

EFFECTS OF PAST BEHAVIOR

Neha Upadhya

Submitted in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

Approved by:
Dr. James Hendler, Chair
Dr. Wayne D. Gray
Dr. Chris R. Sims



Department of Cognitive Science
Rensselaer Polytechnic Institute
Troy, New York

[December 2021]
Submitted November 2021

TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF FIGURES	iv
ACKNOWLEDGEMENT	v
ABSTRACT.....	vi
1. CHAPTER ONE	1
1.1 Introduction	1
1.2 Decision-Making, Behavior Change, and Past Behavior	2
1.3 What’s Missing?	7
2. CHAPTER TWO	8
2.1 Introduction to COVID-19 Study	8
2.2 Methodology.....	10
2.3 Results	12
2.3.1 Barriers to Past Behavior	12
2.3.1.1 Regular Monitoring	12
2.3.1.2 Medication Adherence.....	13
2.3.1.3 Nutrition.....	14
2.3.1.4 Physical Activity.....	15
2.3.1.5 Overall Impact	17
2.3.2 New Behavior	19
2.3.2.1 Regular Monitoring	19
2.3.2.2 Nutrition.....	19
2.3.2.3 Physical Activity.....	20
2.4 Conclusion of COVID-19 Study	21
3. CHAPTER THREE	24
3.1 Lessons Learned from COVID-19 Study	24
3.2 Proposed Framework.....	25
3.3 Conclusion.....	26
REFERENCES	29

LIST OF TABLES

Table 2.3: Pre-pandemic behaviors, source for change of behavior, and new behavior..... 18

LIST OF FIGURES

Figure 1.2: Key themes in decision-making and behavior change	3
---	---

ACKNOWLEDGEMENT

I would like to thank my advisor, Dr. James Hendler, and my committee members, Dr. Wayne Gray and Dr. Chris Sims, for their support and feedback on my thesis.

I would like to thank Dr. Ching-Hua Chen for her support and feedback during all stages of this research study.

I would like to thank Amar Das, Morgan Foreman, Daniel Gruen, Jon Harris, Marco Monti, and the IBM-RPI HEALS Lab for their collaboration and support in arranging and conducting the interviews, analyzing the data, and interpreting the results.

ABSTRACT

How does past behavior affect future choices? Several different answers exist in the decision-making and behavior change domains, but the focus of previous literature is on merely stating that past behavior can influence intentions, and that people may default to past behavior in the absence of a strong intention. It fails to explain the mechanism of the effects of past behavior, or how it can bridge decision-making and behavior change.

One possible way to look at the effects of past behavior is to consider situations where past behavior is not repeated, and understand why and how novel behaviors were adopted. We conducted one such quasi-experiment amidst the COVID-19 pandemic. The COVID-19 pandemic had a significant impact on self-management behaviors used to manage chronic conditions such as diabetes, and diabetics were forced to adapt their behaviors in order to keep up with their self-management during a changing and uncertain environment.

We conducted semi-structured interviews on diabetes self-management and COVID-19 was raised in the context of challenges to self-management as part of the wider interview. There were 21 participants with Type 2 diabetes that stated they played a major role in making their food choices. We used content analysis to identify behavior changes resulting from the COVID-19 pandemic. We saw that several different areas of diabetes self-management showed a behavior change as a result of the COVID-19 pandemic, and several participants showed adaptations to their self-management routines when there were challenges to past behaviors.

Aside from the COVID-19 pandemic, the circumstances in which participants choose new behaviors over past behaviors can be explored in an experimental set-up designed to test different factors that could be used to influence the choice of what behavior to implement.

1. CHAPTER ONE

1.1 Introduction

In a perfect, logical world, humans would make decisions based on risk and value, and choose behaviors with the maximum long-term utility. Making healthy decisions and engaging in healthy behavior would be a matter of fact.

Unfortunately, we don't live in that world.

Both the decision making and behavior change domains have theories and models that explain the process of choosing a decision and executing a behavior, but in this vast field, interventions to change behavior often fall short (Davis et al, 2005). There is a disconnect between theories of decision-making and models of behavior change, and in that gap, there exists an interesting and often overlooked factor—the effect of past behavior.

In this paper, I will begin by giving a brief overview of the key themes in the decision-making and behavior change domains and emphasize the theories and models that mention past behavior. Next, I will discuss a qualitative interview study that showed how participants adapted behaviors when performing past behaviors was no longer possible. Finally, I will end by proposing a new framework to understand the mechanism by which past behavior affects future action.

1.2 Decision-Making, Behavior Change, and Past Behavior

Among the several, varied models of how people make decisions and engage in healthy behavior, certain key themes stand out with a separate set of concepts in the decision-making and the behavior change domains.

Decision-making leans heavily into the economics domain, with ‘rational’ decision-making (Edwards, 1954) dependent on the expected value of the outcome, with further definitions including the concept of gains and losses under risk (Kahneman & Tversky, 1979); and heuristic decision-making utilizing simple strategies to make decisions, usually by ignoring some portion of the available information (Gigerenzer & Gaissmaier, 2011).

However, the types of choices these participants are making are often ones that require no follow-through. These models of decision-making measure a person’s choice of *intention* but are not extrapolated to their actual behavior.

In contrast, models of behavior and behavior change focus on behavioral outcomes, of the actual course of action a participant takes—usually in relation to the health domain—and focus on intentions, attitudes, the subjective norms of society, and agency (Montano & Kasprzyk, 2015), with minor features of environmental constraints, salience, ability, and experience. A simplified model (Michie, M van Stralen, & West, 2011) broke it down into capability, opportunity, and motivation.

But these factors don't make any mention of the decision-making process that goes into choosing an intention, and how risks and heuristics play into behavior.

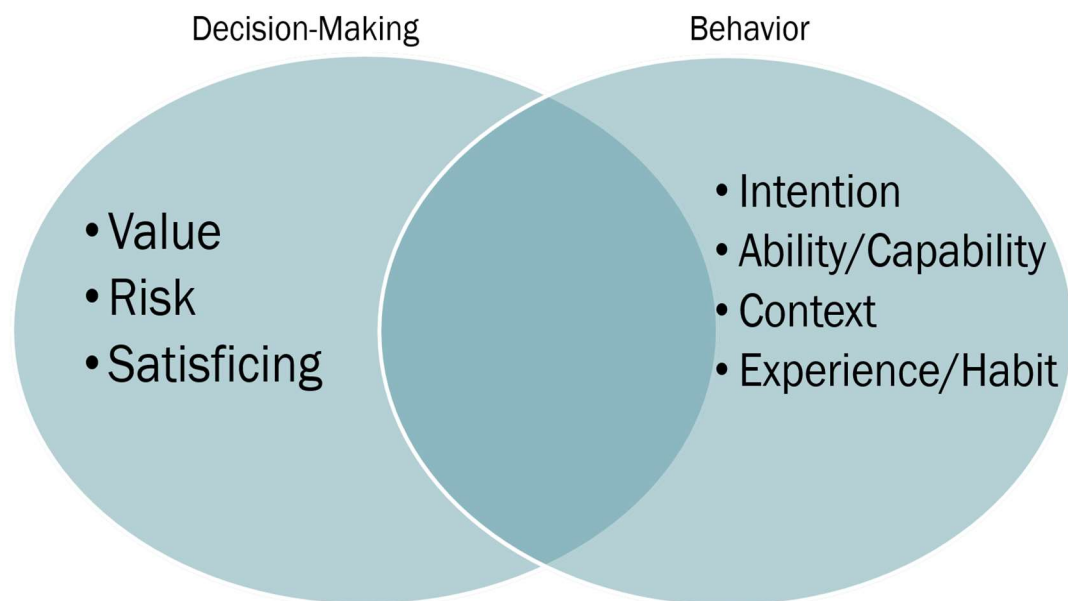


Figure 1.2: Key themes in decision-making and behavior change.

Terminology:

- Value—the 'expected' value, subjective value, or otherwise calculated from experience with the outcome associated with each choice (Edwards, 1954).
- Risk—the probabilities of occurrence and nonoccurrence of any given outcome of the choice (Kahneman & Tversky, 1979).
- Satisficing—the human tendency to pause the decision-making process once a 'good enough' option is found (Simon, 1955).
- Intention—a person's goal or motivation to perform the behavior (Ajzen, 1991).
- Ability—the capability to perform the behavior (Ajzen, 1991).
- Context—the opportunity to perform the behavior (Ajzen, 1991).
- Experience—the collection of a person's past behavior and habits (Ajzen, 1991).

I will be focusing on the last point—experience. In regard to health behaviors like diet and exercise, everyone has a great deal of past behavior and past habits to leverage, and their choices are not made in a vacuum. Any intervention or model designed to understand how people make decisions about their behavior must incorporate the wealth of past decisions and past behavior and how they affect a future decision.

The intersection of decision-making and behavior change provides the closest look at where experience and past behavior play a role in future decision-making and behavior change.

One of the theories of decision-making that involves past experience is dynamic decision making (Edwards, 1962). In this theory, instead of assuming that the state of the world ends once the choice is made, the value of the past decisions (outcomes and information) is considered in future choices. Choices can be made to further the amount of information, or to maximize outcomes.

In a step further, Gonzalez, Lerch, & Lebiere (2003) showed that experienced decision-makers show less fit to heuristics, and instead use accumulated prior knowledge to make decisions. In their theory of instance-based learning (IBLT), they state that people learn by accumulation, recognizing, and refining instances of past decisions or instances. These instances contain the context of the decision, the choice made, and the outcome of the choice. But how do these effects play out?

One research area that aims to explain this is the effect of prior outcomes on risky choice, and here there are conflicting views. Thaler and Johnson (1990) showed the house money and the break-even effects as opposing consequences to an initial gain or an initial loss. In the house money effect, an initial gain leads to more risk-seeking behavior, and in the break-even effect, an initial loss leads to more risk-averse behavior—unless an option is offered that allows participants to ‘break even’ and cancel out their losses, in which case they tend to choose the ‘break even’ option.

However, Staw (1981) looked at commitment to a course of action and found the opposite result. When a series of decisions were associated with a course of action, he saw that participants continued their course of action even when it produced negative outcomes. He saw that participants showed a tendency to justify their previous decisions, and to cling to the norms of consistency, or the idea that they shouldn’t change their minds. Retrospective rationality was playing a role in decision-making—people didn’t want their future decisions to conflict with their previous ones.

Habits can fall under commitment to a course of action, and habit formation usually falls under the behavior domain. “Past behavior is the best predictor of future behavior,” (Ajzen, 2002) is an old adage in the behavior domain, though the mechanism of the effects remains to be seen.

One possible mechanism is habits. Habitual systems are formed on the basis of behavioral repetition, context cues, and rewards, and they explain stable and repetitive behavior (Wood & Neal, 2007).

The three principles of habits are (Wood and Neal, 2007):

- 1) Habits are encoded as context-responses and are triggered by cues in the environment.
- 2) Habits are originally formed in service of a goal but soon become repetitive behaviors that are not goal-directed.
- 3) Habits are context-response pairs that are learned slowly.

Described thusly, a ‘habit’ actually describes a much smaller subset of behaviors than it commonly labels, because many behaviors do not occur in a stable context, or occur after thought and deliberation. This is what has led some researchers (Ajzen, 2002) to reject the explanation of habitual systems for the effects of past behavior, and they instead turn to semi-automatic response patterns.

In semi-automatic response patterns, certain actions may be automatic, but they exist amid controlled phases of making decisions. In this vein of deliberate reasoned action (intentions inform behavior), Ajzen (2002) proposed several alternate explanations for the residual impact of past behavior, one of them being behaving in accordance with one’s intentions. When a person doesn’t put their intention into practice, they can fall back on behaviors they’ve performed before.

Sniehotta, Scholz, & Schwarzer (2005) refer to this as the intention-behavior gap. Here, intentions are choices to act in a certain way, and inclined abstainers refer to people who’ve formed an *intention* to act, but fail to do so. This gap between intention and behavior is explained by a model with two different phases of behavior. In the motivational phase, people make a choice or

intention to perform a behavior, but the volitional phase is where they plan, initiate, and maintain this intended behavior. Constructs that can bridge the gap between these two phases are planning, self-efficacy, and action control.

1.3 What's Missing?

The literature has shown that there is a variety of ways in which past behavior is shown to play an impact on future behavior. What isn't shown, however, is *how* we can use past behavior to influence future behavior.

The closest we can get is the field of habits, but habitual behaviors are cued to stable contexts, and many behaviors occur outside these stable contexts. Experience still plays a role in these choices and actions, and yet there exists no mechanism to understand just what their impact is.

While we are considering what influences people to choose behaviors that they have performed previously, we can look at a different perspective. What influences people to *not* choose to repeat past behaviors? What factors push people towards making new decisions and engaging in new behaviors?

And what role would a drastic change in environment play?

2. CHAPTER TWO

2.1 Introduction to COVID-19 Study

When it comes to behavior change in the health domain, self-management of chronic conditions is an important area to cover. An example of a chronic condition is Type 2 diabetes, a disease in which the body cannot properly utilize insulin, a hormone used to regulate blood glucose levels (U.S. National Library of Medicine, 2021). In the United States alone, approximately 34.2 million people have diabetes (Centers for Disease Control and Prevention, 2020).

Self-management is concerned with everyday behaviors that must be performed on a routine basis. It is critical to ensure that people stick to following their self-management behaviors, as failure can lead to serious implications for long-term health.

Specifically in regards to diabetes, the ADCES7 Self-Care Behaviors (Association of Diabetes Care & Education Specialists, 2021) focus on seven self-management behaviors:

- Regular monitoring—self-monitoring of blood glucose as well as routine clinician visits to get A1C tests and address the smooth functioning of treatment.
- Medication adherence—complying with a prescribed medication regime.
- Nutrition—ensuring that a proper diet is followed to minimize fluctuations in blood glucose levels.
- Physical activity—regular exercise to lose weight and stay active.
- Problem solving skills—developing skills to manage any issues that may come up during treatment.

- Reducing risks—avoiding complications as a result of having diabetes.
- Healthy coping skills—developing skills to manage living with a chronic condition.

All of these behaviors are an important part of treatment, and self-management is crucial to living with Type 2 diabetes. Unfortunately, the COVID-19 pandemic caused a severe impact on daily routine starting in early 2020, when states imposed shutdown orders and came out with social distancing guidelines that closed gyms, restricted access to outdoor recreation, limited gatherings, required facemask use, closed non-essential workplaces, and reduced grocery store hours (New York Times, 2020). This disruption has been especially harmful to diabetes self-management.

There have been several pieces of research published on the effects of the COVID-19 pandemic on diabetes. Specifically, the current research focuses on diabetes as an at-risk category for COVID-19, the possible causes for the complications of COVID-19 in diabetics (Bornstein et al, 2020), and a collection of tentative clinical therapies for treating COVID-19 in people who have diabetes (Gupta, Hussain, & Misra, 2020).

In regard to self-management of chronic conditions, Wright et al (2020) show that the pandemic has had an impact on how frequently screening and prevention services are conducted, and rightfully point out the long-term consequences of failing to detect chronic conditions in their early stages. Banerjee, Chakraborty & Pal (2020) focus on the effect of the pandemic on self-management education in India, and how guidelines need to be adjusted to take into account factors relevant to the Indian population. Mukona & Zvinvashe (2020) show a similar outlook on the

effect of the pandemic on self-management of diabetes in Zimbabwe, and the challenges that come with diabetes self-management during a pandemic in a country with limited resources.

We conducted an interview study in May and June 2020 to understand how people with Type 2 diabetes make decisions in regard to their self-management, with an emphasis on their nutrition and their physical activity (Upadhy et al, 2021). The COVID-19 pandemic was discussed in the context of challenges to self-management. Our results were grouped into the specific barriers to past behavior that were raised by the COVID-19 pandemic, and the new behaviors that resulted from this change.

2.2 Methodology

We had 21 participants (age range: 28-81 years old, average: 52.67 years, s.d.: 18.05 years; 12 female) in the interview study. All participants were screened for the following inclusion criteria: U.S. resident, diagnosed with Type 2 diabetes within the past 5 years, fluent in English, and regularly engaged in making their own meal choices.

Participants were recruited through Schlesinger Group, which handled the pre-survey and screening questions. Participants who passed the screening stage completed informed-consent forms and were sent instructions about the interview through email. The interview was semi-structured, lasted 90 minutes long, and was conducted virtually through the Cisco Webex videoconferencing application with screen-share and no video. Audio recordings of the interviews were transcribed through a third-party service provided by Schlesinger. The study protocol was approved by the Institutional Review Board at Rensselaer Polytechnic Institute.

The interview focused on the participant’s experience with diabetes self-management, the support and tools they used to help keep on track, the factors influencing their dietary choices, their experiences with food recommendations, and their opinions towards the use of technology and AI in diabetes self-management.

The COVID-19 pandemic was brought up as a follow-up (“Has this changed at all since the coronavirus pandemic and social distancing started? How?”) to two questions—“What kind of doctors or clinicians have you seen this past year to help you manage your diabetes?” and “Aside from meeting with your clinicians, what do you do on a regular basis to manage your diabetes?”. Aside from these direct questions, we probed further whenever the participant brought up COVID-19 or social distancing in relation to diabetes self-management.

We performed content analysis on the interview transcripts in two phases. In the first phase, we extracted all content from the transcripts that captured any change in personal circumstances, perception, or behavior due to the pandemic or social distancing guidelines. In the second phase, we identified the target behavior in each extract, and also noted the direction of change of behavior and any explicitly mentioned descriptors of perception. In every phase, two members of the research team were assigned to the same content, and any discrepancies in coding were resolved in a discussion with the wider research team.

2.3 Results

2.3.1 Barriers to Past Behavior

Identification of target behavior across extracted content was a match in 77.044% of cases. All cases of mismatch were resolved in a discussion with the wider research team.

All participants reported that the COVID-19 pandemic had impacted their diabetes self-management in at least one domain. The variety of impacts came in the form of challenges to routine self-management, changed perceptions in regard to self-management behaviors, and behavioral changes due to the pandemic.

The following sections highlight the specific barriers the pandemic created to previous diabetes self-management behaviors.

2.3.1.1 Regular Monitoring

Regular monitoring entails going for routine visits to a clinician and doing blood glucose monitoring to keep track of the progression and status of their diabetes management.

Only one participant reported that they had gone to the hospital to get regular lab work done after the COVID-19 pandemic had started—most participants had been forced to cancel appointments or switch to virtual visits.

This was a result of social distancing guidelines and practices—either directly, with many hospitals and doctors’ offices closing for all but essential visits, and indirectly, with increased caution surrounding COVID-19 leading participants to delay appointments or switch to telemedicine.

“That's really just been the biggest thing, just not really having as much access to a doctor as I would have before. Before I would be able to make an appointment and go in the next day. Now it's like I kind of—it almost feels like you're on a waiting list to talk to somebody.” [A13]

In addition, one participant reported that getting laid off had lost them the insurance needed to make appointments with a dietitian. Another participant stated that, due to the pandemic, they had “a lot more faith in the medical community before these last two months.” [A09]

In regard to self-monitoring of blood glucose, one participant reported that they were having problems getting access to blood glucose strips due to financial reasons. Another participant, who uses the blood glucose meter before all meals, reported that stay-at-home practices made the meter easier to use.

2.3.1.2 Medication Adherence

No participant reported any difficulties in accessing their medication or adhering to their medication regime.

2.3.1.3 Nutrition

A healthy diet is an important part of diabetes self-management. Participants reported impacts of the COVID-19 pandemic in three major areas related to nutrition: grocery shopping, cooking, and eating.

Several participants reported that as a result of reduced hours at the grocery store and social distancing practices to avoid crowded areas, they went grocery shopping less frequently. One participant, however, reported the opposite—that the pandemic had reduced the number of times they ate out, and due to that, they were grocery shopping more often.

“We have made a decision not to go to the store as often and I try to buy a couple weeks’ worth of food at a time.” [A05]

The changed grocery shopping experience also impacted cooking—reduced access to fresh vegetables proved a barrier to one participant’s plant-based diet. On the flip side, increased time spent at home resulted in more time to cook homemade meals.

“In March once we started having to be in the house I have been cooking with more meat. Trying not to shop all the time it’s harder to keep fresh stuff available.” [A05]

Finally, the pandemic caused a sudden disruption in scheduling due to work-from-home edicts that resulted in reduced eating out and changed eating schedules.

“I actually don’t really eat a formal lunch anymore. And I think that’s actually kind of changed with COVID. Because lunch was a huge opportunity at work to not only get things done, like meetings, lunch and learns, getting deals done over lunch.” [A27]

But the increased time spent at home, as well as emotions caused by the pandemic, also resulted in an increase in eating of dessert, junk food, and snacks.

“Especially during this pandemic you end up eating like an animal. Out of boredom, out of a lot of stupid reasons.” [A09]

In addition, social distancing guidelines also caused a shift away from social gatherings and social interactions in workplaces. This impacted healthy eating by either reducing the number of social events that might’ve caused temptation to stray from nutritional guidelines, or by reducing socialization with other diabetics that provided a support system to help manage their diabetes.

“I have a pretty large family so there’s always something going on, there’s always an event, always someone’s birthday or holiday, so sometimes it’s hard not to give in to the temptation. But I guess I’m kind of lucky that we’re on quarantine because there’s been no events.” [A13]

2.3.1.4 Physical Activity

Regular physical activity to maintain a healthy lifestyle and help regulate blood sugar is an essential part of diabetes self-management. Participants reported that the COVID-19 pandemic

impacted their regular physical activity in three different areas: going to the gym, having an active workplace, and physical activity outdoors.

Several participants were impacted by gym closures, or wariness of public spaces, leading to a reduction in physical activity in the gym.

“The workouts have. That’s probably the only thing that’s really changed a lot, because we used to go to the gym multiple days a week.” [A07]

“Well yes, I don’t go to the gym as much because I think it’s not clean.” [A21]

Several participants also reported a consequence of increased work-from-home as workplaces closed—working in-person lent itself to a level of physical activity in regards to moving around the workplace, activity that was lost in the transition to working from home.

“Like I say, when I’m at work, we walk the stairs. Our friend, she walks the stairs every single day and I just happen to catch her one day. And that’s how I started walking the stairs. And I try to partner up and go for walks, not sitting at the desk all day. And taking a break more often. Like I said, with this social distance, all that stopped.” [A25]

“Because COVID has had an adverse effect on how—not necessarily how active I’ve become. It’s just, it’s easier to be active at an office, because I could be just walking to the printer

to grab a sales report. Or meeting with someone in their cubicle or things like that, that just aren't there anymore.” [A27]

Finally, participants reported that their walking routines were affected by the social distancing precautions as areas like parks and malls had limited access or reduced capacity.

“Yes, for one, places that we can go and walk around and run around have changed. We basically can walk around in our community and a couple parks. But we don't really want to take that risk with the parks. Whereas before, we would go to a mall and run around with the kid.” [A19]

Some participants also reported benefits of the stay-at-home orders and work from home. They had more time to walk, they could exercise without worrying about their physical appearance, and they could complete more home projects.

“It's nice to be able to do [walking] without being rushed now that I'm home, I'm working from home.” [A15]

2.3.1.5 Overall Impact

The pandemic had multiple impacts on daily life, and more specifically on diabetes self-managements. Its effects were caused by multiple factors—social distancing guidelines, stay-at-home practices, work-from-home edicts, closures of businesses, reduced capacity at hospitals,

financial impacts and unemployment, and emotions surrounding the pandemic. All of these effects played a role in halting many behaviors vital to diabetes self-management.

But participants did not stay idle. When their previous behaviors proved difficult to continue, they adapted to new behaviors. Table 2.3 shows participants' past behaviors, the corresponding new behaviors that replaced them, and the source of this change.

Table 2.3: Pre-pandemic behaviors, source for change of behavior, and new behaviors.

Past Behavior	Source of Change	New Behavior
Clinician visit	Offices closed; social distancing guidelines	Telemedicine
Cooking with fresh vegetables	Reduced frequency of grocery shopping	Cooking with more meat; cooking with frozen items
Meal planning for a week	Reduced frequency of grocery shopping	Meal planning for 2-3 weeks
Going to gym	Gyms closed; social distancing guidelines	Workouts at home; walks; swimming
Having a protein shake; not eating breakfast	Work from home	Cooking more
Eating out	Restaurants closed; social distancing guidelines	Cooking more; grocery shopping more frequently
Grocery shopping	Social distancing guidelines	Online grocery delivery
Being active at work	Work from home	Scheduling active breaks
Lunch meetings	Work from home	Eating healthier lunches; eating out less

2.3.2 New Behavior

2.3.2.1 Regular Monitoring

When participants were unable to conduct appointments in person, many switched to telemedicine. While this was not an ideal solution, as telemedicine provides no path for the lab work necessary for monitoring of Type 2 diabetes, it did provide a general check-up and an opportunity for the participants to ask any specific questions they might've had.

2.3.2.2 Nutrition

The reduced grocery shopping frequency forced participants to adapt by buying foods that lasted longer, meal planning for longer stretches of time, and opting for grocery delivery instead of in-person shopping.

“Just trying to calculate and figure it all out so that I am not forced to run to the store. In normal times I would just be planning a week in advance.” [A05]

“Yes, most of the grocery stores around us, during the pandemic in the beginning, we were having groceries delivered.” [A19]

Eating out less and staying home more often also resulted in an increase in cooking at home, and work-from-home edicts resulted in changed eating schedules in terms of both time and quantity.

“I cook even more so now from home. I try not to eat out at all.” [A25]

“I’m not a big breakfast person. During the pandemic, I’ve actually been eating breakfast more regularly.” [A09]

2.3.2.3 Physical Activity

When participants were impacted by gym closures, several of them found other ways to stay active, by going on walks or shifting to at-home workouts.

“The pull-ups from push-ups and things along those lines, because we can’t go to the gym these days, it’s just scheduling every 15 minutes until I can’t do anymore.” [A10]

“Well yes, I don’t go to the gym as much because I think it’s not clean. I still don’t feel comfortable going to that right now. I live in a nice development where we have nice walk trails so that’s something that I can do and then I can be in my pool and still feel safe without having to wear a mask.” [A21]

Participants also adapted to loss of active workplaces by setting reminders or scheduling breaks to move around.

“Like I said, with this social distance, all that stopped. I try to put the reminder on my phone so it will beep me and I’ll get up and kind of go outside my room and interact with my sons or play with the dog a little bit, just to take a break from staring at the screens so much.” [A25]

2.4 Conclusion of COVID-19 Study

The COVID-19 pandemic has caused significant disruption to daily life all around the world. One of the impacts has been on self-management of chronic conditions such as Type 2 diabetes. Diabetics who were interviewed reported challenges, behavioral changes, and unintended benefits of behavior change across several different self-management areas, including nutrition, physical activity, and regular monitoring.

The effects of the pandemic—fear, social distancing, changes in social interaction, the workplace, and school, the uncertainty that surrounds everyday life, increased awareness of health risks—are unprecedented. The changes it has wrought across all facets of daily life would've been impossible to predict. When it comes to behavior change, however, it provides us a unique look at the impact on human behavior when there is no prior experience to fall back on.

Whether the behavior is termed as a 'habit' (Wood and Neal, 2007), or if the effects of experience are linked more generally to behavior (Montano & Kasprzyk, 2015), there is no denying that prior choices and their observed outcomes play an important role in future decisions. In the field of nutrition and physical activity, however, these effects become difficult to untangle, complicated by years of experience and a vast array of possible choices. That was not, however, the case with the pandemic.

Nutrition behaviors were impacted by shifted grocery store hours and social distancing regulations, increased time spent at home and sometimes with close family, and a rise in stress.

The confluence of these factors allows us to take a look at what participants did, in the absence of a prior framework to help them make decisions and in an uncertain environment.

The same holds true for physical activity behaviors. These were mainly impacted by social distancing regulations and limited environmental affordances to exercise, and participants adapted in a variety of ways, showcasing behavior change in order to maintain some level of physical activity.

Habits have been shown to be very effective in creating long-lasting behaviors (Wood & Neal, 2016), and effects of past behavior (Ajzen, 2002) can be observed beyond just habitual systems. In light of the observed behaviors as a result of the pandemic, however, we can see behavior change that occurs when habit cues are disrupted and past behavior is no longer an appropriate framework to build on.

This study was a qualitative look at behavior change in a quasi-experimental setup—we leveraged the context of the COVID-19 pandemic to answer our questions on health behaviors and diabetes self-management. Unfortunately, the pandemic created a disruption on multiple scales, and affected a wide variety of factors that cannot be controlled for. Aside from reported sources of change, we cannot be sure what other factors caused a shift in behavior. We also had a limited sample size focusing on a specific subset of the population—Type 2 diabetics that engaged in decisions about their meal choices. These are participants used to actively managing and maintaining healthy behaviors for the specific goal of controlling their blood glucose levels.

What we did observe was that participants made changes, on their own, in order to deal with the individual interferences in their routines. They increased their meal planning to cope with the reduced frequency of grocery shopping and adjusted cooking to account for family, resources, and time. They shifted exercise routines from the gym to at home, or substituted with walks or other activities. What remains to be seen is how these changes were made, and if they will last.

3. CHAPTER THREE

3.1 Lessons Learned from COVID-19 Study

The COVID-19 pandemic was an unforeseen and vast disruption to daily life. While we could take advantage of this situation to gather data about responding to large-scale disruptions, running a controlled experiment on this scale is impossible. We can, however, learn from what the pandemic has shown us about behavior change.

Firstly, the pandemic's impacts were varied—it caused disruptions in environment and opportunities, in people's emotions, in their planning, and several of these cascaded to cause behavior change.

Secondly, we noticed that participants did adapt; when their past behavior was no longer possible, they picked up a new behavior to fill the gap. When gyms closed, they decided to go on walks, when grocery shopping was more hazardous, they switched to delivery, when doctors' offices closed, they moved to telemedicine. A large-scale disruption effectively caused people to stop previous behaviors and begin new ones.

What does this tell us about past behavior, and when and why it would be repeated? From the interviews, we can see that when past behavior carries a certain extra cost, people recognize this cost, stop the past behavior, and explore new behaviors. This suggests that people are considering the risk and value of performing past behaviors and pivoting away from them when it passes some threshold.

But to decompose risk and value in behavior change means understanding what factors of past behavior cause a behavior to be repeated or not repeated. During the pandemic, there was a confluence of differing factors that caused behavior change. I hope to untangle them and lay out a framework of the effects of past behavior on future choices.

3.2 Proposed Framework

I intend to look at how past behavior affects future behavior by determining when and why a new behavior is chosen over a past behavior. As seen from the effects of the COVID-19 pandemic on diabetes self-management, new behaviors are chosen when there are barriers to old behaviors, in either increasing risk or decreasing value.

In order to observe this effect in a controlled environment, I propose an experimental framework designed to measure when past behavior switches to a new behavior (at what point does a participant make a choice to engage in a new behavior instead of a previous behavior) and why past behavior switches to a new behavior (what factor triggered this change).

To study this, we need to consider a few key variables—first is the task at hand, or what goal the participants are aiming for. Second is the different behaviors that can be utilized to achieve this goal. Third is the different risks and values associated with each behavior. And fourth is inducing a change in these risks and values to ascertain when and why someone switches from one behavior to another.

These variables can be observed in a game-like setting. As an example, consider a simple task that requires ‘energy’ to continue playing. Energy can be harvested from one of two methods—either a method that takes comparatively longer but leads to energy that gets depleted slower, or a method that takes comparatively shorter but leads to energy that gets depleted faster. Participants play this game for a certain number of trials, and the choice of which behavior they choose to engage in is observed.

Then, after this baseline has been established, the mechanics are changed, such that either the time taken to complete one of the two methods, or how quickly the energy gets depleted, is adjusted. The participants’ reactions are then observed—does this change cause a change in which of the two methods they choose to use? Which change caused the greatest switch to a new behavior? Which change caused no switch at all?

Time duration is merely one of the factors that can be changed to affect selection of past behaviors. In this framework, several different factors can be tested for to observe the effects they have on causing a switch to new behaviors. And we can begin to understand why and when people choose past behaviors instead of new ones.

3.3 Conclusion

That past behavior is a contributor to decision-making has long been known in the behavior change and decision-making domains, but seldom explored. Several different models that try to explain the mechanism by how past behavior influences future choices only focus on a small slice

of the problem and are limited to specific contexts. These specific contexts are of limited value to the field of health behavior change, because staying healthy is a part of everyone's daily life.

The COVID-19 pandemic created a way to look at the effects of a large-scale disruption to healthy behavior, in the terms of diabetes self-management. Diabetes self-management, and especially nutrition and physical activity, are a big part of healthy behavior, and the pandemic created a quasi-experimental set-up to observe how participants' behaviors changed as a result of the many impacts of social distancing guidelines, business closures, uncertainty, and work-from-home edicts.

What we observed was that many participants stopped regular past behaviors when the risks and values of those behaviors changed. Instead, they substituted several of the past behaviors with new behaviors in order to continue their diabetes self-management.

Creating such a large-scale disruption in a controlled environment, however, is impossible. Instead, to untangle when and why a past behavior is chosen over an alternative new behavior—or vice versa—we can design an experiment to test out various factors that would make a past behavior undesirable, and lead to a participant substituting it with a new one.

If we know what factors cause a participant to shift to a new behavior, we know what factors a participant is considering when selecting a past behavior. This will enable us to better understand the mechanism by which past behaviors influence future choices.

People do not make choices in a vacuum. In order to understand how to help them lead healthier lives, we must first understand the weight of all the choices they have made before and how that impacts future decisions.

REFERENCES

- Association of Diabetes Care & Education Specialists. (n.d.). *Tools and resources for living with diabetes*. Retrieved October 22, 2021, from <https://www.diabeteseducator.org/living-with-diabetes/Tools-and-Resources>.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and Social Psychology Review*, 6(2), 107-122.
- Banerjee, M., Chakraborty, S., & Pal, R. (2020). Diabetes self-management amid COVID-19 pandemic. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(4), 351-354.
- Bornstein, S. R., Rubino, F., Khunti, K., Mingrone, G., Hopkins, D., Birkenfeld, A. L., Boehm, B., Amiel, S., Holt, R. I. G., Skyler, J. S., DeVries, J. H., Renard, E., Eckel, R. H., Zimmet, P., Alberti, K. G., Vidal, J., Geloneze, B., Chan, J. C., Ji, L., & Ludwig, B. (2020). Practical recommendations for the management of diabetes in patients with covid-19. *The Lancet Diabetes & Endocrinology*, 8(6), 546–550.
- Centers for Disease Control and Prevention. (2020, February 11). *National diabetes statistics report, 2020*. Retrieved October 22, 2021, from <https://www.cdc.gov/diabetes/library/features/diabetes-stat-report.html>.
- Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychology Review*, 9(3), 323-344.
- Edwards, W. (1954). The theory of decision making. *Psychological Bulletin*, 51(4), 380.
- Edwards, W. (1962). Dynamic decision theory and probabilistic information processing. *Human Factors*, 4(2), 59-74.
- Gigerenzer, G. and Gaissmaier, W. (2011). Heuristic decision making. *Annual Review of Psychology*, 62(1), 451-482.
- Gonzalez, C., Lerch, J. F., & Lebiere, C. (2003). Instance-based learning in dynamic decision making. *Cognitive Science*, 27(4), 591-635.
- Gupta, R., Hussain, A., & Misra, A. (2020). Diabetes and COVID-19: Evidence, current status and unanswered research questions. *European Journal of Clinical Nutrition*, 74(6), 864-870.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 363-391.

- Michie, S., M van Stralen, M., and West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(1), 1-12
- Montano, D. E., & Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health Behavior: Theory, Research and Practice*, 70(4), 231.
- Mukona, D. M., & Zvinavashe, M. (2020). Self- management of diabetes mellitus during the COVID-19 pandemic: Recommendations for a resource limited setting. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(6), 1575–1578.
- The New York Times. (2020, April 25). *See reopening plans and mask mandates for all 50 states*. Retrieved October 22, 2021, from <https://www.nytimes.com/interactive/2020/us/states-reopen-map-coronavirus.html>.
- Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69(1), 99-118.
- Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention–behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, 20(2), 143-160.
- Staw, B. M. (1981). The escalation of commitment to a course of action. *Academy of Management Review*, 6(4), 577-587.
- Thaler, R. H., & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Science*, 36(6), 643-660.
- Upadhyia, N., Das, A., Foreman, M., Gruen, D., Harris, J., Hendler, J., Monti, M., Chen, CH. (2021). *Supporting diabetic self-management behaviors during the COVID-19 pandemic*. Manuscript submitted for publication to PLOS One.
- U.S. National Library of Medicine. (2021, October 1). *Diabetes | type 1 diabetes | type 2 diabetes*. MedlinePlus. Retrieved October 22, 2021, from <https://medlineplus.gov/diabetes.html>.
- Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review*, 114(4), 843.
- Wood, W., & Neal, D. T. (2016). Healthy through habit: Interventions for initiating & maintaining health behavior change. *Behavioral Science & Policy*, 2(1), 71-83.
- Wright, A., Salazar, A., Mirica, M., Volk, L. A., & Schiff, G. D. (2020). The invisible epidemic: neglected chronic disease management during COVID-19. *Journal of General Internal Medicine*, 35(9), 2816-2817.