	No sig. differences in either time- or location-convenience

Reason for Partial Support:

While Online was rated highest and likely superior, the pairwise significance for both comparisons wasn't definitively confirmed in the output (i.e., not statistically confirmed). Therefore, the hypothesis is considered only "Partially Supported". These results suggest that while participants rated online most convenient overall, they did not perceive it as significantly more convenient in specific subdimensions. Hence, the hypothesis is confirmed in general terms, but time and location factors appear equally accessible across methods

H6 (Perceived Value: AR > Online): Not Confirmed.

Although AR was often praised for its product preview capabilities, the perceived value score was not significantly higher than online shopping. This suggests that while AR adds experiential depth, it must overcome trust and technical barriers to be seen as a clearly superior value channel.

Test used	P-value	Test Results	Null Hypothesis	Comments
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Friedman's test with post hoc analysis.	<.001	$\chi^2(2) = 15.602, p < .001$; AR \approx Online	Rejected	No significant difference between AR and Online; hypothesis not supported statistically.
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Reason of not Confirmed:

Although overall differences existed, post hoc tests showed no significant difference between AR and Online. AR's perceived value wasn't statistically superior. Interviews highlighted trust issues with AR.

H7 (Social Engagement: In-Store > AR > Online): Not Confirmed.

In-store eyewear shopping clearly led in social engagement, allowing users to physically try frames, receive live feedback, and engage staff. AR significantly outperformed online, though it still lacked human interaction.

Test used	P-value	Test Results	Null Hypothesis	Comments
Cochran's Q with McNemar pairwise	<.05	Cochran Q = 7.818, p = .020; AR > Online (p = .008), others not significant	Rejected	Cochran's Q confirmed overall significance. Only AR > Online was statistically confirmed; In-store vs others were not significant. Descriptive trends and interviews support the hierarchy.
Observations	N/A	Sensory cues in-store	N/A	Qualitative data dominant

Reason for not confirmed:

While observational and interviews data confirmed in-store social interactions, survey results paradoxically showed higher self-reported social engagement in AR than in-store. This suggests participants may interpret 'social engagement' differently across modalities, warranting further investigation.

H8 (Age Differences: Younger Prefer AR): Not Confirmed.

Regression analysis revealed no significant correlation between age and AR satisfaction or engagement, although descriptive trends showed younger users slightly more receptive. This indicates that AR adoption may be influenced more by digital literacy and prior experience than by age alone.

Test used	P-value	Test Results	Null Hypothesis	Comments
Regression	> .05	No significant differences found	Accepted	No significant difference between AR and Online
Kruskal-Wallis	> .05	No significant differences found	Accepted	All TAM constructs showed no significant differences

Reason of not Confirmed:

No statistically significant correlation between age and preference for AR. Descriptive trends hinted at younger users being more open, but this was not confirmed by regression. All TAM constructs showed no significant differences by age group; no evidence supports age-based preference for AR.

4. Implications

4.1 Theoretical Contributions

This study reinforces the relevance of both the Technology Acceptance Model (TAM) and Customer Experience (CX) Theory in evaluating consumer responses to different eyewear shopping methods. The results affirm that ease of use is a central factor influencing online shopping adoption, consistent with TAM, while engagement, sensory feedback, and perceived usefulness play a more significant role in AR and in-store experiences. In the context of eyewear, where fit, comfort, and aesthetics are critical, interactive experiences provided by AR and in-person shopping contribute to greater confidence and satisfaction. These findings suggest that immersive and

sensory-rich experiences can offset lower usability, especially for high-involvement products like prescription glasses or designer frames.

4.2 Practical Recommendations for Retailers

Eyewear retailers should tailor their strategies to leverage the unique strengths of each shopping channel:

Augmented Reality (AR): Enhance usability and technical performance of AR try-on tools by simplifying interfaces, improving accuracy of face tracking, and ensuring cross-device compatibility. AR should emphasize realistic simulations of frame fit, colour under different lighting, and personalized style suggestions. Retailers can also offer AR guides or tutorials to improve adoption among less tech-savvy users.

In-Store Shopping: Continue to highlight tactile interaction, real-time staff guidance, and social reassurance. In-store services such as personalized frame fitting, optical consultations, and immediate trial of prescription lenses remain key drivers of trust and purchase confidence.

Online Shopping: Improve product visualization, customer reviews, and specification clarity to address the ongoing issue of uncertainty. Consider integrating AR try-on modules, 360° product views, or virtual consultations to make the digital experience more engaging and trustworthy.

Blended Strategies: The data suggest that hybrid approaches (e.g., offering AR tools in-store through smart mirrors or enabling customers to switch between online and in-person support) may offer the best overall user experience. Retailers should strive for seamless channel integration, especially for consumers who move fluidly between discovery and purchase across platforms.

5. Conclusion

This study examined consumer experiences with in-store, online, and AR shopping for eyewear, highlighting how each channel meets different user needs. Thematic and statistical analyses revealed that in-store shopping remains the most trusted for confident purchasing, especially due to its sensory and social advantages. Online shopping continues to lead in convenience, though many users cited concerns about

product uncertainty and lack of fit verification. AR shopping emerged as an immersive, engaging alternative, offering interactive visualization that supports style-based decisions, though it is still limited by usability and technical issues.

In terms of perceived value, in-store experiences foster the most trust, while AR offers potential to improve confidence when enhanced with smoother functionality. Online channels, while accessible, often fall short in conveying physical product characteristics necessary for eyewear decisions.

While age-based trends suggested younger users may be more receptive to AR, no significant patterns were confirmed, emphasizing the role of individual experience and comfort with technology over demographic assumptions. While previous studies such as Venkatesh and Davis (2000), Venkatesh et al. (2003), and Lian and Yen (2014) have consistently shown that older consumers are often more cautious about adopting digital technologies due to higher perceived risk and lower confidence, my findings suggest that these age effects were not significant in the context of eyewear shopping. This could be because purchasing eyewear typically involves a high level of personal relevance and visual assessment, which might overcome any hesitations based on age or digital familiarity. In addition, as eyewear is both a functional and a style-driven product, older consumers may be equally motivated to engage with digital channels that offer immersive try-on experiences, regardless of any initial uncertainty. Another possible explanation is the increasing digital literacy across all age groups, which may have reduced age-related differences in adoption behaviour (Gao et al., 2015; Lian and Yen, 2014). These findings challenge the assumption that older consumers are automatically less likely to use immersive shopping technologies, suggesting that product type and context-specific factors can play a more critical role than age alone.

The findings of this study challenge other commonly held assumptions in the existing literature. For example, while earlier research often suggests that immersive technologies like AR consistently provide superior engagement and perceived value (Poushneh and Vasquez-Parraga, 2017; Flavián et al., 2019), my data indicate that although AR was engaging and helpful in visualization, it did not significantly outperform in-store shopping in satisfaction or purchase confidence. Indeed, while AR enhanced the visualization of frame options, participants still valued the tactile and

social benefits of the in-store experience, which they described as offering reassurance and confidence that AR could not fully replace.

Ultimately, the study highlights that no single channel is universally superior. Instead, the most effective strategy for eyewear retailers lies in adapting each channel to its core strengths and developing integrated experiences that combine the convenience of online platforms, the personalization of AR, and the tactile confidence of in-store shopping.

Future research should explore longitudinal adoption of AR technologies, the impact of device usability, and design interventions that reduce uncertainty in digital eyewear experiences. These insights will be key to advancing more seamless and satisfying consumer journeys in the evolving retail landscape.

6. Study Limitations and Future Work

This study offers important insights into consumer experiences with in-store, online, and AR shopping for eyewear. However, some limitations should be acknowledged. Although the total sample included 100 participants from diverse backgrounds and age groups, not all participants engaged with every component of the study. For example, only a subset took part in eye-tracking tasks, which may limit the generalisability of those specific findings. While efforts were made to recruit a varied participant pool, the sample size for certain sub-analyses may not fully capture the range of experiences across all demographics. In addition, the snowball sampling technique used may introduce selection bias and limit generalizability due to non-random participant recruitment. While it enabled access to a diverse population across age and shopping familiarity, findings should be interpreted with this constraint in mind. Eye-tracking was successfully conducted for online and AR modalities but not in-store due to logistical and cost constraints. To mitigate this gap, structured observational methods were employed to capture in-store engagement.

Moreover, in the context of online and AR shopping experiences, technical factors such as device performance, internet speed, or user context may have influenced participants' perceptions but these were not explored in this study.

Finally, one limitation of this study is the use of non-validated, single-item measures in the first survey. As a result, internal consistency tests such as Cronbach's alpha were

not conducted. While this approach helped minimise survey length and improve respondent engagement, it limited the ability to assess latent constructs and may have reduced the overall robustness of the measurement.

Future research should build on these findings by conducting longitudinal studies that track changes in consumer attitudes toward AR as technology matures and adoption increases. Expanding the scope to include larger and more balanced subgroups for each method (e.g. more participants in eye-tracking) will also improve comparative strength. Further, integrating qualitative insights with biometric or behavioural data, such as facial expression analysis, can deepen understanding of emotional and cognitive responses across shopping channels. Exploring AR integration with AI-based personalisation or virtual optician consultations also presents promising directions for enhancing future eyewear retail experiences.

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Appendix A: Email to Obtain Brand Approval

Hi Yousef,

Thank you for contacting [REDACTED]

My name is Maria and I am taking care of your request.

For all requests on partnerships and collaborations, please visit the following link <https://www.essilorluxottica.com/en/contacts/>, select 'Partnership/Collaboration Requests' from the drop-down menu and write an email to the relevant address.

We recommend checking our careers page in order to find the positions that are currently available:

<http://careers.luxottica.com/en/job-opportunities>

If you are unable to find a suitable position, we advise to join our talent community using the link below by providing us with some details about yourself and your interests:

<https://jobs.luxottica.com/talentcommunity/subscribe/>

Should any suitable positions become available our specialist department will then get in contact with you.

You can also check our LinkedIn page, that is always updated with positions that are currently open:

<https://www.linkedin.com/company/luxottica>

Your request shall then be forwarded internally for review. Please note that due to high volumes of requests, a response will only be provided in case of interest.

We wish you good luck and if there is anything else that we can help you with, please do not hesitate to let us.

Kind Regards,
Maria

[REDACTED] Customer Service



GENUINE SINCE 1937

Appendix B: Participants Information Sheet

Participant Information Sheet

Project Title: *Comparative Analysis of Eyewear Shopping Experiences: In-Store, Online, and AR*

Researcher:

Yousef Abdulmonsef S. Lyas
Student Number: 1800001458
İstanbul Kültür University

Introduction

This research explores consumer experiences with eyewear shopping across three primary shopping platforms: in-store, online, and augmented reality (AR). The study aims to understand how users interact with each of these channels, highlighting the factors that influence consumer satisfaction, decision-making, and engagement.

What is the purpose of the study?

The purpose of this study is to gather in-depth insights into consumer preferences, challenges, and behaviours when shopping for eyewear across three distinct platforms. By combining qualitative and quantitative data, the study will evaluate each shopping channel to identify strengths, weaknesses, and opportunities for improvement.

Why have I been invited?

You have been invited to participate because you are a consumer who has experience with in-store, online, or AR-based eyewear shopping. Your feedback will help provide a deeper understanding of consumer behaviour and how each channel affects your shopping experience.

Do I have to take part?

No, participation is voluntary. You are free to withdraw from the study at any time, without providing a reason. Your decision will not affect your legal rights or any benefits you are entitled to.

What will happen if I take part?

If you agree to take part, you may be asked to:

- Participate in user observations session when shopping for eyewear in-store.
- Complete a survey and participate in a short interview to discuss your personal shopping experiences with eyewear in-store, online and using AR.
- You may be asked to do the online or AR shopping using eye-tracking.

To provide feedback on how each shopping method influenced your decision-making, satisfaction, and engagement.

Sessions will take 30-60 minutes and will be scheduled at your convenience.

Will my information be kept confidential?

Yes. All information collected will remain confidential. Any recordings, photos, or personal data will be anonymized, and only the research team will have access to this data. Only aggregated data will be shared in reports, ensuring no personal identification.

What are the benefits and risks of taking part?

There are no immediate benefits to participating, but your involvement will contribute valuable insights to improve consumer experiences across eyewear shopping platforms. There are no foreseeable risks beyond normal daily activities.

Who has reviewed the project?

This research has been looked at by an independent group of people, called an Ethics Committee, to protect your interests. This study has been reviewed by and received approval from the Research Ethics Committee at the University of İstanbul Kültür University.

Thank you for taking the time to read this information sheet.

Your participation will help provide valuable insights for improving eyewear shopping experiences and shaping future retail strategies.

Appendix C: Consent Form

CONSENT FORM

Title of Project: Comparative Analysis of Eyewear Shopping Experiences: In-Store, Online, and AR

Name of Researcher: Yousef Abdulmonsef S. Lyas

Student Number: 1800001458

Please tick each box:

1. I confirm that I have read the information sheet for the above study. I have had the opportunity to consider the information, ask questions, and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without my legal rights being affected.
3. I understand and agree to the use of audio/video recording as part of the study, with the possible use of verbatim quotations or visual material as a means of communicating the findings in research reports and presentations.
4. I understand that data collected during the study may be accessed by academic supervisors or members of the research team where relevant to the conduct of this study.
5. I understand that any personal data collected will be treated confidentially and anonymized. If shared with other researchers or published, it will not be identifiable as mine.
6. I agree to take part in the above study.

Name of Participant: _____

Date: _____

Signature: _____

Name of Researcher: Yousef Abdulmonsef S. Lyas

Date: _____

Signature: _____