

# **Conducting Experimental Research on Shopify: An Initial Discussion and Guide to Getting Started**

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## **Abstract**

This paper introduces the *online behavioral store* as a tool for conducting research through e-commerce platforms. Online behavioral stores offer many possible benefits, including enhancing experimental realism, measuring actual behavior, and creating a consequential choice environment. Stores do not need to actually sell products to enhance experimental designs; however, using an online behavioral store to make real sales is a viable strategy for conducting field experiments without a field partner. This paper provides a preliminary guide to creating and using an online behavioral store in a fast and cost-efficient manner. The methods described here do not require any coding knowledge and leverage an assortment of off-the-shelf Shopify tools and third-party applications. Using this approach, you can establish your own store capable of conducting on-site experiments (A/B tests), measuring individual-level behavior, and matching that behavior with external identifiers (e.g., Qualtrics information). The functionality, methods, and best practices surrounding online behavioral stores are in an early stage of development, and all should continue to improve.

## Introduction

Marketers and researchers across various disciplines may be interested in using e-commerce stores to conduct behavioral research. Traditionally, such research necessitated partnerships with field collaborators. While these studies can produce compelling results (e.g., Duke and Amir 2023), field collaborations can be risky and time-consuming. An alternative is to create an *online behavioral store*: a fully functional e-commerce store designated for research. These stores offer many advantages, including exceptional realism, a multitude of behavioral measures, and the opportunity to observe consequential consumer actions. In the past, creating such stores may not have been feasible due to financial or time constraints, or advanced web development requirements. Today, creating an e-commerce store is quick, affordable, and does not require any coding knowledge. Using a set of readily available apps and methods outlined here, you can create an online store capable of tracking individual-level behavior. As the functionality and methods surrounding online behavioral stores continue to evolve, they may become a powerful tool for conducting behavioral research.

The paper is organized into several parts. Section 1 discusses the reasons why a researcher might use an online behavioral store. This discussion weighs the potential benefits of enhancing experimental realism and behavioral measures (Morales, Amir and Lee 2017) alongside validity concerns (Cook and Campbell 1979; Cook, Campbell and Shadish 2002). This section clarifies how an online behavioral store is a flexible tool that may be independently valuable for both conveying treatments (IVs) and measuring outcomes (DVs). This discussion identifies how a store can be a research asset even without actually selling items. Section 2 provides a guide for quickly building an online store for behavioral research using Shopify.

Much of this section is dedicated to sourcing products, with a discussion of how sourcing will depend on whether or not the store is designed to make actual sales. Section 3 provides a guide to tracking and managing individual-level behavior. This section introduces several third-party apps and a method of linking information between websites using de-identified query parameters. The methods developed here allow the researcher to map store behavior with information from other platforms (e.g., Qualtrics). Section 4 introduces A/B tests, where both randomization and the experimental manipulation occur within the online behavioral store. Within-store randomization is a powerful feature that allows the experimenter to conduct real field experiments (without a field partner). Section 5 discusses data collection, focusing on sample size, sample source (traffic), and data storage and privacy. Section 6 concludes, before additional considerations are described in the Appendix.

The goal is to introduce the online behavioral store as a burgeoning method for enhancing consumer research in terms of experimental realism, behavioral measures, and consequentiality. However, like with any new method, there are numerous challenges, obstacles, and shortcomings. The tools and methods discussed here are still in their infancy. Yet, progress is swift, and highlighting this opportunity—along with its shortcomings—will surely encourage future improvement.

## **Section 1: Why Use an Online Behavioral Store?**

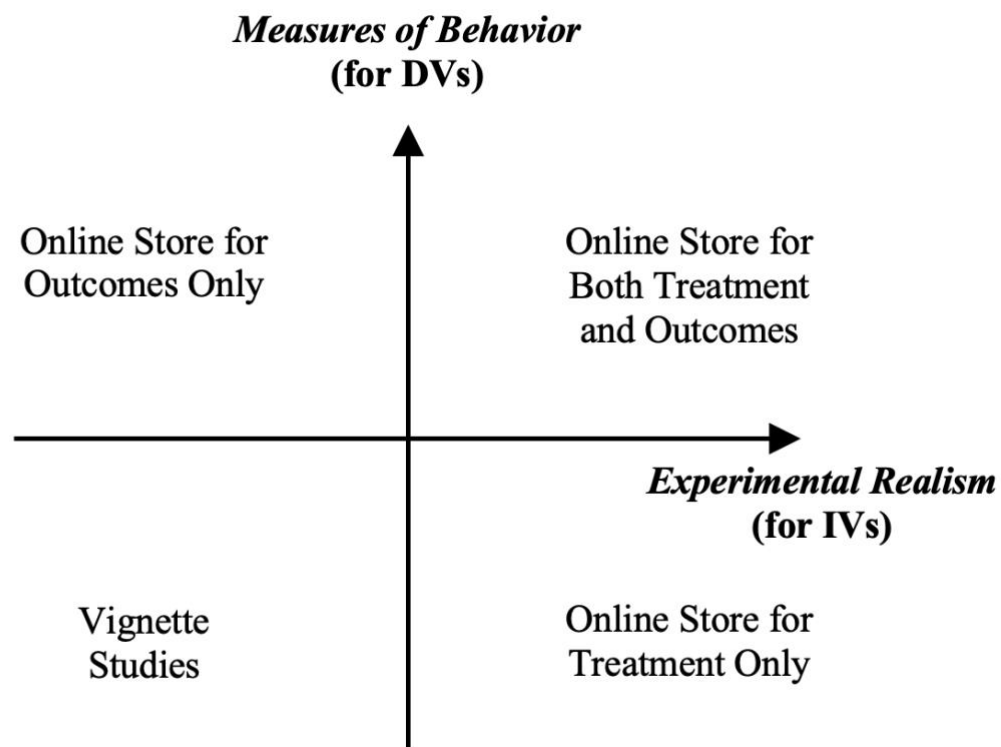
Consumer researchers often seek experimental designs that maintain a high degree of realism and provide measures of actual consumer behavior (Gneezy 2017; Howe, Ubel and Fitzsimons 2022; Lieberman, Morales and Amir 2019; Morales et al. 2017). Realism refers to the

degree to which the experimental design mirrors a real-world context, particularly in relation to the design of treatments and the presentation of information. This is frequently discussed in connection with the selection and operationalization of independent variables. In terms of dependent variables, consumer researchers often aim to measure actual behavior, rather than judgments, attitudes, and hypothetical decisions. Behavior is broad, and can be defined as “actions, consciously intended or not, that participants engage in as part of the DV” (Morales et al. 2017).

A traditional and effective approach has been to conduct studies in actual brick-and-mortar businesses, where both the manipulations and behavior are real (Argo, Dahl and Morales 2006, 2008; Burke et al. 1992; Iyengar and Lepper 2000; Keinan and Kivetz 2008; Kivetz, Urminsky and Zheng 2006; Lee et al. 2019; Nunes and Drèze 2006; Raghurir and Srivastava 2009; Stilley, Inman and Wakefield 2010). Alternatively, researchers have created store environments to convey treatments (Mogilner, Rudnick and Iyengar 2008; Morales 2005) or measure behavior (Kristofferson et al. 2017; Raghurir and Srivastava 2008; Shah et al. 2016). In today’s digital age, online behavioral stores may be fitting and realistic environments for many research questions. Furthermore, online stores are easy to use, modify, and adapt, while capturing various measures of behavior.

For appropriate research questions, online behavioral stores can excel in both realism and providing behavioral measures (figure 1). Consider the following research question: do evaluations of products in online stores depend on the presence or frequency of unavailable items (e.g., listings for “sold out” products)? A researcher in the lab or using an online survey platform might use a vignette manipulation or create some survey-based stimuli to resemble the online shopping experience, prior to measuring evaluative judgments. To improve experimental

realism, the researcher might instead use their online behavioral store to realistically manipulate the presence of unavailable items. What if the researcher is interested in more than product judgments? An online behavioral store can be used to collect various downstream behavioral measures, ranging from product views to consequential spending. This discussion highlights that online behavioral stores need not be used solely for field experiments or to actually sell products. Online behavioral stores can help improve research on both dimensions of experimental realism and behavioral measures.



*Figure 1.* Research methods can be evaluated along the dimensions of realism (in the IVs) and by measures of actual behavior (as the DVs). Compared to common vignette studies, either or both dimensions can be improved by using an online behavioral store.

## Validity

Concerns about realism (in the IVs) and behavioral measures (in the DVs) relate to broader issues about the validity of causal inference (Lieberman et al. 2019). Researchers constantly balance internal validity (does *X cause Y*?), construct validity (are *X* and *Y* properly operationalized and/or measured?), and external validity (does this causal relationship extend to other contexts?) in experimental design (Cook and Campbell 1979; Cook et al. 2002). Such trade-offs reflect a generally accepted pattern: achieving greater realism and behavioral measures tends to be associated with relinquishing experimental control (Lieberman et al. 2019).

To understand why this trade-off often exists, consider the challenges of transitioning an experiment from the lab to the field. The field may present numerous challenges compared to the lab. Observing selection or attrition may be more difficult, and treatments may be harder to cleanly administer and contain (Cook et al. 2002). These and other potential confounders threaten internal validity. Moreover, there may be situations where moving into the field hinders—rather than enhances—operationalizations or measurements due to pragmatism, ethics or profit concerns, or other competing interests between parties. A field partner might be reluctant to test the manipulation that aligns most closely with the researcher's theory, perhaps due to concerns about brand identity, product image, profitability, or feasibility. The same reluctance can arise in dependent variable selection. Consequently, compromises in field work will reduce construct validity when operationalizations or measurements deviate from theory due to field partners' concerns. However, conducting studies in the field can expand access to new contexts (subjects, settings, treatments, measurements) beneficial for external validity (Cook et al. 2002; Gneezy 2017; Lieberman et al. 2019).

The pattern of greater experimental realism and behavioral measures being often associated with less experimental control is not a steadfast rule. For specific research questions, online behavioral stores can provide both exceptional realism and behavioral measures without sacrificing control. Therefore, online behavioral stores have the potential to perform well across all types of validity. This potential presents various use cases. Stores can be used to enhance the realism of the independent variables, incorporate behavioral outcome measures, or both (figure 1). The case of using an online store for both realism and behavioral measures can approximate or even completely mirror field experiments, where unaware participants make consequential decisions. By assuming the role of the store owner, the researcher can pursue their research question without the risks, delays, or compromises often associated with field partners (Gneezy 2017).

## Flexibility

An online behavioral store is a versatile asset that can be tailored to various research questions and designs. Just as a lab store might be reorganized for different studies with varying aims, an online store can be similarly adjusted. Whether an online store is used for randomization, deploying a manipulation, measuring behavior, or selling actual products should depend on the research question and study objectives (specific use cases are discussed in section 4). Online behavioral stores offer a range of possibilities for research design, providing flexibility rather than imposing specific requirements.

*Option: randomization.* Participants can be randomly assigned either prior to or while visiting an online store. This grants the researcher considerable flexibility concerning the types of manipulations they employ. For instance, participants in a lab study could be randomly assigned to experience one of two physical environment conditions (e.g., clean vs. cluttered workspace) prior to engaging in a shopping task to measure behavior. Alternatively, the researcher may prefer randomization to occur when participants visit the store. For example, a store link could be distributed to a large e-mail list, where it is desirable to both (i) send everyone the same initial message and (ii) only consider the manipulation among people who visit the store. In this case, the researcher could randomly assign site visitors to different versions of the online behavioral store (A/B tests discussed in section 4).

*Option: realistic manipulations.* Certain research questions may be especially suited to experimentation within an online store. For example, studying the effects of choice context on consumer search and product choice benefits from an extensive, interactive menu of options for a convincing study (Howe et al. 2022). In some cases, developing elaborate stimuli may be less practical, less realistic, and more time-consuming than using an online store, where features and functions are already built in. For research questions directly related to online consumption, such as search patterns, on-page financing options like 'buy-now, pay-later', review features and distributions, chatbot behavior, and shopping cart features, using your own e-commerce platform could provide a faster and more effective way to deploy manipulations.

Keep in mind, an online behavioral store can be used to enhance the realism of a treatment even if judgments and decisions are made outside the store. For example, a viable use case might be to direct participants from an online microtask platform (e.g., Amazon Mechanical

Turk) to visit your store, where you then manipulate product features. You might then collect your primary dependent variable (e.g., affordability judgments) through a survey platform, like Qualtrics. This approach potentially saves you time—while also offering improved realism—by leveraging a feature that already exists in Shopify.

*Option: multiple measures of consumer behavior.* One of the greatest appeals of online behavioral stores is the potential for multiple measures of consumer behavior. As discussed by Morales et al. (2017), there are many reasons why researchers may strive to measure behavior, as opposed to judgments, attitudes, or hypothetical decisions. Online stores allow for various behavioral measures that might be inaccessible through other mediums or platforms (e.g., Qualtrics). Mouse movements, button clicks, page visits, product sorting, viewing reviews, and dwell times can all be recorded within a dynamic environment that participants can freely explore and interact with. Such behaviors can provide additional insights into process, which can complement downstream dependent measures like cart additions or actual purchases (if the store sells real products).

*Option: consequentiality.* Selling products is not a prerequisite to reap the benefits of an online behavioral store. Behavioral stores might be appealing due to the wide array of non-spending behavioral measures they provide access to (e.g., product views, page visits, and button clicks). However, the option to actually sell products is valuable, enabling the researcher to study real spending behavior in a consequential context.

## Opportunity

Online behavioral stores are full of opportunity. They can be used to create realistic manipulations and observe various measures of behavior, enhancing both construct and external validity, while not necessarily sacrificing internal validity. They can cater to a variety of research questions and designs, ranging from simple additions to online survey studies to full-blown, consequential field experiments. As researchers begin to use online behavioral stores, we will gain a fuller understanding of the opportunities—and limitations—of this experimental methodology.

## **Section 2. Guide to Creating an Online Behavioral Store**

Just one year ago, the methods described here might not have been possible without a considerable amount of custom coding. However, with developments from third-party applications, creating your own online behavioral store can now be accomplished in a single day without any coding. The apps discussed in this guide are themselves evolving, and I have worked with (read: pestered) the app development teams to clarify the needs of researchers. Many of these apps have been agile in responding and implementing new features to make these methods possible. Nevertheless, many features are still being developed and improved. Change is the only constant in this landscape. This tutorial is a compass to guide you to the starting point, not the finish line.

This guide is in no way comprehensive. The methods are not definitive. Let this serve as an initial prototype, a proof-of-concept to showcase the potential of using Shopify for experimental research. The strategies and approaches are bound to evolve.

## Building the Store

Michael Scott—the eccentric boss from NBC’s *The Office*—once outlined the initial steps for creating a business. “So, you want to start a business. How do you start? What do you need? Well, first of all, you need a building. And secondly, you need supply, you need something to sell. Now, this could be anything.” This advice nicely summarizes the initial steps to create an online behavioral store. Initially, you must create the storefront (a digital version, not an actual building) and then stock it with virtually any product you desire. When building the store and sourcing the products, the best practice is to keep it generic for broader appeal, making it easier to adapt your online store to a range of different research questions and projects over time.

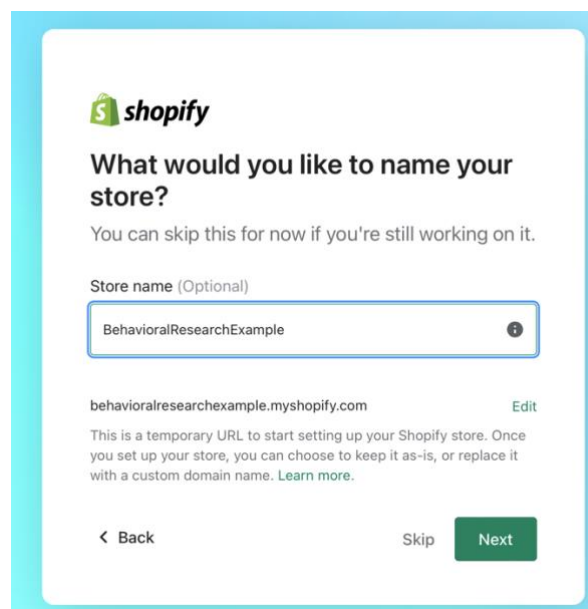
*Before building your store: logistics.* There are several key details to consider prior to building your store. While providing business, tax, or legal advice falls outside the purview of this guide, a preliminary, albeit non-exhaustive, set of questions might include the following: What should it be called<sup>1</sup>? Who will manage the store? How will finances be managed, including paying fees (e.g., the recurring \$29.99/month Shopify fee) and receiving disbursements from sales, if applicable? Remember, any store that sells products operates as a legitimate business

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<sup>1</sup> If the store might eventually benefit from greater perceived legitimacy (e.g., you will eventually run field experiments), consider names with available .com domains.

entity, so understanding the ownership structure and its implications is prudent before initiating sales. Some researchers may sidestep or delay these considerations by creating online behavioral stores that do not sell products (but can still be useful for implementing experimental realism and observing non-transactional behavior).

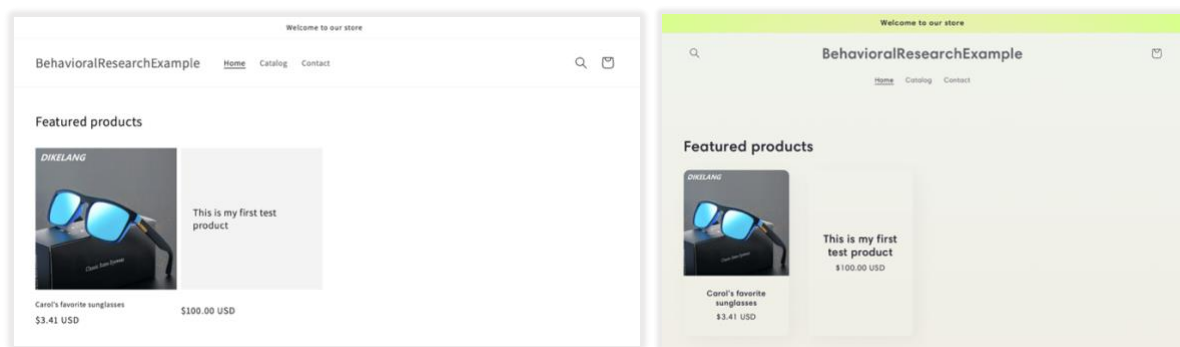
*Building your store.* After navigating the logistics of starting a business, creating the initial version of your online storefront takes a matter of minutes (figure 2). From the Shopify webpage, you can “Start a free trial” to quickly build a store, based on your chosen name. You can change this name later, as it does not refer to a specific domain (e.g., [www.BehavioralResearchExample.com](http://www.BehavioralResearchExample.com)), but rather a directory within the Shopify domain (i.e., [BehavioralResearchExample.myshopify.com](http://BehavioralResearchExample.myshopify.com)). With just a few clicks, you can have a fully functioning Shopify storefront powered by tens of thousands of lines of code. The best part? You can easily modify this code without ever having to directly interact with it.

The image shows a screenshot of the Shopify store creation interface. At the top is the Shopify logo. Below it, the heading reads "What would you like to name your store?". A subtext says "You can skip this for now if you're still working on it." There is a text input field labeled "Store name (Optional)" containing the text "BehavioralResearchExample". Below the input field, the temporary URL "behavioralresearchexample.myshopify.com" is displayed, with an "Edit" link to its right. A paragraph explains that this is a temporary URL and can be replaced with a custom domain, with a "Learn more" link. At the bottom, there are three buttons: "< Back", "Skip", and a green "Next" button.

*Figure 2.* Building the first version of your storefront takes only minutes and involves only basic information (e.g., store name) to get started.

*Modifying your store's layout and appearance.* There are three tiers to tailoring the layout and appearance of your store.

1. Theme Selection: You can choose from a variety of free and paid themes. These are style sheets that alter the aesthetics of all pages within your store (see figure 3).
2. Theme Customization: A theme can be personalized (Sales Channels → Online Store → Themes → Customize) via a straightforward graphical user interface. This customization allows you to decide what content is showcased and how it is organized.
3. Code Editing: You also have the option to alter your theme's code. This level of modification is typically unnecessary for most users and requires an advanced understanding of CSS, HTML, JavaScript, and Liquid. The ability to manipulate code provides immense flexibility because nearly everything on your Shopify store can be custom-coded. However, most researchers interested in utilizing Shopify for experimental research will never need to employ this method.



*Figure 3.* Changing between themes immediately changes the layout and aesthetics of your store.

*Adding pages and navigation.* Now or later, you may want to create non-product pages (e.g., “About Us”, “Sizing Chart”, “FAQs”). You can add, remove, or modify pages at any time (Sales Channels → Online Store → Pages). You can also organize the placement of these pages through the Navigation tab (Sales Channels → Online Store → Navigation). If you are selling products (operating as a real business), you can view and [modify](#) your Privacy Policy, Refund Policy, and Terms of Service (Settings → Policies).

*Upgrading your domain.* By default, Shopify stores are accessed through a URL of the form: `www.YourStoreName.myshopify.com`. This refers to a directory of files hosted on the `myshopify.com` domain. Under certain circumstances—like if you will be running field experiments and want to appear as legitimate as possible—you might wish to upgrade your store with its own domain (e.g., `www.YourStoreName.com`). Shopify offers a convenient method of purchasing a custom domain (Settings → Domains). You may also use an existing domain purchased directly from another domain registrar.

## Sourcing Products

There are many ways of adding products to your digital storefront. This guide will discuss only two: sourcing from drop-shipping partners and importing product lists.

*What is drop-shipping?* Drop-shipping is a common practice in online retail. A customer places an order through a retailer, who then arranges fulfillment of the order with the manufacturer. For instance, if Carol orders a pair of sunglasses from the

BehavioralResearchExample store, the store then places the identical order with the sunglass manufacturer, who then ships the item directly to Carol. This is a profitable business model when the price Carol pays exceeds the costs of ordering and marketing the sunglasses. But profit is almost certainly not the motivation for an online behavioral store. Instead, the appeal of drop-shipping is that you can list and sell virtually limitless products from any number of approved drop-shipping partners. Anything a partner manufacturer can make, you can technically sell. The number and variety of offerings is nearly limitless. Using this approach, you can populate an entire store very quickly and without any financial cost.

Drop-shipping as a business model is not without controversy, and for good reason. One can imagine the multitude of issues that arise when a merchant sells an unfamiliar product without any direct involvement in assuring the quality or delivery. Drop-shipping relies on the promptness and quality of manufacturers who you will never meet, often located in different parts of the world. This poses a potential risk to customers that manufacturers will not follow-through promptly or with high standards of quality. Moreover, drop-shipping without consent can pose a threat to other companies, as they lose control over their branding, pricing, and quality. Therefore, it is crucial to understand how drop-shipping can go wrong to ensure that it is done right.

Setting fair prices, providing clear expectations around shipping times, and offering customer support provides the best chance of satisfying your customers with drop-shipping<sup>2</sup>.

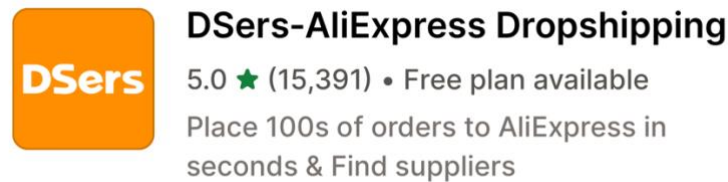
Drop-shipping only from registered and authorized drop-shipping partners eliminates any

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<sup>2</sup> Dolifka (2023) placed a total of 110 drop-shipped orders in April of 2023. 93/110 delivered within 35 days, which was faster than the stated delivery window. The median delivery time was 19 days. One item was reported as defective. Average star rating from 29 reviews was 3.76/5.00. Of the 7/29 reviews earning a low 1- or 2-star rating, 6/7 discussed shipping speed, and only 1 discussed aspects of the product.

concern about inadvertently threatening the manufacturer's brand. Treating these as the minimum standards ensures you will be part of the solution, not the problem.

*Drop-shipping through your behavioral store.* Getting started with drop-shipping is easy, thanks to several third-party apps. This guide will focus on DSers, which is the most widely used and highest-rated drop-shipping application (figure 4).



*Figure 4.* DSers (formerly Oberlo) is used by hundreds of thousands of affiliate stores on Shopify and has a nearly perfect rating from users.

*Getting started with DSers.* DSers integrates with AliExpress, a large online retail service based overseas and owned by Alibaba, an Amazon competitor. AliExpress is a platform for manufacturers and small businesses to sell their products at prices significantly lower than those found on other retail platforms. The site draws 400-500 million visitors every month (Coppola 2022) and boasts nearly 100 million products (Ferreira 2023). DSers seamlessly integrates with AliExpress, providing you access to this entire network of suppliers and products.

Within the app, search for products by using the “Find Suppliers” tab. Consider choosing products from reputable suppliers—those with a long sales history and a significant number of reviews—and with sufficient stock levels. Add products using the “Add to your import list” button. At any point, you can transfer one or more products from your import list to your store by

clicking the “Push to Shopify” button. DSers allows you to decide whether to use an automated pricing rule or manually price each product. You may also wish to update the product details, such as the product name and description.

*Product selection.* Your specific research question may inform your product selection, or you might choose to build an online behavioral store for more general use. Regardless, if you plan on selling items, three principles are essential in selecting your product set. (These concerns may be less significant if you are using an online behavioral store for experimental realism or practicality without actually selling items, as in Howe et al. 2022). First, list appealing items that customers would want. Second, avoid selling products that are potentially dangerous or harmful. Err on the side of caution, avoiding anything you think could potentially pose a health and safety risk. Several categories of products are obviously problematic (e.g., knives and weapons), while others may seem more benign but could still expose the store to unnecessary risk. Anything ingested (e.g., packaged foods) or applied to the body (e.g., cosmetics) carries a high risk. Also avoid products designed for infants and young children, or those that pose a potential risk of accidental ingestion. Third, refrain from selling branded or trademarked content (e.g., a Star Wars mug). Fortunately, with 100 million products spanning virtually all product categories (Ferreira 2023), there are plenty of suitable items to choose from. The majority of items available on AliExpress are safe, generic, unbranded, and good quality consumer goods.

*Manually importing products.* You may want to add your own products. You can do this manually (one at a time) or through an imported product list. Click on “Add product” (Products tab) to manually create or update a product through the associated form fields. You may also

bulk create or update products by importing a .csv file. To do this, simply export your product list (Products tab) to get the current .csv file. Then add or modify rows. Import the .csv file to update the store offerings. Note: you need at least one active product to export the product list file.

This approach can be useful if you want to sell your own products. It is also the best way to rapidly add or change your store's product selection if you do not plan to make real sales. For stores used for experimental realism but not actual sales, you can quickly add items from import lists. These import lists can be shared between stores, introducing possibilities for collaboration between researchers, as well as standardization and reproducibility of product lists. The product list from Dolifka (2023) is available upon request.

### **Section 3: Guide to Measuring and Managing Behavior with Query Parameters**

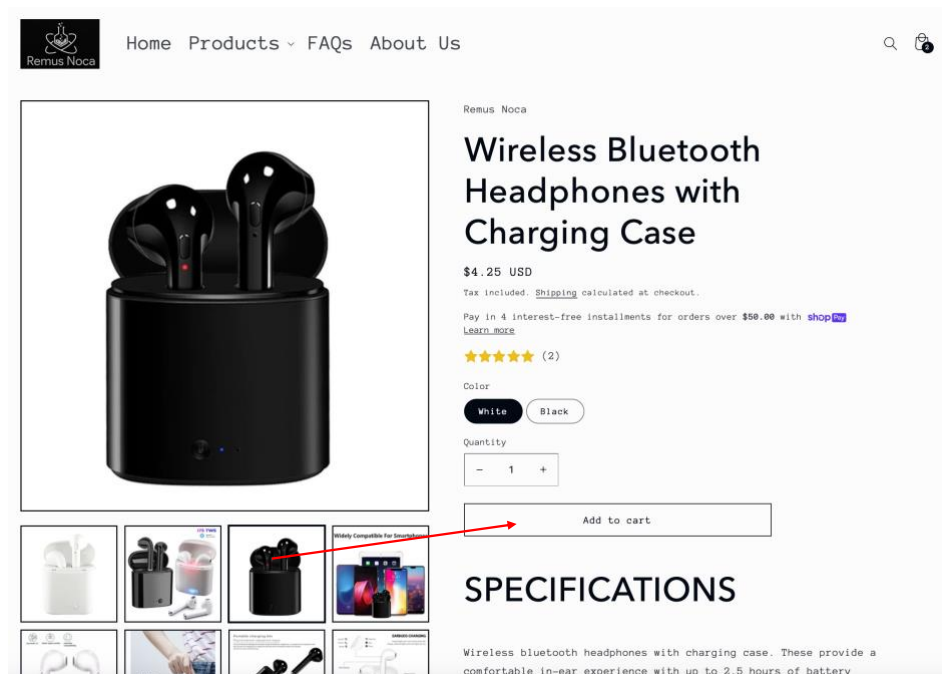
This section of the guide discusses managing the flow of traffic through your online behavioral store. It begins with a tutorial on measuring traffic and visitor behavior and concludes with instructions on controlling traffic and access to your store. Both measuring and managing store behavior are made possible through the use of URL parameters.

#### **Measuring Visitor Behavior**

Every action a potential customer takes—from visiting the site, to looking at various pages, to sorting by a certain attribute, to adding or removing items from the cart, to checking out—is a potentially informative behavioral measure. Historically, most of this rich behavioral

data at the customer level has been inaccessible to Shopify users without the help of a team of custom web developers. However, new developments by third-party applications are making these data increasingly accessible.

The primary method for measuring individual-level data is through recording software. As the name suggests, this software records portions of the customer journey in real-time video. While several recording apps are available for Shopify stores, Replay Pro currently appears the most promising for use in behavioral research. Unlike other apps, which require page clicks or card additions to initiate recorded sessions, Replay Pro begins recording the moment someone visits the store. It records all behavior, so you can review every mouse movement, button click, and page visit (figure 5). Additionally, unlike other apps, Replay Pro can extract vital customer-level information and organize it into a downloadable file.



*Figure 5.* An illustration of how Replay Pro might track mouse movements from a given visitor on a given product page.

*Page-level data.* Replay Pro provides a video recording of mouse movements on every page. At present, certain mouse-tracked outcomes could be manually coded through observing the recordings (e.g., does a customer click on a given product thumbnail, sort by a given attribute, or scroll down to read reviews). As the development of this app has been rapidly advancing, this or similar apps may soon be capable of additional functionality (e.g., mapping mouse movements to x-y page coordinates to automatically extract dwell times in regions of interest).

*Customer-level data.* Replay Pro records every visited page, with the exception of purchase pages containing sensitive personal and financial information. Therefore, researchers may also be interested in data aggregated across pages. This aggregation occurs at two levels: the session level and the visitor level. Sessions are continuous episodes of site access within the same browser tab. For example, a session might be characterized as: arriving at the site, reading the FAQs, searching for "headphones", looking at the product in figure 5, then viewing the cart. Sessions can be further aggregated to the visitor level, which is useful when the same visitor has multiple sessions, perhaps because they are using multiple tabs, or they left and subsequently returned to the store. Replay Pro makes it easy to view session- and visitor-level data. It even allows the export of visitor-level data as a file containing location, visit date, duration, sessions, page views, cart items, cart value, orders, and query parameters. As video replays are only stored for one month, it is good practice to export visitor-level data as soon as data collection is complete.

## Identifying Visitors through Query Parameters

The recording software uses IP addresses and browser information to identify distinct visitors. However, in many cases, it may be useful to identify your visitors in a way that can be linked beyond your online behavioral store. For example, imagine you exposed participants on a microtask platform (e.g., Amazon Mechanical Turk; “MTurk”) to a between-subjects manipulation through Qualtrics. The question is then whether the two experimental groups behave differently in the store. For this type of design, observing individual-level store behavior is only useful if it can be mapped back to the original condition assignment. Fortunately, Replay Pro can extract URL information. This means identifiers embedded within URLs can be used to link visitor-level replay data to an external source.

Query parameters are strings attached to unique identifiers embedded within a URL. Query parameters always begin at the end of the URL pointed at the target page. Consider the following URL path to the landing page of `www.website.com`. Initiating a query string requires inserting a “?” character following the main URL. After initiating a query string, both a key (required and directly follows “?”) and a value (optional and directly follows “=”) are embedded within the URL. Additionally, URLs may contain multiple parameters, separated by an “&”.

Example 1: `www.website.com/?session=tester1`

In example 1, the query parameter key “session” is being stored, as is the value of “tester1”. A researcher might therefore use a uniform key (“session”) with values unique at the individual

level (e.g., “tester1”, “tester2”, etc.). Alternatively, it may be desirable to assign keys at the individual level (example 2).

Example 2:    `www.website.com/?Key1`

`www.website.com/?Key2`

Finally, additional key=value pairs may be assigned following the separator “&” (example 3).

Example 3:    `www.website.com/?session=tester1&version=2`

To summarize, the purpose of query parameters for conducting research is to link individual-level behavior to sources beyond your online behavioral store. For many research designs, this may be imperative. Advanced users might find additional ways of harnessing the power of query parameters to enhance and streamline data collection. For such users interested in adding or modifying code, one promising app to consider is Mechanic.

### Assigning Query Parameters

If you plan to track behavior using query parameters, these must be assigned within the URL outside of Shopify. Consider two different scenarios.

*Scenario 1.* Participants are externally assigned to a condition (e.g., condition “A” vs. “B”), but no other information is known. As an example, imagine traffic from an A/B test of two

different Facebook ads containing your manipulation. In this case, a suitable set of URLs with embedded query parameters might be `www.website.com/?A` and `www.website.com/?B`. With this approach, you could observe individual behavior using Replay Pro; however, you would only be able to match that individual behavior to condition assignment (A or B).

*Scenario 2.* Participants are externally assigned to a condition, and other useful information is known (e.g., a participant's level on a key moderator). A scenario where this might be required is when merging online store data with Qualtrics/MTurk data at the individual level. Best practice is to avoid inserting personally identifiable information into URLs, so a participant's "workerId" shouldn't be used. However, there are many ways of constructing other unique identifiers that avoid exposing personally identifiable information. Examples include using the survey start time, generating random numbers, or assigning new IDs that differ from the workerId. My preferred approach is to take a workerId and apply some transformation to it such that it is encrypted and uninterpretable to anyone outside of the research team. For instance, if a workerId is "abcdefg1234567", you could remove the first and last two characters to get "cdefg12345" and then reverse the contents to get "54321gfedc". This is now a unique, encrypted identifier that doesn't expose the personally identifying workerId. Using this example, you could provide this particular MTurker with the link: `www.website.com/?54321gfedc` (alternatively, the URL could have used the key=value formatting to convey both condition assignment and unique identifier simultaneously: [www.website.com/?A=54321gfedc](http://www.website.com/?A=54321gfedc)).

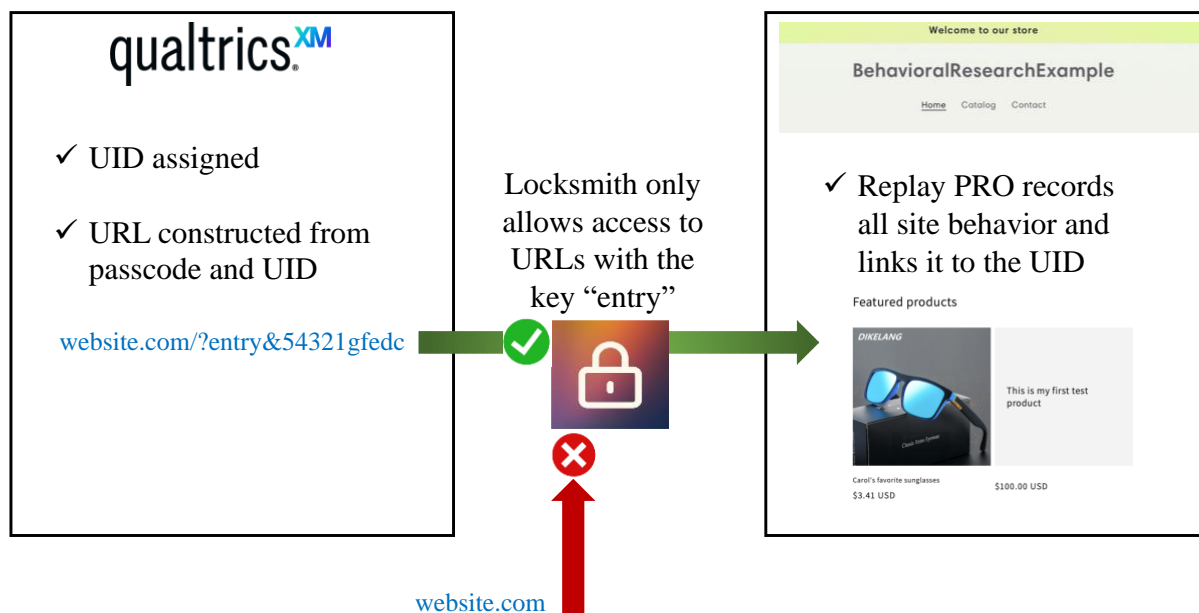
## Managing Store Access

Managing store access is another critical aspect of running an online behavioral store. There might be many reasons why researchers would want to limit access to the store. A store built for experimental research might not want to sell products to the general public. Unwanted visitors might add noise to the data and could potentially affect the functioning of the store. For instance, if your products are displayed in order of popularity (a default Shopify setting that can be modified), your store's recommendations might be skewed based on the preferences of these unwanted visitors. Also, providing open access to your store could expose you to a lot of attention (like shares on social media), which might not be desirable. There are at least two effective ways of preventing unwanted access to your online store.

*Password protection.* Shopify provides a default feature of password protection (Sales channels → Online Store → Preferences → Password protection). This feature lets you set a password that must be entered by any visitor to gain access to the site. Researchers might use this tool in one of two ways. They could either require their intended visitors to enter the password or they could keep the store "closed" (password-protected) by default and "open" it (temporarily remove password) only during data collection.

*Locksmith.* Another option is to use an App called Locksmith, which can protect your store from unwanted access while keeping the restriction invisible to your target participants. This approach is imperative for certain applications, like conducting field experiments, in which participants should be naive to the experimental nature of the website. Locksmith can selectively

provide site access based on various rules and criteria. For the current purposes, the most effective usage is to limit access based on query parameters. This means a visitor with a specific URL can access the site without any awareness of the lock feature, while unwanted visitors will be blocked (figure 6).



*Figure 6.* A demonstration of using query parameters to both limit access (Locksmith) and track behavior (Replay Pro) at the individual level. Given some external unique identifier (UID), a URL can be constructed with a de-identified UID as a query parameter.

To use locksmith with query parameters, create a new lock based on whether a customer “arrives via a secret link” and set the “secret link code” as your query parameter key (note: this must be a *key*; Locksmith does not recognize *values*). For instance, the URL `www.website.com?entry&54321gfedc` would grant access based on the query parameter keys (“entry”, or “54321gfedc”). The researcher might treat one participant-invariant key, “entry”, as the access code, while the other key “54321gfedc” is the de-identified tracking variable. By

leveraging these two apps (Replay Pro and Locksmith) alongside the flexibility of query parameters, you can effectively filter and track the behavior of your target audience through the URLs you generate.

*Managing repeat site visits.* In some cases, it may be desirable to limit additional site visits among your target audience. This may be theory driven. For example, maybe you have a priming manipulation, which you expect to affect immediate behavior, but not behavior an hour, a day, or a week later. Alternatively, this could be driven by practical considerations. For instance, you might be selling products at a loss to encourage engagement and transactions, and therefore would not want to extend a repeated arbitrage opportunity to your experimental subjects.

While there are methods for managing repeat site visits, they are not perfect. If you know the URLs or secret keys in advance of the study, you can use the "input list" feature, which allows you to specify the number of times each subject can visit the site. Most other methods require JavaScript coding to erase browser cookies after a given timeout. However, the team at Locksmith is currently working on a new, user-friendly option to restrict access after user-defined time intervals.

## **Section 4: Guide to Randomization and A/B Tests**

Experiments require randomly assigning subjects to different conditions. An online behavioral store can accommodate randomization that takes place either before or after accessing the site. For instance, a researcher in a lab might randomly assign participants to visit a store

page on either their phone or a lab computer. This is a case where randomization occurs before visiting the store, even though the manipulation actually involves the site (mobile vs. desktop browsing).

Alternatively, a researcher might randomize *and* expose participants to a manipulation before accessing the site. For instance, an online survey could manipulate whether participants consider their budgets in terms of inflows or outflows, before asking them to visit the online behavioral store.

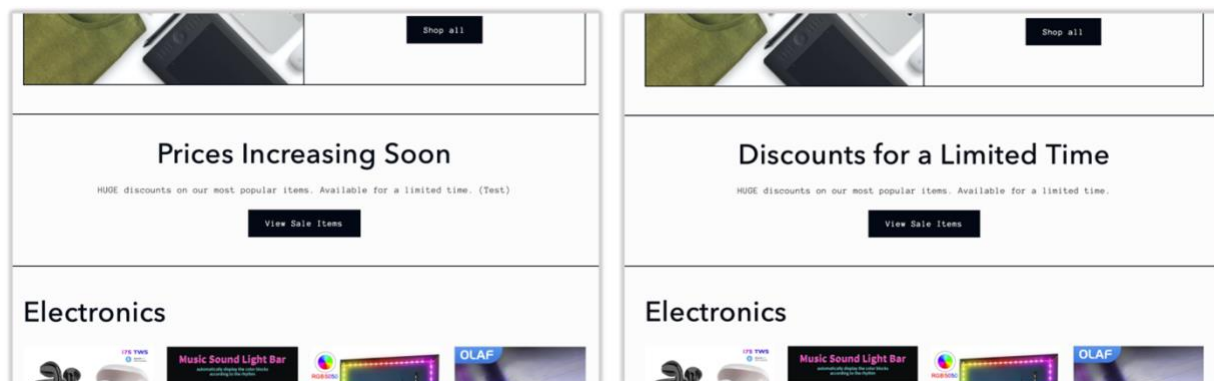
In some cases, experimenters might want to randomize site visitors. This on-site randomization is consistent with the industry practice of A/B testing. Online behavioral stores are well-equipped to handle various use cases involving randomization, manipulations, and measurement (table 1).

Use Case	Randomization	Manipulation	Measurement	Procedure
1	-	-	-	Participants are exposed to manipulation prior to visiting the online store. Subsequent judgments and/or decisions are provided elsewhere (e.g., Qualtrics).
2	-	✓	-	Participants are randomly assigned to receive different URLs (indicating condition assignment). Manipulation occurs through online behavioral store, and judgments and decisions are provided elsewhere (e.g., a Qualtrics survey).
3	-	-	✓	Participants are exposed to manipulation prior to visiting the online store. Individual-level store behavior is mapped back to prior condition assignment.
4	✓	✓	-	Participants access the store through a single URL and take part in an A/B test before providing judgments and/or decisions elsewhere (e.g., Qualtrics).
5	-	✓	✓	Participants are randomly assigned to receive different URLs (indicating condition assignment). Distinct URLs lead to distinct store pages as the key manipulation. Individual-level store behavior is measured and mapped back to prior condition assignment.
6	✓	✓	✓	Participants access the store through a single URL and take part in an A/B test, where individual-level store behavior or aggregate (by condition) behavior serves as the dependent measure.

*Table 1.* Six different use cases differing in whether randomization, manipulations, and measurement occur internally or externally to the online behavioral store.

## A/B Testing

A/B testing (also referred to as “split testing”) is an experimental technique where site visitors are randomly assigned to different versions of a webpage. When properly implemented, A/B tests align perfectly with randomized controlled trials for the sample population of website visitors. Several Shopify apps allow you to conduct [A/B tests](#). These experiments are incredibly straightforward for manipulating product attributes (e.g., price, description, photographs, etc.) and page elements (e.g., banners, buttons, text, styling). For changing product attributes, [NA Product+Upsell A/B Testing](#) is a simple and effective tool. [Lomio](#) provides additional functionality for modifying page elements. [FigPii](#) offers the most functionality, though [installing](#)<sup>3</sup> and [using](#) this app requires some additional steps. An example of an A/B test comparing two price framing announcements is depicted in figure 7.



*Figure 7.* Example of an A/B test of two different framings of future price changes, using FigPii. The “test” variant (left) and original version (right) are randomly assigned to visitors based on sequential order visits, and the number of clicks of “View Sale Items” is stored as the dependent measure.

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<sup>3</sup> The automatic installation method is currently flawed, resulting in a high likelihood that participants in the treatment condition will be exposed to both the treatment and control. [Manually installing](#) the FigPii tracking code to the theme.liquid file (Online Store → Themes → Edit Code) solves this problem and takes only a minute.

Using A/B tests to randomize and deploy manipulations offers several potential benefits. First, this can improve internal validity compared to external randomization as it is designed to prevent cross-treatment exposure. A/B testing effectively creates multiple versions of your site, and the A/B test apps use browser cookies to limit exposure to the assigned version. Second, A/B testing provides an entirely self-contained experiment within the store, eliminating the need to match user data or identifiers across platforms. This might be appealing for researchers who prefer not to track participants due to privacy concerns for certain types of experimental designs. Third, A/B tests can be quite simple to run and analyze. The referenced apps provide condition-level summary information (e.g., proportion of visitors clicking “View Sales Items” in figure 6), meaning it is technically possible to run effective A/B tests without using replay software or measuring additional behavior.

*Randomization.* When using an A/B testing app, it is important for the researcher to know how visitors are being randomized. Some apps, like NA Product+Upsell A/B Testing and Lomio, use time intervals to assign participants to different versions of your store. For example, visitors in a 30-minute interval are assigned to condition A, while visitors in the next 30-minute interval are assigned to condition B, and so on. This approach may be acceptable if participant characteristics are time-invariant, but could potentially lead to imbalanced conditions if the flow of visitors is time dependent. On the other hand, FigPii randomizes visitors sequentially, making it a better choice when there is uncertainty about variance in the flow or characteristics of participants over time.

*Manual A/B tests.* The A/B test apps (NA Product+Upsell A/B Testing, Lomio, and FigPii) are excellent for manipulations of your base Shopify store. Specifically, these apps can seamlessly create variants from your Shopify store code. Currently, these apps are not capable of A/B testing other third-party apps. For example, a researcher may be interested in how the presence or tone of a chatbot impacts customer search behavior. There are several programmable chatbot apps (Tidio offers exceptional functionality and customization) that could be used in such an experiment. The challenge is that A/B apps do not interact with the chatbot app, because both third-party apps only have access to modify base Shopify code—not the code of the other app. Therefore, the researcher would need to manually alter the site at regular intervals (similar to manually changing product displays in a grocery store; e.g., Iyengar and Lepper 2000). For example, the Tidio chatbot could be manually turned on/off or toggled between programming modes at regular intervals, creating a form of time-based assignment. Of course, there are several limitations of this method—some already discussed—and better practices and improved app interfacing should continue to develop.

## **Section 5: Guide to Data Collection, Storage, and Privacy**

Data collection through an online behavioral store can be similar to that in a lab or online experiment. Subjects could be from a university lab's participant pool, who are required to visit the store. They could be workers on a microtask platform, who are required to make judgments about the store, or who are enticed—but not required—to visit. They could also be users of a forum, subscribers on an email list, or regular people encountering a Facebook or Google ad. In such cases, you are quite literally marketing a product to potential customers, so you will need

compelling tactics (e.g., appealing promotional offers) to overcome low base rates of engagement and site visits. The specific research question—and whether or not participants are aware they are taking part in an experiment—should guide sample recruitment decisions.

### Considerations for Data Collection

*Power and sample size.* Online behavioral stores can accommodate a variety of designs depending on whether the manipulation, the dependent measures, or both, take place on the site (table 1). These design choices directly impact your store's traffic flow and potential attrition rates. For instance, consider a scenario where both randomization and the manipulation occur before visiting the store, and the measured behavioral DV is spending. Participants receive an invitation to visit the store post-manipulation, though visiting is not required. In this scenario, the researcher faces two significant challenges in observing spending behavior. The first is the proportion of participants who voluntarily visit the online store. Dolifka (2023) motivated Prolific participants to visit an online behavioral store with a \$1.00-off discount code, resulting in an approximately 26% visit rate. The second challenge is the low conversion rates. For instance, in Dolifka (2023), 27% of site visitors added at least one item to their cart, and 9% made a purchase. (While these percentages may appear large relative to industry standards, products were priced very cheap.) Therefore, non-visitors and visitors who never add products to their cart can create very skewed, zero-heavy distributions on measures like cart additions or purchases. This has implications for power. As a result, designs measuring actual spending behavior need to address sample size concerns due to low purchasing rates.

Designs that do not involve actual purchasing (and thus never collect private information) can likely benefit from making site visitation mandatory. For instance, participants in a lab or online study could be instructed to make decisions on an online store designed for research purposes. This approach effectively addresses earlier concerns about reduced sample size due to attrition and low conversion rates. While these designs might not capture meaningful spending as a dependent measure, they still yield a wealth of other behavioral data in a realistic environment.

*Obtaining traffic.* Many researchers are familiar with sourcing participants from university subject pools or online microtask platforms, such as MTurk, Prolific, and others. These could be suitable sources of traffic for your online store. However, if the objective is to make sales (rather than using the store merely to enhance experimental realism), one must proceed with caution. Amazon Mechanical Turk and Prolific both prohibit advertising and solicitation in their terms of use. Selling to participants from these platforms via an online behavioral store may violate these terms. Nonetheless, there could be acceptable workarounds. For example, Dolifka (2023) obtained written permission from Prolific to use a real online behavioral store for sales, provided that store visits were entirely optional and unrelated to survey completion. Incorporating online behavioral stores into experiments where it is communicated the external site is for research purposes—not making sales directly to participants—should mitigate these concerns.

Researchers could also explore alternative traffic sources. Options might include other microtask platforms, digital labor markets, online forums, e-mail lists, social media platforms, or paid advertisements.

*Limiting traffic.* If your study design necessitates individual-level tracking with Replay Pro, it could be beneficial to control the volume of store traffic at any given time. This approach might be particularly useful if the design requires manual coding of within-page behavior. Manual verification of replay data might also be necessary if you aim to discard observations falling outside a specified time frame (e.g., pre-registering to only consider behavior within ten minutes of a manipulation). In instances where manual coding or verification is involved, organizing traffic into manageable batches can simplify the process. However, as Replay Pro continues to enhance and broaden its functionality, the need for manual coding should decrease over time.

#### Data Storage and Privacy

*Data storage.* The data collected from apps is stored within the apps themselves. Replay Pro currently preserves replays for one month, with plans to extend this period to two months soon. As a best practice, researchers should avoid depending on third-party apps as long-term data storage solutions. Among other risks, apps may come and go, and it is prudent to ensure all relevant data is copied and safely stored outside of Shopify. Note that purchase information is permanently stored directly within your Shopify store.

*Data privacy.* Online behavioral stores involved in actual sales will unavoidably gather real customer information. This information, however, does not include transaction details such as credit card numbers, since Shopify, being PCI compliant, restricts access to this data for both store owners and third-party apps. However, order details do include delivery names and

shipping addresses, which are forms of personally identifying information and require the highest level of care. Thankfully, this information is securely stored within Shopify and not the apps from which you will export data. This means researchers should not need to access this personally identifying information. For instance, when tracking individual-level behavior using Replay Pro, the exported data will include page-level behavior and visitor-level details such as query parameters, total duration on site, and an order number (if applicable), but not personal identifiers. Consequently, with the methods and applications detailed in this tutorial, there should be no need to access or store this personally identifying information for research purposes. The data remains securely stored within Shopify and untouched for research<sup>4</sup>.

## **Section 6: Concluding Remarks**

Researchers studying consumer behavior stand to benefit from utilizing realistic consumption contexts that involve actual behavior. Historically, researchers have conducted field studies in various real businesses, ranging from car washes (Nunes and Drèze 2006) and coffee shops (Kivetz et al. 2006), to shopping malls (Keinan and Kivetz 2008), campus bookstores (Argo et al. 2006), and grocery stores (Iyengar and Lepper 2000; Lee et al. 2019; Stilley et al. 2010). Such experiments can provide compelling evidence of external validity, demonstrating effects extend beyond the controlled—and often contrived—confines of lab and online studies. In today's digital age, researchers may be particularly interested in exploring consumer behavior in e-commerce stores. Certain research questions are unique to the online retail space, benefitting from the use of an ecologically valid online store. Many other questions can be easily adapted.

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<sup>4</sup> Clarifying this point may be useful for garnering Institutional Review Board approval.

Compared to physical store experiments, online behavioral stores can offer improved experimental control (preserving greater internal validity) and a wider range of behavioral measures. Online behavioral stores present vast opportunity, potentially allowing researchers to conduct their own field experiments in a fast, cost-efficient, and compelling manner.

The opportunity is real, but the tools and methods are far from refined. The primary purpose of this paper is to identify the potential benefits to conducting research through an online behavioral store and to highlight various approaches for doing so. The secondary purpose is to provide an initial tutorial for how to get started, sharing the methods I devised and the tools I helped develop. These methods are surely flawed, riddled with inefficiencies, and ripe for improvement. The tools—the apps discussed in this paper—are constantly evolving. Just as I have collaborated with the development teams of several of these apps to make the current methods possible, I encourage any interested readers to reach out to the app developers and voice their needs.

One area in dire need of additional thought and exploration involves traffic acquisition. While a researcher might immediately begin using a non-sales online behavioral store with readily accessible subject pools (e.g., lab pools and microtask platforms), these subject pools may be somewhat restricted for experiments involving actual sales<sup>5</sup>. Are there other, widely accessible subject pools that can be utilized? Surely, there are. Ultimately, this is a question of how to drive customers to an online store: a question many readers may have the expertise to answer.

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<sup>5</sup> As previously noted, it is against the terms of use on Amazon Mechanical Turk and Prolific to solicit or advertise. Dolifka (2023) received written permission to use a real sales experiment on Prolific; however it remains unclear such permissions will become an exception or the rule.

I waited five years to test these methods and write this paper. For five years, I used Shopify for non-research purposes, often lamenting that the platform, the code, or the apps seemed unready for high-quality experimental research. To some extent, these concerns remain today. But the landscape is quickly evolving. The methods discussed here were not possible a short year ago, and there is great promise for where we might be a year from now. This is merely a preliminary guide highlighting where to begin. I have no idea where we will end.

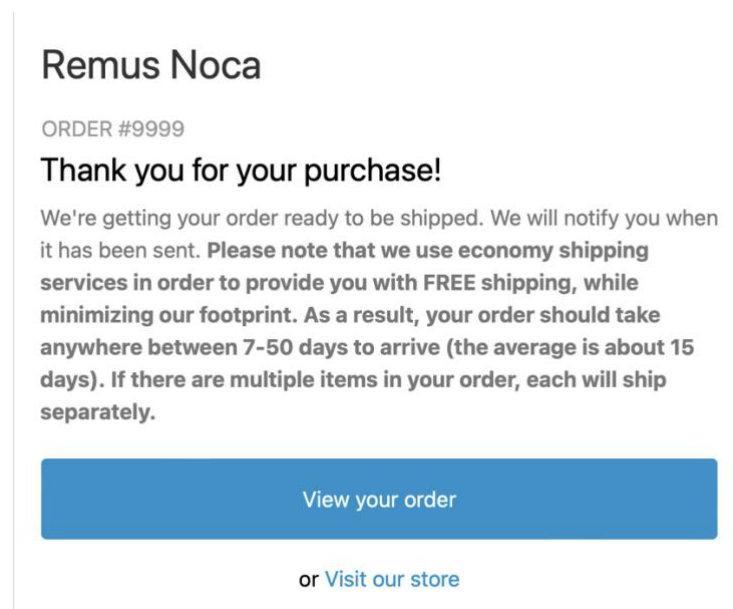
## **Appendix: Additional Considerations**

This section documents some additional considerations and applications that may be useful in establishing and using an online behavioral store.

### **Limiting Communications**

In establishing an online behavioral store, it is good practice to protect your privacy by using a separate e-mail, rather than any of your primary work or personal accounts. From personal experience, owning a behavioral store on Shopify generates a fair amount of spam messaging. This is especially true of any accounts linked with AliExpress, where merchants may reach out with product announcements and promotional offers. If you are making sales, order confirmations and shipping notifications can easily dominate an inbox. For these reasons, it is best to establish a dedicated account to manage these messages. This may also facilitate easier collaboration and shared access across members of the research team.

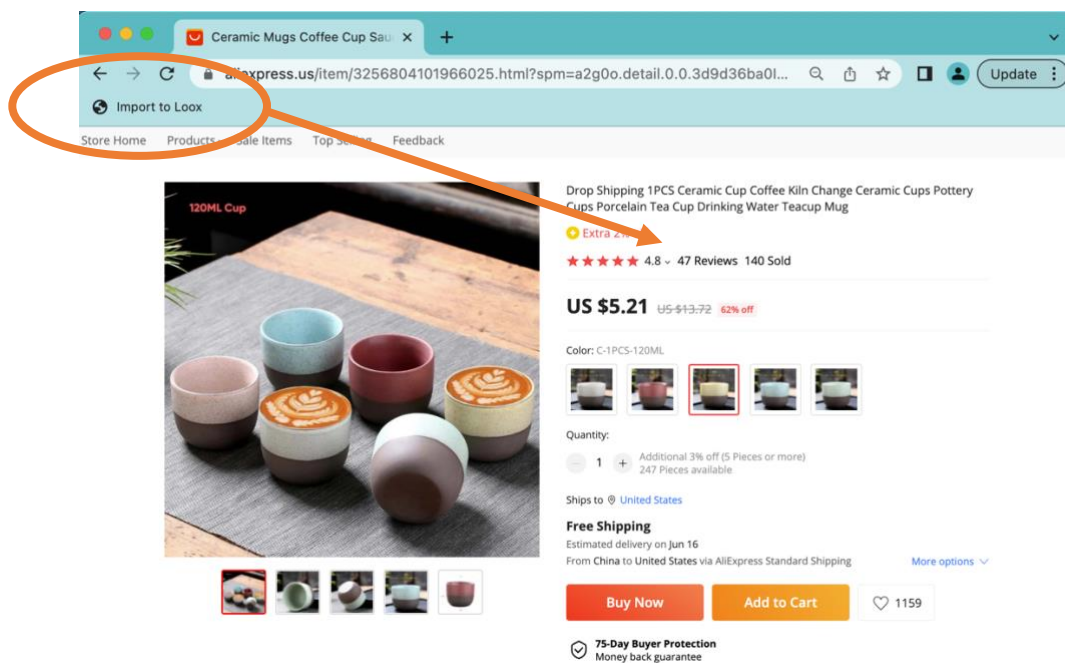
If using an online behavioral store to make sales, you may also consider limiting or eliminating the automatic communications sent to potential customers. Being an e-commerce platform, Shopify has several default features and messages designed to minimize attrition through the purchase funnel and maximize conversions. This includes e-mail reminders to potential customers who initiated, but did not complete, the checkout process. For most research purposes, you may want to disable “abandoned checkout messages” (Settings → Checkout) and update the default messages Shopify sends (Settings → Notifications). If making actual sales, you can update these notifications to help with clear expectation-setting around delivery times (figure A1).



*Figure A1.* Updating the messages sent to your customers can help set expectations to reduce confusion and increase satisfaction. This is an example of a modified “Order confirmation” page, where everything in bold was added to clarify shipping times (Settings → Notifications).

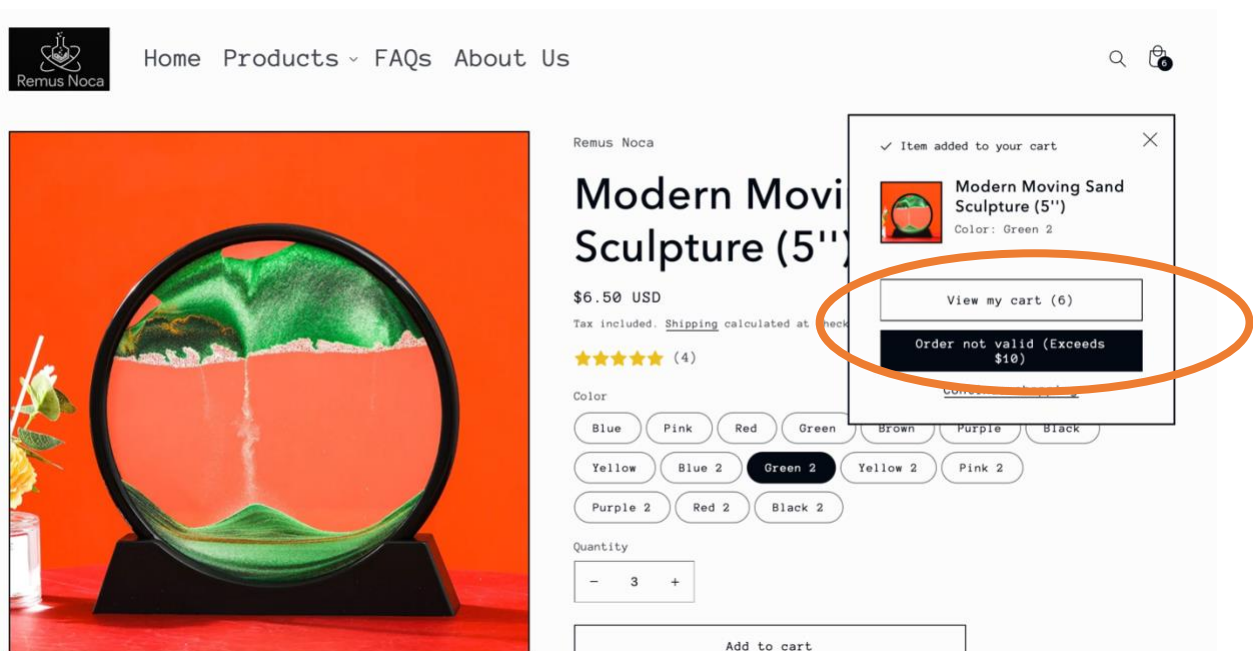
## Additional Third-Party Applications to Consider

*Loox for product reviews.* Product reviews are an important part of the e-commerce ecosystem. Shopify has their own [free add-on application](#) to add and customize product reviews. This default app is useful for changing review layout or experimentally manipulating the distribution of reviews. However, you may want to initially source reviews for your products, as well as give your customers the opportunity to leave reviews for the products they buy. [Loox](#) is an app that integrates with DSers to extract real customer reviews for the drop-shipped products you are selling. Using this app allows you to import real star ratings and user comments and photos directly to your store. The easiest way to use Loox is to install the [Chrome browser extension](#), which then allows you to extract reviews from any product found through DSers/AliExpress (figure A2).



*Figure A2.* Use the Loox Chrome browser extension (*top left*) to automatically import prior product reviews from AliExpress.

*MinMaxify for Limiting Order Size.* If you are selling real products, you may wish to place limits upon how much customers can purchase. This use case is fairly unique to online behavioral stores, as most businesses would not want to prevent customers from placing orders. Fortunately, [Order Limits - MinMaxify](#) provides this functionality. This app will modify the code to your shopping cart pages, preventing visitors from progressing to check-out if their cart contents do not pass your custom validation. The app provides an intuitive interface allowing you to customize the limits, error messages, and buttons, as in figure A3.



*Figure A3.* With MinMaxify, exceeding preset order limits will prompt an error message in the shopping cart, preventing purchases until all conditions are satisfied.

## Summary of Applications and Associated Costs

This guide introduces and describes various third-party applications, which are summarized by table A1. The specifics of the research question and study design will surely

dictate which apps are used. As researchers become more familiar with conducting experimental research on Shopify, this list of apps is sure to change and grow.

A concluding thought pertains to finances, and the claim that conducting research on Shopify is both fast and cost-effective. Apps introduce an enormous amount of functionality very quickly, without the need to write custom code. For this service, they generally charge a monthly fee (current costs documented by table A1). These fees are typically modest, with all referenced apps charging less than \$25 per month. Furthermore, the researcher does not need to subscribe to applications in perpetuity. One practice is to install and utilize applications as necessitated by the research design, but to uninstall when not in use. There is no need to pay for a suite of unused applications every month.

<b>App Name</b>	<b>Usage</b>	<b>Monthly Cost</b>
<a href="#"><u>DSers</u></a>	Sourcing drop-shipped products	\$19.90
<a href="#"><u>Replay Pro</u></a>	Viewing and exporting visitor-level data based on query parameters	\$9.00
<a href="#"><u>Mechanic</u></a>	Adding custom site functionality	\$9.00
<a href="#"><u>Locksmith</u></a>	Limiting access to site based on query parameters (or preset ID lists)	\$9.00
<a href="#"><u>Tidio</u></a>	Implementing chatbots	Free - \$19.00
<a href="#"><u>NA Product+Upsell A/B Testing</u></a>	A/B testing product and price attributes	Free - \$9.95
<a href="#"><u>Lomio</u></a>	A/B testing page and theme attributes	\$19.00
<a href="#"><u>FigPii</u></a>	A/B testing with additional features for measuring outcomes, randomizing	\$24.99
<a href="#"><u>Loox</u></a>	Importing product reviews from AliExpress	\$9.99
<a href="#"><u>Shopify Reviews</u></a>	Displaying and customizing product reviews	Free
<a href="#"><u>Order Limits - MinMaxify</u></a>	Limiting order size	\$4.99

*Table A1.* A list of the third-party applications discussed in this guide.

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