Essays on Consumers and Numbers

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Essays over consumenten en nummers

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
rector magnificus

Prof. dr. A.L. Bredenoord

and in accordance with the decision of the Doctorate Board.

The public defence shall be held on
Thursday, 15 December 2022, at 1300 hours

by

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Erasmus Research Institute of Management – ERIM
The joint research institute of the Rotterdam School of Management (RSM)
and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam
Internet: www.erim.eur.nl

ERIM Electronic Series Portal: repub.eur.nl/

ERIM PhD Series in Research in Management, 559
ERIM reference number: EPS-2022-558-MKT
ISBN 978-90-5892-644-9

Cover: Manissa Putri Gunadi
Design: PanArt, www.panart.nl
Print: OBT bv, www.obt.eu

This publication (cover and interior) is printed on FSC® paper Magno Satin MC.

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Chapter 1

Introduction

Numbers are a quintessential part of our lives as consumers, or as humans in general. From our resting heart rate at the moment we wake up in the morning, to different forms of numerical information we encounter in our day to day activities such as temperature, inflation rates, performance metrics or grades, or prices and discounts in stores, the omnipresent nature of numbers in our lives is indisputable. Numbers play a large role in driving consumers' judgments, decisions, as well as behavior (Bagchi and Davis 2016), and they present a precise and factual quantification of various attributes and characteristics in the environment we live in. Ultimately, numerical information plays a key role in affecting choices that humans make in a host of important facets of their lives, such as health care, finance, and politics. Similarly, in the managerial landscape, decisions are often largely based on numerical data and the judgments derived from them (De Langhe 2016). Understanding how individuals understand, process, and draw inferences from numerical information is therefore of utmost importance.

In recent times, the ways numerical information is presented to its end-users have also evolved significantly. For example, there is an ever-growing presence of various devices and mobile applications that allow consumers to record and monitor various personal and health-related metrics. This implies that consumers can now

access, log, and review information about their activities and behavior more than ever before (Etkin 2016). This has resulted in the growth of the phenomenon coined self-quantification (Almaki, Gray, and Sanchez 2015; Jakicic et al. 2016; Etkin 2016; Pettinico and Milne 2017). Importantly, through these devices consumers can even receive immediate, real-time feedback regarding a certain (physical) activity they are currently completing. Similarly, there is an increasing body of online platforms and websites that provide consumers access to aggregated numerical information—be it historic or current—across a variety of domains. Several notable examples from the marketplace include CamelCamelCamel that provide consumers with historical prices of goods sold on Amazon, or various travel fare aggregators such as SkyScanner, Momondo, and Kiwi that also give consumers information about how certain prices they are looking at fares compared to the historical average for that specific period. Consumers also have access to forms of numerical information that are dynamic in nature. I argue that the biggest distinction between dynamic forms of numerical information versus its static counterpart is that at the time of judgment, consumers would not be solely evaluating the present value of the figure. Importantly, values that precede it, can also play a role in the inference process.

This dissertation aims to build upon existing research on consumer behavior as well as judgment and decision-making by presenting a novel outlook on consumers' judgments and choices in an ever-changing decision environment, where numerical information is becoming increasingly ubiquitous and varied in terms of its presentation. Evidently, numbers often take central stage in consumers' lives. Importantly, in this

dissertation, how consumers' judgments and inferences are influenced by the different manifestations and presentation of numerical information will be closely examined. The three empirical chapters in this dissertation will examine how consumers process and draw inferences based on numerical information from varying angles. The first two chapters shed light on how consumers are influenced by the dynamic sequence in which numerical information is presented to them. Chapter 2 examines how factors related to historical price information, namely the frequency and direction of the changes, jointly influence decisions to make or defer a purchase. Chapter 3 examines on how consumers' judgments about the magnitude of a specific numerical value is formed, based on the frequency in which changes in value is presented to them. In Chapter 4, I examine how framing of instructions of a task—either output-based on input-based—can influence motivation during the task. Both framing modes may involve a specific numerical figure—perform 10,000 steps as fast as you can, or perform as many steps as you can in 24 hours. However, ultimately, I argue that focusing on either expected output or input could lead to differences in motivation.

Dissertation Overview

Chapter 2 focuses on the interaction between frequency and direction of price changes, and the effect on consumers' decision to defer or a purchase. Controlling for the total magnitude of price changes, I propose that consumers are more likely to defer purchase when the price of the product has previously increased, versus when the price has decreased. Importantly, we hypothesize and show evidence that this effect would

be more pronounced upon observing a single large change in price, compared with multiple, smaller changes in price. I also document the role of consumers' expectations about future prices, as well as a host of different moderators of the effect.

Chapter 3 tests whether people would perceive an identical numerical value as larger when it stems from a more (versus less) frequently updated source. Holding the starting value, total magnitude of change, and value at the time of judgment constant across the lower and higher frequency experimental conditions, one could make a normative prediction that frequency should not bear any impact on magnitude judgments. However, data from this chapter suggest that exposure to higher frequency of update leads to higher magnitude judgments. The effect occurs because people misattribute higher frequency for greater magnitude, and is attenuated when people's focus of attention is shifted to the size of each increase.

Chapter 4 examines how framing mode used in task instructions can influence motivation while completing the task. For example, an individual wishing to increase their physical activity could be instructed to walk 10,000 as fast as they can, or they could be told to walk as many steps as they can in a time frame of 24 hours. I examine if these two different framing modes above lead to differences in motivation during the task. They differ in the variability and specificity of expected output (i.e., quantity) and expected input (i.e., duration). In the first framing mode, the expected output is fixed (i.e. 10,000 steps), but completion time is variable (i.e. as fast as you can). In the second option, target quantity is unspecified (i.e. as many steps as you can), but expected duration is specified (i.e. 24 hours). Data from a series of real-effort

experiments collectively suggest that stipulating expected output leads to higher motivation compared to specifying expected input.

In Chapter 5, I will discuss a general discussion of the research presented in the three empirical chapters. Importantly, I will discuss the theoretical contributions of this dissertation, as well practical and managerial implications.

Declaration of Contribution

Chapter 1 (*Introduction*) and Chapter 5 (*General Discussion*) were written by me. In the writing process, I have incorporated feedback and suggestions from my advisors. Chapter 2 (*The Impact of Historical Price Information on Purchase Deferral*) presents research done in collaboration with Ioannis Evangelidis, which was recently published in the Journal of Marketing Research[1]. The research presented in Chapter 3 (*Processing Moving Numbers: How Update Frequency Influences Magnitude Judgments*) was done in collaboration with Christophe Lembregts. The research presented in Chapter 4 (*The Effects of Output and Input-Based Framing Mode on Motivation*) was done in collaboration with Bram Van den Bergh. Formulation of research question, literature review, design of the experiments, data collection, and analyses were all done throughout my doctoral studies with the help and guidance of my co-authors and advisors. Lastly, I wrote the manuscripts and incorporated feedback and comments from my co-authors.

[1] Gunadi, Manissa P., and Ioannis Evangelidis (2022), "The Impact of Historical Price Information on Purchase Deferral," *Journal of Marketing Research*, 59 (3), 623-40.

Chapter 2

The Impact of Historical Price Information on Purchase Deferral

Background and Overview

In the marketplace, prices of products change recurrently over time. In fact, it has been documented that in the past 10 years, price changes have become increasingly prevalent across multi-channel retailers (Cavallo 2018). For online retail channels, price changes seem to be growingly pervasive (Mims 2017). For example, Amazon has been reported to change the prices of its products up to 2.5 million times a day (Mehta, Detroja, and Agashe 2018). However, dynamic and ever-changing prices are not only common in the online shopping experience. Evidence from large multi-channel retailers suggests that price changes on offline (i.e., in physical stores) and online channels tend to share similar frequencies and sizes (Cavallo 2017).

As price changes become gradually more prevalent in the marketplace, consumers themselves have growing access to historical price information. Currently, there are numerous online platforms and applications in the marketplace with the primary purpose of helping consumers monitor prices of various goods. For example, CamelCamelCamel and Keepa are price tracking websites, where consumers have access to historical price charts of goods that are sold on Amazon. Their popularity has grown in recent years, with CamelCamelCamel and Keepa clocking in 2 million and 4 million visitors on average per month, respectively (WebsiteIQ 2021). In a similar

manner, consumers who are interested in buying airplane tickets could use platforms such as Google Flights, a travel fare aggregator website. On top of providing current ticket prices for a given route, it also provides its users with data in the form of the price history for that specific route[2]. These examples illustrate the surge of platforms that serve to aid consumers in acquiring price information of goods they consider purchasing. What is crucial to note is that consumers do not only have access to *current* prices, but these platforms also provide information on *historical* prices. In such a decision environment, historical price information, alongside current price information, could potentially play a pivotal role in influencing consumers' purchase decisions.

From the perspective of retailers and manufacturers, understanding how consumers react to changes in prices in this increasingly dynamic purchase environment is of critical importance. Especially considering the fact that often times, firms may have considerable discretion in influencing and optimizing their prices. Importantly, they could regulate and manage how price changes are implemented and communicated to consumers over time. To this end, we advance a theoretical framework that examines the association between historical price information, future price expectations, and purchase deferral. Our framework enriches our understanding of consumers' reactions to price changes and yields prescriptive insights for pricing-related managerial decisions.

[2] At the time of writing, Google Flight shows '*price history for this search*' dating back to 60 days prior.

In our studies, we investigate the impact of historical price information on consumers' decision to make or defer a purchase at a given point in time. We primarily focus on two independent variables: the *direction* and the *frequency* of past price changes for a given product, while controlling for the total magnitude of those changes. The *direction* of price changes pertains to whether the price has decreased versus increased. We operationalize the *frequency* of price changes as the number of changes in a given direction that led to the current price. This operationalization of frequency involves a distinction between a *single* large change in price versus *multiple* (i.e., at least three) smaller changes in price, all of which involve changes in the same direction, while controlling for the total magnitude of the change.

Fundamentally, our framework proposes that the direction and frequency of past changes in price *jointly* influence consumers' expectations about future prices, and in turn, their tendency to defer purchase. We postulate that the impact of the direction of price changes on purchase deferral is contingent on the frequency of changes. We further propose that the magnitude of our results depends on two additional factors: the monotonicity and the timing of price changes. We elucidate our framework and derive our predictions in the following pages.

Theoretical Development

The Effects of Direction and Frequency of Price Changes on Purchase Deferral

We begin our theoretical development by focusing on the impact of the direction of price changes on purchase deferral. Controlling for the actual price of the product,

we propose that, on average, consumers will be more likely to defer purchase when the price has increased (i.e., current price > past price(s)) compared to when price has decreased (i.e., current price < past price(s)). This is because past price serves as a reference point against which current price is compared. This comparison can shape the utility of buying the product at a given point in time (Thaler 1985; Tversky and Kahneman 1991). In the case of a price *increase*, the change between the previous and current price will be perceived as a loss, as the current price is higher and therefore considered less attractive. As a result, a consumer may be more likely to hold off purchase. On the other hand, in the case of a *decrease*, the current price will be seen as more attractive, with the lowered price signifying a gain. In this case, consumers will be more likely to purchase the product now. Importantly, our main proposition is that the magnitude of the impact of direction of price changes on purchase deferral will crucially depend on the observed *frequency* of price changes.

We will now turn to frequency of price changes—a factor that has been documented to play a pivotal role in influencing consumers' reactions to prices and eventual purchase behavior (see Blattberg, Briesch, and Fox 1995 for an overview). In particular, this has been predominantly investigated in the case of discounts, or price decreases. It is found that frequency tends to dominate as a salient information cue, especially in contexts where the decision environment is more complex, such as in the case of multiple stores and brands with overlapping distributions (Alba et al. 1999). Consumers are also found to be more attentive to the frequency of discounts, compared to the magnitude of savings realized from those discounts (Alba et al. 1994).

Perhaps most crucially, frequency affects consumers' reference price for a specific product category and it also shapes *expectations* regarding the incidence of future deals (e.g., Bolton 1989; Lattin and Bucklin 1989; Mela, Jedidi, and Bowman 1998; Raju 1992). Indeed, if consumers aim to curb costs of their purchases over time, expectations about both their future demand and future prices should influence present purchase decisions (Blattberg et al. 1978; Erdem, Imai, and Keane 2003; Krishna, Currim, and Shoemaker 1991; Krishna 1992). For example, a stream of research has examined the effects of price promotions on purchase behavior, particularly stockpiling. Consumers' expectations of future price changes play an important role in determining whether they will decide to purchase more now and stockpile, or to wait for the next deal (e.g., Blattberg et al. 1978; Gupta 1988; Mela et al. 1998). In other words, the decision to purchase is determined not only by the size of the reduction, but also by the time until the next expected discount (Krishna et al. 1991; Krishna 1992). Therefore, prior literature suggests that the frequency of price discounts can influence purchase decisions by shaping consumers' *expectations* about future deals. Building on this, we surmise that, similar to the case of discounts, the frequency of price increases will also influence consumers' purchase decisions by shaping their expectations about future changes in prices. In the next pages, we elucidate how consumers form expectations about future prices as a function of historical price information.

How Consumers Form Expectations about Future Prices

While past research in marketing and economics concurs that expectations about future prices can be an important driver of purchase decisions (e.g., Jacobson and Obermiller 1990; Kalyanaram and Winer 1995; Malinvaud 1972; Winer 1986), said research has yet to firmly establish how future price expectations are formed as a function of historical price information. For example, Jacobson and Obermiller (1990) put forth a serial correlation model, according to which future price expectations are the result of current price information and unobserved autocorrelated factors that are captured by an error term. While Jacobson and Obermiller argue that a study of the properties of these unobserved factors is an area of future research (p. 427-428), they speculate that these factors may entail individuals' perceptions about the information contained within a given price, as well as the "knowledge gained through prior experience about patterns in price movements." Relatedly, Kalyanaram and Winer (1995) argue that few prior studies that have invoked expected future prices show that consumers estimate future prices based on a linear extrapolative approach. According to this approach, consumers form expectations about future prices by extrapolating from information about past prices (see also Winer 1985). This hypothesis is grounded on the finding that predictions about the future are often largely influenced by past, observed trends (e.g., De Bondt 1993). This notion has been examined across a variety of fields. As mentioned previously, studies on extrapolation theories in marketing have shown that consumers generally use information about past prices when extrapolating and making predictions about future prices (Winer 1986). Relatedly, studies from the

judgmental forecasting area suggest that individuals' forecasts about future performance tend to correlate with trends in historical data, albeit being slightly dampened (e.g., Lawrence and Makridakis 1989; Makridakis, Wheelwright, and Hyndman 1998). The finance literature also boasts numerous findings in this regard. Investor expectations are generally extrapolative, in that they correlate with past market returns (Greenwood and Shleifer 2014), and predictions of future asset prices are often largely extrapolated from past patterns and trends (Lakonishok et al. 1994; De Bondt 1993). Likewise, perceived risk held by investors largely depends on observed past performance (De Bondt 1993), with more weight often placed on most recent returns (Malmendier and Nagel 2011).

Taken together, existing work from different streams of research suggests that expectations about the future are generally extrapolative in nature. That is, people's future predictions have been shown to be largely based on past, observed occurrences. However, in this paper, we theorize that forecasts about future prices are possibly more nuanced. We hypothesize that consumers will, in some cases, extrapolate from past observed occurrences, while in other cases, they may anticipate reversals of previous events. We propose that this would crucially depend on the frequency of the observed, past changes.

An Integrative Framework: Historical Price Information, Expectations, and Purchase Deferral

As discussed previously, we postulate that whether one has observed a single change or multiple changes in price would crucially affect what they predict would

follow suit. We will now discuss how the impact of the direction of price changes on expectations about future prices varies as a function of the frequency of past price changes, and how it concurrently affects the decision to defer purchase.

First, we will consider the case where consumers are deciding to make or defer purchase upon observing a *single* past price change in a specific direction (i.e., a single decrease or increase). Intuitively, one could argue that a single price change may be regarded as an isolated event. This is inspired by recent research by Rao and Hastie (2020), who studied decision-makers' predictions about binary outcomes as a function of the number of viewed prior outcomes (i.e., the length of streaks). Participants in their studies view that a given outcome has occurred anything from 2 to 7 times before the time of the prediction. When participants know that a given outcome has occurred *twice* before, they expect the *reverse* outcome to follow suit.

But what if a consumer has only observed *one* price change, either a single increase or decrease? We surmise that a similar pattern may hold, as is the case of observing two occurrences. That is, consumers may perceive the single price change as an isolated event that is temporary in nature. They will consequently anticipate a price change in the *opposite* direction to follow, such that the original change is largely cancelled out. This prediction is also in line with a view of change as a self-correcting process, whereby "a deviation in one direction induces a deviation in the opposite direction to restore the equilibrium," (Tversky and Kahneman 1974, p. 1125; see also Kahneman and Tversky 1972). Whereas Tversky and Kahneman articulated this perspective for chance outcomes, we conjecture that the same will hold for price

changes when the latter comprise a single event (i.e., a single change in price) because consumers will treat single price changes as isolated outcomes, rather than components of a general trend. This view is also consistent with research in behavioral finance which argues that investors commonly believe that a given event (e.g., a positive shock to earnings) is more likely to be followed by the opposite event (e.g., a negative shock to earnings) rather than a repetition of the same event (Barberis, Shleifer, and Vishny 1998).

In sum, we propose that consumers will be highly unlikely to defer purchase after observing a single large price decrease because they will expect a large change in the opposite direction (i.e., a large price increase) in the future. Conversely, consumers will be highly likely to defer purchase upon observing a single large price increase, because they will expect the price of the product to decrease substantially in the future. Furthermore, we propose that this will be true even if marketers do not explicitly communicate that the price change is temporary, as typically done in the case of price discounts (cf. Blattberg et al. 1995; Krishna et al. 1991). Indeed, in our studies we do not provide participants with any information about the temporal duration of any of our price changes.

Second, we will turn to the case where participants are deciding to make or hold off purchase upon observing *multiple*, smaller past price changes in the same direction. People have been documented to exhibit a general likelihood to perceive a sequence of successive events as a streak (e.g., Albright 1993). Specifically, prior research suggests that people are likely to perceive a streak upon observing three similar events in

succession (Carlson and Shu 2007; see also Rao and Hastie 2020). As discussed previously, research has shown that consumers' predictions about the future generally tend to be extrapolative in nature. Following the findings on streaks, upon observing multiple instances of the same event, consumers may expect this streak to continue. In the context of price changes, upon observing a sequence of changes in the same direction, consumers may anticipate additional changes in that direction to follow in the future. This prediction is also supported by findings from existing research on price promotions. When consumers have previously observed a relatively high frequency of price promotions, they may expect the future price of the product to actually decrease further (Kalwani and Yim 1992). In other words, they will likely anticipate additional price changes in the same direction. This is because the multiple recurrences of changes in the same direction should signal that these changes are rather common (Kalwani and Yim 1992; Krishna et al. 1991; Krishna 1992). In turn, people may expect this pattern to continue in the future, as opposed to treating said changes as isolated events that are temporary in nature. In sum, we hypothesize that upon observing multiple small price changes, consumers may expect additional small changes in the same direction. Importantly, we propose that the impact of the direction of price changes on deferral will likely be attenuated when consumers observe multiple small price changes because they will cease to anticipate substantial price changes in the opposite direction in the future. To summarize our theoretical framework until this point, we formulate the following hypotheses. We predict there is an interaction between the direction and frequency of price changes on purchase deferral. Consumers are more likely to defer

purchase when the price of the product has previously increased (vs. decreased); this effect is more pronounced when consumers observe a single large change in price compared to when they observe multiple (i.e., at least three) smaller changes in price. Furthermore, the predicted effects are driven by differences in consumers' expectations about future prices.

We would like to note that prior research, which asserts that expected future prices are derived from past prices based on a linear extrapolative approach (e.g., Kalwani and Yim 1992; Kalyanaram and Winer 1995; Winer 1985; Winer 1986), can inspire a different prediction. Specifically, in light of that literature, one may expect that consumers will be *more* likely to defer purchase the *more* price decreases they have observed. This is because they will increasingly believe that price will decrease further in the future. Similarly, one may expect that consumers will be *less* likely to defer purchase the *more* price increases they have observed, as they will increasingly believe that price will increase further in the future. Taken together, these predictions imply that consumers should be more likely to defer purchase upon observing multiple price decreases compared to when they observe multiple price increases. In contrast, we theorized that, regardless of the number of observed price changes, the prospect of purchasing the product now is unlikely to be seen as more attractive when the price has increased compared to when it has decreased. As a result, we predicted that consumers, in general, will be more likely to defer purchase upon observing price increases as opposed to price decreases. Importantly, we hypothesized that this effect will be smaller upon observing multiple changes in the same direction.

Empirical Overview

We report findings from eleven experimental studies (N = 11,232) that test our key hypotheses. Design, procedure, and analysis plans for all studies were preregistered at aspredicted.org[3]. Studies 1a-1d document our key effect and provide support for our main hypothesis. These first studies will test the prediction that there is an interaction between the direction and frequency of price changes on purchase deferral. Specifically, consumers are more likely to defer purchase when the price of the product has previously increased (vs. decreased), and this effect would be more pronounced when consumers observe a single large change in price compared to when they observe multiple (i.e., at least three) smaller changes in price. Study 1a employs a cross-sectional design, whereas Study 1b documents the effect in a longitudinal design, where choices are made sequentially over time. Study 1c replicates the effect when price information is presented visually, as opposed to using numerical text, as is the case in all other studies in this paper. In Study 1d, we varied the frequency of the changes that were presented to participants. Study 2 provides support for the mechanism underlying our results. Consistent with our theoretical framework, we find robust evidence that our effects are driven by differences in consumers' expectations about future prices. Studies 3 through 7 examine potential moderators of our effects. We will explore several

[3] In the write-up of the studies below, we include the AsPredicted.org preregistration link for each of the study. Note that for several studies reported here (Studies 1c, 1d, 6, 7, and 8), the study number used in this chapter does not correspond to the study number in the preregistration document. This is because the study order reported here is slightly different than the order used in the original *Journal of Marketing Research* manuscript, which is reflected in the preregistration document. For reference: Study 1c is SS1 in the preregistration, Study 1d is SS2, Study 6 is SS3, Study 7 is SS4, and Study 8 is Study 5.

factors that potentially play a role in impacting the magnitude of our results, namely the role of monotonicity (Study 3), the timing of the price change (Study 4), presence of a reference price (Study 5), underlying cause of the price changes (Study 6), and the nature of the purchase or demand (Study 7). Lastly, Study 8 provides further support for our findings using consequential purchase decisions for four different products.

Studies 1a-1d

Study 1a

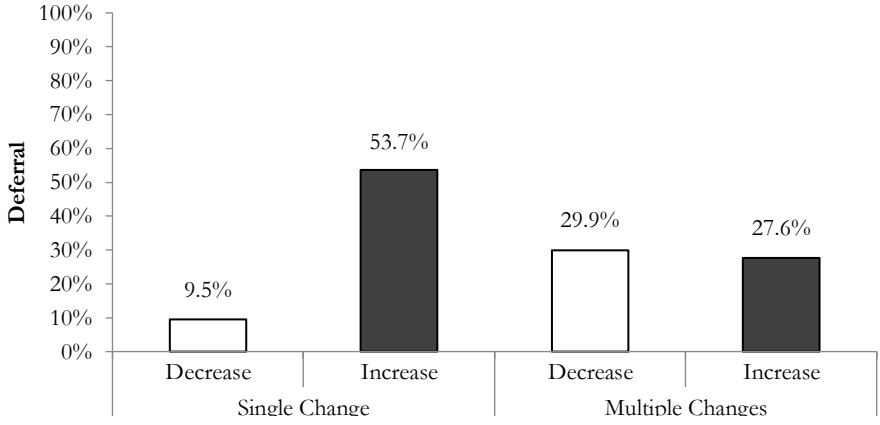
In this study, we aim to test the prediction that consumers are more likely to defer purchase when the price of the product has previously increased (vs. decreased). Furthermore, we expect this effect to be more pronounced when consumers observe a single large change in price compared to when they observe multiple smaller changes in price. This study was preregistered at https://aspredicted.org/MDE_GAS.

Participants (N = 802, 61.3% female, M_{age} = 38.5, mTurk) were asked to imagine that they were buying flight tickets for their upcoming holidays and that only one airline flies directly to their destination. We randomly assigned participants to one of four conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) between-participants design. Participants in the *single decrease* condition were told that the tickets were priced at $600, $600, $600, $600, 4, 3, 2, and 1 week ago respectively. Participants in the *multiple decreases* condition were told that the tickets were priced at $600, $550, $500, $450, 4, 3, 2, and 1 week ago

respectively. Participants in the *single increase* condition were told that the tickets were priced at $200, $200, $200, $200, 4, 3, 2, and 1 week ago respectively, Participants in the *multiple increases* condition were told that the tickets were priced at $200, $250, $300, $350, 4, 3, 2, and 1 week ago respectively. We told participants in all conditions that the tickets currently cost $400. We asked participants whether they would buy the tickets now versus later.

Consistent with H1 (see Figure 1), the predicted interaction between the direction and frequency of price changes on purchase deferral was statistically significant (Wald $\chi^2 = 49.88$, $p < .001$). When participants observed a single change in price, they were much more likely to defer purchase when the price had previously increased (53.7%) compared to when the price had decreased (9.5%), Wald $\chi^2 = 74.28$, $p < .001$. This result was eliminated when participants observed multiple changes (increase = 27.6% vs. decrease = 29.9%, Wald $\chi^2 = .24$, $p = .625$).

Figure 1: Results of Study 1a



In this study, we presented participants with all price information in the same page, similar to platforms that provide historical price information in the marketplace. Importantly, participants made a single purchase decision at one point in time. In Study 1b, we test our predictions when price information is presented *sequentially* and participants have the option to terminate the decision process at any point in time by opting to purchase.

Study 1b

This study serves to replicate the findings of Study 1a in a setting whereby participants are presented with information about the price changes sequentially. We first explained to participants that prices of products change frequently over time, and that they would be asked to make a purchase decision upon receiving information about the product's price at different points in time. This study was preregistered at https://aspredicted.org/SSU_SFE.

Participants (N = 800, 51.3% male, M_{age} = 37.4, mTurk) were asked to imagine that they considered buying a new TV and that they have been checking the price of a TV that they liked during the past days. We randomly assigned participants to one of four conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) between-participants design. All participants began with the same starting page which stated, "it is now January 16, 2021. Currently, the price of the TV is $1200" (page 1). In the following pages (pages 2-4), we manipulated frequency by altering how many price changes were communicated to participants. On each

subsequent page, after seeing price updates, participants had the option to buy now versus later. In all conditions, there were four pages in total, with each page communicating a price change depending on the experimental condition. Importantly, if the participant selected "buy now" on a given page, the study would end there for them. If the participant selected "buy later", they would proceed to the next page.

Participants in the *single decrease* condition were first told (page 1) that "it is now January 16, 2021. Currently, the price of the TV is $1200." Participants were presented the option to buy now or later. As mentioned previously, if the participant selected to buy now, the study terminated there for them. If the participant selected to buy later, they would proceed to the next page (page 2) which stated that "on January 16, 2021, the price of the TV was $1200. It is now January 17, 2021. Currently, the price of the TV is $900." Again, participants were presented the option to buy now or later. If they waited, they would proceed to the next page (page 3) which featured the following information: "On January 16, 2021, the price of the TV was $1200. On January 17, 2021, the price of the TV was $900. It is now January 18, 2021. Currently, the price of the TV is $900." Again, participants were provided with the choice to buy versus wait. If they waited, they would proceed to the final page (page 4) which stated that "On January 16, 2021, the price of the TV was $1200. On January 17, 2021, the price of the TV was $900. On January 18, 2021, the price of the TV was $900. It is now January 19, 2021. Currently, the price of the TV is $900." Again, the participant was provided with the choice to buy versus wait, and the study would terminate at this (fourth) page regardless of the participant's decision. The other three conditions were set up in an

identical manner, except for the displayed prices. For participants in the *multiple decreases* condition, the displayed prices were $1200, $1100, $1000, and $900. For participants in the *single increase* condition, the prices were $1200, $1500, $1500, and $1500. For participants in the *multiple increases* condition, the prices were $1200, $1300, $1400, and $1500. Note that, in this study, the starting price of the product was held constant across conditions, while we varied subsequent prices. Our dependent variable was the total number of times that the participant selected to purchase later. This measure had a minimum value of 0 and a maximum value of 4.

Replicating the findings of Study 1a, the interaction between our two experimental factors was statistically significant ($t(796) = -4.55$, $p < .001$). When there was a single large change in price, participants deferred purchase much more when the price increased ($M = 3.17$, $SD = 1.56$) compared to when the price decreased ($M = 1.72$, $SD = 1.48$), $t(796) = 9.52$, $p < .001$. This result was attenuated in the case of multiple price changes ($M_{increase} = 3.12$, $SD_{increase} = 1.58$ vs. $M_{decrease} = 2.65$, $SD_{decrease} = 1.50$, $t(796) = 3.07$, $p = .002$).[4]

In the studies reported so far, we examined the effect of frequency of price changes and direction on purchase deferral in a setting where the price information is presented in numerical text form. We aim to provide more evidence for our effect by

[4] Although not central to our hypotheses, we found that the impact of the direction of price changes on total revenue (i.e., revenue generated from all submitted decisions) was much larger when consumers observed a single large change in price (total revenue single decrease = $146700 vs. total revenue single increase = $61800; diff. = $84900) compared to when they observed multiple smaller price changes (total revenue multiple decreases = $114400 vs. total revenue multiple increases = $64100; diff. = $50300).

showing our findings replicate when price information is displayed visually, in the form of line charts in Study 1c.

Study 1c

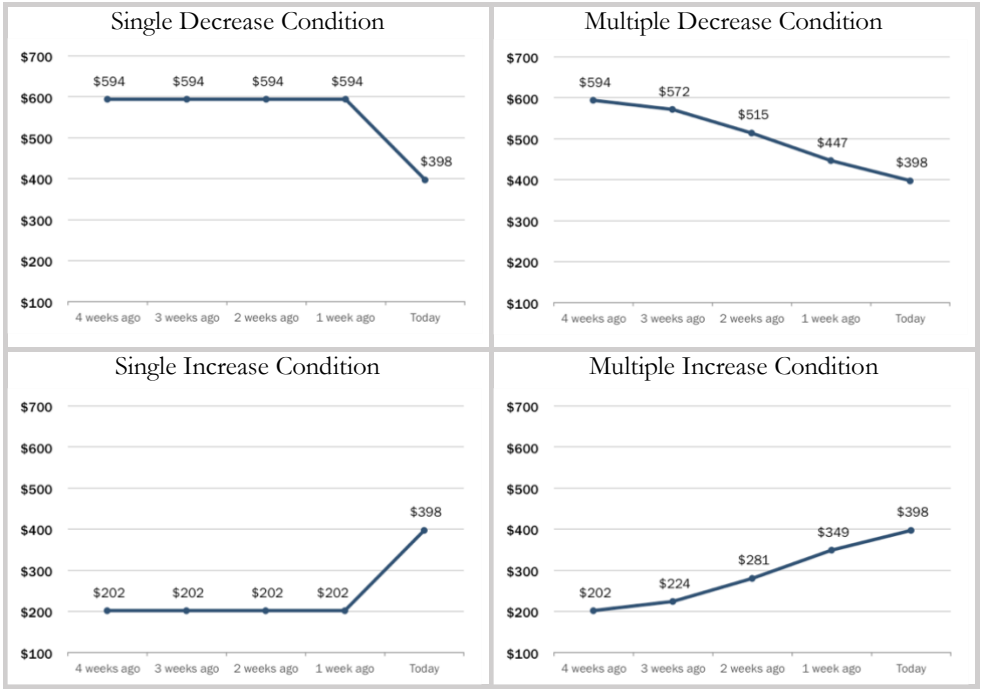
In the marketplace, consumers commonly encounter historical price information that is depicted visually using line charts that feature time on their horizontal axis and price on the vertical axis (e.g., Google Flights, CamelCamelCamel, Keepa). In this study, the experimental stimuli we used were graphs that were designed to take on the appearance of those charts. In particular, we loosely followed the design of price charts found on Google Flights.

One may argue that presenting price changes visually may invoke greater salience in terms of direction: even if a participant does not pay close attention to the prices themselves (which would be expressed numerically), they may be able to infer the pattern of changes simply from visual inspection of the graph. For example, seeing a downward line may indicate that prices are decreasing. Indeed, it has been found that when visual representations are used, people may attend to the most salient features of the information (Lurie and Mason 2007). Nevertheless, we predicted that our results would replicate when prices are presented visually. This study was preregistered at https://aspredicted.org/VGB_TSX.

The procedure for this study was very similar to that of Study 1a, except that we used flight tickets as the focal product and that prices were displayed visually in a graph. Participants (N = 902, 57.2% female, M_{age} = 38.6, mTurk) were asked to imagine that

they were buying flight tickets for their upcoming holidays and that only one airline flies directly to their destination. Participants were told that "today, you see the following prices on Google Flights for this specific route." This study employed a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) between-participants design. Information was displayed with a line chart that featured time on the horizontal axis (from 4 weeks ago up to today), and price on the vertical axis (from $100 to $700), and all graphs had the same axis configuration irrespective of experimental condition, as can be seen in Figure 2. Price was displayed using a dark blue line. For participants in the *single decrease* condition, the graph indicated that the price of the tickets was $594, $594, $594, $594, 4, 3, 2, and 1 week ago respectively. For participants in the *multiple decreases* condition, the graph indicated that the price of the tickets was $594, $572, $515, $447, 4, 3, 2, and 1 week ago respectively. For participants in the *single increase* condition, the graph indicated that the price of the tickets was $202, $202, $202, $202, 4, 3, 2, and 1 week ago respectively. For participants in the *multiple increases* condition, the graph indicated that the price of the tickets was $202, $224, $281, $349, 4, 3, 2, and 1 week ago respectively. For all conditions, the graph showed that today's price was $398. Participants were asked whether they would buy the tickets now versus later.

Figure 2: Stimuli of Study 1c



The interaction between the direction and frequency of price changes was statistically significant (Wald $\chi^2 = 85.27$, $p < .001$). Upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased (51.1%) compared to when the price had decreased (10.2%), Wald $\chi^2 = 74.60$, $p < .001$. This result reversed when consumers observed multiple changes in price (increase = 17.3% vs. decrease = 34.7%, Wald $\chi^2 = 17.23$, $p < .001$).

Overall, in this study we found that when participants were asked to appraise the price information visually, they respond similarly to when price information is presented in numerical form. In the next study, we will round out the initial

demonstration of our key effect by exploring *how many* changes are presented to participants and whether that bears influence on deferral.

Study 1d

In the previous studies, we have argued and demonstrated that the impact of the direction of price changes on purchase deferral decreases when the frequency of price changes is relatively higher. In the studies presented so far (as well as the studies that would follow), our operationalization of frequency involved *one* change in price versus *four* changes. Naturally, readers may wonder whether the impact of the direction of price changes on purchase deferral decreases further when a *higher* number of changes is communicated to participants in the multiple changes conditions. To address this question, we conducted a study that employed three frequency levels: a *single* change in price vs. *three* changes in price vs. *six* changes in price. This study was preregistered at https://aspredicted.org/RIC_QQJ.

Participants (N = 1,002, 53.8% male, M_{age} = 38.5, mTurk) were asked to imagine that they were considering to buy a Bluetooth speaker and that they had been checking the price of a speaker that they liked during the past weeks. The study employed a 2 (direction: decrease vs. increase) by 3 (frequency: single change vs. three changes vs. six changes) between-participants design. Participants in the *single decrease* condition were told that the speaker's price was $100, $100, $100, $100, $100, $100, 6, 5, 4, 3, 2, and 1 week ago respectively. Participants in the *single increase* condition were told that the price of the speaker was $40, $40, $40, $40, $40, $40, 6, 5, 4, 3, 2, and 1 week ago

respectively. Participants in the *three decreases* condition were told that the price of the speaker was $100, $100, $90, $90, $80, $80, 6, 5, 4, 3, 2, and 1 week ago respectively. Participants in the *three increases* condition were told that the speaker's price was $40, $40, $50, $50, $60, $60, 6, 5, 4, 3, 2, and 1 week ago respectively. Participants in the *six decreases* condition were told that the price of the speaker was $100, $95, $90, $85, $80, $75, 6, 5, 4, 3, 2, and 1 week ago respectively. Participants in the *six increases* condition were told that the speaker's price was $40, $45, $50, $55, $60, $65, 6, 5, 4, 3, 2, and 1 week ago respectively. We told all participants that, currently, the speaker's price was $70. We asked participants whether they would buy the speaker now versus later.

Replicating our previous findings, upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased (94%) compared to when the price had decreased (6.6%), Wald $\chi^2 = 143.46$, $p < .001$. This result was attenuated when participants viewed three (increase = 74.3% vs. decrease = 40.7%, Wald $\chi^2 = 36.67$, $p < .001$) and six changes in price (increase = 76.6% vs. decrease = 53.3%, Wald $\chi^2 = 19.41$, $p < .001$). The impact of the direction of price changes on deferral was significantly smaller in the three changes conditions compared to the single change conditions (interaction single change vs. multiple changes (three) = Wald $\chi^2 = 60.69$, $p < .001$). Similarly, the impact of the direction of price change was significantly smaller in the six changes conditions compared to the single change conditions (interaction single change vs. six changes = Wald $\chi^2 = 72.41$, $p < .001$). Further, although the impact of the direction of price changes on deferral was smaller in the six changes conditions compared to the three changes conditions,

this difference was not statistically significant (interaction three changes vs. six changes = Wald $\chi^2 = 1.26$, $p = .262$).

Our results suggest that the interaction between the direction and frequency of price changes on purhase deferral may hinge on the presence versus absence of a trend or streak. For example, Carlson and Shu (2007) argue that three changes are sufficient to create perceptions of a streak or trend. Consequently, additional changes are unlikely to influence consumers' beliefs to a great extent. Indeed, our data suggest that the impact of the direction of price changes on deferral decreases significantly when comparing a situation in which a trend is present (i.e., when there are three or six changes) versus a situation where a trend is absent (i.e., when there is a single change). Importantly, we do not observe substantial differences in the impact of the direction of price changes on deferral between two situations that involve streaks with different amounts of changes (i.e., three vs. six changes).

Discussion on Studies 1a-1d

Results from Studies 1a through 1d provide collective support for our focal prediction. We documented the key interaction between frequency and direction of changes, and we also have examined contexts where the price information is presented visually, as well as where the level of frequency of changes was varied. While these studies provide robust evidence for our effects, until this point, still little is known about the underlying process. In Study 2, we test the prediction described in our theoretical framework that consumers form expectations about what changes in price

will come next, based on the changes they have observed previously. These expectations about future price changes will then impact their decision to defer purchase.

Study 2

In Study 2, we provide evidence for the proposed process and examine the potential role of expectations about future prices. To this end, we ask participants to generate forecasts about the future price of the product upon observing changes in price. Based on our framework, consumers will be highly likely to defer purchase upon observing a single large price increase, because they should expect the price of the product to decrease substantially in the future. Conversely, consumers will be highly unlikely to defer purchase after observing a single large price decrease, because they should expect that the price of the product will increase substantially in the future. Further, the impact of the direction of price changes on deferral will likely be attenuated when consumers observe multiple price changes because they will cease to anticipate substantial price changes in the opposite direction in the future. In fact, upon observing multiple price changes, they may expect additional small changes in the same direction. This study was preregistered at https://aspredicted.org/JSE_LOG.

Procedure

We instructed participants (N = 802, 51% female, M_{age} = 37.6, mTurk) to imagine that they were considering to buy a Bluetooth speaker and that they had been checking the price of a speaker that they liked during the past weeks. The study employed a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) between-participants design. Prices were displayed similarly to Study 1a. Participants in the *single decrease* condition were told that the speaker's price was $100, $100, $100, $100, 4, 3, 2, and 1 week ago respectively. Prices displayed in the *multiple decreases* condition were $100, $90, $80, and $70. Prices displayed in the *single increase* condition were $20, $20, $20, and $20. Prices displayed in the *multiple increases* condition were $20, $30, $40, and $50. All participants were told that currently the speaker's price was $60. We asked participants whether they would buy the speaker now versus later.

Subsequently, participants responded to two measures tapping into the proposed process, which were displayed in random order. First, participants were asked to predict the price of the product in a week from now (in $; open-ended with minimum of $0 and maximum of $150). We expected that participants in the single increase condition would predict that the price would be lower in the future compared to participants in the single decrease condition, and that this result would likely reverse in the multiple changes conditions. We also asked participants to express their level of agreement with a statement that measures their beliefs about whether the price will keep changing in the same direction in the future (decrease conditions: "the price will

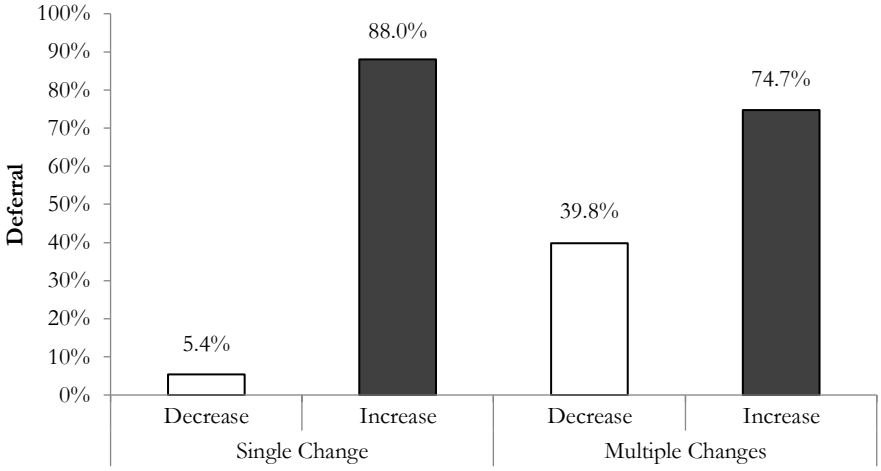
continue to decrease in the future;" increase conditions: "the price will continue to increase in the future" (1 = *strongly disagree,* 4 = *neither agree nor disagree*, 7 = *strongly agree*). We expected that participants in the single change conditions would hold weaker beliefs that the price changes will follow the same direction in the future compared to those in the multiple changes groups.

Results

Consistent with previous findings, the interaction between the direction and frequency of price changes was statistically significant (Wald $\chi^2 = 58.87$, $p < .001$). Mean deferral rates are presented in Figure 3. Upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased (88%) compared to when the price had decreased (5.4%), Wald $\chi^2 = 164.10$, $p < .001$. This result was attenuated when participants observed multiple price changes (increase = 74.7% vs. decrease = 39.8%, Wald $\chi^2 = 47.28$, $p < .001$).

Further, in line with our predictions, we observed a significant main effect of frequency on participants' agreement with the statement that concerned whether the price would keep changing in the same direction in the future. Participants held weaker expectations that the speaker's price would continue to change in the same direction in the future when they observed a single change (decrease: M = 3.47, SD = 1.65; increase M = 3.17, SD = 1.67; collapsed across direction: M = 3.32, SD = 1.66) compared to multiple changes (decrease: M = 4.54, SD = 1.67; increase M = 4.02, SD = 1.93; collapsed across direction: M = 4.28, SD = 1.82), $F(1, 798) = 60.08$, $p < .001$.

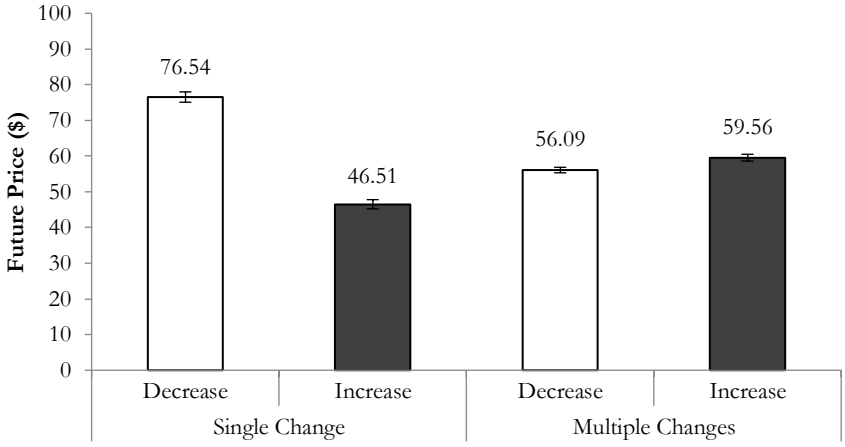
Figure 3: Results for Study 2 (Deferral Rates)



Importantly, we found support for our predictions concerning participants' forecasts of future prices. Mean forecasts are presented in Figure 4. Participants in the single increase condition predicted that the future price of the product would be much lower (M = \$46.51, SD = 18.18) compared to participants in the single decrease condition (M = \$76.54, SD = 20.51) , F(1, 798) = 345.61, $p < .001$. This result is consistent with our hypothesis that, upon observing a single large change in price, consumers anticipate a large price change in the opposite direction to follow suit. In contrast, participants in the multiple increases condition predicted that the price of the product would be slightly higher (M = \$59.56, SD = 13.34) compared to participants in the multiple decreases condition (M = \$56.09, SD = 10.95) , F(1, 798) = 4.55, $p = .033$ (interaction F(1, 798) = 213.86, $p < .001$). This result is partly consistent with our hypothesis—as well as a host of research on trends—stating that, upon observing

multiple (small) changes in price, consumers should expect another price change in the same direction to follow in the future. While this was true for participants in the multiple decreases condition, we did not obtain evidence for this prediction in the multiple increases condition. Upon observing multiple small increases in price, participants believed that the price of the product would remain unchanged—rather than increase further—in the future.

Figure 4: Results for Study 2 (Means of the Forecast for Future Price)



Importantly, a conditional process analysis (10,000 bootstraps; 95% bias-corrected confidence intervals; Hayes 2018) showed that participants' forecasts mediated the interaction between the direction and the frequency of price changes on deferral (index of moderated mediation = −1.68, SE = .40, 95% LLCI = −2.55, ULCI = −1.01).

Data from Study 2 largely support our theoretical framework. Specifically, the direction and frequency of price changes jointly shape consumers' *expectations* about future prices and, in turn, their decision to defer purchase. However, the way consumers form expectations may hinge upon the consistency of the observed change, especially in terms of direction (i.e., decrease or increase). Therefore, our effects may be contingent on whether these observed changes are monotonic in nature. We will examine the role of monotonicity as a moderator of the effect in the next study.

Study 3

This study focuses on the monotonicity of price changes. Monotonicity refers to the extent to which the changes in prices are directionally consistent. If a series of price changes involves a change that goes in the opposite direction compared to the other changes, we define that series of changes to be nonmonotonic in nature. For example, a set of changes is nonmonotonic when, after several decreases, the price actually increased instead of decreasing again. Similarly, when the price decreased after a series of increases instead of increasing again, we consider this series to be nonmonotonic.

Importantly, we expect that the presence of an inconsistent change may crucially affect how expectations about future prices are formed. If indeed formation of expectations about the future depends on the consistency of observed changes (e.g., a series of decreases), a single change in the opposite direction (e.g., an increase) may complicate what would be expected to occur in the future. Instead of expecting the

price to follow the past trend and keep decreasing, upon observing the increase, the consumer may now believe that increases may occur again in the future. This, in turn, would make the consumer more inclined to buy now (vs. later). Similarly, upon observing multiple price increases coupled with a price decrease, the consumer may now believe that decreases may occur again again in the future. This, in turn, would make the consumer more inclined to defer (vs. buy now). We will examine whether the impact of the direction of price changes on purchase deferral will be larger when consumers observe multiple price changes that are nonmonotonic (vs. monotonic) in nature. The study was preregistered at https://aspredicted.org/IAD_SAS.

Procedure

We randomly assigned participants (N = 1,506, 53.9% male, M_{age} = 38.7, mTurk) to one of six conditions of a 2 (direction: decrease vs. increase) by 3 (frequency: single change vs. multiple monotonic changes vs. multiple nonmonotonic changes) between-participants design, with a Bluetooth speaker as the focal product in the scenario. The stimuli for the single change and multiple monotonic changes conditions were identical to those of Study 2. In the multiple nonmonotonic changes conditions, participants observed one directionally inconsistent change within a streak of changes in a given direction. Specifically, participants in the *multiple nonmonotonic decreases* condition were told that the speaker's price was $100, $90, $80, $70, $80, 4 weeks, 3 weeks, 2 weeks, 1 week, and 4 days ago respectively. Participants in the *multiple nonmonotonic increases* condition were told that the price of the speaker was $20, $30, $40, $50, $40, 4 weeks,

3 weeks, 2 weeks, 1 week, and 4 days ago respectively. Like in Study 2, all participants were told that the current price of the speaker was $60, and they were asked if they would buy the speaker now versus later. Afterwards, we asked participants to predict the price of the product in a week from now (in $; open-ended with minimum of $0 and maximum of $150). Further, we predicted that expectations about future prices would mediate our effects, consistent with the findings from Study 2.

Results

We found support for our predictions pertaining to monotonicity. Upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased (94.5%) compared to when the price had decreased (2.8%), Wald $\chi^2 = 183.63$, $p < .001$. Replicating previous studies, this result was largely attenuated when participants observed multiple price changes that were monotonic in nature (increase = 74.4% vs. decrease = 34%, Wald $\chi^2 = 77.10$, $p < .001$). However, upon observing multiple changes that were nonmonotonic in nature, participants were again much more likely to defer purchase when the price had increased (85.9%) compared to when the price had decreased (22.2%), Wald $\chi^2 = 166.97$, $p < .001$. The impact of the direction of price changes on purchase deferral was significantly different across frequency conditions (interaction single change vs. multiple changes (monotonic) = Wald $\chi^2 = 83.17$, $p < .001$; interaction single change vs. multiple changes (nonmonotonic) = Wald $\chi^2 = 39.77$, $p < .001$; interaction multiple

changes (monotonic) vs. multiple changes (nonmonotonic) = Wald $\chi^2 = 18.71$, $p < .001$).

Further, in terms of the predictions that participants made regarding future prices, we found patterns consistent with the results of Study 2. Specifically, participants in the single increase condition predicted that the price of the product a week later would be much lower (M = \$44.13, SD = 17.94) compared to participants in the single decrease condition (M = \$81.27, SD = 20.28) , F(1, 1500) = 772.72, $p < .001$. In contrast, participants in the multiple increases (monotonic) condition predicted that the price of the product would be slightly higher (M = \$61.40, SD = 12.03) compared to participants in the multiple decreases (monotonic) condition (M = \$56.22, SD = 10.26) , F(1, 1500) = 14.88, $p < .001$. Importantly, the latter result reversed when participants observed multiple changes that were not monotonic in nature ($M_{increase}$ = \$54.02, $SD_{increase}$ = 13.93 vs. $M_{decrease}$ = \$61.92, $SD_{decrease}$ = 13.15, F(1, 1500) = 34.68, $p < .001$; interaction between direction and frequency on expectations: F(2, 1500) = 262.00, $p < .001$).

Finally, conditional process analyses (10,000 bootstraps; 95% confidence intervals; Hayes 2018) showed that expectations mediated the interaction between the direction and the frequency of price changes on deferral (index of moderated mediation for single change vs. multiple changes (monotonic) = −3.85, SE = .59, 95% LLCI = −5.20, ULCI = −2.88; index of moderated mediation for single change vs. multiple changes (nonmonotonic) = −2.66, SE = .43, 95% LLCI = −3.65, ULCI = −1.95; index

of moderated mediation for multiple changes (nonmonotonic) vs. multiple changes (monotonic) = −1.19, SE = .23, 95% LLCI = −1.71, ULCI = −.80).

In this study, we focused on the consistency of the direction of changes and found that in the case of multiple price changes, the impact of the direction of price changes on deferral is larger when consumers observe changes that are nonmonotonic (vs. monotonic) in nature. One may inquire whether it matters *when* the price changes are taking place, especially when there is only one change in price. In our next study, we examine the *timing* of the price change as another potential moderator of our effect.

Study 4

The moderator we are examining in this study—*timing*—concerns variations in *when* the price change is taking place. When consumers only observe a single change in price, does the impact of the direction of price changes on deferral depend on *when* the change occurs? In this study, we will manipulate the timing of the single price change. Our prediction is that when consumers observe a single change in price, the impact of the direction of the price change on purchase deferral would be particularly pronounced when the change occurred *later* in the sequence. Notably, this was the case in our previous studies, as changes that occurred were situated later in the sequence, closer to the time of judgment. Data from those studies show that upon observing a single large change in price, participants expect a large price change in the opposite direction to follow suit in the future, consistent with their beliefs that price changes are likely temporary. However, consider the opposite situation, whereby the observed price

change occurred *earlier* in the sequence. This effectively creates the perception that the most recent prices appear to be relatively stable. In this case, we concur that it is likely that consumers will hold weaker expectations that the price changes are temporary because it appears that the price has remained unchanged for a considerable amount of time. Thus, the impact of direction of price changes on purchase deferral is likely to be attenuated when consumers observe a single price change that occurred early (vs. late) in time. This study was preregistered at https://aspredicted.org/CIB_EQJ.

Procedure

We randomly assigned participants (N = 1,506, 51.4% male, M_{age} = 37.8, mTurk) to one of six conditions of a 2 (direction: decrease vs. increase) by 3 (frequency: single change (late) vs. single change (early) vs. multiple changes) between-participants design, with a tablet being the focal product in the purchase scenario. Participants in the *single decrease (late)* condition were told that the tablet's price was $399, $399, $399, $399, $399, 5, 4, 3, 2, and 1 week ago respectively. Prices displayed for the *single increase (late)* condition were $199, $199, $199, $199, and $199. Prices displayed for the *single decrease (early)* condition were $399, $399, $299, $299, and $299. Prices for the *single increase (early)* condition were $199, $199, $299, $299, and $299. Prices for the *multiple decreases* condition were $399, $379, $359, $339, and $319. Prices for the *multiple increases* condition were $199, $219, $239, $259, and $279. We told all participants that, currently, the tablet's price was $299. We asked participants whether they would buy the tablet now versus later and to predict the price of the product in a week from now

(in $; open-ended with minimum of $0 and maximum of $500). We randomized the order of our two measures. Consistent with previous studies, we predicted that expectations about future prices would mediate our effects.

Results

In line with our predictions, we found that upon observing a single price change that occurred late, participants were much more likely to defer purchase when the price had previously increased (91.6%) compared to when the price had decreased (16.3%), Wald $\chi^2 = 198.96$, $p < .001$. As we predicted, this result was smaller in magnitude when participants observed a single price change that occurred earlier in time, (increase = 75.1% vs. decrease = 33.9%, Wald $\chi^2 = 80.78$, $p < .001$). Moreover, the impact of the direction of price changes on purchase deferral was further attenuated when participants observed multiple changes (increase = 68.9% vs. decrease = 51.4%, Wald $\chi^2 = 15.88$, $p < .001$). The impact of the direction of price changes on purchase deferral was significantly different across frequency conditions (interaction single change (late) vs. multiple changes = Wald $\chi^2 = 92.84$, $p < .001$; interaction single change (early) vs. multiple changes = Wald $\chi^2 = 14.51$, $p < .001$; interaction single change (late) vs. single change (early) = Wald $\chi^2 = 41.98$, $p < .001$).

Further, consistent with the results of previous studies, participants in the single increase (late) condition predicted that the price of the product a week later would be much lower (M = $271.86, SD = 48.05) compared to participants in the single decrease (late) condition (M = $333.06, SD = 54.92) , $F(1, 1500) = 211.63$, $p < .001$. However,

as we predicted, this result was largely attenuated when participants observed a single price change that occurred earlier in the sequence (increase: M = $285.06, SD = 53.14 vs. decrease: M = $292.84, SD = 51.46), $F(1, 1500) = 3.45$, $p = .063$. Further, consistent with previous studies, participants in the multiple increases condition predicted that the price of the product would be slightly higher (M = $303.98, SD = 35.87) compared to participants in the multiple decreases condition (M = $286.42, SD = 34.40) , $F(1, 1500) = 17.48$, $p < .001$; interaction between direction and frequency on expectations: $F(2, 1500) = 91.48$, $p < .001$).

Finally, conditional process analyses (10,000 bootstraps; 95% confidence intervals; Hayes 2018) showed that expectations mediated the interaction between the direction and the frequency of price changes on deferral (index of moderated mediation for single change (late) vs. multiple changes = −1.01, SE = .22, 95% LLCI = −1.49, ULCI = −.64; index of moderated mediation for single change (early) vs. multiple changes = −.32, SE = .09, 95% LLCI = −.53, ULCI = −.17; index of moderated mediation for single change (late) vs. single change (early) = −.68, SE = .18, 95% LLCI = −1.09, ULCI = −.40).

Results from this study show that in the case of a single price change, the impact of the direction of price changes on deferral is attenuated when consumers observe a single change that occurred relatively earlier in time. Therefore, the magnitude of our effect does not only depend on the monotonicity of the direction of price changes, but also on the timing of the change itself. A common thread in these two factors that we have examined thus far is that they both crucially impact consumers' *expectations* about

future changes in price. First, in the case of nonmonotonic changes, an inconsistent change may potentially disrupt consumers' expectations about the occurrence of a streak. Second, when consumers observe a single price change that occurred relatively early in time, they may cease to expect another price change in the opposite direction to follow suit in the future. In the next study, we will examine another possible factor that could be considered when forming expectations about future price changes: a reference point. We operationalize this as a range that is perceived to be typical or common for the price of the focal product.

Study 5

For a given product, it is quite common that a consumer knows how much that product typically costs in the marketplace. When consumers have such a reference point in mind, how would it impact the way they form expectations about future prices, upon observing price changes? In turn, how would that impact their tendency to defer purchase? We surmise that the presence of a reference point about the price of the focal product should attenuate the effect we have documented thus far. Importantly, we propose this reference point should play a role when forming expectations about future changes in price. In turn, the extent to which consumers rely on the direction and frequency of price changes would likely diminish when consumers are endowed with this reference point information. This is because, irrespective of the price changes that they observe, the consumer should have an expectation of what the typical price

for the product should be, which is largely informed by the reference point. This study was preregistered at https://aspredicted.org/MMB_HCM.

Procedure

Participants (N = 1,208, 51.3% female, M_{age} = 36.8, mTurk) were asked to imagine that they were considering to buy a Bluetooth speaker and that they had been checking the price of a speaker that they like during the past weeks. We randomly assigned participants to one of eight conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) by 2 (reference point: no vs. yes) between-participants design. Participants in the *single decrease* conditions were told that, 4 weeks ago, the speaker was priced at $100. Participants in the *multiple decreases* conditions were told that the price of the speaker was $100, $90, $80, $70, 4, 3, 2, and 1 week ago respectively. Participants in the *single increase* conditions were told that, 4 weeks ago, the speaker was priced at $20. Participants in the *multiple increases* conditions were told that the price of the speaker was $20, $30, $40, $50, 4, 3, 2, and 1 week ago respectively. We manipulated the presence of reference points by also including information on a typical price for such speakers. Thus, participants in the *reference point* conditions were additionally told that speakers of similar quality are typically priced between $55 and $65. All participants were told that speaker is currently priced at $60. We asked participants whether they would buy the speaker now versus later.

Results

We found support for our predictions. The three-way interaction among our direction, frequency, and reference point factors on deferral was statistically significant (Wald $\chi^2 = 3.95$, $p = .047$). This result indicates that the interaction between our direction and frequency factors was stronger when there was no reference point (Wald $\chi^2 = 37.52$, $p < .001$) compared to when participants were endowed with a reference point (Wald $\chi^2 = 16.60$, $p < .001$).

Upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased compared to when the price had decreased and this result was more pronounced in the absence (increase = 90% vs. decrease = 15%, Wald $\chi^2 = 123.27$, $p < .001$) compared to the presence of the reference point information (increase = 81% vs. decrease = 19.9%, Wald $\chi^2 = 96.37$, $p < .001$). These effects were attenuated when participants viewed multiple price changes (reference point absent: increase = 78.9% vs. decrease = 52%, Wald $\chi^2 = 22.73$, $p < .001$; reference point present: increase = 67.3% vs. decrease = 35.8%, Wald $\chi^2 = 29.25$, $p < .001$). Overall, results from this study suggest that the interaction between the direction and frequency of price changes on purchase deferral is relatively stronger in the absence (vs. presence) of a reference point.

Study 6

Continuing with the examination on other factors that could potentially play a role in the impact of frequency and direction of price changes on deferral, we will now

examine whether reasons underlying the observed price changes themselves would be of significance. Again, this ties into how expectations are formed, depending on why the price changes supposedly came to be. Prior to conducting this study, we suspected that if consumers observed price changes that appear to be less predictable in nature, it would be more difficult to form expectations about future prices. For instance, while price changes may often reflect strategic firm decisions, they may also be caused by factors outside the firm's control, rendering these changes more unpredictable. We use the example of random fluctuations in the price of gas. In such cases, it is plausible that consumers will experience uncertainty about what would happen in the future, and they cannot as easily form expectations about future prices. In turn, the interaction between the direction and frequency of price changes may be attenuated when price changes are attributed to factors outside the firm's control—implying that people should be less affected by the interaction of frequency and direction of price changes. This study was preregistered at https://aspredicted.org/SQE_RUW.

Procedure

Participants (N = 1,206, 57.5% female, M_{age} = 38, mTurk) were asked to imagine that they were buying flight tickets for their upcoming holidays. We randomly assigned participants to one of eight conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) by 2 (gas price explanation: no vs. yes) between-participants design. Participants in the *single decrease* conditions were told that, 4 weeks ago, the tickets were priced at $387. Participants in the *multiple decreases*

conditions were told that the price of the tickets was $387, $343, $321, $282, 4, 3, 2, and 1 week ago respectively. Participants in the *single increase* conditions were told that, 4 weeks ago, the tickets were priced at $123. Participants in the *multiple increases* conditions were told that the price of the tickets was $123, $167, $189, $228, 4, 3, 2, and 1 week ago respectively. Further, participants in the *gas price explanation* conditions were additionally told that "company sources indicate that the price changes were due to fluctuations in the price of gas." Importantly, this gas price manipulation relates to the notion that reasons underlying the price changes that are outside the firm's control would render the price fluctuations as more uncertain and hard to predict, in the minds of participants. All participants were told that the tickets currently cost $255. We asked participants whether they would buy the tickets now versus later.

Results

Contrary to our expectations before conducting this study, our effects were robust even when participants were told that price changes were due to fluctuations in the price of gas. The three-way interaction among our direction, frequency, and gas factors on deferral was not statistically significant (Wald $\chi^2 = .43$, $p = .514$). The interaction between our direction and frequency factors was slightly stronger in the absence (Wald $\chi^2 = 29.02$, $p < .001$) compared to the presence of our gas price explanation (Wald $\chi^2 = 17.41$, $p < .001$).

Upon observing a single price change, participants were much more likely to defer purchase when the price had previously increased compared to when the price

had decreased both in the absence (increase = 39.6% vs. decrease = 5.4%, Wald χ^2 = 37.16, $p < .001$) and in the presence of the gas price explanation (increase = 54.9% vs. decrease = 4.6%, Wald χ^2 = 59.14, $p < .001$). Both effects were attenuated when participants observed multiple price changes (gas price explanation absent: increase = 23.3% vs. decrease = 26.1%, Wald χ^2 = .32, p = .571; gas price explanation present: increase = 32.9% vs. decrease = 14.1%, Wald χ^2 = 14.06, $p < .001$).

Overall, in contrast with our initial predictions, results from this study suggest that the interaction between the direction and frequency of past price changes persists even when price changes occur for reasons outside the firm's control. These results suggest that consumers may be relatively insensitive to the reasons that drive observed changes when they form expectations about future prices, even though such reasons should be relevant for—and influence—their expectations. In the subsequent study, we examine one last potential moderator for the effect, namely the nature of the purchase itself.

Study 7

In the previous studies, we have examined a host of potential moderators. We will now explore whether nature of the purchase itself may attenuate the impact of the interaction between the frequency and direction of price changes on the incidence of purchase deferral. Our rationale when designing this study was that if the reason underlying the purchase is urgent, a consumer's demand would be inherently more inelastic. Given this, they may be less sensitive to changes in prices, as they may feel

more inclined to make the purchase anyway regardless of the fluctuations in prices. As a result, we predict that the frequency and direction of past price changes may exert little impact on the decision to buy now or later. This study was preregistered at https://aspredicted.org/WEW_PNL.

Procedure

Participants (N = 1,201, 56.3% female, M_{age} = 38.7, mTurk) were asked to imagine that they were considering to buy flight tickets. They were randomly assigned to one of eight conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) by 2 (nature of purchase: non-urgent vs. urgent) between-participants design.

Participants in the *non-urgent purchase* conditions were told, "Imagine that you are buying flight tickets for a potential weekend away on your own. Because of the nature of the trip, it is not a problem for you if you do not end up going." Participants in the *urgent purchase* conditions were told, "Imagine that you are buying flight tickets for visiting your family because of an emergency. Because of the nature of the emergency, your family really expects you to be there." This context allowed us to hold the focal product constant across conditions, while still manipulating the underlying reason for buying the ticket and the eventual perceived urgency of the demand for purchasing flight tickets. Expected travel date was also the same across conditions. We told participants that "the only time you can leave is in 4 days, so you plan to depart on that

day. Today, you see the following prices on Google Flights for this specific route, for the day that you want to fly."

Similar to Study 1c, we displayed price information in a graph, with price on the vertical axis and time (in days) on the horizontal axis. Participants in the *single decrease* conditions saw that the tickets were priced at $324, $324, $324, $324, 4, 3, 2, and 1 day ago respectively. Participants in the *multiple decreases* conditions saw that the tickets were priced at $324, $298, $281, $243, 4, 3, 2, and 1 day ago respectively. Participants in the *single increase* conditions saw that the tickets were priced at $112, $112, $112, $112, 4, 3, 2, and 1 day ago respectively. Participants in the *multiple increases* conditions saw that the tickets were priced at $112, $138, $155, $193, 4, 3, 2, and 1 day ago respectively. All participants saw that the tickets were currently priced at $218, and they were asked whether they would buy the tickets now versus later. After making a decision, participants responded to a question measuring the perceived urgency of the trip ("In your opinion, how urgent is this trip?" 1 = not at all, 7 = very much so).

Results

Data from this study suggest that our effects are not moderated by the nature of the purchase. The three-way interaction among our direction, frequency, and nature of purchase factors on deferral was not statistically significant (Wald $\chi^2 = .025$, $p = .876$). The interaction between our direction and frequency factors was similar when the purchase was not urgent (Wald $\chi^2 = 24.91$, $p < .001$) compared to when purchase was urgent (Wald $\chi^2 = 15.79$, $p < .001$).

Upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased compared to when the price had decreased both when the purchase was not urgent (increase = 49% vs. decrease = 5.4%, Wald $\chi^2 = 50.35$, $p < .001$) and when the purchase was urgent (increase = 21.3% vs. decrease = 2.6%, Wald $\chi^2 = 17.83$, $p < .001$). Both effects were attenuated when participants viewed multiple changes in price (non-urgent purchase: increase = 30.5% vs. decrease = 22%, Wald $\chi^2 = 2.77$, $p = .096$; urgent purchase: increase = 13.9% vs. decrease = 16.7%, Wald $\chi^2 = .44$, $p = .506$).

We should note that participants in the urgent purchase conditions did find the trip to be more urgent (M = 6.31, SD = 1.12) than their counterparts in the non-urgent conditions (M = 3.18, SD = 1.92), t(1,199) = 34.50, $p < .001$. Therefore, our manipulation of urgency was successful. Further, urgency exerted a significant main effect on deferral. On the whole, participants in the urgent conditions were overall less likely to defer purchase compared to their counterparts in the non-urgent conditions (13.6% vs. 26.7%, Wald $\chi^2 = 32.34$, $p < .001$).

Importantly, contrary to our initial predictions, our data suggest that urgency does not influence the interaction between the direction and frequency of price changes on purchase deferral. The predictions we had prior to running Studies 6 and 7 were rooted in the idea that inelastic demands and rather uncertain changes in price would attenuate the effect. However, the experimental evidence we have thus far suggests that the interaction between direction and frequency seem to be robust. It does not seem to be affected by these factors that we initially thought would be of importance. It

seems that participants' natural inclination is to base their deferral decision more on the patterns observed in the price changes, and less so on factors surrounding the purchase decision or the price changes themselves.

Study 8

In this final study, we aim to demonstrate the robustness of our previously documented effect. As opposed to using hypothetical decision contexts—such is the case in the studies presented thus far—we will now examine whether our key findings extend to consequential purchase decisions. This study was preregistered at https://aspredicted.org/AEH_CBV.

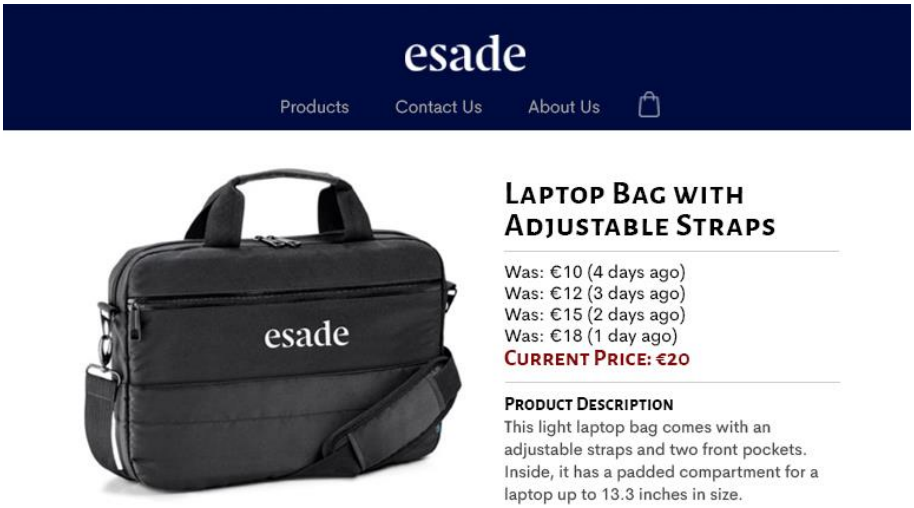
Procedure

For this study, we recruited students from a European business school, who completed the study in exchange for course credits. Participants (N = 297: 53.5% female, M_{age} = 18.9) were told that we were testing out a new online platform for the university store, where various university-branded products are sold. Participants were informed that the store uses dynamic pricing, similar to other online retailers such as Amazon, which means prices of products may change frequently over time. Participants received extensive instructions about the study procedure and incentives scheme, and were required to first complete a training phase to ensure they properly understood the instructions before moving on to complete the study.

All participants reviewed four different products that were selected based on potential appeal and their affordability for our student sample: a card holder, a laptop bag, a portable battery charger, and a reusable water bottle. Our key manipulation pertained to the prices displayed to participants. For each product, participants were randomly assigned to one of four conditions of a 2 (direction: decrease vs. increase) by 2 (frequency: single change vs. multiple changes) between-participants design. Participants reviewed each of the four products separately, in a random order. For example, a participant may view a water bottle with a single price increase, followed by a laptop bag with multiple price decreases, and so on.

Each product page was designed to resemble the official university online store. In every page, we included the product name, a picture, a brief product description, and price information. Along with the current price we also listed historical prices, which were displayed above the current price. Price specifications for each product and condition are displayed in Table 1, and an illustration of the product page can be found in Figure 5. Similar to the previous studies, the key dependent measure was the decision to buy now, which was recorded on each product page, below the product description and price specifications by asking the question "What will you do?". Participants could choose between "I will buy the [product] now" or "I will wait to buy".

Figure 5: Example of the Product Page used in Study 8



Importantly, during the instructions and training phase, participants were informed that the decisions they make in this study would be consequential. Specifically, once the study was over, a random draw was done to select 5 participants to have their purchase decisions carried out in reality. Participants were told that if they were among the selected participants, we would fund their decision with €20 and they would receive the product of their, as well as €20 minus the current price of the product. If a participant opted to buy more than one product, we would randomly select which product they would receive. Furthermore, participants were also told that if they chose "I will wait to buy", they could opt in to receive an update through e-mail about future price changes, and that they would be given another opportunity to

purchase the product(s)[5]. This set-up ensured that 'waiting to buy' in this study is akin to actually delaying the purchase until another time. It allowed participants to wait and see if there would be any future price changes and decide later if they wanted to buy, which is arguably similar to how purchase decisions are made in the marketplace. If a participant did not want to buy any of our products, and in case that participant was among the 5 randomly chosen winners, they would receive the entire €20[6].

After participants reviewed and made decisions for all four products, they were asked to briefly write in a few sentences what motivated their decisions, and they were asked to indicate if they wanted to receive price updates for the products they chose to wait to buy. We ended the study with four filler questions about the look and feel of the online platform and demographics measures. The look and feel filler questions were included to substantiate the idea that this study aimed to test out the university's store new online, and responses to these questions were not part of our analysis. Participants received a debriefing about our study a few weeks after data collection, as per the standard protocol of the university's behavioral laboratory.

[5] The price updates were sent out in the week following the completion of the study. All updated prices were actually the same as the 'current' price in the study. We kept prices the same to ensure that all participants were given the opportunity to buy the products at the same price throughout the study. The random draw was done with all submitted decisions, both from Time 1 (original study) and Time 2 (after receiving the price updates).

[6] The draw yielded five 'winners' who have all opted to buy at least one product, implying all randomly chosen participants ended up receiving an actual product.

Results

We replicated our key results, Wald $\chi^2 = 27.79$, $p < .001$ (see Tables 1-2). Consistent with our predictions and our previous studies, across products, upon observing a single change in price, participants were much more likely to defer purchase when the price had previously increased (88.9%) compared to when the price had decreased (49.5%), Wald $\chi^2 = 82.71$, $p < .001$. This result was largely attenuated when participants observed multiple price changes (increase = 74.8% vs. decrease = 63.8%, Wald $\chi^2 = 7.00$, $p = .008$).

Further, the interaction between the frequency and direction of price changes was statistically significant for all products (card holder: Wald $\chi^2 = 3.86$, $p = .049$; laptop bag: Wald $\chi^2 = 10.13$, $p = .001$; battery charger: Wald $\chi^2 = 10.75$, $p = .001$; water bottle: Wald $\chi^2 = 7.91$, $p = .005$). The impact of the direction of price changes on purchase deferral was stronger when participants observed a single price change (card holder: increase = 88% vs. decrease = 51.4%, Wald $\chi^2 = 20.83$, $p < .001$; laptop bag: increase = 90.5% vs. decrease = 56.2%, Wald $\chi^2 = 18.95$, $p < .001$; battery charger: increase = 84% vs. decrease = 39.7%, Wald $\chi^2 = 27.53$, $p < .001$; water bottle: increase = 93.2% vs. decrease = 50.7%, Wald $\chi^2 = 24.90$, $p < .001$) compared to when they observed multiple changes (card holder: increase = 78.7% vs. decrease = 61.6%, Wald $\chi^2 = 5.02$, $p = .025$; laptop bag: increase = 78.7% vs. decrease = 77.3%, Wald $\chi^2 = .04$, p

= .844; battery charger: increase = 64.9% vs. decrease = 56%, Wald $\chi^2 = 1.22$, $p = .269$; water bottle: increase = 77% vs. decrease = 60%, Wald $\chi^2 = 4.90$, $p = .027$). While the studies henceforth has examined our effects using hypothetical decisions, this final study adds to the existing body of evidence by replicating our findings in a setting where decisions are consequential.

Table 1: Stimuli and Results of Study 8

Aluminum Card Holder with Leather Case	
Product description: Maximum capacity of 8 standard-sized cards. Made with soft and durable leather. Minimalist and slim design, extremely light and convenient to carry.	
Price	*Deferral (%)*
Single Decrease (N = 74): €24 (4 days ago), €24 (3 days ago), €24 (2 days ago), €24 (1 day ago).	51.4%
Single Increase (N = 75): €6 (4 days ago), €6 (3 days ago), €6 (2 days ago), €6 (1 day ago).	88%
Multiple Decreases (N = 73): €24 (4 days ago), €22 (3 days ago), €19 (2 days ago), €17 (1 day ago).	61.6%
Multiple Increases (N = 75): €6 (4 days ago), €8 (3 days ago), €11 (2 days ago), €13 (1 day ago). Current price for all conditions: €15.	78.7%
Laptop Bag with Adjustable Straps	
Product description: This light laptop bag comes with an adjustable strap and two front pockets. Inside, it has a padded compartment for a laptop up to 13.3 inches in size.	
Price	*Deferral (%)*
Single Decrease (N = 73): €30 (4 days ago), €30 (3 days ago), €30 (2 days ago), €30 (1 day ago).	56.2%
Single Increase (N = 74): €10 (4 days ago), €10 (3 days ago), €10 (2 days ago), €10 (1 day ago).	90.5%
Multiple Decreases (N = 75): €30 (4 days ago), €28 (3 days ago), €25 (2 days ago), €22 (1 day ago).	77.3%
Multiple Increases (N = 75): €10 (4 days ago), €12 (3 days ago), €15 (2 days ago), €18 (1 day ago). Current price for all conditions: €20.	78.7%
Portable Battery Charger	
Product description: External portable battery charger with 2,200 mAh capacity. Very light, aluminum finished body, with an extra-flat design. Has both MicroUSB and USB-C inputs.	
Price	*Deferral (%)*

Single Decrease (N = 73): €23 (4 days ago), €23 (3 days ago), €23 (2 days ago), €23 (1 day ago).	39.7%
Single Increase (N = 75): €7 (4 days ago), €7 (3 days ago), €7 (2 days ago), €7 (1 day ago).	84%
Multiple Decreases (N = 75): €23 (4 days ago), €21 (3 days ago), €20 (2 days ago), €17 (1 day ago).	56%
Multiple Increases (N = 74): €7 (4 days ago), €9 (3 days ago), €10 (2 days ago), €13 (1 day ago). Current price for all conditions: €15.	64.9%
Reusable Water Bottle	
Product description: Reusable water bottle, made from durable glass with a protective BPA free silicone sleeve. 500ml/16.9fl.oz. capacity.	
Price	*Deferral (%)*
Single Decrease (N = 75): €16 (4 days ago), €16 (3 days ago), €16 (2 days ago), €16 (1 day ago).	50.7%
Single Increase (N = 73): €4 (4 days ago), €4 (3 days ago), €4 (2 days ago), €4 (1 day ago).	93.2%
Multiple Decreases (N = 75): €16 (4 days ago), €15 (3 days ago), €13 (2 days ago), €12 (1 day ago).	60%
Multiple Increases (N = 74): €4 (4 days ago), €5 (3 days ago), €7 (2 days ago), €8 (1 day ago). Current price for all conditions: €10.	77%

General Discussion

In this article, we investigated how historical price information—particularly, the direction and frequency of past price changes—influences consumers' decision to hold off or make a purchase at a given point in time. We advanced an expectation-based framework which proposes that the impact of the direction of price changes on purchase deferral is contingent on the frequency of price changes. Controlling for the total magnitude of price changes, we predicted a that the impact of the direction of price changes on purchase deferral would be stronger upon observing a single large change in price, as opposed to multiple smaller changes. We provided support for our

predictions in a series of preregistered studies using both hypothetical and consequential purchase decisions across a wide range of products. We also examined the robustness of our results using different manipulations of our key constructs, while also testing a host of potential moderators of our effects.

Studies 1a through 1d provide evidence for the key interaction between frequency and direction of price changes on purchase deferral. Study 1a tested our paradigm in a context where information about the different past prices as well as the current price were presented all at once, whereas in Study 1b we presented the price information in a sequential manner. Both studies show that the impact of the direction of price changes on purchase deferral is contingent on the frequency of price changes. Importantly, this effect on deferral is stronger in the case of a single large change in price (vs. multiple smaller changes). Further, we examined whether the way in which price information is presented plays a part in how frequency impacts the decision to hold off or make a purchase. Study 1c documents that our findings replicate in a setting where price information is presented visually in a graph, as is common in the marketplace. In Study 1d, we varied the frequency of price changes that were communicated to participants. We previously argued that the interaction between the direction and frequency of price changes on purhase deferral hinges on the presence versus absence of a trend or streak. According to Carlson and Shu (2007), three changes are sufficient to create perceptions of a streak. Consequently, additional changes are unlikely to further influence consumers' expectations about future prices. Indeed, data of Study 1d suggest that the impact of the direction of price changes on deferral

decreases significantly when comparing a situation in which a trend is present (i.e., when there are three or six changes) versus a situation where a trend is absent (i.e., when there is a single change). We do not observe substantial differences in the impact of the direction of price changes on deferral between two situations that involve streaks with different amounts of changes (i.e., three vs. six changes). We also provide an account of our key predictions in a setting where decisions logged by participants were consequential in Study 8.

How exactly does historical price information affect people's inclination to make or defer purchase? We contend that this is because it shapes how people form expectations about how the price would be in the future. Indeed, in Study 2 we found that the effect of frequency and direction of price changes on deferral is mediated by people's expectations of what the product price would be in the future. At this point, it is important to note that the notion of expectations plays a key role in the studies that follow. The moderators that we explored tend to center on the idea that certain factors can help or hinder how consumers form these expectations about future price changes.

First, in Study 3, we examined the role of monotonicity of the price changes. Of course, in the marketplace prices can change in a number of directions, without necessarily sticking to a concurrent pattern. Does consistency of observed price changes matter in the context of our effect? We contend that the presence of an inconsistence change in terms of direction would evoke a sense of uncertainty, with

regards to what consumers would expect the future price would be. Study 3 provided empirical evidence in line with this prediction.

Second, in Study 4, we tested whether timing of the price changes plays a significant influence in the context of our effect, specifically in the case of a single price change. Does it matter, whether the change happens early on in the sequence, or later and closer to the time of judgment? Our rationale was that if the single price change occurred earlier on in the sequence, changes would be perceived to have tapered off at the time of judgment. Consequently, further changes would be deemed less likely to occur. On the contrary, if it happened later on in the sequence, the price would appear to be less stable and further changes may be expected. Data from Study 4 confirmed this hypothesis.

We then explored a variety of other factors that could moderate the effect. We examined the effect of reference prices in Study 5. We surmised that if people have a typical price range for the product in mind, they would be less affected by the interaction between the frequency and direction of price changes. Knowing a typical price range for the product means consumers would have an expectation of what the product price should be, regardless of possible price changes. Indeed, data from Study 5 show that the interaction between the direction and frequency of price changes on purchase deferral is attenuated in the presence (vs. absence) of a reference point about price.

Further, Study 6 shows that consumers are largely insensitive to the reasons underlying the changes in price. Surprisingly, our effects replicated even when the

reasons were exogenous in nature, in that the changes occurred for reasons outside the firm's control (e.g., fluctuations in the price of gas). Our prediction prior to running the study was that an introduction of a seemingly exogenous and unpredictable reason for the price changes would undermine participants' ability to form expectations about future price changes. While one could expect that consumers would experience uncertainty about future prices if the underlying reason for the change pertains to an external factor, our results do not support this prediction. In Study 7, we then manipulated elasticity of the demand for the product itself to see if that would attenuate the effect. This study shows that our effects are largely the same when the purchase decision involves an inelastic demand. We suspected that, when the reason underlying the purchase is urgent (e.g., because of an emergency), consumers may be less sensitive to changes in prices as their demand may be inherently more inelastic. Consequently, frequency and direction of past price changes should exert little impact on the decision to buy now or later. However, our data suggest that our effects are only slightly smaller in magnitude when participants are making a purchase that is inelastic in nature.

All in all, these studies on the different potential moderators of the effect yielded several insightful points and they have deepened our understanding of the intricacies of the key effect. First, factors such as *consistency* of the direction of the price changes and the *timing* of these changes play an important role in the expectations formation process. Consumers tend to expect past patterns to replicate in the future, and the introduction of a directionally inconsistent change makes it harder for them to extrapolate what the future price would be. Similarly, timing matters in that if a single

change occurs later in the sequence, it may evoke feelings of uncertainty and that more changes may come. On the other hand, if the single change happened earlier in the sequence, the price may be perceived to be more stable. That said, the effect is attenuated when participants are endowed with a reference price which would allow them to have in mind a typical price range for the focal product. If they know what to expect in terms of a common retail price for the product, historical prices and changes bear little influence on their decision to defer or make a purchase. Nevertheless, the last two moderator studies suggest that historical prices can indeed drive purchase or deferral decisions—as participants seem to be more reliant on patterns observed in the price changes, and less so on factors such as inelasticity of the demand or even when the changes themselves were unpredictable in nature.

Theoretical Contribution

Our work is relevant for multiple streams of research, within the marketing, psychology, and judgmental forecasting literatures. First, our research extends prior work that examined the impact of the frequency of discounts on price perceptions and purchase decisions (e.g. Alba et al. 1994; Alba et al. 1999; Kalwani and Yim 1992; Krishna et al. 1992; Krishna 1991). We contend that our research meaningfully extends this line of work by considering the role of frequency on purchase decisions not only in the case of price discounts, but also in the case of price increases. Further, we document the role of frequency on a different criterion variable besides price perceptions and purchase quantity decisions, namely the decision to *defer* purchase on

the product level. While the research that we built on was conducted in the context of retailers selling fast-moving consumer packaged goods, we believe that our criterion variable is particularly relevant for goods such as services (e.g., flight tickets) or durables (e.g., speakers) that consumers would buy rather infrequently and in limited quantities. Moreover, our work answers Mazumdar, Raj, and Sinha's call (2005, p. 94) for marketing research on the impact of reference prices on purchase timing decisions for durable goods and services. To the best of our knowledge, our theoretical framework and research are the first to demonstrate that the magnitude of the effect of the direction of price changes on purchase deferral is contingent on the frequency of price changes. Further, beyond investigating the interaction between the direction and frequency of price changes on purchase deferral, we advanced multiple moderators of these effects—ultimately putting forward a more holistic view of the impact of historical price information on purchase deferral.

Second, our work contributes to research on consumer expectations. A vast amount of research has documented the downstream consequences of consumers' expectations about various consumption-related factors. For example, existing research has documented the consequences of consumer expectations about product performance on satisfaction, (e.g., Bearden and Teel 1983; Cadotte et al. 1987; Churchill and Surprenant 1982; LaBarbera and Mazursky 1983; Oliver 1980; Oliver and DeSarbo 1988), while other research has documented that expectations about attribute levels can influence choice between alternatives (Evangelidis and van Osselaer 2018). Perhaps more relatedly, extant literature argues that expectations about future prices

should affect purchase decisions (Jacobson and Obermiller 1990; Malinvaud 1972). In the context of frequently-purchased consumer goods, Winer (1986) shows that consumers' brand choices for two different coffee brands are driven by the discrepancy between expected price—which is shaped by previously-encountered prices—and the actual (observed) price at the store. Nonetheless, while prior research has argued that future price expectations should influence purchase behavior, relatively little is known about how those expectations are formed upon observing past changes (see future research directions in Alba et al. 1999; p. 112). In this paper, we advanced a theoretical account as well as empirical evidence showing that, controlling for the magnitude of change, expectations may be primarily driven by the interaction between the direction and frequency of the observed changes. Moreover, consistency of the direction of prior changes (Study 3), the timing of changes (Study 4), as well as reference information (Study S5 in our Web Appendix) also play a pivotal role. Therefore, our work expands our understanding on the formation of expectations that pertain to future prices.

Third, our work contributes to prior research on people's ability to identify trends and utilize this information in making prospective forecasts. For instance, early work by Brehmer (1971) shows that people can identify trends when provided with graph information and are particularly skilled in assigning numeric values to those trends when the trend is positive and linear. Further, other researchers have examined individuals' forecasts about the future (typically compared to predictions by a statistical model) as a function of historical information. For example, work by Lawrence and Makridakis (1989) shows that individuals are influenced by trends in past sales when

making forecasts about future sales and this effect appears robust for both positive and negative trends. Similar evidence in forecasts about stock performance was found by De Bondt (1993) and Lakonishok et al. (1994; see also Barberis et al. 1998 for an overview and a proposed model that captures investor sentiment). Our contribution to this research is threefold. First, we focus on forecasts about future prices rather than forecasts about future performance. That is an important distinction because price is not a performance metric, but an instrument that firms typically have control over (which can, in turn, affect performance). Similar to forecasts about performance metrics, we theorize and show that forecasts about future prices are driven by perceptions of trends. Second, while forecasts are the main focus of this stream of literature, we examine how people rely on (self-generated) forecasts to make purchase decisions. Thus, in our work, forecasts are not the criterion variable, but rather serve as the mediator between historical information and decision-making. Hence, we extend this stream of literature by demonstrating the downstream consequences of forecasts for purchase decisions. Third, we explore a large set of moderators that are potentially relevant for research on judgmental forecasting.

Fourth, our work is relevant for research on reference prices and transaction utility (or value). Transaction utility captures the utility that consumers derive from the commercial transaction and is driven by the comparison between the price that consumers pay vis-à-vis a reference price (Thaler 1985). Note that transaction utility is distinct from the utility that consumers derive from acquiring and using the product, which is typically referred to as acquisition utility (Thaler 1985; see also Grewal,

Monroe, and Krishnan 1998). Rather, transaction utility depends entirely on the perceived "merits of the deal" (Thaler 1985, p. 205; Grewal et al. 1998, p. 48). In conceptualizations of transaction utility, the reference price is the price that consumers expect to pay for a given product. Our data suggest that the interaction between the direction and frequency of past price changes may exert an impact on consumers' reference prices. As we argued and empirically demonstrated, when consumers observe a single large change in price, they tend to believe that this change is temporary. In turn, consumers anticipate a price change in the opposite direction to follow, such that the original change is largely cancelled out. This means that a single change in price—either a decrease or an increase—is rather unlikely to influence consumers' reference prices. In contrast, when consumers observe multiple smaller changes in price, they tend to expect a similar change (i.e., in the same direction) to occur in the future. This implies that, upon observing multiple price changes, consumers' reference prices may eventually be altered, such that they diverge from the original (starting) price (see Friedman 1979; Kalyanaram and Winer 1995; Krishna et al. 1991; Lattin and Bucklin 1989; Mela et al. 1998; Winer 1986). Specifically, upon observing multiple price decreases, consumers' reference prices may eventually start decreasing. Similarly, upon observing multiple price increases, consumers' reference prices may eventually start increasing. Our data are consistent with these hypotheses.

Managerial Implications

Our research holds important implications for manufacturers' and retailers' pricing strategies. More specifically, these implications pertain to how they could introduce or apply price changes. Based on our findings, we propose the following set of recommendations.

First, in the case of price reductions, controlling for the total magnitude of the discount, managers may face a decision between applying the discount in a single large step versus multiple smaller steps. For instance, let us consider the case of a manager who wishes to decrease the price of a good from $300 to $200. The manager may be debating whether to apply the discount in a single large step (e.g., a single discount of $100) versus sequentially, in multiple smaller steps (e.g., a series of four discounts of $25 each). If the manager's goal is to stimulate immediate demand for their product, then we would advise decreasing the product's price in a single (large) step. This strategy can stimulate immediate demand because it prompts consumers to believe that a large increase in price will follow suit in the near future. However, if the manager's goal is to skim the maximum amount of revenue from the various segments of the market when decreasing the price, then implementing the price discount in multiple smaller steps may be a preferred alternative. However, our research highlights a potential threat to such price skimming strategies. That is, consumers may gradually form expectations that the price of the product will decrease further in the future, upon observing a series of price decreases. In turn, they may start holding off purchase, and this tendency should be particularly strong upon observing three or more smaller discounts. Our data suggest an effective way for managers to defend against this

possibility: managers may wish to introduce a small increase in the price between the decreases, to break the perceived streak of price decreases. By doing so, managers can introduce ambiguity about future changes in price and effectively boost consumer demand at any given point in time following a series of discounts (see Study 3).

Second, similar to the case of discounts, in the case of price increases, managers may face a decision between introducing the increase in a single large step versus multiple smaller steps. If, for example, a manager wishes to increase the price of a good from $200 to $300, they may have the option of either applying the increase in a single large step (e.g., a single increase of $100) or in multiple sequential steps (e.g., a series of four increases of $25 each). In this case, we propose that the latter approach may benefit managers and retailers. According to our findings, consumers may anticipate a substantial price decrease upon observing a single large increase in price. In turn, they will be particularly unlikely to purchase upon observing a single large price increase. In contrast, our data show that consumers will not anticipate a future decrease in price upon observing multiple smaller price increases. Consequently, consumers may feel more inclined to purchase when price increases are introduced in multiple smaller steps as opposed to a single large price change.

Conclusion

The purchasing environment we, as consumers, currently find ourselves in involves prices that are increasingly dynamic in nature, as well as arguably unparalleled access to historical information related to prices of goods and services. It is now

possible for consumers to access data on historical prices, effectively allowing them to examine the evolution of the price of a specific good over time. Our aim in this paper is to shed light on how consumers respond to historical price information. Altogether, our research provides a rich amount of data and findings on the relationship between historical price information and purchase deferral. Perhaps most importantly, we now have a better understanding on how consumers process and make use of information about historical prices in deciding whether to buy now versus later. This holistic framework does not only expand and build upon prior work across different streams of research, but it also offers valuable insights that could be used by manufacturers and retailers in making well-informed decisions in terms of how they could optimize, implement, and communicate price changes over time. We hope that our research will inspire future work on this important topic.

Acknowledgements

The authors would like to thank Katica Boric Brenet for her assistance during the data collection process for Study 8.

Chapter 3

Processing Moving Numbers:

How Update Frequency Influences Magnitude Judgments

Content redacted under embargo.

Chapter 4

The Effects of Output and Input-Based Framing Mode on Motivation

Content redacted under embargo.

Chapter 5

General Discussion

This dissertation focuses on the relationship that consumers have with different forms and manifestations of numerical information. As argued by Bagchi and Li (2016), numbers are used to quantify the environment that we find ourselves in, and numbers also often serve as inputs for the choices and decisions that individuals make in their lives. The choice of using the term 'individuals' as opposed to 'consumers' in the previous sentences was a conscious one. This is mostly due to the fact that while consumption is a major activity that we undertake, I contend that individuals interact with and make use of numbers in a variety of settings, going beyond consumption activities. Managerial and strategic decisions within a company are often made based on numbers, so are political or health-related decisions. While I did view some of the questions posed in this dissertation through a marketing and consumer behavior lens, I strongly believe that the findings and implications could be generalized to how we behave as individuals in general.

One of the main aims of this dissertation is to build upon existing research on consumer behavior and judgment and decision-making and to set forth research that highlights how consumers draw inferences from and make use of numerical information in an ever-changing, and increasingly dynamic decision environment. Collectively, the three empirical chapters presented in this dissertation document the effects of different forms of numerical information on a variety of criterion variables:

how decisions to buy now or later are affected by price information, how magnitude judgments are formed and influenced upon exposure to dynamic numerical indicators, as well as how motivation during a task is affected by different framing modes of its instructions. This was done by means of experiments conducted with more than 15,000 participants—using a combination of hypothetical scenarios, incentive-compatible paradigms, as well as real-effort tasks. Altogether, the empirical evidence gathered in these three chapters pose valuable insights for managers, practitioners, or even consumers at the individual level. Ultimately, I argue that these findings help us better understand how we interact with numbers, how the unique characteristics of dynamic representations of numerical information influence how we perceive those numbers, and how our decisions and behavior are collectively affected by them.

Chapter 2: Historical Prices and Expectations

In Chapter 2, I examined how historical price information plays a role in influencing consumers' decision to buy a product now or later. I present a framework featuring two key factors related to historical price information—namely frequency and direction of change—and examine how these factors affect purchase deferral. One of the motivating reasons behind this research question is the growing presence of platforms and applications that provide consumers access to historical price information. Evidently, the price of a product is noted to be one of the most significant attributes that consumers consider when making a purchase decision (Zeithaml 1988; Monroe 2003). However, apart from the actual price of the product at the time of

purchase, the price perceptions that consumers have can also play an important role in influencing purchase decisions (Monroe 2003; Zeithaml 1988; Krishna, Briesch, Lehmann, and Yuan 2002). Importantly, in this chapter, I argue that observed past prices would influence expectations about future prices, which in turn would affect whether consumers would decide to buy the product now or later.

By means of eleven experimental studies, I found evidence for the predicted effect and demonstrated its robustness. First, I documented the interaction between direction and frequency of price changes on purchase deferral. Price changes could come in the form of decreases or increases, and we operationalize frequency of changes as the number of changes in a given direction that led to the current price. Further, in this framework, I distinguish between a single large change in price versus multiple smaller changes, while controlling for the total magnitude of change. Within the context of the studies, 'multiple' smaller changes typically comprise of more than three changes over time. My findings suggest that consumers are more likely to defer purchase when the price of the product has previously increased (vs. decreased). Importantly, this effect was found to be more pronounced when consumers were presented with a single large change in price, compared to when they observed multiple smaller price changes (Study 1a). I found that this result is robust across a variety of different contexts: when the study design was cross-sectional as well as longitudinal, such as when price information were presented sequentially over time, and choices were also elicited upon presentation of each price information (Study 1b). I also found consistent patterns of results when the price information was presented visually by

means of a graph (Study 1c), similar to Google Flights. Importantly, I also found that when the levels of frequency were modified within the high frequency conditions (i.e., 3 versus 6 changes) patterns of results were comparable (Study 1d). This suggests that there is a distinction between 1 and 2 changes versus 3 or more changes, with the latter being more akin to streaks as they comprise of the same changes happening in succession (Albright 1993; Carlson and Shu 2007). I also presented support for the mechanism that underlies the effect: expectations about future prices (Study 2). Crucially, my data suggests that when participants observe a single, large change in price, they tend to expect this to be a one-off occurrence and that the price would change again in the future in the opposite direction. However, if participants observe multiple, smaller price changes in the same direction, they may expect the same pattern of changes to continue occurring in the future. This, in turn, influences their decision to buy now or later. Further, I examined a host of different moderators for the effect. First, I found that monotonicity, which refers to the consistency of the direction of the price changes, crucially impacts the effect (Study 3). Formation of expectations of future prices depend on patterns that can be observed in past prices. Importantly, if past prices were all directionally consistent, it becomes reasonably easy to extrapolate and make predictions as to what would happen next. However, presence of an inconsistent change may disrupt the perception of a streak and therefore make it harder to extrapolate and predict future prices. Second, I examined the timing of the price change (Study 4). I found that the documented effect is stronger when the price change occurred earlier in the sequence, as opposed to later. Third, I found that endowing

participants with a reference price, which we operationalize as a typical price range for the focal product, attenuates the effect (Study 5). Further, I found that participants in the study seemed to be largely insensitive to causes underlying the price changes (Study 6), and that the effect is still replicated when the purchase or demand were presented to be inelastic in nature (Study 7). Lastly, in a study using an incentive-compatible scheme where submitted decisions would be consequential, I replicate the key effect (Study 8). In sum, the collective body of evidence demonstrate the overall robustness of the effect. Furthermore, the examination on the different boundary conditions also help provide a better understanding of the effect. While my key effect seems rather robust in nature, there are still factors that could may potentially impact the magnitude of the effect, as documented in the moderation studies.

The research presented in this chapter boasts several theoretical contributions. First, this work was largely built upon the research on the effects of frequency of discounts (Alba et al. 1994; Kalwani and Yim 1992; Krishna 1992), for example in the context of stockpiling (Blattberg et al. 1978; Gupta 1988). The contribution here is that we extend this work by also examining price increases, as opposed to only discounts. The criterion variable that we focused on, purchase deferral, is also different from what has been studied before in this line of work (i.e., purchase quantity, perceptions on prices). The focal products we used as stimuli in the studies were also varied, going beyond fast moving consumer goods, which was often the focus of existing studies. We examined products such as services or durable products that are not purchased in large quantities or very frequently by consumers. Importantly, this chapter also

contribute to research on the downstream consequences of consumer expectations (Bearden and Teel 1983; Oliver and DeSarbo 1988; Evangelidis and Van Osselaer 2018), as well as the work on judgmental forecasting which show that extrapolative nature of individuals' forecasts about the future (Lawrence and Makridakis 1989; De Bondt 1993). In this regard, the key finding is that expectations about future prices are driven by the interaction between frequency and the direction of changes. As a result, expectations that we have about future prices may differ depending on past, observed pattern of changes. This would crucially affect the decision to buy now versus later.

Furthermore, this chapter offers valuable insights for manufacturers and retailers, in terms of how they could optimize the way in which they communicate and set up price changes over time. Perhaps most importantly, the framework and the findings presented in this chapter outline possible consequences of different types of price change patterns. Not only does direction matters, but the frequency of the observed price changes also play a crucial role. All this pose important consequences in terms of how expectations about future prices are formed. If a consumer sees a single price change in a given direction they may expect that change to be a one-off, isolated event. But if a consumer sees multiple price changes in the same direction in succession, they may expect that same pattern to replicate in the future. The decision to buy now or to hold off purchase will crucially depend on these expectations. Thus, when companies are considering introducing price changes, it is extremely important to first understand *how* consumers would interpret and perceived those communicated changes. Only then should companies be encouraged to optimize the price change

strategy to best match the intended goals and purposes. I argue that this is because perhaps what the company is striving to achieve may not always align with consumers' natural inclinations and tendencies when they are faced with a given pattern of price changes. Thus, understanding the different possible reactions of consumers would be a crucial first step. For example, in the case of price increases, it may be more desirable for companies to introduce multiple smaller changes in price over time as opposed to a single large change. The data we have suggests that when consumers see a single large change, they would have a greater likelihood to hold off purchase. However, if consumers are presented with multiple smaller changes, the expectations would be that the price would continuously increase and they would be more inclined to purchase the product—before the price increases even further.

Despite the richness and robustness of the findings presented in this chapter, it must be admitted that no empirical work is without limitations. Future research can be done with hopes to mitigating and addressing these limitations, and further expanding the broadth and depth of this research. One possible area of extension is to further examine the role of monotonicity of observed price changes. While Study 3 shows that the consistency of the direction of the price changes matters and that it affects the magnitude of the effect, other factors related to monotonicity could still be explored. For example, the examination of monotonicity in this chapter was limited to the inclusion of one inconsistent change. In the marketplace, prices may continuously fluctuate over time. Furthermore, *when* the inconsistencies occur within the sequence of changes could also be examined. Data from Study 4 suggests that the key effect is

stronger when the price change occurred earlier (versus later) in the sequence. However, it is important to note that the sequence here comprises of a largely consistent pattern of changes, in terms of direction. What if the multiple inconsistencies are spread out over the focal time period? In general, when trying to speculate possible patterns of results for these additional factors, I largely anticipate that expectations would again play a pivotal role. For example, theoretically, one could surmise that the more occurences of inconsistent change, the more difficult it would be to form expectations about how the price might be in the future. Ultimately, exploring these additional factors would further enrich our understanding of consumers' reactions to historical price information, and how it relates to their decision to buy a product now or later.

Chapter 3: Introducing Dynamism

A lot of the research done in the field of numerical cognition as well as judgment and decision making has been focused on understanding how individuals process, draw inferences from, and are influenced by different representations of numerical information. One key characteristic of these studies is that these numerical representations are *static* in nature. This implies that at the time of judgment, the focal stimuli come in the form of a specific numerical figure or a set of numerical figures just at that point in time. In other words, the act of judgment is done upon the discrete value of the stimuli at that time. The work presented in Chapter 3 strives to build and expand on this line of findings by introducing *dynamism*. What if the focal stimulus

come in the form of a dynamic figure that is constantly updating over time? What if its values change over time? Indeed, I must admit that at the time of judgment, the individual would still be evaluating a single figure, which I call the present value. However, the fact that that figure materialized as a result of dynamic updating means it is likely that the various numbers that precede it as well as the manner in which those numbers are presented could also influence how the present value is perceived. Much like what we have observed in Chapter 2, observed past information could also influence inferences made in the present times. All in all, the main question that this chapter aimed to answer was whether magnitude judgments of the figure would be different, if the indicator had updated less or more frequently.

In this chapter, I conducted six experimental studies. These studies corroborated the prediction that frequency of updates would have an influence on perceptions of magnitude of the dynamic figure. Specifically, I found that exposure to higher frequency of change would lead to greater magnitude judgment in terms of the total change and that this is not moderated by individual level's of numeracy (Peters et al. 2006). Perhaps most importantly, I also found that frequency of updates also affects magnitude judgments of the present value of the dynamic figure. Again, higher frequency of updates leads to greater magnitude judgments of the present value, when examined in a between-subject design (Study 2), within-subject design (Study 3), and when the context pertains to naturally (i.e., instead of exogenous or arbitrary) occurring changes (Study 4). It is also extremely crucial to understand why this effect occurs. I contend and show that this is due to the fact that people tend to misattribute frequency

for quantity. In line with the predictions rooted in the findings on the numerosity heuristic, I propose that consumers tend to misattribute higher frequency for greater magnitude. Relatedly, consumers may be likely putting a considerable amount of attention on frequency, and not so much on the step-size or exact change in amounts, given that frequency has also been shown to be a particularly salient information cue (Alba et al. 1999). For example, in the case of price discounts, it has been shown that consumers tend to be more attentive to the frequency of discounts, as opposed to the magnitude of the savings generated from the discounts (Alba et al. 1994). Importantly, I found that if attention was shifted away from frequency to the step-size between each change, the effect would be attenuated. Lastly, I also presented a preliminary examination on possible downstream consequences of the effect by means of a real-effort incentive-compatible behavaioral task.

In terms of theoretical contribution, the work presented in this chapter extend and broaden findings from a variety of fields. Naturally these are fields where we draw inspiration when formulating the ex-ante predictions for our experimental studies. For example, one potential prediction for the effect stemmed from the seminal work by Weber (1834) in the field of psychophysics. Importantly, our findings can expand Weber's law and show that when it is applied to a setting where dynamism has been introduced, the results may differ greatly, compared to when the numerical information comes in static form. Weber (1834) suggests that how a change in stimulus is perceived is a function of the total increase in value and the original starting point. In the case of static numerical information where the numbers were not presented as is, instead of to

be a result of preceding values, this account holds. However, in the case of dynamic numerical figures, frequency also plays a pivotal role. Further, the findings also contribute to the budding area of research within numerical cognition on the myriad of factors that can impact subjective perceptions of numerical figures, or inferences or predictions made based on said figures (e.g., Spiller et al. 2020; Pandelaere et al. 2011; Burson et al. 2009). The effects of frequency were shown to be robust in our studies, and frequency should therefore be considered a factor that could influence how people draw inferences based on dynamic representations of numerical information. Last, this work also sheds light on how people judge changes in dynamic representations of attribute values or numerical changes. Despite the proliferation of instances where consumers could gain access to dynamic numerical information, rather limited academic research has been conducted on it. For example, Shen and Hsee (2017) examined the relationship between showing people with a number that was going up in value at an increasing velocity and performance in a task. It is important to note though, that they showed their participants numbers that were inherently meaningless to the task at hand. The research presented in this chapter utilized numbers that bear significance. While our findings indeed show the pivotal role of frequency of updates in influencing subjective perceptions, this line of work could greatly benefit from more research done on this topic.

I strongly believe that the most important extension for the work presented in this chapter should come in the form of further examination on the possible downstream consequences of the effect. What the data collectively show here is that

the effect of frequency of updates on magnitude judgments seems largely consistent and robust, but the downstream effect on behavior seem to be context-dependent. Study 6 above presents a preliminary look into how this may manifest, specifically in the context of competition in a behavioral task. It is important to note that data from this study suggest that indeed exposure to high frequency leads to greater magnitude judgments—in line with the other studies in the paper—but the effect on performance during the task was actually in the opposite direction. Thus, it is extremely crucial to investigate this from a variety of angles, and several factors could be manipulated and modified. First, in Study 6, the dynamic indicator was shown *prior to* participants actually completing their own task (i.e., measurement of the dependent variable). It should also be examined how behavior is affected when the indicator is actually shown during the direct measurement of the dependent variable. Second, the task which allowed us to measure the dependent variable was simply clicking. Despite the inclusion of an incentive-compatible payment scheme, the act of clicking itself could indeed be argued to be rather menial, with little significance or meaning. This effect should also be examined in a setting where the task attached to the dependent variable actually is effortful or has meaningful consequences for the participant, beyond pecuniary benefits linked with the study. Third, in Study 6 we presented the information to be about someone else's performance, not of the participant itself. It would also be crucial to investigate how the effect manifests when the dynamic numerical information pertains to self-relevant statistics or data. Lastly, as argued previously, I expect context to matter greatly. While in Study 6 I found that showing a dynamic figure of another

participant at higher frequency leads to lower performance in a clicking task, this documented direction may not be the same when we utilize a different context, such as altruistic transactions like donations, work in professional settings, and so on. Of course, further research should also explore ramifications of manipulations and modifications of factors such as the direction of change (i.e., in this chapter I have strictly examined increases), monotonicity or consistency of direction, variety in terms of magnitude of the changes that are being communicated. Nevertheless, a detailed examination of how varying levels of frequency of changes would ultimately effect behaviors and decisions across a plethora of contexts would result in the most sizeable contribution.

Taken all together, findings from this chapter present a compelling juxtaposition between consumer preferences for numerical information that is presented in higher frequency (as shown by the additional measure recorded at the end of Study 6, as well as our ancillary study) and how their subjective perceptions actually are, when presented with such information. It is quite natural for humans to want *more*—more information, more updates, more speed, and so on. When thinking of technological developments especially in the field of information, it is now becoming increasingly possible for companies to transmit more information, and thus they indeed strive to provide *more* to their consumers. This could be in terms of quantity, frequency, and velocity. Related to this, for example, Spiller et al. (2020) argued, "With data comes the need to comprehend and act on those data. With the rising tide of big data has come the compulsion to integrate, analyze, and share information at an ever-accelerating rate,"

(p. 2230). While on the surface we could observe this general compatibility of preferences between suppliers and those who demand information, I strongly believe that one important question has to be answered first. That is, what is actually the effect of showing changes in dynamic numerical indicators at higher frequency, as opposed to lower? I argue that this question is important because companies or developers of applications should *not* be providing more information for the sake of providing more, or just because they are now technologically able to. Information, at the end of the day, should be presented in ways that would facilitate interpretation and maximize chances that accurate inferences could derived from it. As a matter of fact, our findings suggest that frequency of updates actually impact subjective perceptions of the value of the figure, going beyond its actual, objective magnitude. This implies that the exact same present value may actually be perceived to be subjectively larger, if it was presented as a result of higher frequency of updates, compared to lower frequency of updates. This is largely driven by the salient nature of frequency, and in certain contexts one could argue that this could ultimately result in a rather inaccurate view of the figure's magnitude. Importantly, as discussed in Study 5, I also found that it is possible to attenuate the key effect by prompting participants to turn their attention to the step-size itself. Thus, if a company finds themselves in a situation where they are planning to transmit change information at high frequency, they could also opt to include an explicit prompt or suggestion to participants to also pay equal attention to the difference between each change. Overall, I hope that findings from this chapter can help shed light on how companies can optimize their strategies when deciding on

communicating and presenting changes in value to participants in dynamic contexts. Numbers are indeed numbers, but as we have seen throughout this chapter, whether those numbers are static or dynamic—and if they are dynamic, how exactly they are being presented—make a considerable difference in terms of how they are subjectively perceived by consumers.

Chapter 4: Framing Modes and Motivation

The last empirical chapter of this dissertation focuses on a criterion variable that is of considerable interest for many: motivation. Motivation, as a construct, is ultimately linked with the production of outcomes (Ryan and Deci 2000), execution of desired or intended behaviors, as well as eventual goal attainment (Bindra 1968; Bagozzi and Dholakia 1999; Fishbach and Ferguson 2007). In this chapter, I set to investigate how instructions of a task could be framed either by focusing on the expected output or expected input, and how these framing modes would eventually impact motivation during the task. More often than not, this information about expected output and/or expected input is conveyed by means of numerical information. For example, the expected output laid out to every PhD student writing a dissertation such as this one is to have three empirical chapters. Alternatively, a PhD student could be encouraged to be as productive as they can during the period of 5 years. In this case, there is no explicit or specific mention of expected output, but the expected input is specified.

Specifically, I aimed to test the prediction that framing a task and its instructions in terms of its expected output would lead to greater motivation in a task, compared

the input-based framing mode. I examined this key hypothesis in a series of nine experimental studies using a real-effort clicking paradigm. This task allows for direct measurement for a form of actual behavior, by which we could then compare motivation between the two experimental conditions of output-based and input-based framing mode. We embedded the framing mode manipulation within the instructions of the task, with participants in the output-based condition being told to perform X number of clicks, and participants in the input-based condition being told that they had to perform clicks for Y seconds. Our key dependent variable, which would ultimately serve as a proxy for motivation, was measured by calculating the number of clicks performed every second by a given participant (i.e., click rate). I documented preliminary evidence for the effect, namely that as predicted, participants who were provided with output-based instructions exhibited greater click rate compared to their counterparts who received input-based instructions (Studies 1a and 1b). I also demonstrated the robustness of this effect in the subsequent studies, where I sought to replicate the effect in a variety of different settings. I found that the effect replicates when the task is calibrated in a way, such that participants in the output-based condition essentially had to perform the task for much longer compared to their input-based counterparts (Study 2). Further, although I did make the point earlier that oftentimes expected output and/or input are often communicated through numerical information, I found that our key effect still persists—despite being weaker—when all numerical elements were removed from the instructions (Study 3). The effect also replicated when examined in a within-subject design, namely when participants had to complete two

versions of the task in random order (Study 4), as well as when a performance-based incentive scheme was implemented (Study 6). I also pitted the two customary output-based and input-based conditions against a condition where I instructed participants expected rate (i.e., output divided by input), in that they were told how many clicks they should aim to perform every second (Study 5). I found that participants in both the output-based and input-based conditions outperformed these participants, even if input-based participants still exhibited lower click rate compared to output-based. Although all the studies above indeed point to the fact that explicating expected output in task instructions lead to greater motivation during the task compared to expected input, I still found it important to find possible ways to increase motivation for participants who are given information that is input-based. I experimented with providing participants in this condition information that they would be able to finish the task sooner if they clicked faster (Study 7). This introduces a sense of agency—how fast or slow one clicks would determine when one finishes—and indeed this manipulation resulted in increased click rate. Lastly, I explored the effects of providing participants with task-relevant information during completion of the task, namely by showing them a click counter that updates and displays the number of clicks performed thus far, as well as a timer showing elapsed time. The data suggests that showing the click count information resulted in increased click rate during the task (Study 8).

Collectively, the work presented in this chapter contributes to different streams of research, many of which also served as the theoretical underpinnings of our hypothesis. Perhaps most importantly, my findings contribute to the research on

factors that motivate effort or behavior (e.g., Gneezy, Meier, and Rey-Biel 2011; DellaVigna and Pope 2018), which include but is not limited to the work on compensation and incentive schemes within labor economics (Seiler 1984; Lazear 1986; Fama 1991; Prendergast 1999). Importantly, I show that the modification of instructions and specific use of numerical information in terms of expected output and input could motivate effort during a task. While I have one study with an incentive-compatible compensation scheme, my findings prove to be robust even when participants were paid equally for their work irrespective of which experimental condition they were assigned to. Even in that case, I still documented a consistent pattern whereby providing task instructions that stipulate expected output resulted in greater motivation during the task, compared to instructions that are input-based. Thus, the work presented in this chapter underscores a novel method that could be used to motivate effort in a task. Importantly, this framing method is relatively simple to execute, has the potential to be widely applied in a variety of different tasks, could be easily calibrated, and does not necessarily require involvements of pecuniary elements for it to actually boost effort.

My findings also contribute to the expansive area of research on goals and motivation (e.g., Carver and Scheier 1990; Fishbach and Ferguson 2007; Woolley and Fishbach 2016; Nunes and Dreze 2006; Amir and Ariely 2008; Kivetz, Urminsky, and Zheng 2006; Wallace and Etkin 2018). The biggest contribution here lies in the fact that my data suggests that motivation or goal-directed behavior during a specific task could be affected by how the task objectives are framed, specifically involving the

comparison between expected output and expected input. My findings also corroborated the work on the prevision of progress-related feedback during completion of the task (Carver and Scheier 1990). Providing participants with countable output such as click counts was found to increase motivation during the task. Lastly, the development of the behavioral task is a contribution in and of itself. For many researchers wishing to study motivation, it is always an issue of finding the task that could measure real, actual behavior or effort (e.g., DellaVigna and Pope 2018; Amir and Ariely 2008; Etkin 2016). Of course, this is much preferred over merely placing participants in hypothetical scenarios where they have to imagine performing a task under specific characteristics. That said, this measurement of real behavior is often easier said than done, as then the researcher must develop a task that would also satisfy a host of other criteria. For example, one may need to a task be possible to be conducted online, be feasible to be executed with a large volume of participants, be highly customizable in terms of the requirements of the experimental manipulations, or even be manageable in terms of its eventual financial costs. Given its characteristics, I strongly believe this clicking paradigm could serve as a suitable task for many researchers studying goals as it ticks off many of the requirements above.

In relation to the discussion of the clicking task, I find it important to underscore a limitation pertaining to it, namely that the data I presented in this dissertation indeed stemmed from one single paradigm. Further research should be done to compare the effects of stipulating expected output versus expected input on a host of different activities. For example, the paradigm used in Chapter 4 only involved using the mouse

or trackpad of one's computer to perform a series of clicks. This is a task that is relatively menial in nature and does not require any skill. Thus, the research question posed in this study should be examined in contexts where for example skill, intelligence, or physical strength is involved. The effects may manifest differently indeed when the nature of the focal task changes. Relatedly, we could also view this in the perspective of goals that are inherently associated with quantity versus quality. To elaborate, consider goals that are essentially about producing a certain amount of output. Irrespective of the quality, these types of goals would be more about hitting the required quantity. On the other hand, quality goals may be more associated with tasks that involve creativity, intelligence, or a certain type of skill to produce outcomes that are of desired quality. The clicking paradigm used in this chapter is more akin to quantity goals—as a click is a click—and clicks cannot be meaningfully evaluated in terms of how good or bad it is. In this regard, future research should also examine whether framing instructions in terms of expected output or expected input would impact motivation in a way that in line with what has been documented in this chapter, or if they would operate in a different manner when applied in tasks that are more geared towards meeting a certain degree of quality requirements.

To end the discussion on this chapter, I think it would be important to pause and think to ourselves how we typically receive instructions in life. Most employees are told to work from 9 to 5. PhD candidates are commonly told they have 5 years to complete their projects and dissertation. These instructions are more akin to the input-based framing mode, as they stipulate the expected time frame or duration of the task

at hand. In other domains, though, such as sports or physical activity for instance, output-based instructions are much more prevalent. For example, tennis players have to reach 7 points in a tie-break, and volleyball games are played first to 25 points. Similarly, many individuals are now familiar with the ever-popular axiom of walking 10,000 steps to improve their physical health—a specific case of an "expected output" which has been scientifically examined by researchers, who in the end contend that 7,000 steps a day would in fact suffice and that positive associations with health outcomes actually taper off at that point (e.g., Tudor-Locke et al. 2011; Lee et al. 2019; Paluch et al. 2021). That said, if we are thinking of a goal of increasing physical activity, specifying a desired amount of output is admittedly not the only way to do so. For example, recent guidelines by the Centers of Disease Control and Prevention (2022) stipulate that 150 minutes (i.e., expected input) of physical activity spread out over the course of days would be beneficial for overall health. In the end, what I hope this chapter shows is that *both* ways could be used to effectively motivate effort. The data collectively suggest that using output-based instructions tend to result in greater motivation in a task, within the context of our studies. With the input-based instructions, it is also possible to boost motivation, but certain slight enhancements would need to be incorporated. For example, participants who were given input-based instructions exhibited even higher click rates when they were also provided with real-time information on the amount of clicks they have been performing, or if they were told that they would be able to finish the task sooner if they clicked faster (i.e., even if the task did not actually change in duration at all, irrespective of performance). With

the seemingly impervious nature of the output-based instructions in terms of how it affects motivation, it is also important to note that data from the ancillary study also suggest that this is what an overwhelming amount of participants in fact prefer to receive, at least within the context of our paradigm. Does that imply that henceforth we should only be utilizing output-based instructions? If the situation permits it, the data suggests that indeed output-based instructions would indeed be effective in motivating effort. However, as I stated at the start of this paragraph, many of us actually do encounter input-based instructions in our daily lives. To question why input-instructions exist in the first place, or why they are so prevalent in certain areas of our lives such as work, would perhaps make this discussion inordinately philosophical. What is important to note, however, is that the empirical evidence does suggest that giving feedback on the output as it is being produced could help evoke the desired behavior when input-based instructions are being used. Importantly, data from this chapter show that while holding financial compensation constant and keeping the task identical in nature, even by modifying how we frame instructions could result in significant effects in terms of behavior.

Closing Arguments

Famed author Nathanael West wrote in his book Miss Lonelyhearts (1933) that *numbers constitute the only universal language*. Indeed, numbers quantify attributes of the human environment and presents it in a manner that is factual and should be equally comprehensible for everyone. While mathematically speaking, 1 is 1, 2 is 2, and 2 is

greater than 1, what I hope to have shown throughout this dissertation is that individuals' relationships with numbers is in fact complex and nuanced. This is mainly due to the fact that while numbers hold objective value and meaning, we have to admit that oftentimes, subjective perceptions prevail. Furthermore, interpretation of numerical information is also largely malleable, in that a variety of different factors may distort how an objective piece of numerical information may be perceived. This could be the units that are used to express quantity information (e.g., Burson et al. 2009; Pandelaere et al. 2011; Van den Bergh and Lembregts 2019), data transformations that have been performed on it (e.g., Spiller et al. 2020), or evaluation mode (e.g., Hsee 1999; Schley et al. 2017). Given that we now live in a world of numbers—and often dynamic numbers—this dissertation ultimately sets out to present research that highlights how consumers interact, make use of, and are affected by different forms of numerical information. Everyone communicates with consumers through numbers: retailers selling products convey price information, governments and political entities convey probability of winning or losing an election, health applications and wearables convey biometric information, companies convey key performance indicators, and employers may convey task requirements or grading. More often than not, these different types of information come in the form of numbers. To effectively reach, communicate with, motivate, and positively influence consumers, an understanding of how consumers perceive and interact with numbers is extremely crucial. While admittedly this dissertation cannot exhaustively answer all the questions pertaining to that, I hope that the work presented in this dissertation inspires future research on

these topics and that the findings offer descriptive and prescriptive insights for scholars, practitioners, and even consumers at an individual level.

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Summary (English)

This dissertation focuses on the relationship that consumers have with different forms and manifestations of numerical information. Numbers can be considered as a universal language, and they are used to quantify a host of attributes within the consumer environment. Importantly, numbers often serve as important cues for the plethora of decisions that consumers make across different facets of their lives. This dissertation aims to show that consumers' relationship with numbers is in fact complex and nuanced—it cannot solely be viewed from a normative, mathematical perspective. That is, while numbers inherently hold objective value and meaning, admittedly subjective perceptions may frequently prevail. Relatedly, interpretation of numerical information is also largely malleable, in that a variety of different factors may distort how numerical figures may be perceived. Perhaps most importantly, how consumers process, perceive, and draw inferences from numbers—be it objectively or subjectively—would hold implications for consumer decisions, actions, and behavior.

The first chapter focuses on numerical information in the form of historical prices. I propose an integrative framework that centers on the interaction between two aspects related to historical prices, namely frequency and direction of observed price changes. Controlling for the total magnitude of price changes, upon observing historic price information, consumers' decision to make or defer purchase crucially depends on this predicted interaction. Crucially, it is hypothesized and documented that this effect is more pronounced when consumers are presented with a single large change in price, as opposed to multiple, smaller changes which would evoke the perception of a trend. Furthermore, I investigate the pivotal role of expectations in driving the effect of frequency and direction on purchase deferral. Expectations about future price changes are found to be extrapolative in nature, in that they should mirror the patterns displayed in the past. these effects are driven by differences in consumers' expectations about future prices. Collectively, the body of evidence presented in this chapter by means of eleven experimental studies corroborate the robustness of this predicted effect, also by means of incentive-compatible paradigms involving consequential choices. A host of different moderators (i.e., the monotonicity of the direction of the price changes, the timing of the change, presence of reference price, characteristics of the cause underlying the price change, nature of the focal purchase) were also examined, further deepening our understanding on factors that could potentially impact the magnitude of the effect.

The second chapter focuses on numerical information that is dynamic in nature. Specifically, it centers on a manifestation of numerical stimulus that result from continuous changes and updates over time. The fact that such dynamic numerical figure materialized as a result of updates concerning its value over time means it is likely that the various numbers that precede it, as well as the manner in which those numbers are presented—for example the frequency of updates—could also potentially influence how the present value (i.e., value at the time of judgment) is perceived. The investigation in this chapter zeroes in on the comparison between higher versus lower frequency of updates. A series of six experimental studies reveal that consumers tend to perceive an identical numerical value to be larger in magnitude, when it stems from a more frequently updated source, versus less frequent. The robustness of this effect is also documented, for example in a within-subject experimental design, or in comparison with static representations of the same present value. Importantly, it is found that this can be explained by the fact that consumers tend to misattribute higher frequency for greater quantity. The effect is attenuated when focus is drawn to the step-size of each change, as opposed to the frequency of changes.

The third chapter focuses on numerical information that can be embedded within task instructions, specifically whether they are framed as expected output versus expected input. Imagine a consumer with a goal of increasing physical activity (e.g., steps). We have two ways of instructing how they should do this. First, they could be instructed to complete as many steps as she can over a fixed period of time (e.g., 24 hours). Second, they could be told to perform 10,000 steps as fast as she can. Analogous to this example, in the workplace environment, the typical working hour structure sets forth fixed working hours for employees (e.g., 9-to-5). Alternatively, employees could also be told to complete a certain amount of tasks (e.g., write two reports) in the shortest time possible. Admittedly, there are different ways of structuring a task or activity and its specifications, which in turn could ultimately influence people's motivation when completing the task. In this paper, we examine how the two different modes of task structure and framing above would lead to differences in motivation. They differ in the variability and specificity of both expected output (i.e., quantity) and expected input (i.e., duration). In the first option, the expected output of the task is fixed (i.e., "10,000 steps"), but the completion time is variable and unspecified (i.e., "as fast as you can"). Contrastingly, in the second option, target output is unspecified in terms of quantity (i.e., "as many steps as you can"), but the expected completion time is specified and fixed (i.e., "24 hours"). A series of nine real-effort experiments with

actual behavior as the key criterion variable points to the conclusion that stipulating expected output within task instructions leads to greater motivation in the task, compared to using input-based framing. This effect was found to be replicable across different task calibrations, and the impact of providing participants with task-relevant information during completion of the task was also explored.

This dissertation aims to build upon existing research on consumer behavior as well as judgment and decision-making by presenting a novel outlook on consumers' judgments and choices in an ever-changing decision environment, where numerical information is becoming increasingly ubiquitous and varied in terms of its presentation.

Summary (Nederlands)

Dit proefschrift richt zich op de relatie die consumenten hebben met verschillende vormen en uitingen van numerieke informatie. Getallen kunnen worden beschouwd als een universele taal, en zij worden gebruikt om een groot aantal zaken binnen de consumentenomgeving te kwantificeren. Bovenal spelen getallen vaak een belangrijke rol bij de vele beslissingen die consumenten nemen op verschillende gebieden van hun leven. Dit proefschrift heeft tot doel aan te tonen dat de relatie van consumenten met getallen in feite complex en genuanceerd is—zij kan niet uitsluitend vanuit een normatief, mathematisch perspectief worden bekeken. Dat wil zeggen dat getallen weliswaar een objectieve waarde en betekenis hebben, maar dat subjectieve percepties vaak de overhand kunnen hebben. Ook is de interpretatie van numerieke informatie in hoge mate vormbaar, in die zin dat allerlei verschillende factoren de perceptie van numerieke cijfers kunnen vertekenen. Het belangrijkste is misschien wel dat de manier waarop consumenten getallen verwerken, waarnemen en daaruit conclusies trekken—of dat nu objectief of subjectief is—gevolgen heeft voor hun beslissingen, acties en gedrag.

In het eerste hoofdstuk staat numerieke informatie in de vorm van historische prijzen centraal. Ik stel een integratief kader voor dat gericht is op de interactie tussen twee aspecten die verband houden met historische prijzen, namelijk de frequentie en de richting van waargenomen prijsveranderingen. Wanneer de totale omvang van de prijsveranderingen constant wordt gehouden, hangt de beslissing van de consument om een aankoop te doen of uit te stellen, bij het observeren van historische prijsinformatie, in doorslaggevende mate af van deze voorspelde interactie. In sterke mate wordt verondersteld en gedocumenteerd dat dit effect sterker is wanneer consumenten één grote prijsverandering krijgen voorgeschoteld, in tegenstelling tot meerdere, kleinere veranderingen die de perceptie van een trend zouden oproepen. Bovendien onderzoek ik de cruciale rol van verwachtingen in het effect van frequentie en richting op het uitstellen van aankopen. Verwachtingen over toekomstige prijsveranderingen blijken extrapolatief van aard te zijn, in die zin dat zij de in het verleden waargenomen patronen zouden moeten weerspiegelen. Deze effecten worden veroorzaakt door verschillen in de consumentenverwachtingen over toekomstige prijzen. Het bewijsmateriaal dat in dit hoofdstuk aan de hand van elf experimentele studies wordt gepresenteerd, bevestigt de betrouwbaarheid van dit voorspelde effect, ook door middel van incentive-compatibele paradigma's waarbij consequentiële keuzes worden gemaakt. Een groot aantal verschillende moderatoren (d.w.z. de monotoniciteit

van de richting van de prijsveranderingen, het tijdstip van de verandering, de aanwezigheid van een referentieprijs, kenmerken van de oorzaak die aan de prijsverandering ten grondslag ligt, de aard van de aankoop die centraal staat) werden eveneens onderzocht, waardoor ons inzicht in factoren die de omvang van het effect kunnen beïnvloeden, verder werd vergroot.

Het tweede hoofdstuk is gewijd aan numerieke informatie die dynamisch van aard is. Het gaat specifiek om het optreden van een numerieke stimulans die het resultaat is van voortdurende veranderingen en aanpassingen met de tijd. Het feit dat een dergelijk dynamisch cijfer tot stand is gekomen als gevolg van actualiseringen van de waarde ervan in de loop van de tijd, betekent dat het waarschijnlijk is dat de verschillende cijfers die eraan voorafgaan, alsmede de wijze waarop die cijfers worden gepresenteerd—bijvoorbeeld de frequentie van de actualiseringen—ook van invloed kunnen zijn op de wijze waarop de huidige waarde (d.w.z. de waarde op het moment van de beslissing) wordt waargenomen. Het onderzoek in dit hoofdstuk is gericht op de vergelijking tussen een hogere en een lagere frequentie van aanpassingen. Uit een reeks van zes experimentele studies blijkt dat consumenten geneigd zijn een identieke numerieke waarde als groter te beschouwen, wanneer deze afkomstig is van een bron die vaker wordt bijgewerkt, dan wanneer deze minder vaak wordt bijgewerkt. De betrouwbaarheid van dit effect is ook gedocumenteerd, bijvoorbeeld in een onderzoeksopzet met herhaalde metingen bij de proefpersonen, of in vergelijking met statische voorstellingen van dezelfde waarde van dat moment. Belangrijk is dat dit kan worden verklaard door het feit dat consumenten geneigd zijn een hogere frequentie verkeerd toe te schrijven aan een grotere kwantiteit. Het effect wordt afgezwakt wanneer de aandacht wordt gevestigd op de stapgrootte van elke verandering, in tegenstelling tot de frequentie van de veranderingen.

In het derde hoofdstuk wordt ingegaan op de numerieke informatie die in taakinstructies kan worden vervat, met name of zij worden gekaderd als verwachte output tegenover verwachte input. Stelt u zich een consument voor met als doel de hoeveelheid lichaamsbeweging (bv. het aantal stappen) te vergroten. We hebben twee manieren om uit te leggen hoe hij dit moet doen. Ten eerste zou hij de opdracht kunnen krijgen om binnen een bepaalde tijd (bv. 24 uur) zo veel mogelijk stappen te zetten. Ten tweede zou hem gezegd kunnen worden dat hij zo snel mogelijk 10.000 stappen moet zetten. Vergelijkbaar met dit voorbeeld zijn in de werkomgeving vaste werktijden voor werknemers vastgelegd (bv. 9 tot 5). Een andere mogelijkheid is dat werknemers

wordt opgedragen een bepaald aantal taken (bv. twee rapporten schrijven) in een zo kort mogelijke tijd af te ronden. Toegegeven, er zijn verschillende manieren om een taak of activiteit en de bijbehorende specificaties vorm te geven, waardoor uiteindelijk de motivatie van mensen bij het voltooien van de taak kan worden beïnvloed. In dit proefschrift onderzoeken we hoe de twee verschillende manieren van taakstructuur en kadering hierboven tot verschillen in motivatie zouden leiden. Zij verschillen in de variabiliteit en specificiteit van zowel de verwachte output (d.w.z. de hoeveelheid) als de verwachte input (d.w.z. de duur). In de eerste optie ligt de verwachte output van de taak vast ("10.000 stappen"), maar de voltooiingstijd is variabel en niet gespecificeerd ("zo snel als je kunt"). In de tweede optie daarentegen is de beoogde output niet gespecificeerd in termen van hoeveelheid ("zoveel stappen als je kunt"), maar de verwachte voltooiingstijd is gespecificeerd en vastgesteld ("24 uur"). Een reeks van negen real-effort experimenten met feitelijk gedrag als de belangrijkste criteriumvariabele leidt tot de conclusie dat het bepalen van verwachte output binnen taakinstructies leidt tot een grotere motivatie in de taak, in vergelijking met het gebruik van input-gebaseerde kadering. Dit effect bleek reproduceerbaar te zijn bij verschillende taakkalibraties, en het effect van het geven van taakrelevante informatie aan deelnemers tijdens het voltooien van de taak werd ook onderzocht.

Dit proefschrift wil voortbouwen op bestaand onderzoek naar consumentengedrag en oordeel- en besluitvorming door een nieuwe visie te presenteren op de oordelen en keuzes van consumenten in een steeds veranderende besluitvormingsomgeving, waarin numerieke informatie steeds alomtegenwoordiger en gevarieerder wordt in de presentatie ervan.

Summary (Bahasa Indonesia)

Disertasi ini berfokus pada hubungan antara konsumen dan berbagai bentuk dan manifestasi informasi numerik. Angka-angka dapat dianggap sebagai bahasa universal, dan mereka digunakan untuk mengukur berbagai macam atribut dalam lingkungan konsumen. Angka-angka sering berfungsi sebagai sumber informasi penting dalam sejumlah besar keputusan yang dibuat konsumen di berbagai aspek kehidupan. Tujuan dari disertasi ini adalah untuk menunjukkan bahwa hubungan konsumen dengan angka-angka sebenarnya kompleks dan bernuansa. Hubungan ini tidak bisa semata-mata dilihat dari perspektif normatif dan matematis. Artinya, meskipun angka secara inheren memiliki nilai dan makna objektif, persepsi subjektif juga bisa memiliki pengaruh. Sehubungan dengan itu, interpretasi informasi numerik juga sebagian besar dapat berubah dan terpengaruh oleh berbagai faktor yang dapat mendistorsi persepsi mengenai angka-angka tersebut. Pada akhirnya, bagaimana konsumen memproses, mempersepsikan, dan menarik kesimpulan dari angka-angka—baik secara objektif maupun subjektif—memiliki implikasi penting untuk keputusan, tindakan, dan perilaku konsumen.

Bab pertama disertasi ini berfokus pada informasi numerik dalam bentuk harga historis. Saya mengusulkan framework integratif yang berpusat pada interaksi antara dua aspek yang terkait dengan harga historis, yaitu frekuensi dan arah perubahan harga yang diamati. Apabila konsumen telah melihat informasi harga historis, keputusan mereka untuk membeli atau menunda pembelian sangat bergantung pada interaksi yang diprediksi ini. Pentingnya, besarnya atau jumlahnya perubahan harga selalu di kontrol. Saya memprediksi bahwa efek ini lebih kuat ketika konsumen diberikan informasi dengan satu perubahan harga yang besar, dibandingkan dengan beberapa perubahan yang lebih kecil yang akan membangkitkan persepsi bahwa adanya sebuah tren. Saya juga menyelidiki peran penting dari ekspektasi dalam membentuk dan mendorong efek frekuensi dan arah pada penundaan pembelian. Saya menemukan bahwa ekspektasi tentang perubahan harga yang akan terjadi di masa depan bersifat ekstrapolatif. Ini berarti bahwa perubahan harga diduga akan mencerminkan pola yang telah terobservasi di masa lalu. Efek ini dibentuk oleh perbedaan ekspektasi konsumen tentang harga di masa depan. Untuk babi ni, saya mengumpulkan data melalui sebelas studi eksperimental yang juga mengunakan 'incentive-compatible paradigm', dan secara keseluruhan data tersebut mendukung prediksi utama saya. Sejumlah moderator yang berbeda (yaitu, monotonisitas atau konsistensi arah perubahan harga, waktu perubahan, harga referensi, karakteristik penyebab yang mendasari perubahan harga, sifat dari

aktivitas pembelian) juga dipelajari dan diselidiki. Hasil-hasil tersebut tentunya memperdalam pemahaman kami tentang faktor-faktor yang berpotensi memiliki dampak pada efek utama di dalam riset ini

Bab kedua berfokus pada informasi numerik yang bersifat dinamis. Bab ini berpusat pada manifestasi stimulus numerik yang dihasilkan dari perubahan dan pembaruan yang terus menerus dari waktu ke waktu. Sifat dinamis dari angka-angka tersebut juga berpotensi mempengaruhi persepsi konsumen tentang 'present value', yaitu jumlah yang tertampilkan pada saat penilaian. Faktor seperti frekuensi pembaruan juga dapat mempunyai pengaruh penting. Riset di dalam bab ini dipusatkan pada perbandingan antara frekuensi pembaruan yang lebih tinggi versus yang lebih rendah. Data dari enam studi eksperimental mengungkapkan bahwa konsumen cenderung melihat nilai numerik yang identik menjadi lebih besar, ketika berasal dari sumber yang lebih sering diperbarui, dibandingkan yang lebih jarang dipebarui. Kuatnya efek ini juga didokumentasikan, misalnya dalam desain eksperimental within-subjects, atau dibandingkan dengan representasi statis dari 'present value' yang sama. Saya mendokumentasikan bahwa efek ini dapat dijelaskan oleh fakta bahwa konsumen cenderung salah mengaitkan frekuensi yang lebih tinggi untuk kuantitas yang lebih besar. Efek ini cenderung melemah ketika fokus para konsumen dialihkan ke besarnya setiap perubahan, daripada saat fokus terarahkan kepada frekuensi perubahan.

Bab ketiga berfokus pada informasi numerik yang dapat disematkan dalam instruksi untuk sebuah aktivitas, khususnya apakah instruksi tersebut dikomunikasikan dalam cara yang lebih berfokus pada output yang diharapkan versus input yang diharapkan. Bayangkan seorang konsumen dengan tujuan meningkatkan aktivitas fisik (misalnya jalan kaki). Kita memiliki dua cara untuk menginstruksikan bagaimana mereka harus melakukan hal ini. Pertama, mereka dapat diinstruksikan untuk jalan sebanyak mungkin dan menyelesaikan sebanyak mungkin langkah yang dia bisa selama periode waktu yang tetap (misalnya, 24 jam). Kedua, mereka bisa diperintahkan untuk melakukan 10.000 langkah secepat yang dia bisa. Terkait dengan hal ini, di lingkungan tempat kerja, struktur jam kerja juga cenderung menetapkan jam kerja tetap bagi para karyawan (misalnya, 9-to-5). Atau, sebagai alternatif, para karyawan juga bisa diinstruksikan untuk menyelesaikan sejumlah tugas tertentu (misalnya, menulis dua laporan) dalam waktu sesingkat mungkin. Tentunya, ada berbagai cara untuk menyusun tugas atau aktivitas dan spesifikasinya, yang pada akhirnya dapat memengaruhi motivasi orang ketika menyelesaikan tugas. Dalam bab ini, saya memeriksa bagaimana dua mode yang dapat

digunakan untuk menyusun struktur dan akan menyebabkan perbedaan motivasi. Keduanya berbeda dalam variabilitas dan spesifisitas dari output yang diharapkan (yaitu, kuantitas) dan input yang diharapkan (yaitu, durasi). Dalam mode pertama, output yang diharapkan dari aktivitas tersebut cenderung sudah 'fixed' dan ditentukan (yaitu, "10.000 langkah"), tetapi waktu penyelesaiannya bervariasi dan tidak ditentukan (yaitu, "secepat mungkin") Sebaliknya, dalam opsi kedua, target output tidak ditentukan dalam hal kuantitas (yaitu, "sebanyak mungkin"), tetapi waktu penyelesaian yang diharapkan cenderung ditentukan (yaitu, "24 jam"). Data dari eksperimen menunjukkan kesimpulan bahwa menetapkan output yang diharapkan dalam menghasilkan motivasi yang lebih besar dalam tugas, dibandingkan dengan menggunakan instruksi yang berbasis input. Efek ini ditemukan dapat direplikasi saat aktivitas utama dikalibrasikan secara berbeda, dan dampak dari memberikan informasi yang relevan dan terkait dengan aktivitas tersebut kepada para partisipan selama penyelesaian aktivitas tersebut juga dieksplorasi.

Disertasi ini bertujuan untuk membangun riset dan penelitian yang sudah ada tentang perilaku konsumen serta penilaian dan pengambilan keputusan dengan menyajikan pandangan baru tentang penilaian dan pilihan konsumen dalam lingkungan keputusan yang terus berubah, di mana informasi numerik menjadi semakin banyak di mana-mana dan bervariasi dalam hal penyampaiannya.

Summary (Ελληνικά)

Η παρούσα διατριβή επικεντρώνεται στη σχέση που έχουν οι καταναλωτές με τις διάφορες μορφές και εκδηλώσεις των αριθμητικών πληροφοριών. Οι αριθμοί μπορούν να θεωρηθούν ως μια παγκόσμια γλώσσα και χρησιμοποιούνται για την ποσοτικοποίηση πλήθους χαρακτηριστικών μέσα στο καταναλωτικό περιβάλλον. Είναι σημαντικό ότι οι αριθμοί χρησιμεύουν συχνά ως σημαντικές ενδείξεις για την πληθώρα των αποφάσεων που λαμβάνουν οι καταναλωτές σε διάφορες πτυχές της ζωής τους. Η παρούσα διατριβή έχει ως στόχο να δείξει ότι οι σχέσεις των καταναλωτών με τους αριθμούς είναι στην πραγματικότητα πολύπλοκες και διαφοροποιημένες—δεν μπορούν να εξεταστούν αποκλειστικά από μια κανονιστική, μαθηματική οπτική γωνία. Δηλαδή, ενώ οι αριθμοί κατέχουν εγγενώς αντικειμενική αξία και σημασία, συχνά μπορεί να επικρατούν ομολογουμένως υποκειμενικές αντιλήψεις. Συνεπώς, η ερμηνεία των αριθμητικών πληροφοριών είναι επίσης σε μεγάλο βαθμό εύπλαστη, δεδομένου ότι μια ποικιλία διαφορετικών παραγόντων μπορεί να στρεβλώσει τον τρόπο με τον οποίο τα αριθμητικά στοιχεία μπορούν να γίνουν αντιληπτά. Ίσως το σημαντικότερο, ο τρόπος με τον οποίο οι καταναλωτές επεξεργάζονται, αντιλαμβάνονται και εξάγουν συμπεράσματα από τους αριθμούς—είτε αντικειμενικά είτε υποκειμενικά—θα είχε επιπτώσεις στις αποφάσεις, τις ενέργειες και τη συμπεριφορά των καταναλωτών.

Το πρώτο κεφάλαιο επικεντρώνεται στις αριθμητικές πληροφορίες με τη μορφή ιστορικών τιμών. Προτείνω ένα ενοποιητικό θεωρητικό πλαίσιο που επικεντρώνεται στην αλληλεπίδραση μεταξύ δύο πτυχών που σχετίζονται με τις ιστορικές τιμές, δηλαδή τη συχνότητα και την κατεύθυνση των παρατηρούμενων μεταβολών των τιμών. Ελέγχοντας το συνολικό μέγεθος των μεταβολών των τιμών, κατά την παρατήρηση πληροφοριών για τις ιστορικές τιμές, η απόφαση των καταναλωτών να προβούν ή να αναβάλουν την αγορά εξαρτάται καθοριστικά από αυτή την προβλεπόμενη αλληλεπίδραση. Συγκεκριμένα, υποτίθεται και τεκμηριώνεται ότι αυτή η επίδραση είναι πιο έντονη όταν οι καταναλωτές παρουσιάζονται με μία μόνο μεγάλη αλλαγή στην τιμή, σε αντίθεση με τις πολλαπλές, μικρότερες αλλαγές που θα προκαλούσαν την αντίληψη μιας τάσης. Επιπλέον, διερευνώ τον καθοριστικό ρόλο των προσδοκιών στην επίδραση της συχνότητας και της κατεύθυνσης στην αναβολή της αγοράς. Οι προσδοκίες σχετικά με τις μελλοντικές μεταβολές των τιμών διαπιστώνεται ότι έχουν εξωστρεφή χαρακτήρα, υπό την έννοια ότι θα πρέπει να αντικατοπτρίζουν τα πρότυπα που εμφανίστηκαν στο παρελθόν. Τα αποτελέσματα αυτά οδηγούνται από διαφορές στις προσδοκίες των καταναλωτών σχετικά με τις μελλοντικές τιμές. Συλλογικά, το σύνολο των στοιχείων που παρουσιάζονται σε αυτό το κεφάλαιο μέσω έντεκα πειραματικών μελετών επιβεβαιώνουν την εγκυρότητα αυτού του

προβλεπόμενου αποτελέσματος. Εξετάστηκε επίσης ένα πλήθος διαφορετικών ρυθμιστικών παραγόντων (π.χ. η μονοτονία της κατεύθυνσης των αλλαγών των τιμών, ο χρόνος της αλλαγής, η παρουσία τιμής αναφοράς, τα χαρακτηριστικά της αιτίας που διέπει την αλλαγή της τιμής, η φύση της αγοράς), εμβαθύνοντας περαιτέρω στην κατανόησή μας για τους παράγοντες που θα μπορούσαν ενδεχομένως να επηρεάσουν το μέγεθος του αποτελέσματος.

Το δεύτερο κεφάλαιο επικεντρώνεται στις αριθμητικές αξίες που έχουν δυναμικό χαρακτήρα. Συγκεκριμένα, επικεντρώνεται σε μια εκδήλωση αριθμητικών δεδομένων που προκύπτουν από συνεχείς αλλαγές και ενημερώσεις με την πάροδο του χρόνου. Το γεγονός ότι ένα τέτοιο δυναμικό αριθμητικό δεδομένο υλοποιείται ως αποτέλεσμα ενημερώσεων σχετικά με την αξία του με την πάροδο του χρόνου σημαίνει ότι είναι πιθανό ότι οι διάφοροι αριθμοί που προηγούνται, καθώς και ο τρόπος με τον οποίο παρουσιάζονται οι αριθμοί αυτοί -για παράδειγμα η συχνότητα των ενημερώσεων- θα μπορούσαν επίσης δυνητικά να επηρεάσουν τον τρόπο με τον οποίο γίνεται αντιληπτή η παρούσα αξία (δηλαδή η αξία κατά τη στιγμή της κρίσης από τους καταναλωτές). Η έρευνα σε αυτό το κεφάλαιο βασίζεται στη σύγκριση μεταξύ υψηλότερης και χαμηλότερης συχνότητας ενημερώσεων. Μια σειρά από έξι πειραματικές μελέτες αποκαλύπτουν ότι οι καταναλωτές τείνουν να αντιλαμβάνονται μια πανομοιότυπη αριθμητική αξία ως μεγαλύτερη σε μέγεθος, όταν αυτή προέρχεται από μια συχνότερα ενημερωμένη πηγή, έναντι της λιγότερο συχνής. Η ανθεκτικότητα αυτού του αποτελέσματος τεκμηριώνεται επίσης, για παράδειγμα σε πειραματικό σχεδιασμό εντός του υποκειμένου ή σε σύγκριση με στατικές αναπαραστάσεις της ίδιας παρούσας αξίας. Είναι σημαντικό ότι διαπιστώνεται ότι αυτό μπορεί να εξηγηθεί από το γεγονός ότι οι καταναλωτές τείνουν να αποδίδουν λανθασμένα την υψηλότερη συχνότητα σε μεγαλύτερη ποσότητα. Το αποτέλεσμα αμβλύνεται όταν η προσοχή στρέφεται στο μέγεθος του βήματος κάθε αλλαγής, σε αντίθεση με τη συχνότητα των αλλαγών.

Το τρίτο κεφάλαιο επικεντρώνεται στις αριθμητικές πληροφορίες που μπορούν να ενσωματωθούν στις οδηγίες εργασίας, και συγκεκριμένα στο κατά πόσον αυτές διαμορφώνονται ως αναμενόμενο αποτέλεσμα έναντι αναμενόμενης εισφοράς. Φανταστείτε έναν καταναλωτή με στόχο την αύξηση της σωματικής δραστηριότητας (π.χ. βήματα). Έχουμε δύο τρόπους να του δώσουμε οδηγίες για το πώς θα πρέπει να το κάνει αυτό. Πρώτον, θα μπορούσε να του δοθεί η εντολή να ολοκληρώσει όσα περισσότερα βήματα μπορεί σε μια καθορισμένη χρονική περίοδο (π.χ. 24 ώρες). Δεύτερον, θα μπορούσε να του ζητηθεί να εκτελέσει 10.000 βήματα όσο πιο γρήγορα μπορεί. Ανάλογα

με αυτό το παράδειγμα, στο εργασιακό περιβάλλον, η τυπική δομή του ωραρίου εργασίας ορίζει σταθερές ώρες εργασίας για τους εργαζόμενους (π.χ. 9-5). Εναλλακτικά, θα μπορούσε επίσης να ζητηθεί από τους εργαζόμενους να ολοκληρώσουν έναν ορισμένο αριθμό εργασιών (π.χ. να γράψουν δύο εκθέσεις) στον συντομότερο δυνατό χρόνο. Ομολογουμένως, υπάρχουν διαφορετικοί τρόποι δόμησης μιας εργασίας ή δραστηριότητας και των προδιαγραφών της, οι οποίοι με τη σειρά τους θα μπορούσαν τελικά να επηρεάσουν τα κίνητρα των ανθρώπων κατά την ολοκλήρωση της εργασίας. Στην παρούσα εργασία εξετάζουμε πώς οι δύο διαφορετικοί τρόποι δόμησης και διαμόρφωσης της εργασίας που προαναφέρθηκαν θα μπορούσαν να οδηγήσουν σε διαφορές στα κίνητρα. Διαφέρουν ως προς τη μεταβλητότητα τόσο του αναμενόμενου αποτελέσματος (δηλαδή της ποσότητας) όσο και της αναμενόμενης εισφοράς (δηλαδή της διάρκειας). Στην πρώτη επιλογή, το αναμενόμενο αποτέλεσμα της εργασίας είναι σταθερή (π.χ. «10.000 βήματα»), αλλά ο χρόνος ολοκλήρωσης είναι μεταβλητός και απροσδιόριστος (π.χ. «όσο πιο γρήγορα μπορείτε»). Αντίθετα, στη δεύτερη επιλογή, το αποτέλεσμα - στόχος είναι απροσδιόριστο ως προς την ποσότητα (δηλ. "όσα περισσότερα βήματα μπορείτε"), αλλά ο αναμενόμενος χρόνος ολοκλήρωσης είναι καθορισμένος και σταθερός (δηλ. "24 ώρες"). Μια σειρά από εννέα πειράματα πραγματικής προσπάθειας με την πραγματική συμπεριφορά ως βασική μεταβλητή κριτηρίου υποδεικνύει το συμπέρασμα ότι ο καθορισμός της αναμενόμενης εκροής εντός των οδηγιών εργασίας οδηγεί σε μεγαλύτερη παρακίνηση στην εργασία, σε σύγκριση με τη χρήση διαμόρφωσης βάσει εισροών. Το αποτέλεσμα αυτό βρέθηκε ότι μπορεί να αναπαραχθεί σε διαφορετικές διαβαθμίσεις της εργασίας, ενώ διερευνήθηκε επίσης ο αντίκτυπος της παροχής στους συμμετέχοντες πληροφοριών σχετικών με την εργασία κατά τη διάρκεια της ολοκλήρωσης της εργασίας.

Η παρούσα διατριβή έχει ως στόχο να αξιοποιήσει την υπάρχουσα έρευνα σχετικά με τη συμπεριφορά των καταναλωτών, καθώς και την κρίση και τη λήψη αποφάσεων, παρουσιάζοντας μια νέα προοπτική σχετικά με τις κρίσεις και τις επιλογές των καταναλωτών σε ένα διαρκώς μεταβαλλόμενο περιβάλλον λήψης αποφάσεων, όπου οι αριθμητικές πληροφορίες γίνονται όλο και πιο πανταχού παρούσες και ποικίλουν ως προς τον τρόπο παρουσίασής τους.

About the Author

Manissa Gunadi was born in Jakarta, Indonesia on August 14th, 1991. Manissa obtained her BSc degree in Economics from Erasmus School of Economics, Erasmus University (2012) and MSc degree in Marketing Management from Rotterdam School of Management, Erasmus University (2013). Prior to starting as a PhD candidate, she also completed the two-year MSc in Business Research program (with a specialization in Marketing) at Erasmus Research Institute of Management (2015). As part of her PhD trajectory, Manissa was a Visiting Graduate Researcher at Anderson School of Management, University of California, Los Angeles in the Fall of 2017. Following her doctoral studies, in 2019, Manissa worked as a Post-Doctoral Researcher in Marketing at ESADE Business School, Barcelona, Spain. She currently works as Assistant Professor at the Department of Marketing, Operations and Supply at EADA Business School, Barcelona, Spain.

In her research, Manissa primarily investigates how different forms of numerical information influence consumers' judgments, decision making, and behavior. Additionally, she is also interested in examining drivers of consumer motivation. Her work has been published in the Journal of Marketing Research and Journal of the Association of Consumer Research. She has presented her work at various international conferences (e.g., Society of Judgment and Decision Making, Association for Consumer Research, Theory and Practice in Marketing Conference, Subjective Probability, Utility and Decision Making, and European Marketing Academy). Her personal interests include cooking and food culture, traveling, reading, and long-distance running.

Portfolio

PUBLICATIONS

Gunadi, Manissa P., and Ioannis Evangelidis (2022), "The Impact of Historical Price Information on Purchase Deferral," *Journal of Marketing Research*, 59 (3), 623-40. [PDF]

Mead, Nicole L., Vanessa M. Patrick, Manissa P. Gunadi and Wilhelm Hofmann (2016), "Simple Pleasures, Small Annoyances, and Goal Progress in Daily Life," *Journal of the Association for Consumer Research*, 1(4), 527-539. [PDF]

WORKING PAPERS & RESEARCH IN PROGRESS

"How Categorization Shapes the Probability Weighting Function", with Dan Schley, Alina Ferecatu, and Hang-Yee Chan, in preparation for submission. [PDF]

"Processing Moving Numbers: How Update Frequency Affects Magnitude Judgments," with Christophe Lembregts, in preparation for submission.

"How Input vs. Output-Based Framing Influence Performance," with Bram Van den Bergh, in preparation for submission.

"Inferences and Judgments from Graphical Representations of Different Data Transformations," with Stephen Spiller, writing in progress (data collection completed).

"Effects of Feedback Frequency and Specificity on Motivation," with Bram Van den Bergh, 4 studies completed.

HONORS & AWARDS

Transatlantic Doctoral Consortium (TADC) Fellow, 2018
ERIM Talent Placement Award (€30,000), 2017
Erasmus Trustfonds Grant for Research Visit to UCLA (€900), 2017
ERIM Research Master Tuition Waiver (€27,000), 2013-2015

TEACHING EXPERIENCE

Instructor, *Marketing Strategy* (BBA), EADA, 2022-
Instructor and Course Coordinator, *Marketing Research* (MSc core), ESADE, 2021
Evaluation: 6.2/7.0 (2021)
Instructor, *Marketing Research for Decision Making* (BBA elective), ESADE, 2021
Evaluation: 6.0/7.0 (2021)
Teaching Assistant, *Marketing Analytics in the Digital Era* (MSc), Instructor: Ioannis Evangelidis, ESADE, 2020-2021
Instructor, *Decision Making and Marketing Research* (MSc elective), ESADE, 2020-2021
Evaluation: 6.4/7.0 (2020), 6.7/7.0 (2021)
Co-instructor, *Research Topics on Marketing* (MRes elective), ESADE, 2019-2020
Guest Lecturer, *Marketing* (Undergraduate course), Instructors: Maria Galli & Monica Casabayo, ESADE, 2020
Instructor, *Research Training and Thesis* (BSc course), RSM Erasmus, 2018-2019
Evaluation: 8.7/10.0 (2018), 8.8/10.0 (2019)
Teaching Assistant, *Marketing* (BSc core), Instructors: Vijay Hariharan & Feray Adiguzel, ESE Erasmus, 2013
Evaluation: 4.6/5.0

CONFERENCE PRESENTATIONS & CHAIRED SYMPOSIA **presented by co-author*

How Categorization Shapes the Probability Weighting Function
Association for Consumer Research, virtual conference, Oct 2021*
Marketing Science, virtual conference, Jun 2020*

Price, Purchases, and Beyond: A Multidimensional Perspective
Association for Consumer Research, virtual conference, Oct 2020 (session chair)

Impact of Historical Price Information on Purchase Deferral
Mediterranean Consumer Behavior Symposium, Madrid, Spain, Dec 2019
Society for Judgment and Decision Making, Montreal, Canada, Nov 2019 (poster)

Processing Moving Numbers: How Update Frequency Influences Magnitude Judgments
Society for Judgment and Decision Making, New Orleans, LA, Nov 2018
European Marketing Academy, Glasgow, UK, May 2018
Transatlantic Doctoral Consortium, London, UK, May 2018
Association for Consumer Research, San Diego, CA, Oct 2017

Subjective Probability, Utility and Decision Making Conference, Haifa, Israel, Aug 2017 (poster)

Effects of Input and Output-Based Framing on Motivation
European Marketing Academy Doctoral Colloquium, Glasgow, UK, May 2018
Theory and Practice in Marketing Conference, Los Angeles, CA, May 2018
Association for Consumer Research, San Diego, CA, Oct 2017 (poster)
Subjective Probability, Utility and Decision Making Conference, Haifa, Israel, Aug 2017

Effects of Feedback Frequency and Specificity on Motivation
Society for Judgment and Decision Making, Boston, MA, Nov 2016 (poster)

Simple Pleasures, Small Annoyances, and Goal Progress in Daily Life
European Marketing Academy, Oslo, Norway, May 2016

INVITED TALKS

EADA, Barcelona, Spain (Apr 2022)
ESADE, Barcelona, Spain (May 2019)

SERVICE

Professional
Ad-hoc Reviewer, Association for Consumer Research European Conference, 2018
Ad-hoc Reviewer, Association for Consumer Research Conference, 2016-2019
Trainee Reviewer, Journal of Consumer Research, 2016-2019
Student Volunteer, Association for Consumer Research Conference, 2016

University
Lab Subject Pool Manager, RSM Erasmus, 2017-2018
Member, ERIM Research Master Program Committee, 2014-2015
Co-Chair, ERIM Research Master Council, 2013-2015

EMPLOYMENT HISTORY

Research Assistant, RSM Erasmus (Department of Marketing), 2013-2015
Management Assistant, Erasmus Virtual Knowledge Studio, 2012-2013

RELEVANT GRADUATE COURSEWORK

Consumer Behavior and Marketing
Consumer Behavior, Monika Lisjak (Erasmus)
Behavioral Decision Theory, Peter Wakker (Erasmus)
Current Topics in Marketing Research, Marketing Faculty (Erasmus)
Advances in Consumer Neuroscience, Ale Smidts and Maarten Boksem (Erasmus)
Nudging Consumer Choice, Nicole Mead (Erasmus)
Marketing Analytics, Jason Roos (Erasmus)
Consumer Marketing Research, Carlos Lourenco (Erasmus)
Marketing Strategy, Gerrit van Bruggen and Stefano Puntoni (Erasmus)

Statistics and Methodology
Advanced Research Techniques 1 & 2, Joachim Vosgerau (Tilburg)
Methods Stumblers: Pragmatic Solutions to Everyday Challenges in Behavioral Research, Uri Simohnson (ESADE)
Statistical Methods, Patrick Groenen and Alex Koning (Erasmus)
Experimental Methods, Maarten Wubben (Erasmus)
Research Methodology and Measurement, Tony Hak and Robert Rooderkerk (Erasmus)
Statistical Modeling for Emerging Datasets, Eric Bradlow (Wharton)
Mediation, Moderation, and Conditional Processing, Ioannis Evangelidis (Erasmus)
Crowdsourcing Data Collection, Gabriele Paolacci (Erasmus)
Multilevel Analysis, Jeremy Dawson (Sheffield)
Topics in the Philosophy of Science, Conrad Heilmann (Erasmus)
Data Visualization, Web Scraping, and Text Analysis in R, Jason Roos (Erasmus)

Psychology
The Psychology of Emotional, Behavioral, and Motivational Self-Regulation, Richard McNally (Harvard)
Why People Change: The Psychology of Influence, Richard Wolman (Harvard)

Workshops and Tutorials
Evidential Value of Statistics, Leif Nelson (Berkeley)
Eye-Tracking for Visual Marketing, Michel Wedel (Maryland)
Consumer Neuroscience: Progress and Promise, Vinod Venkatraman (Temple)

The ERIM PhD Series

The ERIM PhD Series contains PhD dissertations in the field of Research in Management defended at Erasmus University Rotterdam and supervised by senior researchers affiliated to the Erasmus Research Institute of Management (ERIM). Dissertations in the ERIM PhD Series are available in full text through: https://pure.eur.nl. ERIM is the joint research institute of the Rotterdam School of Management (RSM) and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam (EUR).

Dissertations in the last four years

Abdelwahed, A., *Optimizing Sustainable Transit Bus Networks in Smart Cities*, Supervisors: Prof. W. Ketter, Dr P. van den Berg & Dr T. Brandt, EPS-2022-549-LIS

Ahmadi, S., *A motivational perspective to decision-making and behavior in organizations*, Supervisors: Prof. J.J.P. Jansen & Dr T.J.M. Mom, EPS-2019-477-S&E

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