Influencing choice behavior and improving well-being by applying behavior analysis and behavioral economics

Hilde Mobekk

OsloMet Avhandling 2021 nr 35

OSLO METROPOLITAN UNIVERSITY
STORBYUNIVERSITETET

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Dissertation for the Degree of Philosophiae Doctor (PhD)
PhD programme in Behavior Analysis
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Faculty of Health Sciences
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Autumn 2021

OsloMet Avhandling 2021 nr 35

ISSN 2535-471X (trykt)
ISSN 2535-5414 (online)

ISBN 978-82-8364-337-4 (trykt)
ISBN 978-82-8364-410-4 (online)

OsloMet – storbyuniversitetet
Universitetsbiblioteket
Skriftserien
St. Olavs plass 4,
0130 Oslo,
Telefon (47) 64 84 90 00

Postadresse:
Postboks 4, St. Olavs plass
0130 Oslo

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To my beloved daughters Kaja and Mina

«Everything is possible»

Mom

Acknowledgments

A long journey is about to end, and I will soon hold a Ph.D. degree. Pursuing a Ph.D. project is like riding a roller-coaster. It is ups and downs, fear and joy; regret that you joined in one minute, and the next full of fun at sharing the ride. Finally, arriving at the end, smiling at your fellow passengers, body shivering, hair blown around, and happy that you survived. But, still, wondering, "should I have another ride?" No time for that; there are other adventures to be had.

Nevertheless, it is time to give gracious thanks to all of you who took the ride with me—from the ones in the first wagon to the ones in the last—it wouldn't have been the same excitement without you. A person who has studied choice behavior and is concerned about others' well-being would be wise to stop here for fear of forgetting someone or making a mistake. But, I am only human.

I would like to extend my sincere thanks to my supervisor Professor Asle Fagerstrøm at Kristiana University College. After being my supervisor for the master's thesis, you still had the will and energy to collaborate further during my Ph.D. project. Thank you for your encouragement and contribution during my Ph.D. work. My co-supervisor, Professor Ingunn Sandaker, who granted me the fellowship in the first place. Professor Erik Arntzen, who got me hooked on behavior analysis despite all the lectures with references to pigeons and rats, and who always had time to answer my questions. Professor George Loewenstein for helping and giving a gentle nudge in the final stage and for the fantastic stay in Pittsburgh and Carnegie Mellon University.

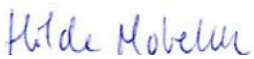
Thanks also to all my co-authors for their input, knowledge, and engagement. Particularly Huy Tran, for all your extra effort and for becoming a very good friend. My Ph.D. colleagues, with a special thanks to Kalliu Carvalho Couto, for always sharing and caring from coffee to knowledge and for being there when I needed you the most. Sigridur Sigurjonsdottir for being the best collaborating mom, and to Elise Frølich Furrebøe for encouraging me and for showing me that it is possible to pursue a Ph.D. even though you might feel "alone." Also, a big hug to Carsta Simon, Steffen Hansen, Siv Kristin Nergaard, and Hanne Augland for all the valuable discussions, encouragement, fun, and laughter.

Everyone at the institute of behavioral science that cheered me on, with a huge thanks to Tone Hee Åker for being you, Tone Johanne Arneberg for sharing and seeing me, Kari Høium for exciting conversations and Pilates, Linda Thøring Øverberg for all the fun and being my private nurse, Per Holth for all the good laughs and blue teeth, Heidi Olaff for all the craziness and outlet hunting, Torunn Lian for being there when Catania almost made me quit, Monica Vandbakk the no. 1 "kappekaffe," Elise Weiberg for reaching out and sharing when life was upside down, Britt Andersen for being my oracle of all the administrative stuff, Anne Bakke for your unfortunate event in Rome that gave me "a grand entrance" to the institute, and Unni Henriksbø who believed in and included all the other Ph.D. fellows and me.

My gracious thanks also to the best librarian Lilja Johannessen for always having the time to help me out, and Tom Muir for being a very inspiring English mentor. Andrew O'Driscoll for enjoyable proofreading. My heartfelt thanks to my family and to my very good friends Grete, Ellen, Marit, Ingrid, Lise, and Marie for believing in me and never giving up on me.

Most importantly, my wonderful daughters, Kaja and Mina, for your love and support every step along the way, which has been essential in enabling me to complete this. Not to mention, never allowing me to get lazy and help me keep in shape and achieve my goals. "Come on, mom, you can do it." One short little sentence that made me walk the extra mile, with and without skis, run another interval, ski the black slopes, try windsurfing, present at conferences, or write articles. Sometimes these words pushed me far out of my comfort zone while the two of you had a good laugh. I sometimes wonder if you have learned more about behavior analysis and optimizing choices than I have. But, if that is so, you will be just fine and reach your ambitious goals. Whatever you choose to do, I will always be there for you. Christian, my husband, for encouraging me to enter upon this journey in the first place and for helping with all the struggling with bits and pieces, and for still being my husband after this hazardous roller-coaster ride.

This dissertation is an aggregated product of all your contributions; every little helps. My endless gratitude to all of you.



Hilde Mobekk

Oslo, August 18th, 2021

Abstract

Humans possess a distinct capacity for behavioral adaption; that is why we have thrived as a species. Even though our ability to adapt is often attributed to rational choices, decades of research show that human behavior is largely explained by past and current interactions with the environment. Behavioral sciences have revealed that human behavior and choice-making are boundedly rational, systematically biased, and strongly habitual. Numerous small suboptimal choices accumulate to unfavorable long-term outcomes. Many of today's societal challenges are rooted in our behavior and controlling environmental variables. To improve society's well-being, as stated by the United Nations sustainable development goal 3, we must: "Ensure healthy lives and promote well-being for all at all ages." Since many of today's policies, warnings, and information campaigns show only modest benefits to well-being, alternative interventions are needed. This dissertation discusses some of the challenges we face regarding well-being and how knowledge produced by behavior analysis and behavioral economics may guide actions. Study 1 is a systematic review of experimental studies to increase healthier food choices. The findings reveal that the few studies on nudging healthier food choices have limited experimental control and minor effects. Study 2 is a field experiment to improve gym members' cleaning behavior using an image of *watching eyes*. The findings support previous research that implicit observation cues influence human behavior. The follow-up study revealed that the salience of the stimuli faded over time. Study 3 is a field experiment that encouraged hotel guests to choose more of the healthier fish options and less meat by altering hotel lunch buffets. The findings reveal that it is essential to consider the microenvironment when utilizing nudges. Study 4 was a field experiment to evaluate the influence of nudges on hospital visitors' use of hand sanitizer. The results showed a significant increase in hand hygiene. Study 5 describes how the Norwegian cultural practice of dugnad applies social involvement in group activities to improve community well-being. The study discusses this practice from a behavior analytic perspective and how such understanding may guide action. Study 6 is a rapid systematic review of health intervention studies done via social media focusing on validity challenges. The studies reported in this thesis are relevant for understanding choice behavior and add to the knowledge on designing behavioral interventions to improve well-being on different selection levels.

Keywords: well-being, choice behavior, rationality, interdisciplinarity, behavior analysis, behavioral economics, three levels of selection, nudging

Sammendrag

Mennesker har en egen evne til å tilpasse seg omgivelsene, og det er grunnen til at vi har overlevd som art. Til tross for vår evne til å tilpasse oss, viser flere tiår med forskning på valgatferd at vi mennesker er begrenset rasjonelle, og at valgene våre ofte er basert på vaner. Mange små suboptimale valg akkumuleres opp til ugunstige konsekvenser på sikt. Mange av dagens samfunnsutfordringer er forankret i vår atferd og dets kontrollerende miljøvariabler. Dersom vi skal forbedre well-being i samfunnet, som det fremgår av FNs mål nr. 3 for bærekraftig utvikling, må vi: "Ensure healthy lives and promote well-being for all at all ages." Siden mye av dagens politikk, advarsler, og informasjonskampanjer ikke gir ønskede resultater, trengs det alternative intervensjoner. Denne avhandlingen diskuterer noen av utfordringene vi står overfor i samfunnet og hvordan kunnskap fra atferdsanalyse og atferdsøkonomi kan bidra til økt well-being. Studie 1 er en systematisk gjennomgang av eksperimentelle studier for å øke sunnere matvalg. Funnene avslører at de få studiene som er gjort på nudging og sunnere matvalg har begrenset eksperimentell kontroll og at det er små effekter. Studie 2 er et felteksperiment hvor bilde av øyne ble brukt for å øke forekomsten av rengjøring av treningsapparater på treningsstudioer. Funnene støtter tidligere forskning som viser at implisitte observasjonstegn påvirker menneskelig atferd. Imidlertid viste oppfølgingsstudien at stimuli mistet effekt over tid. Studie 3 er et felteksperiment for å få hotellgjester til å velge mer av de sunnere fiskealternativene og mindre kjøtt ved å endre hotellenes lunsjbuffeer. Funnene viser at det er viktig å inkludere mikromiljøet når en skal bruke nudging. Studie 4 er et felteksperiment for å undersøke om nudging kan påvirke besøkende på sykehus til å bruke hånddesinfeksjon. Resultatene viste en signifikant økning i håndhygiene. Studie 5 diskuterer norsk dugnad i et atferdsanalytisk perspektiv, og viser til at en slik kulturpraksis påvirker well-being i samfunnet. Studie 6 er en systematisk gjennomgang av helseintervensjonsstudier gjort via sosiale medier med fokus på validitet. Studiene som rapporteres i denne avhandlingen er relevante for å forstå valgatferd i forhold til mange av dagens utfordringer, og de gir økt kunnskap om hvordan designe atferdsmessige intervensjoner for å forbedre well-being på ulike nivåer.

Nøkkelord: well-being, valgatferd, rasjonalitet, tverrfaglighet, atferdsanalyse, atferdsøkonomi, seleksjon på tre nivåer, nudging

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Articles included in the dissertation

Tørris, C., & Mobekk, H. (2019). Improving cardiovascular health through nudging healthier food choices: A systematic review. *Nutrients*, *11*(10), Article 2520. DOI: **https://doi.org/10.3390/nu11102520**

Mobekk, H., Hessen, D. O., Fagerstrøm, A. & Jacobsen, H. (2020). For your eyes only: A field experiment on nudging hygienic behavior. *Frontiers in Psychology*. DOI: **https://doi.org/10.3389/fpsyg.2020.603440**

Mobekk, H., Karevold, K. I., Tran, H., & Stjernen, K. (2018). Fish versus meat: Nudging the healthier choice of food in hotel lunch buffets. *Norsk Tidsskrift for Ernæring*, *16*(3), 6–13. DOI: **https://doi.org/10.18261/ntfe.16.3.2**

Mobekk, H., & Stokke, L. (2020). Nudges emphasizing social norms increased hospital visitors' hand sanitizer use. *Behavioral Science & Policy*. URL: **https://behavioralpolicy.org/journal_issue/covid-19/**

Simon, C., & Mobekk, H. (2019). Dugnad: A fact and a narrative of Norwegian prosocial behavior. *Perspectives on Behavior Science*, *42*(4), 815–834. DOI: **https://doi.org/10.1007/s40614-019-00227-w**

Tengstedt, M. Å., Fagerstrøm, A., & Mobekk, H. (2018). Health interventions and validity on social media: A literature review. *Procedia Computer Science*, *138*, 169–176. DOI: **https://doi.org/10.1016/j.procs.2018.10.024**

List of figures and tables

Prologue

I don't know if this is relevant to you, but guessing you are a human being like myself, you have most likely attempted different strategies to change old habits into new and better ones. Almost every day, every Sunday, or at least every New Year, I think of getting rid of some of my bad habits and starting a new life; becoming a healthier, better person, and increasing my well-being. My New Year resolutions or Sunday afternoon wishes can be anything from exercising more to eating more fish to going to bed earlier to being a more caring citizen doing more to save the world.

Today we face major challenges in society regarding the increase in, for instance, lifestyle diseases and antibiotic resistance. And I, a woman in my prime, am in the risk group for some lifestyle diseases such as high blood pressure, cancer, substance abuse, diabetes, and heart attack. Why? Because I don't have enough self-control… or are there other factors that influence my choices? There's just so much good food, wine, streaming services, etc. Wow, it doesn't sound very optimistic, does it?

Now it might seem that this Ph.D. dissertation is just a self-change project, and—to be honest—to some extent, it is. Why do we start something crazy like a Ph.D. project in the first place? There are some triggers, and these might as well evolve from our learning history. Still, there is no doubt that I am also not the only one that struggles with self-control and behavior change. If you believe that you are more rational than I am and that you don't misbehave, think about your own life and write down the number of times you have done the following things in the last ten days:

Overeaten _____

Texted while driving _____

Drunk too much _____

Not exercised as much as you wanted to _____

Spent money and regretted it later _____

Spent too much time on social media _____

Forgotten to use the hand sanitizer when entering a store _____

Procrastinated _____

Decided to look away when someone asked for help _____

If you were honest and have a score over 0, this thesis might be something for you as well, and everyone else concerned about well-being.

Reading guide

The following text's primary purpose is to describe how the individual elements of published articles relate to the thesis's overall aim: Influencing choice behavior and improving well-being by applying behavior analysis and behavioral economics. The thesis consists of an introductory text comprising eight chapters, followed by a systematic review article, three experimental articles, one interpretative article, and one rapid structured literature review article. Two disciplines, behavior analysis and behavioral economics are used as a conceptual framework in this thesis. The two fields overlap and complement each other, and to increase well-being in society it will be beneficial to apply both disciplines and to have an interdisciplinary approach.

To achieve a better flow and structure, the publications' main content is incorporated by means of article summaries throughout the eight introductory chapters. In the text, Study 1 refers to Article 1, Study 2 to Article 2, and so forth.

Chapter 1. *Introduction* introduces the research's overall topic before the thesis's aim is revealed. Then, one of the key concepts—well-being—is defined and described. Further, a conceptual model and framework of the thesis are presented. Finally, an overview table of the articles in the thesis, including research objectives, is offered.

Chapter 2. *Choice behavior and rationality* defines choice behavior and provide a broad overview of why we face today's well-being challenges, whether it be health, wealth, or happiness. The chapter highlights some of the barriers that influence choice behavior.

Chapter 3. *We don't have a healthcare problem. We have a behavior problem* argues that many of today's healthcare and well-being problems are rooted in our behavior. This chapter also presents the first research article of the thesis. This article is a systematic review to investigate whether nudging has an impact on healthier food choices.

Chapter 4. *From small-scale to large-scale* emphasizes the importance of influencing choice behavior on different levels of selections and scales.

Chapter 5. *Behavior change on three levels of selection* presents behavior changes on different levels of selection. The three experimental studies, smaller-scale interventions, all examine how to improve physical well-being. One focuses on fish consumption (ontogenetic level). The other two emphasize hygienic behavior (phylogenetic and ontogenetic level). The interpretative study, larger-scale intervention, reflects why Norway scores high on societal well-being (cultural level).

Chapter 6. *Methodological strengths and limitations* provides a more general discussion of the overall methodological choices in this thesis. Further, a more in-depth discussion of the studies' methodological strengths and limitations in the dissertation is provided. It also introduces the sixth article regarding validity challenges.

Chapter 7. *Doing well by doing good; Ethical considerations* provides an overall ethical discussion concerning changing or influencing other people's behavior and broader ethical implications for this dissertation's studies.

Chapter 8. *General discussion* summarizes the key findings of the presented research and provides an overall discussion. It also elaborates on some of the issues and challenges to consider when designing interventions. In the thesis's closing, possible implications of the findings and suggestions for further research are discussed.

References for the dissertation are listed at the end. The references for the thesis's articles are included within the articles.

Chapter 1
Introduction

"Why are we not acting to save the world?" B.F. Skinner asked this question in an address to the American Psychological Association in August 1982. The speech was later published in "Upon Further Reflection" (Skinner, 1987). Over three decades later, it is more important than ever to transform *saying* into *doing* as we face extraordinary threats on an individual, societal, and global level. We must act upon the present because the future does not exist (Skinner, 1987). To improve society's well-being, as stated by the United Nations sustainable development goal 3, the target is to: "Ensure healthy lives and promote well-being for all at all ages". This involves, in some sense, transcending selection by improving people's decisions in everyday life since numerous small choices accumulate to global challenges (Skinner, 1981). We need to plan for a future that enables better daily life decisions, accumulating better outcomes for society.

Many of the actions needed to reduce or eliminate societal challenges, such as pollution, poverty, hunger, and obesity, are known. However, there is often a gap between knowledge and the ability to act upon it. Every change starts with a tiny little step, whether it is on an individual, organizational, societal, or global level—it's all about choices. To get something else, you must do something else. It sounds easy and straightforward. However, every person who has experience of New Year's resolutions or Monday mornings and a new week knows how challenging it is to change behavior. Repeated acts determine us, and unfortunately, behavior change rarely endures (Wood & Neal, 2016). How is it, then, that many politicians and other decision-makers still believe that increased knowledge, warnings, information, and attitude campaigns are enough to change people's behavior? Don't they procrastinate and suffer from human frailties like the rest of us? It turns out that these traditional *raising consciousness* methods have little (at best) or no impact on behavior (e.g., Skinner, 1987). Decades of research on choice behavior show that people, despite knowing what is best for them, often make irrational or bad choices even when it comes at the expense of their own well-being (e.g., O'Donoghue & Rabin, 2000; Rachlin, 2000).

All aspects of life involve choices, most of which are habitual and made quickly, intuitively, and impulsively (Kahneman, 2011). These factors are often neglected in traditional policy. Daily life requires frequent tradeoffs between benefits and costs that occur at different points in time. This constant tradeoff between a smaller-sooner outcome and a

larger-later outcome is life's essential dilemma, characterized by self-control challenges (Rachlin, 1974). Every day *routine* choices, such as indulging in dessert or grabbing a bar of chocolate while buying groceries, taking the car instead of walking or biking, or spending too much time on the sofa, can have profound cumulative effects on our physical and psychological well-being. At societal levels, the consequences of an individual's self-serving choices can collectively lead to harmful global outcomes (e.g., Keeney, 2008; Read et al., 1999). The result of an unhealthy diet, physical inactivity, and substance abuse can be non-communicable diseases such as cancers, diabetes, stroke, and heart attack. These are diseases that are not directly transmitted from person to person but are caused by congregative variables, such as genetic, physiological, environmental, and behavioral factors. Non-communicable diseases are the leading cause of death globally, contributing to over 70% of deaths (World Health Organization, 2018b). Other choices, such as poor hand hygiene, can increase pathogenic microorganisms' transmission. A current example is what we face today with the SARS-CoV-2 pandemic. This means that everyday choices influence our well-being for better or for worse.

Behavioral science has received increased interest in recent years, and behavioral economics has emerged as an independent economic discipline in the last few decades (Angner, 2012). According to Camerer et al. (2003), behavioral economics increases economic explanatory power by providing it with more realistic psychological foundations. Behavioral economics and behavioral insights have gained much attention because of many successful and scalable socially significant interventions to change short-term behavior, often based on influencing the antecedent of behavior (e.g., Loewenstein et al., 2016; Milkman et al., 2011; Thaler & Benartzi, 2004). Since most of the challenges we face in society have behavioral roots, where consequences are accumulated and delayed, there is a need to bring behavior under the control of broad and abstract reinforcer contingencies (Rachlin, 2015), by for instance influencing the antecedent of behavior or the consequences. One way of influencing behavior is to organize the environment and context to promote more beneficial choices in the long run (Thaler & Sunstein, 2008).

While much of the research in behavioral economics emphasizes antecedents of behavior, such as rearranging the environment, behavior analysis has historically focused on the role of consequences. Despite the different approaches regarding changing human behavior or optimizing choices, there are many commonalities between the two fields. Nevertheless, they also have unique qualities, benefits, and strengths. Bickel et al. (1995) claim that behavior analysis will benefit from the inclusion of behavioral economics. I argue

that the reverse is also the case, behavioral economics will benefit from the inclusion of behavior analysis. One of the reasons is a generic and evolutionary approach adopted by behavior analysis: selection by consequences. This approach entails three selection levels influencing human behavior: phylogeny, ontogeny, and culture (Skinner, 1981). That is, choices are influenced by traits and biases acquired during our evolutionary history (phylogenesis), during the individual learning history (ontogenesis), and through evolving cultural practices. Therefore, when one wants to influence well-being, it will be beneficial to consider and understand all three selection levels (Catania, 2007) since all levels intervene and influence our choices.

Given the burden of all the threats we face in society, such as non-communicable diseases, the transmission of pathogens, and antibiotic resistance that all influence well-being, we have joint responsibility. Hence, a *unity of knowledge* might be needed to harness the power of different disciplines.

The purpose of the dissertation

Applied behavior analysts have expressed concern about the future of behavior analysis and whether the field addresses an adequate range of socially significant problems (e.g., Critchfield & Kollins, 2001; Poling, 2010). After working in the field for a while, I share some of the concerns, or at least I see there is room for improvement. I study human choice behavior to understand how we can improve well-being in daily life. Therefore, this dissertation has an applied approach. "Applied behavior analysis is the science in which tactics derived from the principles of behavior are applied systematically to improve socially significant behavior and experimentation is used to identify the variables responsible for behavior change" (Cooper et al., 2007, p. 20).

I have always been interested in questions regarding why we do things the way that we do and how to optimize our behavior for better outcomes, especially regarding well-being. Based on some of the challenges we face in society that have roots in choice behavior, the broad behavioral analytic reach, and my interest, this dissertation addresses and discusses some of our encounters in many parts of modern society. The focus is well-being and some strategies and solutions for improving it. Therefore, the overall purpose of this dissertation is to further explore our understanding of choice behavior regarding well-being by considering different levels of selection in behavior analysis, with an emphasis on the behavioral economics framework. It is necessary to define well-being, choice behavior, and selection

levels and describe how behavior analysis and behavioral economics can improve well-being. Further, to test empirically whether it is possible to improve well-being on different levels of selection by structuring the environment to encourage prosocial and healthier behavior.

Defining well-being

In Merriam-Webster (n.d.), well-being is defined as: "the state of being happy, healthy, or prosperous."

Well-being is used throughout the thesis and articles. Therefore, a brief description of well-being is presented to form a foundation for the understanding used within this dissertation. Well-being is a vague concept with many different meanings, and there is no consensus around a single definition. The concept can be understood, defined, and used differently depending on the learning history, educational background, and research disciplines. The meaning of well-being has evolved from a narrower perspective, such as the absence of disease or infirmity, to a broader view, including all living areas and what influences us as human beings.

Well-being is a keyword in the World Health Organizations' definition of health: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (1946, p. 1). Well-being relates to other words, such as happiness, health, and welfare. This also makes it a difficult concept to translate, for instance, to Norwegian (Norwegian Directorate of Health, 2015). Despite the lack of one definition, there is a general agreement that well-being describes a good or positive human existence condition. It often refers to the quality of life, and it is related to prosocial behavior (e.g., Biglan & Glenn, 2013; Houmanfar et al., 2015). It has both a subjective and an objective dimension, and it is not static. It is something that varies in the interaction between people and the environment in a broad sense. This means that how different people perceive well-being is influenced by many areas in life, such as family, school, work, and communities. In other words, a state of sound mental- and physical health doesn't necessarily mean that you will score high on well-being since well-being builds on all aspects of life. According to the Centers for Disease Control and Prevention (2018), well-being can, in simple terms, be described as judging life positively and feeling good.

The non-consensus regarding a single definition might be because researchers have studied well-being from many different disciplines and under very different premises and contexts (e.g., Diener, 2000; Eid, 2008; Houmanfar et al., 2015; Keyes, 2002). The research can be broken down into five major categories of well-being:

- *Physical well-being* consists of performing physical activities and carrying out social roles that are not hindered by physical limitations and experiences of bodily pain and biological health indicators (Capio et al., 2014).
- *Emotional well-being* conceptualizes the balance of feelings (positive and negative) experienced in life and the perceived feelings (happiness and satisfaction) (Keyes, 2007).
- *Social well-being* can be defined as an individual's appraisal of their social relationships, how others react to them, and how to develop meaningful relationships with others (Cicognani, 2014).
- *Workplace well-being* relates to all aspects of working life, from the physical environment's quality and safety, to how workers feel about their work, their working environment, the climate at work, and work organization (International Labour Organization)
- *Societal well-being* is the ability to participate actively and coexists in the community.

High levels of well-being, such as the decreased risk of disease and illness, increased recovery, and longevity, are associated with added work productivity and more engagement and community contribution. This is beneficial and vital for economic and social development and growth on an individual and societal level. The world is changing in many ways that affect well-being, and it demands new ways of thinking and acting. For instance, we can see that the obesity epidemic is one of the most significant public health challenges of the 21st century. Non-communicable diseases impose an unsustainable economic burden on countries across the world. Therefore, an overall goal for the European health policy framework, Health 2020, is to support action across government and society to: "significantly improve the health and well-being of populations, reduce health inequalities, strengthen public health and ensure people-centred [*sic*] health systems that are universal, equitable, sustainable and of high quality" (World Health Organization, 2013b).

This dissertation focuses on physical and societal well-being that has a general interest related to the United Nations sustainable development goal 3. We must: "Ensure healthy lives and promote well-being for all at all ages."

Conceptual framework

This dissertation's focus is that we need society-wide behavioral engineering as Skinner (e.g., 1953) envisioned to cope with today's challenges to impact socially significant behavior. To reach the goal of influencing well-being on different levels—from an individual to society—we need to utilize the best available strategies, and this might mean including other sciences or fields. Since the beginning of our history, people have acted to influence other individuals' behavior (Pierce & Cheney, 2008). Influencing human behavior has also been the primary concern within behavior analysis and behavioral economics. The standard assumption in traditional economic theory is that people are considered entirely rational and maximize utility and self-interest (Wilkinson & Klaes, 2012). However, decades of research show that people deviate from the traditional economic theory of rational man referred to as Homo economicus (e.g., Thaler, 2000; Thaler, 2015). Based on this research, behavioral economics has evolved, integrating both behavioral science and economic principles providing economics with more realistic psychological foundations (e.g., Camerer et al., 2003).

Despite, behavior analysis and behavioral economics sharing many of the same concerns and research topics regarding people's welfare, the attention the different fields receive is not proportional. Behavioral economics has gained a lot of attention (i.e., several behavioral economists have received the Swedish Riksbank's prize in Alfred Nobel's memory) referred to as the forefront of public policy and pop psychology (Reed et al., 2013) while behavior analysis is not that well known (e.g., Becirevic et al., 2016; Furrebøe & Sandaker, 2017; Schlinger, 2010). One reason might be that traditionally behavior analysis has, unlike behavioral economics, mainly focused on individuals' behavior, using single-subject design, and less on larger scale socially significant behavior (Poling, 2010). However, reasons and a discussion for this mismatch of attention and popularity are outside this dissertation's scope.

Scholars such as Bickel et al. (1995) and (Reed et al., 2013) argue that it is beneficial for behavior analysis to include behavioral economics. The reverse is also the case; behavioral economics will likewise advance by including behavior analysis (Furrebøe & Sandaker, 2017). Behavior analysis and behavioral economics represent different traditions. Still, there are relevant points of intersection and complementarities between the two disciplines, such as seeking order and regularities in behavior (da Rocha & Hunziker, 2020). According to Furrebøe and Sandaker (2017), behavioral economics offers good descriptions of critical

phenomena, while behavior analysis contributes with theory and technology for prediction and control, such as the selectionist framework and reinforcement theory.

To evaluate behavioral economics and its potential contributions to experimental and applied behavior analysis, it is central to understand commonalities with and points of departure from other behavioral perspectives (Bickel et al., 1995). Understanding the commonalities and harnessing the disciplines' strengths might advance our understanding of human behavior, contribute to new applications, and further increase society's well-being. Therefore this dissertation adopts an interdisciplinarity approach defined as: "involving two or more academic, scientific, or artistic disciplines" (Merriam-Webster, n.d.).

To change behavior, independently of scale, we must understand the variables influencing individual behavior. From a behavior analytic perspective, our behavior is determined by its environment (Rachlin, 2015). The environment is divided into two functionally distinct variables: antecedents and consequences (Skinner, 1953). To change behavior, it is possible to influence antecedents or consequences. An antecedent is something that comes before, prompts behavior, and is the contextual event. Consequences are environmental events that follow the behavior and affect future occurrences (Catania, 2007; Couto et al., 2020; Daniels & Bailey, 2014). Therefore, a strategy to find out why people do as they do is to look at the behavior and at the environmental conditions of which it is a function (Skinner, 1987).

The focus of interchange in this dissertation is the selectionist framework from behavior analysis and nudging from behavioral economics. The selectionist framework refers to the notion that human behavior is influenced by three levels of selection. According to this perspective, it is the consequences of behavior, not the individual's intentions, which are responsible for the shaping and maintenance of people's behavior. The consequences of behavior can be, for example, positive or aversive, and/or immediate or delayed. A consequence in behavior analysis influences the future probability of behavior. The selectionist perspective is further described in Chapter 5 *Behavior change on three levels of selection*.

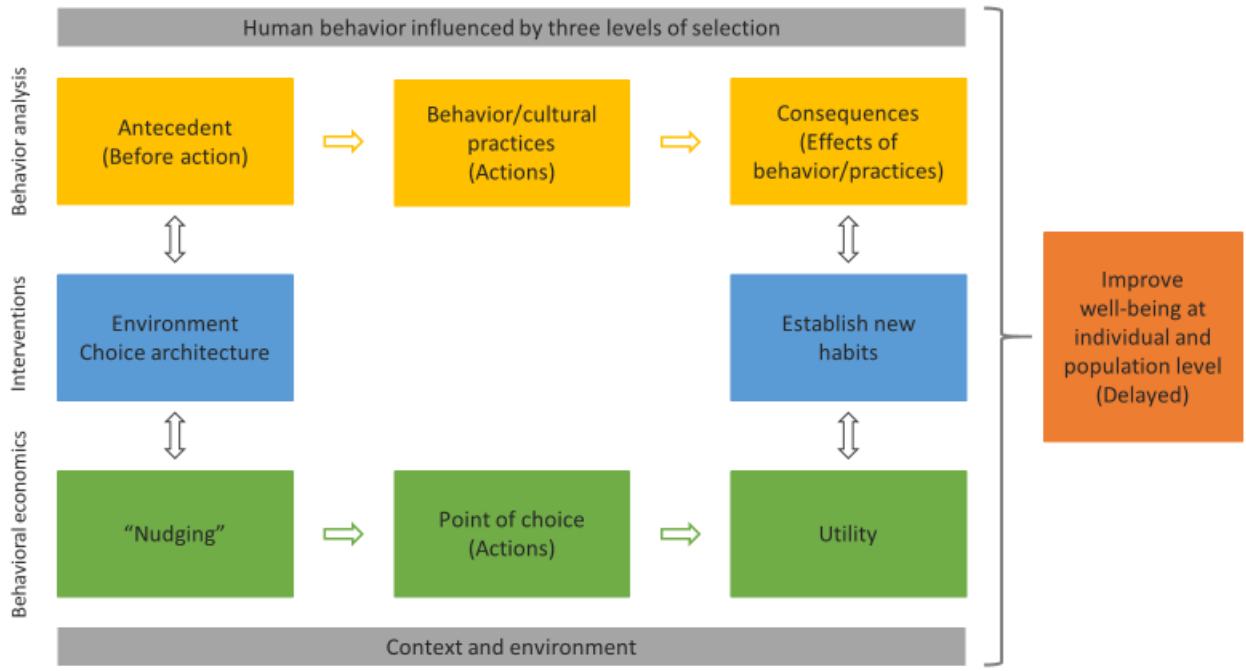
One way to change behavior is to make it easier to choose a more optimal outcome by rearranging the environment with a nudge; predictably influence the antecedent of behavior while preserving the freedom of choice. The term nudge was coined by Thaler and Sunstein (2008) and refers to the practice of influencing choices by designing environmental and social contingencies to improve well-being. To nudge means literally to poke someone gently with one's elbow in order to attract attention. In this context, it is an antecedent aimed at swaying

people's choices toward a more positive outcome that will benefit the individual in the long run, without forcing a particular action. Nudging can be a powerful and cost-effective intervention that can be scaled up. A nudge is comparable with the behavioral analytic term prompt; anything that prompts people to act. However, it is essential to emphasize that nudges are only one concept within behavioral economics that aims to accommodate for better choices, of which nudges might be the most prominent but not necessarily the most powerful (Loewenstein & Chater, 2017).

Figure 1 depicts this dissertation's framework, illustrating how behavior analysis and behavioral economics are linked together.

Figure 1

Conceptual framework



Note. This figure illustrates the framework of the dissertation comprising behavior analysis and behavioral economics. The yellow boxes represent the three-term contingency consisting of antecedent, behavior, and consequence. The green boxes represent the parallel concepts in behavioral economics where nudging is written in quotation marks to illustrate that it is one of the behavioral economics tools. The blue boxes represent the goal of interventions that are interchangeable between the two disciplines.

Table 1

Overview of the articles/studies included in the dissertation

Article/Study	Objectives	Type
1. Improving cardiovascular health through nudging healthier food choices: A systematic review	Investigate if nudging, as an antecedent, can increase healthier food choices. Obesity and being overweight harm health and influence physical well-being.	Systematic literature review
2. For your eyes only: A field experiment on nudging hygienic behavior	Investigate if the illusion of being watched can increase hygienic behavior. Hygienic behavior is one of the most effective measures to prevent the spread of pathogenic microorganisms.	Field experiment
3. Fish versus meat: Nudging the healthier choice of food in hotel lunch buffets	Investigate if altering the choice architecture can increase fish intake. An attempt to implement the Norwegian National Action Plan for Healthy Diets (2017-2021).	Field experiment
4. Nudges emphasizing social norms increased hospital visitors' hand sanitizer use	Investigate if nudging, as an antecedent, can improve hand hygiene among hospital visitors. Hospital-acquired infections are a challenge, and hand hygiene compliance is one of our best preventive tools.	Field experiment
5. Dugnad: A fact and a narrative of Norwegian prosocial behavior	Why does Norway score so high on well-being? The Norwegian *dugnad*—a historical and cultural practice of cooperative and prosocial behavior—is described from a behavioral analytical perspective.	Interpretative
6. Health interventions and validity on social media: A literature review	Social media is an essential element for improving public health and well-being. The purpose is to highlight validity challenges by the use of social media.	Rapid structured literature review

Chapter 2
Choice behavior and rationality

In Merriam-Webster (n.d.), choice is defined as: "the act of choosing," rationality is defined as: "the quality or state of being rational," and rational as: "having reason or understanding."

People make choices all the time, knowingly or unknowingly, in all aspects of life; from the small, ordinary things to tackling life's big questions. Most human activities (i.e., medicine, finance, and art) involve decisions (Kahneman & Tversky, 1984). Decision-making is viewed as one of the most crucial phenomena for understanding how people behave (Payne et al., 1992). Therefore, it is no surprise that the research area has expanded and that many disciplines share the topic of decision-making, such as philosophy, economics, psychology, and political science (Kahneman & Tversky, 1984). This implies that methods and theories are diverse and that there therefore is a diversity in choice theories (Angner, 2012; Rachlin, 1989). Choice behavior is also a core research area within behavior analysis, from basic to applied (Fisher & Mazur, 1997), and in behavioral economics (Bickel et al., 1995).

"A *personal decision* is a situation where an individual can make a choice among two or more alternatives. This assumes that the individual recognizes that he or she has a choice and has control of this choice" (Keeney, 2008, p. 1336). Besides, according to Catania (2007), the responses are incompatible between the emission of one of two or more alternatives. From a behavioral analytic perspective, a choice has been defined as "the distribution of operant behavior among alternative sources of reinforcement" (Pierce & Cheney, 2008, p. 193). The term operant originates from the verb to operate. It refers to behavior that operates on the environment to produce consequences that strengthen or reinforce the probability of future occurrences (Catania, 2007; Pierce & Cheney, 2008). For example, suppose a cappuccino and a croissant give a pleasant feeling. In that case, the coffee shop where they were purchased will become a context signaling the availability of the reinforcer (tasty cappuccino and croissant), increasing the probability of repeating the behavior in the future. Negative reinforcement also strengthens behavior, but then it is to indulge in behavior that prevents aversive outcomes (Baum, 2005). For example, new cars are installed with an alarm that will activate if you drive off without using a seat belt. If using the seat belt removes the aversive noise, it increases the possibility of putting on the seat belt before starting to drive on future occasions.

In behavioral psychology, reinforcement is comparable with utility in the traditional economy (Herrnstein, 1990), where utility refers to maximizing satisfaction. Economics can be defined as the study of scarce resource allocation (Wilkinson & Klaes, 2012), and choice responding again refers to the way individuals allocate their time or response among available response options (Fisher & Mazur, 1997). A decision problem, according to Kahneman and Tversky (1984), is defined "by the acts or options among which one must choose, the possible outcomes or consequences of these acts, and the contingencies or conditional probabilities that relate outcomes to acts" (p. 453). Choices differ regarding complexity, from straightforward choices that are easy to make to more elaborate choices that are difficult to make since we might not have enough information or are ambivalent about our preferences (Sharot & Sunstein, 2020).

Decision-making and choice are usually used interchangeably, but in this dissertation, the two words are distinguished. Decision-making will be used to describe the process and context where choices are made. In Skinner's (1953) words, "'Deciding' … is not the execution of the act decided upon but the preliminary behavior responsible for it" (p. 243). On the other hand, choice will be used to represent the actual response when selecting one of two or more alternatives—the point of choice (the final choice of action)—which can be directly observed (Mobekk & Fagerstrøm, 2015).

People are out of control

The study of decision-making addresses both normative and descriptive questions. The normative theories incorporate a set of logically consistent decision procedures. Meaning it is concerned with the nature of logic and rationality; how people *should* make decisions. This refers to people as Homo economicus—*the economic man*; the well-informed, self-interested, and utility-maximizing agent who is also rational in the course of being economical (Simon, 1955; Wilkinson & Klaes, 2012). In contrast, descriptive theories are concerned with people's beliefs and preferences per se; how people, *in fact*, make decisions (e.g., Angner, 2012; Kahneman & Tversky, 2013). This implies that the agent will evaluate all available alternatives in most rational choice theories before a choice is made. However, strategies that can optimize or degenerate outcomes are influenced by actual human decision-making behavior. For example, an agent may examine alternatives sequentially until the first satisfactory choice is found (Simon, 1955). In addition, many of the decisions humans encounter in real life are concurrently competing with each other. In natural environments,

there are almost always multiple response options available (Fisher & Mazur, 1997). Thus choices are determined by the combination of learning history and the current environment (Fantino, 1998).

The difference between the two dimensions, normative and descriptive, characterizes much of the research regarding choice and judgment, where rational choice has been a central concern. Decades of research suggest that decision-making is mostly a passive and unconscious process far from rational in a traditional economic view. People often fail to act in the manner in which they should (Angner, 2012; Kahneman, 2011). Indeed, humans make suboptimal choices because they are biased and selective (Fantino, 1998). Therefore, a rational choice theory is normatively useful but is fundamentally deficient as an account of behavior since people in reality often behave against self-interest and suffer from human frailties (Herrnstein, 1990).

While *rationality* is used loosely in everyday language as something that *makes sense*, when it comes to traditional choice theories, rational refers to maximizing total utility and includes some elementary requirements of consistency and coherence (e.g., Angner, 2012; Herrnstein, 1990). This means that a rational agent's decisions should be a result of carefully weighing costs and benefits and be informed by existing preferences. For instance, this means not changing the preference between options if only the framing of the options is altered (Tversky & Kahneman, 1981). Utility or reinforcement has, like well-being, a subjective value. This means that we may, for example, be optimizing utility (or reinforcement) by indulging in behavior that we know is harming ourselves, such as overeating, smoking, or excessive drinking (Herrnstein, 1990).

The normative theories assume that more alternatives to choose from are preferred to fewer. This is, according to Schwartz (2004) and Sunstein (2015), a contradiction since *more is less*; also referred to as choice overload (Scheibehenne et al., 2010). Acknowledging all the decisions we encounter every day, it is impossible to always comply with rational decision-making. Indeed, gathering information to optimize choices better is not without cost, and it would be impossible to evaluate all alternatives before every choice is made (Loewenstein, 1999; Simon, 1955). Nevertheless, how do we know when a choice is rational or not since the concept *rational* involves a subjective definition?

Simon (1955) emphasizes that the optimization problem may, in addition to being biologically defined, also be a physiological and psychological limitation of the organism itself. People have limited capacity to process information and lack the necessary knowledge to make choices that are in line with the standard notion of economic rationality. This implies

that *the environment* is partly within the biological organism's skin, meaning that both internal and external constraints define rationality challenges for the organism (Simon, 1955). "Evidently, organisms adapt well enough to 'satisfice'; they do not, in general, 'optimize'" (Simon, 1956, p. 129). This idea came from Simon (1955, 1956), that even though human choices are not rational from an economic point of view, they are still purposeful, and thereby the term *bounded rationality* was coined. Simon's concept of bounded rationality is based on functional and evolutionary arguments. As pointed out by Simon (1988), "it is empirical observation of the behavior pattern that raises the question of why it persists – what function it performs" (p. 61). The concept of bounded rationality has been crucial in identifying that decisions deviate from rationality, and this has been a foundation of much behavioral decision research.

Delay of gratification

In the Encyclopedia Britannica, delay of gratification is defined as "the act of resisting an impulse to take an immediately available reward in the hope of obtaining a more-valued reward in the future. The ability to delay gratification is essential to self-regulation, or self-control" (Conti, 2019).

To delay gratification is a continuous battle, and too often *want* wins over *should* suggesting that self-control is challenging (Bitterly et al., 2015). That humans struggle with self-control has been postulated from millennia of folk wisdom to a mass of psychological research (O'Donoghue & Rabin, 2000). Unfortunately, in our daily life, our self-control frequently lapses when we tend to pursue immediate gratification in a way that influences our well-being in the long run. According to O'Donoghue and Rabin (2000), this is because humans are time-in-consistent and not time-consistent, as assumed in the traditional economic theory of intertemporal choice. This means that humans have one set of preferences for a long-run perspective, but when the future arrives, the preferences shift. For instance, when planning for the long term, most people intend to eat healthily, quit drinking, exercise regularly, and comply with hygiene recommendations. However, these plans require that you can resist temptation and tolerate gratification being delayed. When choosing the immediate gratification, humans forgo activities that involve immediate costs and delayed rewards and over-indulge in activities with immediate rewards and delayed costs (O'Donoghue & Rabin, 2000).

People are said to exhibit self-control if they choose the larger but more delayed reinforcer and to act impulsively if they choose the smaller, more immediate reinforcer (Fisher & Mazur, 1997). However, to choose immediate gratification or what you desire in the heat of the moment might maximize utility or reinforcement. Therefore, this might be considered rational if one looks at every instance one by one. Hence, the question "How can you always choose the best among all available alternatives and still end up in a worse state than when you started?" (Rachlin, 2000, p. 72).

The primrose path

The phrase *primrose path* was coined by Shakespeare (1604/1992a; 1623/1992b) and used in both Hamlet and Macbeth as a metaphor to refer to a pleasant path to self-destruction; the road to hell as opposed to the *rocky road of righteousness*. More relevant than ever, the thought is not new. The idea comes from the Gospel of Matthew 7 (*King James Bible.*, 2021):

> [13]Enter ye in at the strait gate: for wide is the gate, and broad is the way, that leadeth to destruction, and many there be which go in thereat: [14]Because strait is the gate, and narrow is the way, which leadeth unto life, and few there be that find it.

As indicated by Shakespeare in his plays, the primrose path is a series of incremental decisions that give immediate pleasure where the individual does not perceive the consequences until it is too late. According to Rachlin (2000), this concept was proposed as a process for developing addiction by Herrnstein and Prelec in 1992. In Merriam-Webster (n.d.), addiction is defined as:

1. : a compulsive, chronic, physiological or psychological need for a habit-forming substance, behavior, or activity having harmful physical, psychological, or social effects and typically causing well-defined symptoms (such as anxiety, irritability, tremors, or nausea) upon withdrawal or abstinence
2. : a strong inclination to do, use, or indulge in something repeatedly

Theories that view addiction to be a result of a person's choices, even though the choices are not regarded as rational, may be labeled primrose path theories. According to this approach, behavior is controlled by its consequences, but this does not imply that the result is adaptive (Herrnstein & Prelec, 1992). The primrose path theory assumes that addiction results from repeated choices and is not produced by a single choice. The choices are made one by one by maximizing immediate well-being; a long stream of choices before becoming a habit.

Therefore, you don't suddenly wake up one morning and choose to become an addict, independent of whether it is alcohol, tobacco, opioid pain killers, sugar, or junk food. Addiction is also shown in the definition above to be a broad term, meaning that many activities can be considered addictive. Becker and Murphy (1988) point out that: "People get addicted not only to alcohol, cocaine, and cigarettes but also to work, eating, music, television, their standard of living, other people, religion, and many other activities" (p. 675). But most lifestyle questions concern distributed choices, which means that one choice will not make you addictive (Herrnstein, 1990). Instead, it results from numerous minor choices, many of which may be barely, if at all, blameworthy. Therefore, we hardly notice since those human frailties creep upon us gradually and cumulatively before the repeated indulgences eventually become harmful (Herrnstein, 1990; Herrnstein & Prelec, 1992).

Addiction as a sum of choices indicates that addiction is not a disease. Levy (2013) and Lewis (2015) emphasize that treating addiction as a disease is faulty and harmful. However, this view is not shared by everyone as for instance the American Medical Association decided in 2013 to recognize obesity as a disease. Hoyt et al. (2014), are concerned that an unfortunate consequence of that decisions could be that more Americans are giving up trying to exert self-control over their calorie consumption. According to Levy (2013), addiction is a "disorder of a person, embedded in a social context" (p. 1). In comparison, Foxall (2016) refers to addiction as an extreme mode of consumer choice. Therefore, the social context is a necessary element of addiction to occur and refutes the disease concept (Hantula, 2019). This is in line with Skinner's (1987) strategy: to look at our behavior and at the environmental conditions of which it is a function.

All in all, choices that negatively affect our well-being, in the long run, are made one by one and one day at a time without considering the long-term effect. We live in the present, not in the future. Consequences that have not yet occurred have no effect, and therefore advice is seldom enough to change choices (Skinner, 1989). On any occasion, overeating, having a glass of wine, or smoking produces limited harm, but many instances—now, and now, and now (Rachlin, 2000)—pave in the end the primrose path while the individuals themselves might believe they are in control (Herrnstein & Prelec, 1992).

Addiction might involve an intense focus and craving for a reinforcer (i.e., junk food, sweets, alcohol, drugs) to the degree that it negatively influences life's well-being. Thus, many of the non-communicable diseases or threats that we face in society result from many small choices that accumulate over time, and negatively impact our health and society in the long run. However, this doesn't necessarily mean that people who choose to indulge in

behavior that might have a bad impact on well-being in the long term misbehave or act irrationally. Skinner (1977) writes:

> I do not believe that organisms ever misbehave. I long ago adopted the basic rule in animal research that the organism is always right. It does what it is induced to do by its genetic endowment or the prevailing conditions. (p. 2)

Delay discounting

Choices that involve comparing outcomes that occur at different points in time are within behavioral economics referred to as intertemporal choice. Intertemporal choices represent traditional topics in microeconomics. According to Critchfield and Kollins (2001), temporal discounting refers to "the weakening of consequence effects due to delay…" (p. 102). Wilkinson and Klaes (2012) emphasize that all the different psychological factors that may influence a choice are summarized in a single construct: the discount factor. In classic economic theory, discounting curves have been regarded as exponential. The discount rate remains fixed, as rational choice theory assumes (Wilkinson & Klaes, 2012). However, as emphasized earlier, humans don't necessarily hold on to their dietary regime or exercise regularly. These changes in preferences are difficult to explain by the classic economic approach to intertemporal decision-making. There is increasing evidence that decision-makers' valuations of delayed rewards are inconsistent with the constant discount rate implied by the exponential discount function (Estle et al., 2006).

To understand intertemporal choice is critical for understanding many aspects of decision-making (Myerson et al., 2003). Discounting is a framework that has been used to understand and describe complex human behavior that underlies phenomena such as addiction (e.g., Ainslie & Monterosso, 2003; Epstein et al., 2010; Owens et al., 2019), hygiene (e.g., Barlow et al., 2016; Nguemeleu et al., 2020), and altruism (e.g., Kovarik, 2009; Saez-Marti & Weibull, 2005). The most fundamental finding from discounting research is that people often favor a smaller-sooner outcome (reinforcer) to a larger-later outcome (reinforcer); more of what they like, and sooner rather than later (Frederick et al., 2002). However, the choices we face in everyday life are not usually one-dimensional, meaning that we choose between more and less, or sooner versus later. Instead, outcomes are multidimensional, and therefore tradeoffs are necessary (Green & Myerson, 2013). When a smaller-sooner reinforcer is chosen in favor of a larger later reinforcer, the larger later reward's discounted utility is lower than the

smaller sooner reward's utility. This means that people steeply discount the value of future reinforcer over time, ultimately violating long-term well-being (Green & Myerson, 2004).

These findings from behavioral economics studies suggest that the discount rate is not an exponential function of delay. Instead, it is better described as a hyperbolic function where the discount rate shrinks with time (Ainslie, 1992; Chung & Herrnstein, 1967). A behavioral approach to discounting theory, though, is based upon a hyperbolic equation. In hyperbolic discounting, the discount rates are not constant over time but vary systematically until the consequences change. Therefore, a hyperbolic discounting function provides a much better description of the relation between subjective value and the delay until an outcome (reinforcer). The hyperbolic discounting function is a better predictor of human choice behavior and preference reversals. For instance, low self-control over unhealthy food causes overeating to the point of obesity, reflecting heavy discounting (Foxall & Sigurdsson, 2011). This does not imply that hyperbolic discounting is an explanation of behavior. According to Wilkinson and Klaes (2012), it is merely a descriptive theory that does not consider underlying psychological factors.

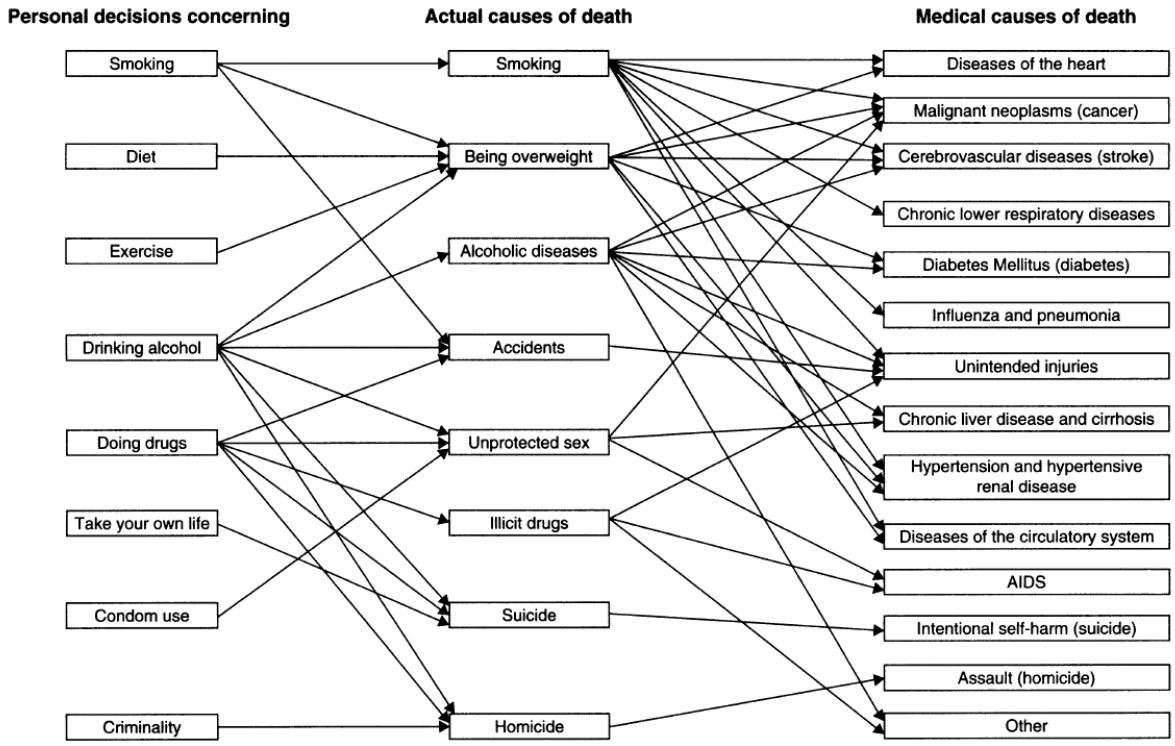
Herrnstein (1990) posits that it is easier to exert self-control tomorrow than today since we are disposed to see things better when they are remote. So, if we could always choose *now* what to eat for tomorrow, rather than for right now, we would probably all eat better than we do. Awareness of the temporal choice dilemmas in everyday life can facilitate more wise choices in the moment and better interventions for increasing well-being (Hantula, 2019). "Advice about predicted consequences is usually taken only if taking comparable advice has been reinforced, and that is seldom if ever, the case when the predicted consequences are remote" (Skinner, 1989, p. 118).

Chapter 3
We don't have a healthcare problem; We have a behavior problem

As elaborated in the previous chapter, personal choices have an overarching impact on our lives, but also our death. According to Keeney (2008), over one million of the 2.4 million deaths in the United States in 2000 might be attributed to personal choices that could have been avoided. For example, an unhealthy diet could lead to obesity being the underlying cause of death, where the medical cause of death would be heart disease, cancer, or diabetes, as shown in Figure 2:

Figure 2

Influences of personal choices on causes of death



Note. An arrow means influences. Figure from Keeney (2008, p. 1336). Copyright 2008 by the Institute for Operations Research and the Management Sciences. Reprinted with permission.

The World Health Organization (2013a) estimates that more than 36 million people die annually from non-communicable diseases—mainly cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes—the world's biggest killers (63% of global deaths). Therefore, the health challenges we face suggest that we might have more of a behavior problem than a health problem that is a barrier to well-being. Despite the World Health Organization's warnings since the 1960s of future epidemics in non-communicable diseases, there is a global rise in these illnesses (James, 2016). This warning is strengthened with modifiable behavioral risk factors, underlying determinants, and intervention opportunities such as inappropriate nutrition, obesity, substance abuse, and sedentary activities hugely affected by lifestyle and demographic. Non-communicable diseases result from a combination of genetic, physiological, environmental, and behavioral factors, but as Figure 2 illustrates, personal choices have a profound impact. The World Health Organization estimates that eight out of ten heart attacks, nine out of ten cases of type 2 diabetes, and over three out of ten cancer cases can be linked to harmful health choices.

The non-communicable disease epidemic affects all countries, genders, and ages, and constitutes a significant public health challenge that undermines social and economic development throughout the world. However, low- and middle-income countries are more vulnerable since their health systems usually have fewer resources to detect diseases and provide comprehensive care to those who are ill. The most disadvantaged groups are the ones that have fewer resources in terms of education and income to have the competence and the budget to choose a healthy lifestyle. One result of the world's inequality is that in some parts of the world, people are starving to death, and in other parts, obesity is one of the most significant public health challenges. According to the World Health Organization, the obesity epidemic has tripled in many countries since the 1980s. The growth is startling, increasing the number of people diagnosed with cardiovascular disease, cancer, and diabetes. The World Cancer Research Fund (2018) reported that greater body fatness increases the risk of 12 types of cancers. The problem is not a few extra kilos but all the kilos that accumulate over time, such as between New Year and Christmas every year.

Several studies indicate that we frequently make choices that negatively affect our well-being even though we have the awareness, intention, and ability to choose better options for the long-term (e.g., Chriss, 2016; Duckworth & Gross, 2020; Loewenstein, 1996; Reed et al., 2013). For instance, many Norwegians have made and continue to make wise choices that affect their health positively. However, a new report from The World Bank (2020) confirms that Norway is among the countries with a very high proportion (≥40%) of overweight people.

This indicates that despite many people knowing what is healthy and unhealthy, people still struggle to make the right choices.

The obesity epidemic is partly due to the prevailing choice architecture, which influences what and how much we eat (White, 2018). Not all conditioned behavior, such as eating unhealthy food, is necessarily adaptive (Skinner, 1981). We have adapted into a consumer-oriented world, leading to lowered fitness. Everywhere, fast food chains, cafes, and gas stations are calling for us. The question is whether you and I can resist the temptation. Optimal choice-making requires self-control (e.g., Duckworth et al., 2018; Rachlin, 2000). These behavioral challenges reveal other preventive means than biomedicine, which has been the dominant healthcare approach for optimizing population health. So, if society as a whole frames thing differently and sees the major causes of death not as heart disease, cancer, or being overweight, but as personal choices that lead to bad outcomes, this will suggest new and potentially more effective alternatives to reverse the negative trend (Keeney, 2008). This can be cost-effective preventive actions such as nudging or rearranging the environment or contexts to influence people to make healthier choices (e.g., Benartzi et al., 2017). This implies that we acknowledge that environmental factors and conditions influence our health and well-being.

Most nudge experiments are in a broad sense related to well-being, ranging from nudging strategies for promoting healthy eating (e.g., Anzman-Frasca et al., 2018; Vecchio & Cavallo, 2019; Velema et al., 2018) to saving for retirement (e.g., Benartzi et al., 2017; Halpern & Sanders, 2016; Thaler & Benartzi, 2004). Since overweight and obesity are one of the significant causes of death, and the use of nudging within behavioral economics and public health is rapidly increasing, there is a strong need to validate the nudging potential further (e.g., Loewenstein et al., 2012; van Kleef et al., 2018).

Study 1 examines experimental field studies, investigating the effects of nudging on healthy food choices and if there are specific nudges that are more effective than others. We chose to focus only on field experiments involving actual food choices that could impact food selection and actual consumption versus perception or choice intentions. The rationale for this is to give further guidance and understanding of how to implement nudges in a natural setting. The context and the environment influence our choices, and we wanted to review how people respond *in the heat of the moment*. This is a similar approach to the approach utilized in a study by Cadario and Chandon (2019).

Article 1 Summary

Obesity and metabolic syndrome are considered major public health problems, and their negative impact on cardiovascular disease and type 2 diabetes mellitus is profound. Targeting modifiable risk factors such as dietary habits is therefore of great importance. Many of today's health challenges with overweight and obesity may have behavioral roots, and traditional methods such as regulations and campaigns are often insufficient to improve dietary choices. There has been an expansion of research regarding how the environment in which our decisions are made influences us. Thus, nudging, as a tool, has gained much attention lately. This paper reviews the current state of the rapidly expanding number of experimental field studies investigating the effects/associations of nudging on healthy food choices. The main objective of this article was to conduct a systematic review to examine whether nudging would influence healthier food choices.

To identify published studies examining nudging and or the related term choice architecture versus possible effects/associations on healthy food choice in humans, a literature search was performed in PubMed. Combined search terms were: (1) nudge and food choice; (2) choice architecture and food; and (3) nudging and healthy food. The review procedure was carried out following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for review reporting. The majority of studies regarding nudging and/or choice architecture consist of multiple nudges and/or interventions. This makes the mapping of the different nudges and the evaluation of their individual effects challenging. However, Hollands et al., 2013 have developed a provisional typology of choice architecture interventions that enabled grouping of the studies.

The literature search identified 142 studies, of which 31 were found in the first search (nudge and food choice), 79 in the second search (choice architecture and food), and 32 in the third search (nudging and healthy food). After screening 74 studies (i.e., titles and abstracts), 62 full-text articles were retrieved and assessed for eligibility. After removing duplicates and those not making it through quality assessment, 21 studies were included in this review. The included studies comprise six randomized controlled trials and 15 non-randomized controlled trials. The results of this systematic review show that the effect sizes are very diverse and also low. Many of the studies included traffic light labeling that might be a promising strategy. Moreover, this study also highlights the challenges such as flawed methodology and unclear framework that must be addressed when experimental studies concerning nudging are conducted.

Chapter 4
From small-scale to large-scale

As discussed in the previous chapters, many factors that affect our health and well-being are not necessarily medical but rather personal choices that are often context-dependent. We need to use this insight to achieve the highest attainable health standard. Given the burden of all the well-being challenges in society there is a clear need for interventions to change behavior that have the potential to be scaled up to population levels.

When designing interventions, one should target physical micro-environments since behavior is a function of the environment. This is more important than ever since cultural evolution has changed our society far faster than biological evolution has managed to change the human body (Gluckman & Hanson, 2008). Baum (2005) emphasizes that evolutionary history has prepared us poorly for some of today's challenges. For instance, foodstuffs have evolved during the human species' history, which has been essential to our survival as a species. In early human history for instance, salt and sugar were scarce. Today we produce extreme quantities of products that contain salt and sugar (Skinner, 1987). The traits that from the very beginning kept us alive, such as the taste for sweet food, are today harming us. In other words, to combat some of the challenges we face, it is crucial to influence choice behavior on different levels of selection and all scales—from individuals to small groups to large populations—since many of the susceptibilities have survived. This involves investigating human behavior as a unit of analysis as the dependent variable and environmental events as independent variables across various populations and applied settings.

By influencing choices at group levels or population levels, the effects might increase since small but cumulative consequences of repeated choices by many people can profoundly impact society's well-being. This means that the positive outcome is both for the person who makes the *right* choices and for all others in society. For instance, small cumulative changes in eating behaviors across populations could lead to substantial reductions in the prevalence of overweight and obesity-related diseases (e.g., Thorndike et al., 2014). Similarly, simple hygiene measures in everyday life, such as using hand sanitizer, can help prevent infection-related consequences. Increasing prosocial behavior in a society can prevent problem development and foster a nurturing environment (Biglan & Glenn, 2013). These are examples of behavior that probably have a short-term consequence for individuals, such as an

immediate pleasure of eating an extra piece of cake, time saved on not using the hand sanitizer, or the comfort of staying on the sofa instead of partaking in a community activity. The cumulative effect of these kinds of operant behavior of many individuals produces consequences at the societal level, such as an economic burden on society. All these examples can contribute to physical, emotional, social and societal well-being.

Unfortunately, people pay too little attention to all the small choices' cumulative health effects, coined the *peanuts effect* (Loewenstein et al., 2012). The facilitation of individual contributions in society will thus be a prerequisite for altruistic choice behavior, improving public health (Ekström, 2012). Using the environment and the context to optimize health also contributes to social equalization, as the focus on individual behavior and measure is less apparent. This also implies that the challenges we face in society, such as non-communicable diseases, are a shared responsibility, not something one should or even could solve alone.

Interventions to improve well-being (or prevent problems of human behavior), whether they be healthier food choices, better hygiene, or creating supportive environments and resilient communities in the public sphere, do not address a specific group of people. People staying in a conference hotel, visiting patients at a hospital, using gym facilities, or living in a *dugnad community* are not well-defined and separate groups. This indicates that some people may be in contact with the contingency only one time, which challenges the upscaling of individual behavior into new cultural practices because one needs repeated actions to form a new habit. To explain the customary behaviors of people, we must turn to the contingencies which generate them. The contingencies are usually a part of the physical environment that works in combination with social contingencies (Skinner, 1971).

Chapter 5
Behavior change on three levels of selection

How can we increase an individual's capability to choose more rationally—in the sense that we are better off in the long-run—given that we are Homo sapiens and not Homo economicus? Human behavior is influenced by three levels of selection: phylogenesis (evolutionary history), ontogenesis (learning history during an organism's lifespan), and current cultural practices (the set of cultural practices that are shared among members of a group) (Catania, 2007) which all intervene with each other. Skinner (1981) describes the three levels of selection thus:

> … human behavior is the joint product of (i) the contingencies of survival responsible for the natural selection of the species and (ii) the contingencies of reinforcement responsible for the repertoires acquired by its members, including (iii) the special contingencies maintained by an evolved social environment. (p. 502)

Humans evolve through the constant and progressive physiological and behavioral adaption to the local environment to improve relative fitness from an evolutionary perspective. Three elements are necessary for evolution to occur at the phylogenetic, ontogenetic, and cultural levels; variation, selection, and recurrence (Baum, 2017). Without variation, there will not be any natural selection, and selection again creates the features of organisms as well as maintains them (Catania, 2007). The Darwinian natural selection approach to human behavior is also described as the selectionist approach within behavior analysis (Glenn, 2004). "Behaviors that contributed to survival were likely to survive" (Biglan, 2003, p. 220).

Behavior, the activity of living organisms, has, according to Skinner (1981), "evolved as a set of functions furthering the interchange between organisms and environment" (p. 501). This implies that all behavior occurs within an environmental context and cannot be emitted in an environmental vacuum. Human behavior is everything people do; how they move, speak, think, and feel (Cooper et al., 2007). Humans are joint products of the processes that shape the physical, biological, and behavioral world (Donahoe & Palmer, 2004). Therefore, to cope with our society`s challenges, such as overweight and obesity, it is crucial to recognize the role of selection at all three levels. Not doing so may seriously impede our efforts (Holth, 2016). Indeed, natural selection will not lead to perfection since species, humans, and cultures

all perish when they cannot deal with rapid changes such as those we face today (Skinner, 1981).

Phylogenetic selection

Phylogeny is the history of the natural evolution of a species (Cooper et al., 2007), and much behavior is influenced by genetically inherited traits. For instance, humans, and other animals, have a dedicated neural architecture for detecting facial features, including the presence of eyes (e.g., Burnham & Hare, 2007). *Gaze detection* is fast and automatic and served as a crucial evolutionary tool in ancestral environments (e.g., detecting lurking enemies and predators). In phylogenesis, genes and individually inherited characteristics have been selected across generations, providing reflexes, fixed action patterns, and respondent conditioning capacity (Baum, 2005). The variation within a population is partly due to environmental factors such as nutrition and climate, and genetic inheritance. During phylogeny, events that enhance fitness by their presence are called reinforcers since they tend to increase behavior that produces them. On the other hand, those events that enhance fitness by their absence are called punishers (Baum, 2005).

Newborns are sensitive to others' gaze from birth, first as a reflex over the first year (e.g., Farroni et al., 2002; Farroni et al., 2004) before they learn the various functions of the eyes and gaze. This implies that both phylogeny and ontogeny contribute to the control of eyes on behaviors. This interplay of selection is the main foundation for later development of our ability to respond to stimuli conveyed by facial expressions and others' eyes to develop social skills. Humans are susceptible to signs of approval and disapproval in others (Baum, 2005). Hence, the eyes as controlling stimuli are highly salient to humans (Vaish et al., 2017). Study 2 in this thesis investigates the influence of a picture of human eyes on hygienic behavior in gyms.

Article 2 Summary

This study was conducted before the outbreak of SARS-CoV-2 and the gyms' closedown to reduce the virus's transmission risk. The use of disinfectants to clean gym equipment has become even more critical since then.

Exercise and training are essential for health and well-being, and gyms and fitness centers are central to people's training facilities. Even though most fitness centers clean their equipment and facilities regularly, it is still easy to become exposed to another person's

pathogens, including viruses, bacteria, or other microorganisms that can cause diseases. To stop the transmission of microorganisms in gyms is a challenge, and infections can be hard to treat and even deadly. Thus, cleaning is of great importance and is the best course of action for reducing microorganisms' transmission and further avoiding antibiotic resistance.

Have you ever had a sudden tingling feeling at the back of your neck? You have the terrifying sensation of being watched. We tend to be on our best behavior when we know that we are being observed and tend to act a bit selfishly or take shortcuts when we believe no one is watching. Previous research (e.g., Bateson et al., 2013; Ekström, 2012) shows that displaying images of human eyes is sufficient to alter behavior in various contexts. Therefore, we wanted to investigate whether this phenomenon is applicable to increase cleaning behavior among gym members.

A picture of *watching eyes* was attached to paper dispensers and cleanser spray bottles at two different gyms in Oslo, Norway. The field experiment included eight workout classes with a total of 254 choice situations. In Center 1, the observations were performed during four spinning classes, and between 31 and 39 people were participating in each class. In Center 2, the observations were performed during four treadmill workout classes, and 23 people participated in each class. In addition, a follow-up study was conducted at Center 2, 5 weeks after the final intervention, where 22 people were participating. The results showed an increase in the number of members who cleaned the equipment at both centers. At Center 1, baseline responses ranged from 45% to 55%, and the intervention increased the positive responses to 81%–83%. At Center 2, we found 39%–41% positive baseline responses, which increased to 65%–73% with intervention. Follow-up responses were 41% positive.

The findings support previous research indicating that human behavior is influenced by the presence of implicit observation cues, in this case observing eyes. However, insights into the long-term effect of implicit observation cues are still needed since the stimuli's salience faded over time.

Ontogenetic selection

Natural selection will guarantee that the most adaptive traits are selected. However, if this were always the case, species would not become extinct. Skinner (1989) emphasizes that natural selection prepares an organism only for a future that resembles the selecting past. The limitation in natural selection is corrected by a different kind of consequence that can select among the variation in samples of behavior within an individual's lifetime; ontogenetic

selection (Skinner, 1989). This process is called operant conditioning, and the selecting consequence a reinforcer (Baum, 2005). A consequent event is considered a reinforcer if it has the effect that it increases the likelihood that similar behavior will occur on subsequent, similar occasions or a punisher if it decreases the likelihood of reoccurrence (Biglan, 2003). The personal reinforcement and punishment history is a part of the ontogeny of the individual.

Studies 3 and 4 in this thesis investigate whether it is possible to rearrange the environment to influence people to choose the healthier food choice (Study 3) and to use hand sanitizer (Study 4).

Article 3 Summary

Healthy food is essential for healthy lives and promotes well-being for all ages, since unhealthy diets are the main risk factors to developing non-communicable diseases such as diabetes, cardiovascular diseases, and cancer. A diet consisting of more fruits and vegetables, more fish, and less meat is a healthier and more sustainable diet, according to The National Action Plan for a Healthier Diet (2017-2021), to combat non-communicable diseases. The dietary guidelines by the Norwegian Directorate of Health are to eat fish two to three times a week and use more fish and fish products for breakfast and lunch. In Norway, we consume more fish than in many other nations. Despite this, only 39% of men and 31% of women eat the recommended amount of fish.

The study aimed to encourage hotel guests to choose to eat more of the healthier fish options and less meat by altering hotel lunch buffets' choice architecture using placement and labeling nudges. An experimental study was conducted in three hotels belonging to the same chain in Oslo, Norway. The participant's choices were observed across three conditions: meat placed before fish (A), fish placed before meat (B), and fish placed before meat with an *Eat smart* sign placed on the fish dish (C). The rest of the buffets remained unchanged. Conference guests (3825 guests at hotel 1, 3710 guests at hotel 2, and 2167 guests at hotel 3) were observed during lunch. The number of entrées taken and the average portion size were also measured.

In all three hotels, the percentage of guests selecting meat decreased in both condition B (48.5%) and condition C (56.1%) compared to condition A (60.3%). The percentage of guests selecting fish increased in both condition B (27.9%) and condition C (34.9%) compared to condition A (23.8%). However, condition B led to a decrease in average fish consumption; similarly, in condition C, fish consumption decreased compared to the baseline

level. The average consumption of fish was 238, 153, and 159 grams in conditions A, B, and C, while the average consumption of meat was 132, 235, and 151 grams in conditions A, B, and C.

Rearranging the order in which food is laid out and using signs can nudge conference attendees toward healthier choices. However, the effect of the two nudges varied between the hotels. The results suggest that the micro-design of lunch buffets influences how well known and well-studied nudges influence guest choices. The effects of food layout order can vary depending on how guests are guided to form queues and whether the available options are visible when the guests line up. Therefore, it is crucial to include the microenvironment when doing interventions in restaurants.

Article 4 Summary

This study was conducted before the outbreak of SARS-CoV-2 and the increased focus on using hand disinfectant. The use of hand disinfectant is even more important now. Even though the frequency of use has increased among many people, there is still considerable room for improvement.

Today, almost 170 years after Semmelweis's discoveries regarding hand hygiene, hygienic behavior is still essential. Despite agreement on the importance of hygiene and knowledge about the transmission of microorganisms, hospital-acquired infections, and antibiotic resistance, people still struggle with hand hygiene compliance. Convincing health care providers to take handwashing seriously is a challenge, and hundreds of thousands of hospital patients get infections each year. Hospital-acquired infections create further suffering for the patient, and in the worst case, may lead to death. They can affect anyone, of any age, in any country, meaning that we have joint responsibility. According to the World Health Organization (2018a), one of our most important, easiest, and most cost-effective infection control measures is hand hygiene.

The purpose of this field experiment was to increase hospital visitors' use of hand sanitizer. Little has been done to improve hand hygiene compliance in hospitals other than with health care workers. In many hospitals and other institutions, hand sanitizers are primarily located behind doors, above sinks or in other places out of immediate sight. The somewhat inconvenient placement might be one reason for the low frequency of use. Timing is vital regarding choice behavior. With placement in bathrooms and bedrooms on the wards, the option to use hand sanitizers is seemingly offered too late after entering the hospital. This

study is a systematic replication of a study done by students of Copenhagen Business School in cooperation with the Danish organization iNudgeyou. The research includes 300 choice situations, 100 per nudge, compared to the Danish study's 90 observations.

The final intervention was based on the nudge-functions: placement, color, norm-emphasizing message and altruistic motive. Introducing the new placement, as a control condition, 7% of the visitors used hand disinfectant. Introducing a red-colored sign, in nudge 1, with the text "Here we use HAND DISINFECTANT" resulted in 46% of the visitors using hand sanitizer. Adding the text "to protect your relatives" in nudge 2, didn't lead to any further increase (40% compliance). The results from both this study and the Danish study indicate that it is possible to increase hand hygiene compliance among visitors by changing the default placement and including a sign.

Cultural selection

Operant conditioning has its limitations, too, like natural selection (Skinner, 1989). Although greatly extending the range of behavior, it also prepares us only for a future that resembles the selecting past since only a small repertoire can be acquired during a single lifetime. However, those limitations are corrected in turn by the evolutionary processes through which organisms receive help from other members of their species. The cultural practices shared among members of a group that pass between individuals independently of ancestral lineage or kinship are the third level of selection called cultural selection (Holth, 2016; Skinner, 1953). This occurs when there is variation in behavior patterns within a particular group and where those behaviors favoring the group's adaptability are selected. Practices that contribute to the group's survival in one culture are transmitted from generation to generation through the shaping of behavioral classes, rule-following (e.g., instruction, advice), and imitation. It is the effect on the group, not the reinforcing consequences for individual members, that is responsible for the evolution of the culture (Skinner, 1981). Without a culturally evolved environment, people would have to learn everything from scratch. The duration of the average human lifespan limits the time available to do this (Holth, 2016). Study 5 in this thesis investigates a cultural practice in Norway called *dugnad*.

Article 5 Summary

In 2017, Norway was granted the title *The Happiest Place to Live*. The Scandinavian countries and, in particular, Norway have for many years placed exceptionally high on lists of

quality of life, economic indicators, and measures of happiness. In search of Norwegian well-being causes, we propose that learning prosocial and cooperative behavior, which stands central in a particular Norwegian cultural practice—*dugnad*—plays a role in the country's success story. The Scandinavian nations' cultures, Denmark, Sweden, and Norway, are similar but also very diverse, and dugnad is a Norwegian word lacking counterparts in any other Scandinavian language. In 2004, dugnad was voted Norway's word of the year.

The heritage of the Norwegian word dugnad is an amalgamation of duge and the suffix nad. Duge means, *to be good enough* or *useful*, while nad corresponds to the Latin atus that is suffixed to a noun to designate passive qualities. The term dugnad refers to a sort of voluntary work done as a community or collective. Traditionally, dugnad was a way of getting big tasks like roofing, haymaking, and housebuilding done by means of collective efforts from the community followed by a meal or a feast.

This article aims to investigate dugnad as a unit of culture by discussing its social context and socially mediated consequences. The article exemplifies how traditions can be understood from a behavior analytic perspective and how such understanding may guide action. Dugnad is a cultural practice in the sense that culture consists of behavior patterns acquired as a result of group membership and that practices are behavioral patterns that are not idiosyncratically acquired by individuals and are, thus, available for replication. The unit of culture is a contingency of social reinforcement (i.e., arranged by other people) that is characteristic of a group.

This article explores how this dynamic of the effects of long-term and short-term consequences on behavior can contribute to the maintenance of and the threat to dugnad practices. The susceptibility of behavior to all three ways of contacting consequences enables forming extended patterns, extended in an individual's time or across several individual's time, such as when participating in dugnad activities. This article suggests that these are the means by which operant selection maintains dugnad activities. Dugnad and its origins are an example of a nurturing environment that promotes prosocial behavior. Paying attention to ontogenetic processes of behavior selection enables us to recognize the complexity of the dynamic and flexible processes that construct social systems.

Chapter 6
Methodological strengths and limitations

All roads lead to Rome, but not all methodology will necessarily yield the same results in the end. This does not imply that there is no convergence between methods and their results. Doing research involves numerous decisions, and when it comes to research methodology, every method has its pros and cons. There will always be some tradeoffs to consider and compromises to make when doing research. With the best intentions and efforts, "the relationship between scientific results and the world that science studies is neither simple nor fully trustworthy" (Shadish et al., 2002, p. 30). Therefore, the best approach to gain an understanding or a fuller picture of the phenomenon under investigation is to use several methods, especially when it comes to humans and complex behavior (List & Reiley, 2010).

The studies presented in this thesis use three different methods. Two of the articles in this dissertation are review studies, one rapid structured literature review, one systematic review. Three of the articles fall within the applied field and are field experiments. One is an interpretative study. In this chapter, I will elaborate on the diverse methods used in this dissertation and provide a broader discussion of the strengths and limitations that are described in the different articles.

Review studies

To get an overall view of a phenomenon, it can be wise to conduct a review study. A literature review can have various purposes, and the search strategy depends on the purpose of the review. These can range from a rapid structured review where components of a systematic review process are simplified or omitted (Tricco et al., 2015), as done in Study 6, to get a brief view of a phenomenon, to a more systematic review to attain a more in-depth knowledge of a research question, as done in Study 1.

Systematic review

A good review study provides an unbiased perspective for the reader regarding a research question. However, according to Krnic Martinic et al. (2019), there is currently no standard or consensus definition of a systematic review. Still, there is a general agreement that a review should be written systematically to be transparent and reproducible. Grant and Booth

(2009) have identified and examined fourteen common review types. They emphasize that few types possess prescribed and explicit methodologies. The Cochrane collaboration, though, describes a systematic review as an attempt to "identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a specific research question. Researchers conducting systematic reviews use explicit, systematic methods that are selected with a view aimed at minimizing bias, to produce more reliable findings to inform decision making" (Cochrane Library, 2000). As defined in the Cochrane Handbook (Higgins et al., 2019), systematic reviews are considered to be the gold standard in knowledge synthesis (Khangura et al., 2012). They do, though, have their limitations. They are very time-consuming, typically requiring between six months and two years to complete, and the research focus is often a very narrow clinical question (Khangura et al., 2012).

Since overweight and obesity are considered one of the major public health problems influencing well-being, a deeper dive into food consumption choices has been prioritized in Study 1. Despite the increased interest in nudging and choice architecture regarding public health (e.g., Forberger et al., 2019; Smith & Toprakkiran, 2019), the field is still relatively new and under-explored. A limited number of articles focus on nudging healthier food choices, as also pointed out by Broers et al. (2017) and Vecchio and Cavallo (2019) in their reviews. Besides, the effects are scarce, there is a lack of conceptual clarity, and many studies have a flawed methodology. Another critical issue regarding effects is publication bias; studies without any significant effects or less robust effects are rarely published (e.g., Hansen et al., 2016; Tincani & Travers, 2019). In building knowledge on what works or not, it is essential to conduct experiments in different contexts, with different populations, different nudges, replicate and publish unbiased of the effects.

By examining the current state of the food nudging research, several systematic reviews were identified (e.g., Arno & Thomas, 2016; Broers et al., 2017; Bucher et al., 2016; Wilson et al., 2016). These reviews were based on searches conducted in 2014/2015. One of the reviews reveals that overall, nudge strategies increased healthy nutritional choices by 15%. However, laboratory studies accounted for 48% of the included studies (Arno & Thomas, 2016). Both lab and field studies were also included in the reviews by Broers et al. (2017) and Wilson et al. (2016). Laboratory experiments yield higher internal validity and are easier to replicate since they exert high experimental control. The disadvantage, though, might be lower ecological validity because of the artificial settings. Besides, laboratory research findings are not necessarily replicated in other settings (Robson & McCartan, 2016). Another critical issue is the participants' awareness of partaking in an experiment that might

bias their behavior. Furthermore, laboratory experiments do not usually last long enough to study repeated behaviors and the possible decay of effects over time.

Vecchio and Cavallo (2019) conducted one of the most recently published systematic reviews, where they examined evidence of nudging approaches in 26 studies to increase healthy food choices. Most of the studies were conducted in the field. Their review focused exclusively on changes primarily related to choice architecture as defined by Münscher et al. (2016), who suggest three basic choice architecture intervention techniques. These are decision information, decision structure, and decision assistance. This means that Vecchio and Cavallo (2019) included studies that mainly altered the decision structure and the physical environment and excluded interventions such as product labeling, sizing, and functional design. This approach might not be in line with the majority view of nudging since, for instance, labeling is one of the most frequently used nudges. Other scholars such as Al-Khudairy et al. (2019), Arno and Thomas (2016), Broers et al. (2017), and Hummel and Maedche (2019) include nudges such as labeling and social references in their systematic reviews.

Vecchio and Cavallo's (2019) review was based on searches conducted in Scopus and Web of Science. Therefore, to provide further insight and to foster the replication and scalability of empirical studies, we wanted to perform searches in PubMed based on the framework of Hollands et al. (2013) further developed by Al-Khudairy et al. (2019). Scopus will usually provide a broader set of results than PubMed, and in a perfect world, we should probably have done an updated search in Scopus as well. Even if Scopus may provide a broad set of results, suboptimal retrieval rates as low as 38% have been observed (Bramer et al., 2017). The use of PubMed adds several unique and relevant references to the review of Vecchio and Cavallo (2019). PubMed is the free version of Medline, which is highly recommended to use when conducting a systematic review and has, for example, been found to retrieve more unique included references (78.8%), compared to Web of Science (68.1%) (Bramer et al., 2017).

The research focus in Study 1 is not in line with a Cochrane review; neither the time nor resources were available. In order to ensure high quality, the review procedure was carried out by following the PRISMA statement for review reporting (Moher et al., 2009). The study selection was executed independently by both authors. The studies included in the review were assessed using a ten items list based on the checklist proposed by Downs and Black (1998), a checklist designed for randomized and non-randomized studies. In the checklist, an overall quality assessment score was calculated. This was done separately by

both authors and then discussed before inclusion. The studies with six points or more were included in the study. Studies aimed at changing only beverage consumption were excluded from this review even though consumption of sugar-sweetened beverages is a significant contributor to the obesity epidemic (World Health Organization, 2014). However, this was also the case in, for instance, the review conducted by Broers et al. (2017).

Rapid structured literature review

To fight the negative trend of non-communicable diseases, an increased interest in and use of technology and social media have emerged. Technology and social media make it possible to have a dialogue independent of time and borders and provide an opportunity for immediate feedback. This open new areas and opportunities to influence public health and well-being (Sigurdsson & Fagerstrøm, 2020). It is possible to reach more people and gather and share health-related information more quickly and directly than at any other time in human history. Consequently, social media plays a role in achieving a new and better public health level that can significantly influence people's well-being. However, when designing a health-related intervention, it is crucial to identify and evaluate validity issues since validity refers to how likely an approximation of a causal relationship is true or false (Cook & Campbell, 1979). With these new opportunities, new challenges unfold regarding methodology and experimental control. Therefore, in Study 6 we wanted firstly to explore the use of health interventions on social media to get a very brief overview of the phenomenon and secondly to investigate validity challenges when conducting research using social media.

A rapid structured literature review includes three major stages: conceptualization (the need and problem definition), operational aspects (conducting the literature search), and structuring and reporting (e.g., Armitage & Keeble-Allen, 2008; McCartney et al., 2017). Compared to the systematic review in Study 1, where two researchers did the literature search independently from the start, one reviewer did the first overall search in this study. The findings were reviewed and updated with additional studies by two other researchers. The inclusion and exclusion criteria are explicit and reproducible, which is likely to have reduced selection and reporting bias in the review. In addition, a concept matrix was designed to structure the studies according to sample, intervention, results, and validity issues, making it easier to verify the findings. A challenge is that most of the health interventions we identified on social media were based on descriptive statistics. This cannot give researchers a clear

answer to the actual effect of using social media in health work. Very few health-related studies were based on experimental designs.

Article 6 Summary

Health interventions in social media are a relatively new phenomenon. Health-related intervention can be defined as policies and programs that attribute health risk to factors such as social, economic, and environmental conditions. There are several advantages of using social media when conducting health interventions, such as no geographical restrictions and immediate delivery of information and feedback. However, when the access and the resources are more or less unlimited, will that influence experimental control? To get an overview, we conducted a rapid structured literature review on health intervention studies done via social media focusing on validity challenges since validity refers to how likely the approximation of a causal relationship is true or false.

As a framework, we used the four validity types described by Cook and Campbell (1979): statistical conclusion validity, internal validity, construct validity, and external validity. An explorative open search was used, and query terms included *Facebook*, *health*, *intervention*, and *social media*. The collection of data was done by searching the databases *Scopus*, *PubMed*, *Medline*, *PsycINFO*, and *Web of Science*. The keywords can be used in a broad sense, and there were many hundreds of hits. Facebook was selected over YouTube and Twitter because Facebook is the biggest social media platform. The inclusion criteria were that the health topic should be related to the World Health Organization's definition of health: "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." Since both the keywords used and the World Health Organization's definition of health are extensive, we cannot rule out that the search strategy adopted missed essential and relevant articles. Forty-four studies were included in the review.

The review provides researchers with an overview of health interventions in social media and challenges with validity. The findings show that health interventions in social media have validity challenges because of the small sample size, geographic area, level of reductionism, measurement instruments, participants' memories, experience, and lack of experimental control. The number of articles included in this review is a limitation. Forty-four articles is an acceptable number, but a larger sample size may have shown other types of interventions and challenges to validity. The conclusion is that health intervention in social media is possible and needed. However, focus on validity is essential.

Field experiments

The three field studies (2, 3, and 4), presented in chapter 5, *Behavior change on three levels of selection*, fall within the applied field. Applied behavior analysis is concerned with problems of social importance (Baer et al., 1968). This emphasizes that within applied behavior analysis, it is essential to have a strong rationale for any experimental intervention underlying that it is socially valid (e.g., Bailey & Burch, 2002; Wolf, 1978). Social validity implies that behavioral change is beneficial for society, that the ends justify the means, and that the citizens are satisfied with the effects (Bailey & Burch, 2002; Wolf, 1978). According to Bailey and Burch (2002), the term applied infers that a technology is being used to achieve a practical effect of more immediate social value. Mace and Critchfield (2010) also argue for the need to better coordinate basic science and applied work, bridging research toward the fundamental problems of most significant societal importance. All the experimental studies included in this thesis are of social importance grounded in empirical evidence. Healthy diets are essential, and fish consumption is beneficial for our health. Hospital-acquired infections are a challenge, and hand hygiene compliance is one of our best preventive tools. Hygienic behavior is one of the most effective measures to prevent the spread of pathogenic microorganisms.

In the applied studies in this thesis, we aimed to see if we could increase healthier food choices (Study 3) and hygienic behavior (Studies 2 and 4) in a natural setting since both food and hygiene impact well-being. According to Baer et al. (1968), applied research is "constrained to examining behaviors which are socially important, rather than convenient for study. It also implies, very frequently, the study of those behaviors in their usual social settings, rather than in a 'laboratory' setting" (p. 2). Field experiments allow us to observe meaningful behavior that is socially important in an environment that captures natural settings yielding high ecological validity (List & Reiley, 2010). The disadvantages are that it is impossible to control all variables in the environment, and extraneous variables can influence the dependent variable rather than just the manipulated independent variable. In exchange for increased realism—humans are complex creatures, and many factors incline our behavior—control might be reduced, influencing the internal validity. The lack of control might also limit direct replications. Nevertheless, Harrison and List (2004) argue that to view field experiments as less controlled variants of laboratory experiments would be to mischaracterize them seriously. Neither does it imply that the effect of an intervention necessarily will differ between the two methods. Indeed Camerer (2011) argues that most laboratory findings can be

generalized to comparable field settings. Both methods have strengths and limitations, and to provide deeper insights, a combination of the two is likely better than either in isolation (Levitt & List, 2007).

Behavior analysis is built on experiments (e.g., Poling, 2010; Schlinger, 2010), which is also the case in behavioral economics (e.g., Camerer & Loewenstein, 2003; Weber & Camerer, 2006). According to Skinner (1953), scientific experimentation is the best approach to understanding our surroundings and clarifying functional relationships between the environment and the behavior of organisms. Behavior analytic research is, by definition, aimed at achieving experimental control over the behavioral processes involved. Experimental control is probably the most crucial element when researching since it influences internal and external validity. However, it is much more challenging to gain experimental control in an applied setting than in a laboratory setting. According to Cooper et al. (2007), experimental control has two meanings. First, an experiment's outcome must demonstrate a functional relation, meaning that a predicted change in behavior (the dependent variable) can be reliably produced by manipulating a specific aspect of the environment (the independent variable); a cause-effect relationship. Second, the extent to which a researcher maintains precise control of the independent variable in all circumstances eliminates or holds constant confounding and extraneous variables.

The gold standard for identifying *good* work in applied behavior analysis is the seven-dimension framework introduced by Baer, Wolf, and Risley in their 1968 article (Critchfield & Reed, 2017). This is not an easy task, if at all conceivable, when it comes to field experiments like the ones presented in this thesis. Discussing whether a given practice or research project really qualifies as applied behavior analysis according to specifications of Baer et al. (1968) has been a recurring ritual nicknamed *baerwolfrisleying* in applied behavior analysis (Critchfield, 2015). The strict and somewhat rigid dimensions of Baer et al. (1968) place, according to Critchfield (2015), cumbersome restrictions on research by (wrongly) assuming that practices that do not correspond to the dimensions are bad. As Hantula (2019) points out, "Social problems are not rocket science. They are behavior science. They are more complex" (p. 368), which challenges the seven dimensions introduced by Baer et al. (1968).

The three field studies presented in chapter 5 are observational. Observable behavior—what the person actually *does*—is the primary focus in behavior analysis (Bailey & Burch, 2002). In all three experimental studies, the participants have no awareness of being observed, which lends the data far greater generalizability. The observer's location was carefully considered in all the studies to ensure that there would not be an observer effect. All

the studies had a team of at least two observers to eliminate and control for observer bias. In all the studies, the observers had detailed information on the experimental conditions, and an interobserver agreement test was conducted in all three studies. In Study 2, the observers participated in the workout sessions using spinning bicycles or treadmills at the back of the room. In each session, the observer recorded if a position was used and whether the user cleaned the spinning bicycle/treadmill. Data were recorded manually on predesigned observation forms in all the experiments. In Study 3, there was one observer per buffet. The observers were placed as discreetly as possible in the corner of the buffets. It was close enough to record but far enough not to interfere with the guests. In Study 4, the research assistant was located out of sight for hospital visitors in the main corridor, one level down from the ward, with a clear view of the free-standing hand sanitizer located on the footbridges. The research assistant also used hospital clothes. Every hospital visitor that passed the nudge was registered. People wearing hospital uniforms were not included in the study; neither were patients. It was not overly crowded in the hospital, but we cannot rule out some contagion effect.

Different procedures were used to facilitate experimental control in the included studies. Using an A-B-A-B design and two centers independently and in parallel, Study 2 gives sufficient control in a field experiment. This reversal design commonly demonstrates reliable control of behavioral change (Baer et al., 1968). The disadvantage of using an A-B-A-B design is that there might be a carry-over effect from the B1 intervention to the A2 control. Participants were not randomly allocated to each condition. Since random allocation cannot be guaranteed, this might violate the chi-square statistical testing's key assumption that each subject may contribute data to one and only one cell in the $\chi 2$ (McHugh, 2013). We could have included a registration up-front to check whether the same members were present for several conditions. Unfortunately, this was not common practice at these training centers. Adding this practice might have revealed this as an experiment, creating questions from the members and a potential bias. If participants were exposed to more than one condition, this might indicate that the intervention worked even better. Nowadays, at least in Norway, it is common to register upfront because of COVID19 to facilitate better tracking of the spread of the disease. Future studies could include pre-registration and potentially a post-session questionnaire to gain added information about participants and their cleaning behavior with the new situation and common registration practice. In such a case, one would have to consider biases regarding the intention-behavior gap and self-reported data.

Study 3 included three conditions, baseline, availability, and labeling, in three locations with a randomized order at the three sites. During the intervention, the buffets' changes were the order of the fish and meat dishes and the placement of the sign for the fish option. The three conditions were: condition A, the meat was placed first, condition B, the fish was placed first, and condition C, the fish was placed first, and an *Eat smart* sign placed next to the fish. Each condition was set up for one month in each hotel. The conditions were counterbalanced across the hotels to ensure that seasonal effects and confounding factors had not influenced guests. The order was; hotel 1: A, B, C; hotel 2: C, A, B; hotel 3: B, C, A. The study used two complementary dependent variables, the number of guest choices and average portion sizes. The various designs of the buffets challenged the experimental control of the procedure.

In Study 4, a random allocation would have been difficult without revealing the scope of the study. The different nudges were alternated several times; over locations (in front of different wards) and days to improve the study's strength. Still, we cannot rule out that some participants may have been exposed to the sign multiple times or during less/more busy hours than others. This is a challenge in field experiments and almost impossible to rule out. The absence of a no-norm (sign only) control condition is a weakness. Therefore, in a perfect world, we should have included a fourth condition or maybe also a fifth condition. In addition to the three we had, we could have included one with only the red color and one with the red sign that just said "Hand disinfectant." That would help us disambiguate how much of the effect was due to a social norm-based message versus simply drawing people's attention to the pole that contained the hand sanitizer. Why we didn't do this might be one of the pitfalls of doing a replication, being framed or biased by the previous experiment. We tested the color, though, and the font size to see if that would influence hand hygiene compliance. We also tested different locations. The one chosen was the most optimal if the sanitizing should be as close to the patients as possible to reduce the risk of transmission of microorganisms.

In none of the experiments did we control for any third variables that might have influenced the choices. In Study 3, for example, this could have been the healthy options' attractiveness and taste, how the *Eat smart* sign was interpreted or how characteristics of the guests might have influenced the outcomes, and in Studies 2 and 4, the other participants' cleaning behavior. For instance, in Study 2, we considered including a manipulation check (e.g., a picture of flowers) as done in some studies. Because of limited resources, this was not possible. It is very time-consuming to observe all sessions. Besides, previous research, such as Bateson et al. (2006) and Ekström (2012), showed that pictures of flowers had a minimal

effect compared to human eyes. Nevertheless, a manipulation check or control for stimuli effect could have increased the study's internal validity.

Interpretative studies

Why does Norway score so high on well-being? We argue in Study 6 that the Norwegian dugnad—a historical and cultural practice of cooperative and prosocial behavior—plays a major role. The practice might be both a product of and a contributor to egalitarian and altruistic values and behavior. Promoting effective action is one of the main characteristics of behavior analysis, where effectiveness is evaluated by the increase in reinforcing consequences in our interactions with the world (Zilio, 2019). If the dugnad tradition plays a role in Norway's success, it raises the questions *how?* and *why?* If all human behavior is a function of environmental events that have occurred during the history of our species and environmental events we experience during our lifetime, how and why do people who live in a *dugnad society* behave differently from those who do not? There is little research on dugnad despite its historical value and impact. According to Zilio (2019), "scientific concepts should be evaluated considering their role in promoting effective actions" (p. 49). Therefore, we wanted to describe and discuss dugnad as a cultural practice.

We interpret how this tradition can be understood from a behavior analytic perspective and how such understanding may guide action. Skinner (1984) defines interpretation as "the use of scientific terms and principles in talking about facts about which too little is known to make prediction and control possible" (p. 578). Interpretation, according to Donahoe (2004), "occurs when some phenomenon is observed under conditions that do not permit experimental analysis but to which the fruits of prior experimental analyses may be applied to explain the phenomenon" (p. 83). By having an interpretative approach, we use the behavioral analytic framework based on experiments to describe and understand the cultural practice of dugnad. Still, we think dugnad could be an empirically tractable (although challenging) phenomenon. A measure of dugnad—experimental analysis of contingencies that support maintaining the practice—in various settings such as schools, sports clubs, neighborhoods, and communities could be vital to preserving the practice. A research program on this topic could be beneficial for preserving and advancing prosocial behavior in society.

Chapter 7
Doing well by doing good; Ethical considerations

"Ethical behavior helps protect individuals, communities and environments, and offers the potential to increase the sum of good in the world" (Israel & Hay, 2006, p. 2). To conduct research, independent of what kind of research, ethical considerations are fundamental, and the core value in research is *to do no harm*. This dissertation consists of six articles, all in accordance with the United Nations sustainable development goal 3.

To do or not to do

All the studies in this thesis are about changing someone's behavior in one way or another. To modify someone's behavior should always include ethical contemplation independent of whose behavior one wants to change. But independent of whether we choose to do something or not there are ethical concerns. In other words, to do or not to do, involves a cost-benefit analysis that includes a broader view than the immediate economic cost of an intervention. When it comes to non-communicable diseases, the World Health Organization claims that the cost of inaction far exceeds the cost of action (World Health Organization, 2013a).

The goal should be to promote people's well-being, whether by bringing them benefits or reducing or preventing harm (Rowson, 2006). This can be challenging since well-being is a subjective matter (Diener, 2000). How to measure well-being is a topic of heated discussion in academia and beyond (e.g., Angner, 2010; Kahneman & Krueger, 2006), but that debate is outside this thesis's scope. Nevertheless, it is crucial to be aware that changing someone's behavior, gently or not, interferes with people’s autonomy or their perception of freedom to choose. Besides, people might view the intervention as irrelevant, coercive, and/or manipulative. As Goltz (2020) emphasizes, soft or hard paternalism relies on assuming that someone other than the individual knows better what that person needs, which raises ethical dilemmas when conducting research. As researchers in the studies that are included in this thesis, whether we know better than the participants involved in the studies what is best for them personally, is unknown. However, we do know that despite the fact that people value their health, they often persist in behaving in ways that undermine it, and we need to improve population health.

The experimental studies in this thesis were designed to influence means, not ends. Participants were free to choose, and the cost was negligible. Rowson (2006) describes an ethical framework that is based on four fundamental values; (1) **F**airness, (2) respect for **A**utonomy, (3) **I**ntegrity, and (4) seeking the most beneficial and least harmful consequences or **R**esults that should be a prerequisite for all professionals in society—summarized as FAIR—an easy and useful mnemonic.

Control is not synonymous with coercion

Behavior analysis and behavioral economics in general, and nudging in particular, have been criticized for potentially undermining autonomy and being coercive in the sense that they undermine freedom of choice and are considered manipulative and paternalistic. One reason for the criticism, might be, as Sidman (1993) emphasizes, "Because coercive control is so prevalent, many take *control* and *coercion* to be synonyms. That is why the concept of behavioral control frightens people" (p. 82). The increased interest in influencing behavior through people's environment has renewed the interest in the concepts and the definition of power, freedom, and coercion (e.g., Goltz, 2020; Hansen, 2016; Hausman & Welch, 2010) in several disciplines. However, whether we like it or not, our behavior is influenced by our environment, and there is no such thing as a neutral environment. The control is always there, and not to acknowledge it is, according to Sidman (1989), to hide from reality:

> The conduct of living beings, too, is controlled, and behavior analysis takes as its task the discovery and clarification of the lawfulness that underlies such control.
>
> Behavioral control is therefore not a matter of philosophy or of personal value systems, to be accepted or rejected according to our preference. It is a matter of fact. It makes no sense, therefore, either to reject or to advocate behavioral control. Rather, the laws of control demand investigation. The notion might displease and even frighten us, but the laws of behavior are a feature of the world we live in: we cannot repeal them. (p. 31)

This means that our behavior is dependent on its environment in that we are physically interacting with it (Skinner, 1953). According to Skinner (1953), control is apparent even though we might disagree about how and how much control the environment holds over us. Sidman (1989) asks whether "it is possible to engineer changes in our own environment so as to bring about changes in our own behavior" (p. viii). The intention is to bridge the gap between what we are doing now and its long-term consequences. In the experimental studies

in this thesis, we arranged the environment, so it should be easier to make the *right* or more optimal choice. For instance, in Study 3, where we changed the buffet's order, switching the order of meat and fish did not involve any coerciveness. Also, placing the meat dish first influence the guests' behavior since several experiments reveal that placement and the order of an item influence our behavior, in this case independently of whether it is fish or meat. Ethical behavior modifications aim to help people to make better decisions and increase their well-being.

According to Rachlin (2015), nudges that promote behavior under the control of long-term abstractly conceived reinforcers support individual liberty rather than suppressing it compared to a person whose behavior is under the control of immediate reinforcers, which offer less liberty. It is essential, though, that interventions, independent of type, are evaluated against ethical rules and guidelines to avoid *sludges*, as Thaler (2018) defines by using nudging techniques for less benevolent purposes. Sludges, or marketing goods and services for maximizing profit rather than to improve the buyer's welfare, makes wise decision-making and prosocial activity more difficult.

The paradox of choice

In the United Nations sustainable development goal 3, we are advised to make well-informed choices to help to improve our own health and the health of those around us. This is easier said than done, as the previous chapters illustrate. The world is becoming increasingly complex, and we have more responsibilities. We have to choose everything from health insurance and mortgages to saving for retirement (Thaler, 2018) independently of our competence or knowledge of the topics in question. Besides, nowadays, an immense amount of information is accessible to people; including information relating to our past, present, and future (Sharot & Sunstein, 2020). This comprises everything from false information, to research that is both supportive and non-supportive to something, to which websites we can trust or not, to whether we are able to understand the overwhelming information. In addition, for various reasons (e.g., illiteracy, not access to information), many people cannot seek information and make well-informed choices.

Many of the dozen choices you have made long before you leave in the morning for work or other activities don’t even count as choices. They are so deeply ingrained that you don’t really anticipate the alternatives, and therefore there is little psychological reality to this freedom of choice (Schwartz, 2004). Besides, countless choices are made by default—where

preselection is already in place (e.g., in the configurations in cell phones)—subject to be overridden by those who are affected (Sunstein, 2015). According to Loewenstein (1999), decision-making is both time-consuming and painful, and sometimes we are better off with fewer options. The downside of too many choices is further elaborated by Sunstein (2015), who states that our freedom and well-being would be improved by choosing not to choose. Sunstein (2015) implies that personalized defaults would enrich our lives and that too many choices can be an immense burden.

The studies' ethical considerations

According to Skinner (1956), “The scientist, like any organism, is the product of a unique history. The practices which he finds most appropriate will depend in part upon this history” (p. 13). Another associated issue, emphasized by Cooper et al. (2007), is that ethical or unethical behavior is ultimately related to cultural practices. Sidman (1960) encourages the researcher to evaluate prior work in the field and carefully consider what kind of data, individual or group, should form the basis of the science they are trying to build. A researcher will face situations where there are no clear-cut answers of right and wrong, so research ethics and professional standards will and should always be a concern among researchers. With one leg in the field of behavior analysis and the other leg in behavioral economics, I have tried to maneuver and seek reliable and valid data by following institutional, national, and international ethical research guidelines.

These include the Norwegian National Research Ethics Committee’s "General guidelines for research ethics" (2019). In these guidelines, four principles are underlined: respect, good consequences, fairness, and integrity, which are intended to guide researchers toward high ethical ideals. All four principles reflected in FAIR, mentioned in the introduction to this chapter, have been taken into account from the very beginning of this Ph.D. project. These principles also coincide with the American Psychological Association's "Ethical Principles of Psychologists and Code of Conduct" (2017).

The Behavior Analyst Certification Boards' "Guidelines for Responsible Conduct for Behavior Analysts" is the most relevant advice. These guidelines are consistent with various other ethical guidelines, such as The American Psychological Association (Cooper et al., 2007). Further, The Declaration of Helsinki (The World Medical Association, 2013) is applicable when participants are involved in the research. This is also the case for the national

authority regulations, the Norwegian Centre for Research Data, and the Regional Committees for Medical and Health Research Ethics.

What are the ethical concerns regarding this thesis in addition to the challenges discussed above? The first overall question to ask and answer might be: Is the research of general interest, and is it socially important behavior? The social value of the research is an essential ethical criterion. The broad social goal of the studies included in this thesis is to influence well-being on different levels of selection. It has been argued in previous chapters that the topics under investigation are socially valid. Three of the studies in this thesis have not collected any data about the participants and fall outside the experimental guidelines' scope. The primarily ethical concerns regarding these studies are the originality of the research, co-authorship, and good citation practice; protecting others' intellectual property rights. This is, of course, also applicable to the experimental studies publication procedures.

Study 1, the systematic review, follows the PRISMA methodology strategy (Moher et al., 2009), where the procedure itself ensures high ethical standards. Even though the rapid structure literature review in Study 6 is not conducted with the same strict guidelines, ethical issues are considered. Despite that Study 6 itself is not an experimental study done using social media, it deals with health interventions that have used social media as a part of their interventions. Therefore, it is worth mentioning that using the Internet raises novel ethical issues of personal privacy and public observation for scientists. The use of technology makes it easier to influence and manipulate behavior, and ethics regarding privacy, data ownership, transparency, and autonomy issues raise concern (Goltz, 2020). As Israel and Hay (2006) emphasize, "Not only are ethics an everyday matter of research practice but they are becoming more complex. This reflects both new methodological and technological patterns of working in social sciences as well as broader social, political and economic shifts in our societies" (p. 7).

The three field experiments, Studies 2, 3, and 4, were performed at two training facilities, in hotels, and a hospital, respectively, in agreement with the management. The study participants were those who happened to be present when the experiments were conducted. None of the participants were aware that they were part of an experiment. No personal data was collected nor stored during any of the three experiments. Since no personal information was registered, approval from the Norwegian Centre for Research Data was not needed. The only traceable item in the studies was the image of the pair of eyes used in Study 2. To avoid copyright issues and time and cost to find the right stimuli, we used a picture of one of the authors' eyes. Since the stimuli could be considered partially identifiable, signed informed

consent with permission to publish the image was submitted to the journal before the publication of the article. None of the experimental studies involved physical or mental health in the sense that they employed therapeutic or non-therapeutic methods. Therefore, they were also out of the Regional Committee's scope for Medical and Health Research Ethics. This does not imply that there is no moral dimension when influencing behavior (Robson & McCartan, 2016).

In behavioral science, data rules; meaning that we don't make any unsubstantiated predictions about behavior but stay close to the data (Bailey & Burch, 2005). The fundamental ethos of science is openness and building research on existing knowledge (Björk, 2017). We have strived to be transparent, so other researchers can verify the results and facilitate replications. All the articles are published in peer-reviewed journals that are registered in the Norwegian Centre for Research Data. Five of the articles are published in open access journals, which is an essential step in the dissemination to reach a wider audience. Ethics is a process and not an endpoint; meaning that ethics should be considered throughout the whole research process (Robson & McCartan, 2016). Finally, it is vital to be aware that ethical codes and guidelines are human products, and many of the codes have undergone several revisions. They are not based on an allegedly infallible procedure (O'Donohue & Ferguson, 2003).

Chapter 8
General discussion

This thesis's overall aim was to further expand our understanding of choice behavior regarding well-being by considering different levels of selection in behavior analysis with an emphasis on the behavioral economic framework. In the introduction to the thesis, a conceptual framework was presented to highlight the interchange between behavior analysis and behavioral economics to further span the corroborating trends and the interdisciplinary approach (e.g., Bickel et al., 1995; da Rocha & Hunziker, 2020; Furrebøe & Sandaker, 2017). As stated in the purpose of the dissertation, the included research has an applied approach. The primary focus has been socially important behavior that has a general interest related to the United Nations sustainable development goal 3. We must: "Ensure healthy lives and promote well-being for all at all ages" .

I have purposely focused on common ground between behavior analysis and behavioral economics, highlighting some of the two disciplines' strengths. Therefore, the discrepancies between the two fields are deliberately omitted in this dissertation. Examples of disagreements or criticism of behavioral economics can include; whether reinforcement can be regarded as interchangeable with utility, the use of mentalistic concepts, and if large-scale interventions can explain individual behavior (e.g., Furrebøe & Sandaker, 2017). However, my choice of excluding the discourse does not imply that I disagree with some of the skepticism, neither that I disregard other people's valuable work and research. It is more of a fundamental belief that humans might be better off in the end if we strive for consilience; if we concentrate on where we can bridge knowledge. After all, every science has its strengths and weaknesses.

First and foremost, the two fields share an essential common ground: to improve people's lives. This is my starting point for this dissertation. To achieve this goal, behavior analysis and behavioral economics represent different theoretical and methodological approaches. The focus of the research studies included in this dissertation has mainly been to rearrange the environment to sway people's choices in a healthier direction, which can be regarded as nudging or choice architecture or simply manipulating the antecedent of behavior.

Both disciplines are concerned with how context influences choice behavior and postulate that humans depart from the classic idea of Homo economicus—a perfectly rational agent. According to Ariely (2008), people are *predictably irrational*. However, whether the

causal mode for choice behavior is found in rationality according to classical economic theory or in irrationality according to behavioral economics is not essential from a behavioral analytic perspective (Furrebøe & Sandaker, 2017). The functional relation, the outcome of human environment interactions, is of interest in behavior analysis. Therefore, in this dissertation, the selectionist perspective in behavior analysis has been emphasized to understand human behavior and its function in designing interventions. Lastly, instead of using a single-subject design, which is the traditional approach in behavior analysis, the studies included are more in the domain of behavioral economics, in the sense that a broader population is included in the research. Nevertheless, the aim has been to target one behavior at a time to achieve the best attainable experimental control.

In the overall introduction in chapter 1, some of the challenges we face in modern society were described. Chapters 2 and 3 further emphasized *why* and *how* our daily choices play a leading role in many of these encounters. The overreaching focus in the included studies has been to improve well-being by influencing healthier choice behavior in a broad sense. The topics chosen for the different studies were selected because they affect society at large. In addition, the issues under investigation are some of our biggest challenges, such as food choices and obesity, hand hygiene and transmission of infections, prosocial behavior and nurturing environments. The methodological strengths and limitations, and ethical issues regarding the studies have been discussed in chapters 6 and 7, respectively. That leaves the key findings to this chapter. In addition to describing and elaborating on the study's contributions and key findings, I will briefly highlight and describe some pitfalls to be aware of when designing nudging interventions. Altogether, this knowledge may contribute to future research on well-being.

Nudging as a tool to improve behavior is often characterized as simple, easy, and low-cost interventions, and this is also the case for the studies in this dissertation. However, using the words *simple* and *easy* concerning behavior change can mask some challenges. According to Craig et al. (2008), few interventions are straightforward. Instead of looking at interventions as simple or complex, one should pay attention to the critical questions in a research project (Richards & Hallberg, 2015), such as "Does the intervention work?", "How does it work?" and "How can we optimize it?" This point is also crucial and relevant regarding nudging interventions, and it is here that knowledge generated by behavior analysis can be used fruitfully.

As found in previous reviews and the systematic review conducted in Study 1, interventions targeting healthier food choices are scarce. Furthermore, systematic studies

within nudging healthier food choices (e.g., Al-Khudairy et al., 2019; Vecchio & Cavallo, 2019) reveal that the effects are minor. In addition, nudging and choice architecture would benefit from better conceptual clarity and experimental control. The systematic review study conducted in this dissertation showed similar results. The effect sizes were very diverse and low, and most of the studies examined included more than one intervention at a time. This makes it difficult to measure, analyze and conclude the effects of each nudge or intervention. Many of the studies included traffic light labeling, which might be a promising strategy. Still, traffic light interventions can also have a downside that will be discussed later in this chapter. Moreover, Study 1 also highlights the challenges such as flawed methodology and unclear framework that must be addressed when experimental nudging studies are conducted.

Data from natural settings are increasingly advocated as a valuable way to test behavioral hypotheses in different fields (Samson, 2015). As part of this dissertation, three field experiments were conducted, emphasizing selection by consequences as a causal mode at three levels: phylogeny, ontogeny, and culture. Since all three levels intervene and influence our choices by their traits and biases, all levels should be considered when applying behavioral interventions. For instance, one of our genetically inherited traits is *gaze detection*, which served as a crucial evolutionary tool in ancestral environments (e.g., detecting lurking enemies and predators). This dedicated neural architecture for detecting facial features, including the presence of eyes (e.g., Burnham & Hare, 2007; Ernest-Jones et al., 2011), has inspired researchers to investigate whether individuals' behavior is altered by being observed or by merely the illusion of being observed by others. Despite an increased interest in recent years, the studies are still scarce, and the results are somewhat mixed (e.g., Cai et al., 2015; Ernest-Jones et al., 2011).

In Study 2, we interpreted that an image of a pair of eyes could improve hygienic behavior: cleaning the gym equipment after use. By using a picture of a pair of eyes, we tried to influence ontogenetic behavior while at the same time considering our evolutionary history: the inherited trait of eye awareness. This approach implies that both phylogeny and ontogeny contribute to the control of eyes on behaviors. The study results are based on 254 individual choice situations during nine observation sessions conducted over nine weeks at two fitness centers. We used an A-B-A-B design, which entails applying and withdrawing intervention following an initial baseline phase. An A-B-A-B design demonstrates direct replication if intervention delivery reliably coincides with behavior change, and intervention removal reliably coincides with behavior returning to baseline levels (Baer et al., 1968; Tincani & Travers, 2019). At Center 1, the positive baseline responses ranged from 45% to 55%, and the

intervention increased the positive responses to 81%–83%. At Center 2, the findings were 39%–41% positive baseline responses, which increased to 65%–73% with intervention. In addition, to be statistically significant, the data revealed that fewer than 50% of the members cleaned the equipment after use. The findings in Study 2 support previous research indicating that human behavior is influenced by the presence of implicit observation cues, in this case, watching eyes.

Digging deeper, we also included a follow-up study that gives added value to the watching eyes research. Field experiments seldom include follow-up studies, which are vital to gain knowledge of whether the nudge or invention endures over time. The follow-up study after five weeks showed that the number of members that cleaned the equipment after use went back to baseline level at only 41%. After exposure over time, the salience of the eye image faded, which might result from the individual's habituation to the stimuli. Hence, insights into the long-term effect of implicit observation cues are still needed. Furthermore, today we live in a world where we are *watched* more than at any time in modern history, both online and on the street, so more research is needed to understand the effects that being watched have on our decisions and actions (Dear et al., 2019).

In Study 3, the aim was to investigate if altering the choice architecture would increase fish intake. In hotel 1, placing fish first did not increase the number of guests who chose fish, but adding the sign, *Eat smart,* led to significant growth in the number of selections. In hotel 2, placing the fish first increased the number of guests who selected fish, but adding the sign had no additional effect. In hotel 3, neither food order nor labeling influenced the number of guest choices. This indicates that Study 3 did not produce any systematic effects since the outcomes were quite diverse for the different hotels. Usually, a lack of systematic effects is regarded as no effect, meaning that the study provides no evidence that the nudging accomplished much. Two obvious points of interest are whether there was something peculiar about the interventions' design or whether the study reveals previously unacknowledged limits to when nudging effects can be expected to occur. The results suggest that the micro-design of lunch buffets influences how well known and well-studied nudges influence guest choices. Food order effects can vary depending on how guests are guided to form queues and whether the available options are visible when the guests line up. Therefore, it is crucial to include the microenvironment when doing interventions in restaurants.

In Study 4, the aim was to increase hand hygiene compliance by hospital visitors, which can ultimately reduce infection rates among patients in hospitals. This can also have

broader implications for the health of the population. Most studies on infection control and hand hygiene have concentrated on medical professionals. Along with health care workers, visitors can potentially transmit pathogenic microorganisms, and hand hygiene is one of the most effective behaviors for limiting transmission of harmful germs and preventing illnesses. Study 4 is a systematic replication of a hand hygiene experiment conducted at Gentofte hospital in Denmark (Aarestrup et al., 2016). This study included 300 choice situations during visiting hours across 3 weeks, compared to 90 observations in the Danish study. In addition, the nudges differ regarding baseline observations and the text on the signs. The hand sanitizers' original positioning at Oslo University Hospital made it difficult and impractical to collect baseline data with the limited resources available. Therefore, the newly accessible placement of the hand sanitizer worked as a control condition. By introducing the new placement in the control condition, 7% of the visitors used hand sanitizer. Adding a red-colored sign with the normative-emphasizing message: "Here we use HAND DISINFECTANT," resulted in 46% of the visitors using hand sanitizer. In comparison, 40% of the visitors used hand sanitizer when the altruistic motive "… to protect your relatives" was added to the message.

The intervention in Study 4 resulted in a quantitatively meaningful and statistically significant increase in hand hygiene compliance, as also shown in the Danish study. However, there was no statistically significant difference between the nudge that simply stated the norm at the hospital and the nudge that stated the norm and included an altruistic motive for compliance. Nonetheless, during the observations, gender was also registered. A closer look at the data revealed an intriguing finding: more women than men used hand sanitizer in response to the altruistic nudge. It would be interesting to further explore this effect.

Studies 2, 3, and 4 are all population-based studies as the participants change over time, and a single participant contributed relatively small amounts of data in the studies. Observing in a natural setting, in which participants are not aware of their participation, lends the data greater generalizability. Unfortunately, it is also very time-consuming, and it can be costly, especially if over long periods. This is the reason for the somewhat small sample size, especially in Studies 2 and 4. Still, even with a small number of observations, the studies produced important insights, expanding previous research.

Sidman (1960) has defined and underlined the importance of direct and systematic replication in behavior analysis research. In recent years, it has become clear that many fields are facing a *replication crisis* (e.g., Camerer et al., 2016; Tincani & Travers, 2019). According to Camerer et al. (2016), it is the ability to replicate empirical findings directly and

independently that gives trust in scientific knowledge. Further, replication is essential to test whether an effect or outcome holds in different contexts or settings. Study 4 is a systematic replication of a study with much smaller sample size. That Study 4 is a replication of another study increases confidence in the conclusions (McNutt, 2014). The experimental design used in Study 2, an A-B-A-B design, also counts as a replication within the study and therefore yields higher validity. Replication studies are critical and necessary for revealing truths about relationships between the environment and behavior.

The systematic review (Study 1) presented in this dissertation revealed that many nudge interventions use multiple nudges simultaneously, and they lack experimental control. Whether the introduction of nudging as *simple* and *easy* tools to change behavior has influenced the research methodology is only speculation. Nevertheless, *simple* and *easy* does not imply that influencing and change behavior is a *quick fix*. Behavior analysis is, as it says, an analysis of behavior, breaking complex behavior down into its functional parts (Catania, 2007). "The analysis of individual behavior is a problem in scientific demonstration, reasonably well understood (Skinner, 1953, Sec. 1), comprehensively described (Sidman, 1960), and quite thoroughly practised [*sic*] (*Journal of the Experimental Analysis of Behavior*, 1957–)" (Baer et al., 1968, p. 1). The challenges concerning human behavior and research that Baer et al. (1968) raised are still current. The primary concern is the reliability and generality of data as explored in Study 6 regarding health interventions on social media and validity challenges. The analytical approach in behavior analysis focuses on the demonstration of experimental control over the behavior in question. That involves designing and executing studies in a way that demonstrates a functional relationship between the procedures implemented and the behavior changed (Bailey & Burch, 2002). One way to demonstrate functional relationship is to use the A-B-A-B design as done in Study 4, where the target behavior is accurately defined and carefully observed through reversal conditions.

The topics under investigation in this dissertation are choices that involve a *social dilemma*. That is, a situation where (immediate) personal interests are at odds with that of the collective. As elaborated in the first three chapters, self-serving choices can collectively lead to harmful outcomes on different levels in society depending on the frequency and number of individuals engaging in the same behavior. Witnessed in the gyms, the baseline data showed that fewer than 50% of the members cleaned the equipment after use, indicating that personal interests or the immediate reinforcer conflict with the collective interest of a clean gym. Or all the small choices' cumulative health effects leading to non-communicable diseases that constitute a significant burden on society. In contrast, the Norwegian dugnad activity is

related to the *common good*; something that is done out of a concern for others' good. In other words, for their well-being, where our verbal community shapes altruistic choices.

Norway has for many years placed exceptionally high on lists of quality of life, economic indicators, and measures of happiness. In search of reasons for Norwegian well-being, we propose a selectionist perspective in Study 5. Learning prosocial and cooperative behavior, which stands central in the Norwegian cultural practice of dugnad, plays a role in the country's success story. Dugnad practices have been transmitted across generations. It is the effect on the group, not the reinforcing consequences for individual members, that is responsible for the evolution of the dugnad culture (Skinner, 1981). By discussing the Norwegian cultural practice of dugnad, Study 5 exemplifies how traditions can be understood from a behavior analytic perspective and how such understanding may guide action.

In addition to the systematic reviews, the studies presented in this dissertation have investigated human behavior, the unit of analysis, as the dependent variable, and environmental events as independent variables across various populations and applied settings by considering different selection levels. The results reveal that it is possible to influence choice behavior by rearranging the environment, at least in the short term. However, we aim for behavior—such as choosing to use the hand sanitizer, cleaning the gym equipment, and eating more fish—to become a habit or a cultural practice on a par with participating in a dugnad activity.

Some pitfalls in designing interventions

The research findings presented and discussed in this dissertation show that many interventions have no, or only a small, impact on choice behavior, as revealed in, for instance, Study 1 and Study 3. Another critical issue, other than the effect of the actual nudge or intervention, is the potential pitfalls when conducting behavioral interventions and implementing nudges. Pitfalls are undesired side-effects and problematic longer-term effects of the nudge. For instance, the consequences of an intervention can be that the effect is only short-term, such as in Study 2 in this dissertation. Nevertheless, this doesn't imply that nudges with short-term effects can't be useful. It depends on the intended use and the purpose of the nudge. However, it is essential to be aware that nudges' effects may fade over time and that follow-up studies and continuous evaluations are needed.

Nudging can also have a *perverse effect*. That is when the nudge has the opposite effect to the intended consequence (Sunstein, 2017), for instance, when calorie and traffic

light labels increase calorie intake. As mentioned previously in this chapter, traffic light labeling has a promising effect on healthier food choices. However, the studies using traffic lights don't usually measure the total food consumption. Hence, if an individual chooses *green* food for lunch, it is unknown whether they choose to eat more later that day to compensate or reward themselves for the good behavior at lunch. If they choose to compensate, this can result in no net effect, indicating that the intervention did not result in reduced overall calorie intake. In the worst case, they choose to eat unhealthier the rest of the day than they usually do, resulting in a perverse effect: an increased calorie intake.

Standardized nutrition facts labels on food are often mandated by federal and local governments and are therefore common practice in many countries worldwide. The rationale behind the policy is that people will make healthier choices if they are informed about food and beverages' energy content (Marteau et al., 2011). The intention is to help people to make better and more well-informed food choices. The obesity epidemic has, particularly in the US, led to further informational interventions in attempts to reduce food intake at the population level. Nutrition labels and calorie posting can benefit people if they understand the information and know how to make use of it. However, numerous research studies have demonstrated that providing nutrition and calorie fact labels is not sufficient to influence healthier food choice behavior (e.g., Downs et al., 2009; Peters et al., 2013). Either they have minor effects, or they might also backfire, such as cheaper meals with more calories which might be viewed as a better deal among low-income dieters (Loewenstein, 2011). Another perverse effect of calorie labeling is the *health halo* trap. It refers to an overestimating of food's healthfulness based on it being low in calories or low in fat, resulting in higher consumption of certain food, yet lower perceived calorie intake (Chandon, 2013).

According to Peters et al. (2013), nutrition labels exceed cognitive limitations. In general, people don't have the knowledge and the capabilities to understand all the information and to do the calculations required to make well-informed choices based on nutrition and calorie labels. The most disadvantaged members of society may also lack the ability to read the information. These issues are related to people's health literacy. Health literacy is defined as people's ability to make *well-informed* decisions and their ability to *use* health information (Centers for Disease Control and Prevention, 2021). Unfortunately, people tend to make poor and rash decisions that are not in accordance with a high degree of health literacy.

Despite the somewhat scarce evidence of the effect of calorie labeling, it is frequently used, indicating that policy gets ahead of science (Loewenstein et al., 2012). More research is

needed to examine how calorie labeling influences subpopulations and what mechanisms may enhance it (Peters et al., 2013). However, even though some nudges seem to have no effect on an aggregated level, this doesn't mean that they don't have any effect at all. Sometimes it is worth doing some sub-analyses to reveal whether a nudge is effective on distinct subpopulations, during distinct periods, or in specific contexts. For instance, calorie labels might have an impact on some people with serious weight problems (Sunstein, 2017).

Recommendations for future research

The findings reported in this thesis reveal that the robustness of many nudges still needs further research. There might be several reasons for this, and some of them have been elaborated on in this dissertation already. For instance, many interventions include multiple nudges and a somewhat flawed methodology. In addition, previous systematic studies and the one included in this dissertation also reveal a lack of a common foundation of the nudging framework. There is no unison framework of the typology of nudges that makes it challenging to compare nudges and their effects. In Study 1, to map the different nudges, we further modified the framework by Al-Khudairy et al. (2019) that is built on the typology of Hollands et al. (2013). The nudging framework could benefit from better clarity regarding the typology, and more stringent methodology, such as focusing on one nudge at a time. In this dissertation's field experiments, we have been very explicit in describing the methods and have included pictures of the interventions in the articles. This is important so that other researchers can evaluate the work. It also makes it easier to conduct replications.

Another issue that is probably even more important when the field is young is publication bias. It is vital to publish despite no effect or not the intended effect being observed. This can be challenging since journals generally prefer to publish significant results. It is essential to learn from failures; what is learned might also reveal other potential nudges or interventions. Furthermore, replications and carefully designed field studies, including follow-up studies in different contexts, are needed to draw definite and general conclusions of what works or doesn't work. Besides, it would be interesting to investigate whether including feedback (reinforcer) after the preferred choice—cleaning the gym equipment after use in Study 2, using the hand sanitizer in Study 4—would further increase compliance. Studies that include antecedents (i.e., prompts, nudge, choice architecture) and feedback (reinforcer) might nurture further compliance and enable new habits.

Concluding remarks

Most of the challenges we face in society are rooted in our behavior, and small cumulative choices can lead to global challenges (i.e., poor hand hygiene and transmission of pathogens). Likewise, even though some interventions might yield small effects, the cumulative consequences or the *peanuts effect* might influence our well-being in the long run. To cope with today's challenges regarding well-being, whether it is obesity, hygiene, or societal issues, we need high-quality, scalable, and effective interventions. We need a *unity of knowledge*, a global dugnad to save the world. This means to harness and implement best evidence practice independently of disciplines, such as nudging theory, and larger-scale interventions from behavioral economics and the selectionist perspective, and more stringent methodology from behavior analysis.

Behavior is complex, context is compelling, and details matter; therefore, there is no *quick fix* and not one solution for all. To improve well-being, it is critical to understand behavior and how environmental conditions influence choices on all three levels of selection and all scales to develop successful human well-being interventions. After all, we are Homo sapiens and not Homo economicus.

Epilogue

Before leaping into a project, you need to have an idea about what you are letting yourself in for… Does this also apply to a Ph.D. project? I thought I had an idea, but frankly, I don’t think anything turned out as planned. When I started my master's degree and got acquainted with behavior analysis, I got hooked. I was a naïve rat believing that we could save the world with behavior analysis; Walden Two would become a reality. I still have faith and a lot of enthusiasm, but I have transformed from a naïve rat to a dirty rat, or I might just be more realistic in my optimism.

After this hazardous roller-coaster trip, including everything from failed experiments, refusals, new knowledge, publications, cooperation, unwilling competition, conferences worldwide, frustration, new friendships, and joy to a research stay at Carnegie Mellon University, I was also diagnosed with cancer. Before the diagnosis, I thought that if something very serious happens, one would easily make optimal choices and change behavior. The only thing that really changed… was this idea. I am surer than ever that to combat the challenges we face in society regarding well-being, whether it is on an individual, organizational, or societal level, we need involvement such as that presented in the Norwegian dugnad, interventions targeting all three levels of selection, and a *unity of knowledge*.

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Article 1

Tørris, C., & Mobekk, H. (2019). Improving cardiovascular health through nudging healthier food choices: A systematic review. *Nutrients*, *11*(10), Article 2520.
DOI: https://doi.org/10.3390/nu11102520

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Review

Improving Cardiovascular Health through Nudging Healthier Food Choices: A Systematic Review

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Received: 29 September 2019; Accepted: 15 October 2019; Published: 18 October 2019

Abstract: Obesity and metabolic syndrome are considered major public health problems, and their negative impact on cardiovascular disease (CVD) and diabetes mellitus type 2 (DM2) is profound. Targeting modifiable risk factors such as dietary habits is therefore of great importance. Many of today's health challenges with overweight and obesity may have behavioral roots, and traditional methods such as regulations and campaigns are often insufficient to improve dietary choices. Nudging or choice architecture might be a viable tool to influence people's everyday choices and behaviors to better outcomes. This paper reviews the current state of the rapidly expanding number of experimental field studies that investigate the effects/associations of nudging on healthy food choices. A systematic literature search was conducted in PubMed, where 142 citations were identified. Based on selection criteria, six randomized controlled trials and 15 non-randomized controlled trials were ultimately included. The results of this systematic review show that many of the studies included traffic-light labeling, which may be a promising strategy. The reviewed findings, however, also highlight the challenges that confront experimental studies examining the impact of nudging on diet.

Keywords: food choice; eating behavior; healthy food; nudging; choice architecture; obesity; cardiovascular health; diabetes; public health; dietary habits

1. Introduction

Metabolic syndrome (MetS) affects public health, and has been associated with a doubling of cardiovascular disease (CVD) risk as well as a five-fold increased risk of diabetes mellitus type 2 (DM2) [1]. To be diagnosed with MetS, three of five risk factors (abdominal obesity, elevated triglycerides, reduced HDL cholesterol, elevated blood pressure, and elevated fasting glucose) have to be found [2]. Obesity seems to be a driver of MetS, and the highest prevalence of MetS is found in obese populations [3]. The syndrome affects public health, as it increases the risk of morbidity and mortality [4]. Studies from most countries indicate that 20–30% of the adult population can be characterized as having MetS, and the prevalence seems to increase with age [3]. In addition, both parity and increased numbers of children have been associated with higher rates of MetS in women [5]. In addition to genetic predisposition, the initiation of MetS is influenced by environmental factors, such as a sedentary lifestyle together with a diet containing excess calories [6,7]. Targeting modifiable risk factors such as dietary habits is therefore of great importance to reduce the number of morbidity and mortality.

Throughout the past decades research in behavioral sciences has revealed that human behavior and decision-making is boundedly rational, and as a result, people make suboptimal, often self-destructive

decisions [8]. Therefore, many of today's health challenges, such as overweight and obesity, have behavioral roots. These unhealthy habits contribute to the development of long-term conditions such as diabetes and cardiovascular diseases. A habit becomes established by repetition and routine [9]. Even though most people are aware that their habits or lifestyle are unhealthy, especially in the long run, they are not able to change their behavior since it is habitual and influenced by the environment where the choices are made [10]. According to Marteau, Hollands, and Fletcher, 2012 [9], a great part of human behavior is automatic and cued by stimuli in the environment, which in turn results in actions unaccompanied by conscious reflection. Vecchio et al., 2019 [11] also argue that food choices are more likely to fall into the category of fast and unconscious decisions. In addition, as stated by Scott and Loewenstein, 2008 [12], "the benefits of eating are immediate and tangible, whereas the benefits of dieting are delayed and intangible" (p. 3819).

To improve health outcomes nudging or choice architecture (a related term) [13] might be a viable tool to influence people's everyday choices and behaviors to better outcomes. In their popular book "Nudge: Improving Decisions About Health, Wealth and Happiness" (2008) [8], Richard Thaler and Cass Sunstein suggest that rearranging the contexts (i.e., physical, social, and psychological) where decisions are made may "nudge" or sway people toward preferred options rather than obstructing or imposing behavior. Nudging does not rely on effortful processes but rather on many decisions that are made automatically and unconsciously [14]. Nudging implies an analytical and experimental approach to changing behavior by integrating insights about human behavior and its boundaries, biases, and habits into the choice architecture [15]. There has been an expansion of research regarding how the environment in which our decisions are made influences us. Findings from this research show that behavioral and contextual interventions based on nudging strategies are promising for promoting healthy eating. Hummel et al., 2019 [16] note that nudges are not just a theoretical concept anymore, but something that might affect citizens in many countries through their increased influence in the political decision-making process.

Several systematic reviews have suggested that nudging may be effective in increasing the consumption of healthy food and decreasing the consumption of unhealthy food: Broers et al., 2017 [17] (nudging to encourage people to select more fruit and vegetables), Arno et al., 2016 [18] (nudge strategies and changing adults' dietary choices to healthier ones), Wilson et al., 2016 [19], (nudging and its influence on adults food and beverage choices) and Bucher et al., 2016 [20] (the effect of positional changes of food placement on food choice). These reviews were based on searches conducted in 2014–2015. One of the reviews reveals that overall nudge strategies increased healthy nutritional choices by 15%. However, laboratory studies accounted for 48% of the included studies [18]. Both lab and field studies were included in the other reviews as well [17–19]. Recently, Vecchio et al., 2019 [11] did a systematic review of the literature (2016–2018) where they investigated evidence of nudging approaches to increase healthy food choices. The results showed that more than 80% (21 of the 26 included studies) of the reviewed research reported positive outcomes [11]. Most of the studies were conducted in the field. However, none of the nudge types were considered more effective than others. The review by Vecchio et al., 2019 [11] was based on search conducted in Scopus and Web of Science. In addition, Vecchio et al., 2019 [11] focused exclusively on changes primarily related to choice architecture as defined by Münscher, Vetter, and Schuerle, 2016 [21]. This involved studies that mainly alter the decision structure and the physical environment and excluded interventions such as product labeling, sizing, and functional design. The field is rapidly increasing and to provide further insight and to foster the replication and scalability of empirical studies we wanted to do a search in PubMed based on the framework of Hollands et al., 2013 [13] and further developed by Al-Khudairy et al., 2019 [22]. The use of PubMed adds several unique and relevant references to the review, which were not found/included in the paper by Vecchio et al., 2019 [11]. Therefore, we wanted to contribute to the current literature on the topic by conducting searches in PubMed.

To better understand how nudges may be implemented in real-world settings, this review primarily aims to examine experimental field studies, investigating effects/associations of nudging on

healthy food choices, and if there are specific nudges that are more effective than others. We included studies involving actual food choices that can have a real impact on food selection and/or actual food consumption versus perception or choice intentions. This gave further guidance and understanding of how to best implement nudges in a real-world setting. The research question was explored by reviewing experimental field studies conducted on humans, and reporting nudging or eating behavior as being related to healthy food choices.

2. Materials and Methods

In order to identify published studies examining nudging and/or the related term choice architecture [13], versus possible effects/associations on healthy food choice in humans, a literature search was performed in PubMed. The combined search terms were (1) *nudge* and *food choice,* (2) *choice architecture* and *food,* and (3) *nudging* and *healthy food*.

According to Hollands et al., 2013 [13], choice architecture involves altering small-scale physical and social environments, or microenvironments such as restaurants, cafeterias, lunchrooms, and shops, to cue healthier behavior. This is a more context specific definition than the definition stated by Thaler and Sunstein in "Nudge: Improving Decisions About Health, Wealth And Happiness" in 2008 [23]. The last search was performed in July 2019. Potential abstracts and full-text articles were screened before removing duplicates. Both randomized control trials (RCTs) and non RCTs (published field studies) written in English were included. Animal and lab studies were excluded. A summary of the selection criteria (participants, interventions, comparators, and outcomes) were considered according to PICOS strategy, and is provided in (Table 1). The procedure for the review was carried out in accordance with the PRISMA statement for review reporting [24], and a protocol of the study selection was made. The study selection, which took place during January 2019 to July 2019, was conducted independently by CT and HM. The studies included in the review were assessed using a ten items list (resulting in 11 points), based on the checklist proposed by [25], a checklist designed for both randomized and nonrandomized studies. In the checklist, an overall quality assessment score was calculated. This was done separately by CT and HM, and then discussed before inclusion. The studies with six points or more were included in the study. The selection process is illustrated via a flow diagram (Figure 1).

Table 1. Inclusion and exclusion criteria.

PICOS	Inclusion Criteria	Exclusion Criteria
Population	Humans	Animal studies
Intervention	Nudging interventions aimed at increasing healthy food choice	Lab studies Not food
Comparison		
Outcome	Food choice/consumption	Studies that do not report food choice/intake as primary outcome
Study design	Randomized and nonrandomized controlled trials (quasi-experimental study)	Abstracts and protocols

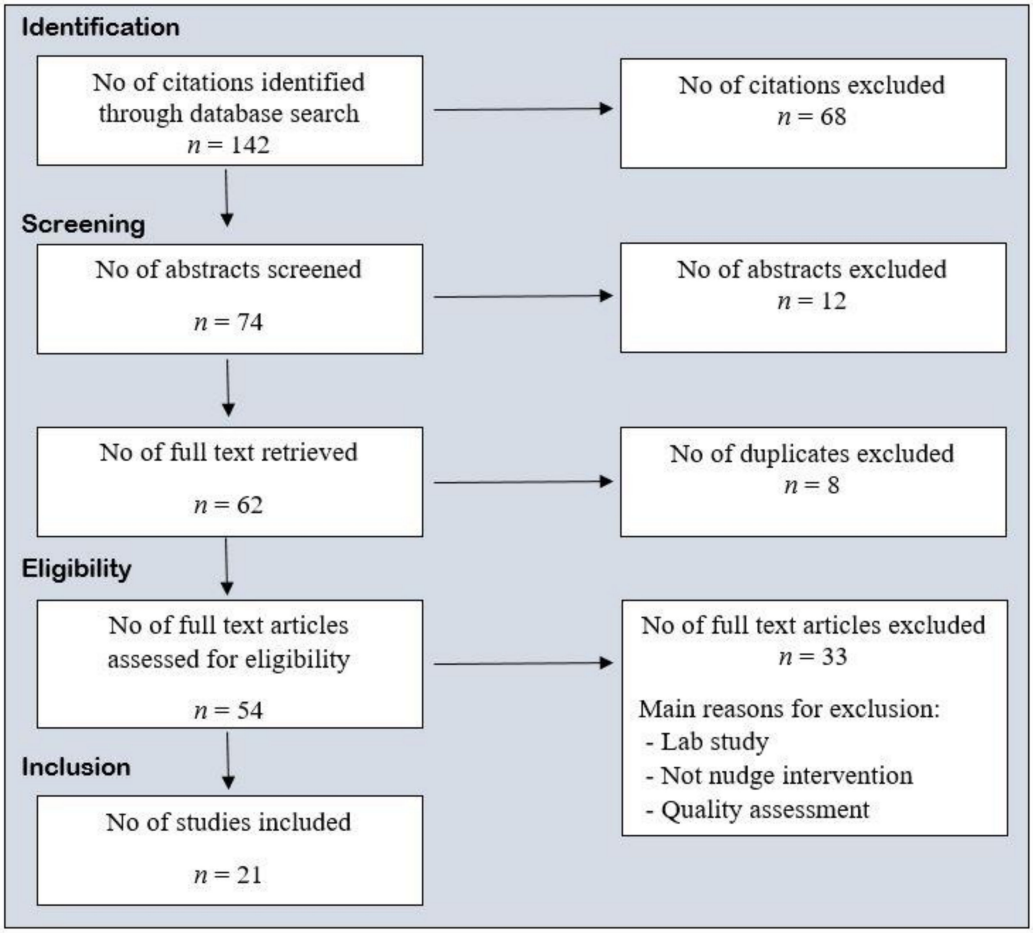

Figure 1. Flow of studies through the different phases of this systematic review.

The majority of studies regarding nudging and/or choice architecture consist of multiple nudges and/or interventions. This makes it a challenge to map the different nudges and to evaluate their effects. However, Hollands et al., 2013 [13] have developed a provisional typology of choice architecture interventions that enable grouping of studies. The typology is divided into three intervention classes as presented in Table 2.

Table 2. Nudging and choice architecture typology from Al-Khudairy et al., 2019 [22] and Hollands et al., 2013 [13].

Intervention Class	Intervention Type
Primarily alter properties of objects or stimuli	Ambience—alter aesthetic or atmospheric aspects of the surrounding environment
	Functional design—design or adapt equipment or function of the environment
	Labeling—apply labeling or endorsement information to product or at point-of-choice
	Presentation—alter sensory qualities or visual design of the product
	Sizing—change size s of the product
	Pricing—change price of the product
Primarily alter placement of objects or stimuli	Availability—add behavioral options within a given microenvironment
	Proximity—make behavioral options easier or harder to engage with, requiring reduced or increased effort
Alter both properties and placement of objects or stimuli	Priming—place incidental cues in the environment to influence a non-conscious behavioral response
	Prompting—use nonpersonalized information to promote or raise awareness of a behavior

3. Results

The literature search identified 142 citations, of which 31 were found in the first search (*nudge* and *food choice*), 79 in the second search (*choice architecture* and *food*), and 32 in the third search (*nudging* and *healthy food*). After screening 74 studies (i.e., titles and abstracts), 62 full-text articles were retrieved and assessed for eligibility. After removing duplicates and those not making it through quality assessment, 21 studies were included in this review. The included studies comprise of six RCTs and 15 non RCTs. A matrix was designed to get an overview over all the included articles. The articles were structured according to reference, participants/site, and results. The study characteristics are provided in Table 3, and the nudges/interventions are presented in Tables 4–6.

Table 3. Characteristics of included studies.

Reference	Participants/Site	Results
RCTs		
Anzman-Frasca et al., 2018 [26]	58 families with 4–8 year old children, quick-service restaurant	Placemats: ordered more healthy food compared to controls (B = −1.76, 95% CI −3.34, −0.19). No (overall) differences in dietary intake compared to control.
Cohen et al., 2015 [27]	Students 1–8 grade urban, low-income districts, school cafeteria	Fruit and vegetable selection increased in smart cafe, however smart café intervention alone had no effect on consumption.
Greene et al., 2017 [28] 9 week cluster	Ten middle schools (5–8 grade), cafeteria	Overall, fruit selection increased by 36% ($p < 0.001$), and fruit consumption increased by 23% ($p < 0.017$) in the fruit intervention group, compared to controls.
Hollands et al., 2018 [29] stepped wedge	Nine worksite cafeterias	No significant change in daily energy purchase when data from all six sites were pooled.
Vasiljevic et al., 2018 [30]	Six worksite cafeterias	No overall effect in energy purchase. One site 6.6% reduction (95% CI −12.9 to –0.3, $p = 0.044$) in energy purchased, however, the association diminished over time.
Velema et al., 2018 [31]	Employees	Positive effects on purchases for three of seven products
Non RCTs		
Cole et al., 2018 [32]	US Army active duty soldiers, military installation	Intervention associated with increased diet quality and consumption of healthy food.
Hubbard et al., 2015 [33]	Students (n 43) 11–22 years with intellectual and developmental disabilities	Smarter lunchroom increased selection (whole grains) and consumption (whole grains, fruit) of healthy food.
Kroese et al., 2015 [34]	Travelers, train station snack shops	More healthy (but not fewer unhealthy) products were sold in both nudge conditions.

Table 3. *Cont.*

Reference	Participants/Site	Results
Levy et al., 2012 [35]	Employees who were regular cafeteria patrons (n = 4642)	Labeling decreased unhealthy purchases and increased healthy purchases.
Lowe et al., 2010 [36]	Employees, worksite cafeteria	Total energy intake: no difference. Dietary intake improved over study period.
Nikolaou et al., 2014 [37]	120 students, catering	Calorie-labeling associated with a 3.5 kg less weight gain.
Olstad et al., 2014 [38]	Patrons, recreational swimming pool	In the full sample, sales of healthy items did not differ across periods. In the subsample, the sale of healthy items increased by 30% when signage + taste testing was implemented ($p < 0.01$).
Seward et al., 2016 [39]	6 college cafeterias (Harvard University, Cambridge, Massachusetts)	No significant changes (items served) were revealed when intervention sites were compared with controls.
Thorndike et al., 2014 [40]	Cafeteria	The traffic-light and choice architecture cafeteria intervention resulted in increased sale of healthier items over 2 years (from 41% to 46%).
Thorndike et al., 2012 [41]	Hospital cafeteria	A color-coded labeling intervention improved sales of healthy items and was enhanced by a choice architecture intervention.
Van Kleef et al., 2018 [42]	Participants at a Dutch university	Regardless of the topping, when the whole wheat bun was the default option, 94% decided to stick with the default.
Van Kleef et al., 2015 [43]	Customers in self-service restaurant during breakfast	The sales increased significant during the verbal prompts intervention periods compared to baseline.
Van Kleef et al., 2014 [44]	Children (n = 1113) primary schools in the Netherlands	Consumption of fun-shaped whole wheat bread rolls almost doubled consumption of whole wheat bread (p = 0.001).
Van Kleef et al., 2012 [45]	Students	Assortment structure led to higher sales of healthy snacks.
Vermote et al., 2018 [46]	University students and employees	Total french fries intake decreased by 9.1%, and total plate waste decreased by 66.4%. No differences in satiety or caloric intake (dietary recall) between baseline and intervention week.

RCT: Randomized Control Trials.

Table 4. Nudging and choice architecture types and effectiveness examined in the included studies.

Intervention Class	Intervention Type	Anzman-Frasca et al. 2018 [26]	Cohen et al. 2015 [27]			Cole et al. 2018 [32]	Greene et al. 2017 [28]	Hollands et al. 2018 [29]	Hubbard et al. 2014 [33]	Kroese et al. 2015 [34]	Levy et al. 2012 [35]	
			A	B	C						A	B
Primarily alter properties of objects or stimuli	Ambience											
	Functional design											
	Labeling	X		X	X	X	X				X	X
	Presentation		X	X			X		X			
	Sizing							X	X			
	Pricing											
Primarily alter placement of objects or stimuli	Availability					X	X		X			
	Proximity			X	X		X		X	X		X
Alter both properties and placement objects and stimuli	Priming									X		
	Prompting	X							X	X		
	On food choice							N		Y	Y	Y
Effect	On dietary consumption Short-term	N	Y	Y	N	Y	Y		Y			
	On dietary consumption Long-term		N	Y	N	Y						

A, B, and C refer to different conditions in the same study. Effect: Short-term <6 months, and long-term ≥6 months. X: Nudging and choice architecture types. Y: Yes, N: NO.

Table 5. Nudging and choice architecture types and effectiveness examined in the included studies.

Intervention Class.	Intervention Type	Lowe et al. 2010 [36]		Nikolaou et al. 2014 [37]	Olstad et al. 2014 [38]			Seward et al. 2016 [39]	Thorndike et al. 2014 [40]		Thorndike et al. 2012 [41]	
		A	B		A	B	C		A	B	A	B
Primarily alter properties of objects or stimuli	Ambience											
	Functional design											
	Labeling	X	X	X	X	X	X	X	X	X	X	X
	Presentation						X			X		X
	Sizing											
	Pricing		X				X					
Primarily alter placement of objects or stimuli	Availability	X	X					X				
	Proximity									X		X
Alter both properties and placement objects and stimuli	Priming					X	X					
	Prompting											
Effect	On food choice	Y	Y		N	N	N	N	Y	Y	Y	Y
	On dietary consumption Short-term											
	On dietary consumption Long-term			Y								

A, B, and C refer to different conditions in the same study. Effect: Short-term <6 months, and long-term ≥6 months. X: Nudging and choice architecture types. Y: Yes, N: NO.

Table 6. Nudging and choice architecture types and effectiveness examined in the included studies.

Intervention Class.	Intervention Type	Van Kleef et al. 2018 [42]	Van Kleef et al. 2015 [43]	Van Kleef et al. 2014 [44]	Van Kleef et al. 2012 [45]	Vasiljevic et al. 2018 [30]	Velema et al. 2018 [31]	Vermote et al. 2018 [46]
Primarily alter properties of objects or stimuli	Ambience							
	Functional design							
	Labeling					X		
	Presentation			X			X	
	Sizing						X	X
	Pricing						X	
Primarily alter placement of objects or stimuli	Availability				X		X	
	Proximity	X			X		X	
Alter both properties and placement objects and stimuli	Priming						X	
	Prompting		X					
	On food choice	Y	Y		Y	N/Y	Y	N
Effect	On dietary consumptionShort-term			Y				Y
	On dietary consumptionLong-term							

A, B, and C refer to different conditions in the same study. Effect: Short-term <6 months, and long-term ≥6 months. X: Nudging and choice architecture types. Y: Yes, N: NO.

3.1. Randomized Control Trials

Anzman-Frasca et al., 2018 [26] investigated whether placemats affected children's meal selection and intake in the US. Fifty-eight families with 4-to-8-year-old children were randomized to return to a quick-service restaurant during an intervention or control period (n = 28 intervention, 30 control). The participants were blinded to group assignment. The intervention group received placemats featuring two healthy "Kids' Meals of the Day" upon the restaurant entry, to nudge children toward healthy options. Forty-eight families had looked at the placemat before ordering (n = 18 intervention, 30 control). After the families finished dining, researchers recorded children's orders and collected leftovers for quantifying dietary intake via weighed plate waste. Families who were exposed to the study placemats ordered more healthy food compared to controls. However, there were no significant differences in dietary intake when comparing the intervention versus control groups overall. Nevertheless, children who ordered one of the promoted healthy entrées consumed less saturated fat across the total meal compared to those who did not (p = 0.04).

Cohen et al., 2015 [27] investigated the short- and long-term effects of chef-enhanced meals and extended exposure to choice architecture on healthier school food selection and consumption. In this seven months school-based RCT, children aged 8–16 years in urban, low-income school districts were included (intent-to-treat analysis). Firstly, fourteen schools were randomized to chef (n = 4) or control (n = 10) for five months. Then, the chef schools were further randomized to chef (n = 2) or chef + smart café (n = 2), and the control schools were further randomized to smart cafe (n = 4) or control (n = 6). In the smart café, vegetables were offered at the beginning of the lunch line. Fruits were placed in attractive containers, or next to the cash registers. Signage and images promoting fruits and vegetables were prominently displayed. White milk selection was placed in front of sugar-sweetened milk (e.g., chocolate milk). All the modifications were simultaneously present and applied daily by existing food service staff. School food selection was recorded, and food consumption was measured using plate waste methods. The study revealed no association between the smart café intervention alone and food consumption. Fruit selection increased in the chef (OR, 3.08; 95% CI, 2.23–4.25), smart café (OR, 1.45; 95% CI, 1.13–1.87), and chef plus smart café (OR, 3.10; 95% CI, 2.26–4.25) schools compared with the control schools. Vegetable selection increased in the chef (OR, 2.54; 95% CI, 1.83–3.54), smart café (OR, 1.91; 95% CI, 1.46–2.50), and chef plus smart café schools (OR, 7.38, 95% CI, 5.26–10.35) compared with the control schools.

Greene et al., 2017 [28] conducted a 9 week cluster RCT, to evaluate the impact of fruit-promoting Smarter Lunchroom interventions on middle school students' selection and consumption of fruits. Ten middle schools (Grades 5–8) were recruited and randomized into a fruit intervention (n = 4), vegetable (n = 3) or control group (n = 3). However, the paper only focuses on the fruit intervention and control groups. The fruit intervention group made changes to the convenience, visibility, and attractiveness of fruit in their lunchrooms for a period of 6 weeks. The control group made no changes. The selection and plate waste data were assessed. Fruit selection increased overall by 36% ($p < 0.001$), and fruit consumption increased overall by 23% ($p < 0.017$) in the fruit intervention group, compared to controls.

Hollands et al., 2018 [29] examined the impact on energy purchased of reduced portion sizes in six worksite cafeterias, in a stepped wedge randomized controlled pilot trial. Each site was randomized to a date of implementation. The intervention comprised reducing the portion sizes by at least 10% (by volume without changing energy density) of specified food items (main meals, sides, desserts, cakes). The primary outcome was total energy (kcal) purchased per day from intervention categories. There was found no significant change when data from all six sites were pooled. However, borderline associations were observed at two sites.

Vasiljevic et al., 2018 [30] investigated the potential impact of calorie labeling on energy purchased in six worksite cafeterias in a stepped wedge RCT. The intervention comprised labeling cafeteria products with their calorie content in the same font style and size as for price. The primary outcome was the total energy (kcal) purchased from intervention items in each cafeteria each day. No overall

effect of the intervention was revealed, however, a 6.6% reduction (95% CI −12.9 to −0.3, $p = 0.044$) in energy purchased in the day following the introduction of calorie labeling was found in one site. However, the effect diminished over time. No changes in energy purchased were revealed in the remaining five sites.

Velema et al., 2018 [31] examined the effects of a healthy worksite cafeteria ("worksite cafeteria 2.0" (WC 2.0)) intervention on Dutch employees' purchase behavior over a 12 weeks period. The intervention consisted of fourteen strategies based on nudging and social marketing theories, involving product, price, placement, and promotion (simultaneously executed), to encourage the employees to make healthier food choices during their daily worksite cafeteria visits. The primary outcome were sales data of selected foods. Higher numbers of healthier ("better choice") products were sold in the intervention group, compared to control three of seven product groups (healthier sandwiches, healthier cheese, and fruit). The increased sales of these healthier meal options were constant throughout the 12 weeks intervention period.

3.2. Nonrandomized Control Trials

Cole et al., 2018 [32] investigated the impact of a dining facility intervention on patron diet quality and meal satisfaction in a nonrandomized, controlled time series study. US Army active duty soldiers were included in the intervention consisting of food placements and nutrition labeling to influence food choice (in addition to new food recipes and revised menus). The primary outcomes of the study were change in dietary intake and diet quality scores (Healthy Eating Index 2010 scores). The intervention resulted in higher diet quality scores compared to controls, in addition to increased consumption of citrus, melon fruits, red and orange vegetables, yoghurt, legumes, and whole grains. In addition, oils and solid fat consumption were decreased.

Hubbard et al., 2015 [33] investigated whether a smarter lunchroom would increase the selection and consumption of fruits, vegetables, and whole grains. The 3 months intervention took place at a residential school, where students ($n = 43$, 11–22 years) with intellectual and developmental disabilities were included. The intervention included: (i) prompting by 'celebrity servers', (ii) the creation of fruit and vegetable-inspired artwork for the dining hall, (iii) classroom-based taste-testing activities, and (iv) logo naming and branding activities. Selection and plate waste of foods at lunch were assessed. Smarter lunchroom increased selection (whole grains) and consumption (whole grains, fruit) of healthy food, and decreased selection and consumption of unhealthy food (refined grains).

Kroese et al., 2016 [34] investigated whether repositioning of food products could promote healthy food choices among travelers at a train station. Three snack shops were included: (1) repositioning healthy products, (2) repositioning together with an explanatory sign, and (3) control. More healthy products, but not fewer unhealthy, were sold in both nudge conditions, compared to control.

In a 9 months longitudinal study, Levy et al., 2012 [35] investigated whether a two-phase point-of-purchase intervention improved food choices across racial and socioeconomic (job type) groups. The participants were employees ($n = 4642$) of a large hospital in Boston, MA, US, and regular cafeteria patrons. In the first phase, a traffic-light labeling system was introduced to encourage the patrons to purchase healthy items (labeled green) and avoid unhealthy items (labeled red). In the second phase, certain cafeteria items were rearranged, making green-labeled items more accessible and the red-labeled items less accessible. The main outcome measures were proportion of green or red labeled items purchased. Labeling decreased the red item purchases and increased green purchases. The intervention effects were similar across all race/ethnicity and job types.

Lowe et al., 2010 [36] investigated if environmental changes and pricing incentives would influence employees' lunch choices. The included participants ($n = 96$, BMI = 29.7 ± 6.0 kg/m^2) who regularly ate lunch at their workplace cafeteria, were randomly assigned into one of two intervention groups: (1) Environmental change (low-energy-dens foods and food content labeling) or (2) Environmental change, education and pricing incentives. Food intake and energy intake was assessed with scan card technology coupled with computerized cafeteria cash registers. No difference in total energy intake

were revealed between the groups over the study period. However, significant changes in energy intake were observed across the groups from baseline to the intervention period, with an increase in the percentage of energy from carbohydrates and a decrease of energy from fat.

Nikolaou et al., 2014 [37] investigated whether calorie information would help young adults to avoid weight gain, in an interrupted time-series study. Students in full-time education reported weight changes over 36 weeks in two year-groups, each of 120 young adults. Both groups were similar in age, gender, and ethnicity, and living in fully-catered accommodation. In the first year, the participants were observed without calorie-labeling, apart from a 5 weeks pilot. In the second year, calorie-labeling was introduced at main meals for 30 of the 36 weeks. The study found that calorie-labeling was associated with a 3.5 kg less weight gain.

Olstad et al., 2014 [38] investigated if nudging and economic incentive was associated with increased healthy food purchases. The participants were patrons at a recreational swimming pool. Three additive interventions were introduced: (1) signage/menu labels, (2) signage and taste testing, and (3) both nudges together with 30% price reductions. Each period was 8 days in length. The primary outcome was the change in the proportion of healthy items sold. In the full sample, sales of healthy items did not differ across periods, whereas in the subsample, sales of healthy items increased by 30% when a signage + taste testing intervention was implemented ($p < 0.01$).

Seward et al., 2016 [39] investigated if traffic-light labeling and choice architecture interventions improved dietary choices among students at a northeastern US university. The 7 weeks intervention included traffic-light labeling (red: least nutrient rich; yellow: nutrient neutral; green: most nutrient rich), choice architecture (how choices are presented to consumers), and "healthy-plate" tray stickers. Two cafeterias received all interventions, two received choice architecture only, and two were controls. The sales for 6 weeks before and 7 weeks during interventions were reported and using interrupted time-series analyses, changes in red, yellow, and green items served were measured. No significant changes in items served were revealed when intervention sites were compared with controls.

Thorndike et al., 2014 [40] investigated the effectiveness of traffic-light labeling and choice architecture over 24 months in a longitudinal pre–post cohort follow-up study. In a large hospital cafeteria, food items were labeled green (healthy), yellow (less healthy), or red (unhealthy) and rearranged to make healthy items more accessible. The traffic-light and choice architecture cafeteria intervention resulted in increased sale of healthier items over 2 years (from 41% to 46%). In addition, the sales of unhealthy items decreased from 24% at baseline to 20%.

Thorndike et al., 2012 [41] investigated whether a two-phase labeling and choice architecture intervention would increase sales of healthy food in a large hospital cafeteria. Phase 1 consisted of a 3 months color-coded labeling intervention (red = unhealthy, yellow = less healthy, green=healthy), and Phase 2 added a 3 months choice architecture intervention where visibility and convenience of some green items were included. The outcome was relative changes in 3 months sales from baseline to Phase 1, and from Phase 1 to Phase 2. The color-coded labeling intervention improved sales of healthy items, and was enhanced by a choice architecture intervention.

Van Kleef et al., 2018 [42] investigated the effect of whole wheat bread as a default option in a sandwich choice situation. A pilot survey (n = 291) examined the strength of combinations of toppings and bread type, and the main study consisting of a two (bread type) by two (topping type) between-subjects design. The included participants (n = 226) were given a free sandwich at a university stand with an unhealthy deep-fried snack (croquette) or a healthy topping. About half of the participants were offered a whole wheat bun unless they asked for white bun, and the other half were offered a white bun unless they asked for a whole wheat bun. Regardless of the topping, the whole wheat bun was the default option in 94% of the participants. When the default of bread offered was white, 80% of the participants chose the default option. The study revealed a strong default effect of bread type.

Van Kleef et al., 2015 [43] investigated the effectiveness of "verbal prompting" as a nudge to increase fruit salad sales in a self-service restaurant during breakfast time. After an initial baseline

period, the intervention involved four different prompts suggesting ordering a side dish (i.e., orange juice, fruit salad, pancakes) given by cashiers. The sales of orange juice increased significant during the orange juice verbal prompts intervention periods (35% to 42% of all breakfasts sold) compared to baseline (20%). Similarly, sales of fruit salad (9%) and pancakes (3%) rose to a small but significant extent compared to baseline sales (3% and 1%, respectively).

Van Kleef et al., 2014 [44] investigated whether the shape of bread rolls is able to shift children's bread choices from white to whole wheat to increase whole grain intake. In a between-subjects experiment conducted at twelve primary schools in the Netherlands, children were exposed to an assortment of white and whole wheat bread rolls, both varying in shape (regular versus fun). Children were free to choose the type and number of bread rolls and toppings to eat during breakfast, and consumption of bread rolls was measured at class level (number of bread rolls before and after breakfast). In addition, children (n = 1113) responded to a survey including questions about the breakfast. Results showed that consumption of fun-shaped whole wheat bread rolls almost doubled consumption of whole wheat bread (p = 0.001). However, consumption of white bread rolls did not differ according to shape.

Van Kleef et al., 2012 [45] investigated how manipulation of the assortment and shelf layout near the checkout counter could guide the customers to select healthier snacks. The study applied a two-factor experimental design manipulating snack offerings in a hospital canteen. The shelf arrangement (i.e., accessibility) was altered by putting healthy snacks at higher shelves versus lower shelves, and the assortment structure (i.e., availability) was altered by offering an assortment that either included 25% or 75% healthy snacks. Daily sales data were collected for a period of four weeks. The study revealed that assortment structure led to higher sales of healthy snacks.

Vermote et al., 2018 [46] investigated associations between portion size reduction and french fries consumption, in a pre–post real-life experiment. The participants consisted of university students and employees from Belgian, in an on-campus restaurant setting. The intervention consisted of a reduction of the french fries' portions by 20%, by replacing the usual porcelain bowl served during the baseline week (±200 g) with smaller volume paper bags during the intervention week (±159 g). French fries consumption and plate waste were measured in 2056 consumers at baseline and 2175 consumers at intervention. Total french fries intake decreased by 9.1%, and total plate waste decreased by 66.4%. No differences were found in satiety or caloric intake between baseline and intervention week. The majority (n = 24, 86%) of french fries consumers noticed the reduction in portion size during the intervention.

3.3. Mapping of the Nudges in the Included Studies

Al-Khudairy et al., 2019 [22] have modified Hollands et al., 2013 [13] typology and included pricing as one nudge/intervention type. Additional, Al-Khudairy et al., 2019 divide the effects in their systematic review on purchasing or on dietary consumption. This is also relevant for this systematic review. We have modified it further by dividing the dietary consumption into short-term (<6 months) and long-term effects for 6 months or longer. The mapping of the nudges in the included studies are presented in Tables 4–6.

4. Discussion

Nudging or choice architecture interventions aim to improve dietary choices, but empirical evidence to support the effectiveness has been scarce. An important criterion for an intervention to qualify as a nudge is that the targeted audience/participants/customers retain their freedom to make a choice [23]. In this systematic review, we explore whether behavioral interventions restricted to nudging or choice architecture can influence healthier food choices. Further, we wanted to investigate if there are specific nudges that are more effective. We identified 21 papers that both met the inclusion criteria and the quality check. The core focus in the studies, as this review also reveals, is choice

architecture. Fourteen studies examined more than one nudge, and of these studies six studies had more than one condition (A and B or A, B, and C). Seven studies examined pure choice architecture.

4.1. Primarily Alter Properties of Objects or Stimuli

Labeling is the most frequent used nudge in this review and nineteen of the studies include labeling. Previous studies have shown mixed results and labeling has been debated [47]. Despite the disputes of labeling, several states and municipalities in the US have introduced regulations that mandate calorie labeling on menus and menu boards in restaurants [48]. The results of the study of Downs et al., 2013 [48] did not support the calorie labeling recommendation, but the authors agree that transparency is beneficial. The traffic-light approach has been regarded as the most effective intervention when it comes to labels. This is simple, informative, and people are already familiar with the connotation of the different colors compared to nutrition labels that are considered more complex to understand. The results in this systematic review is in the line with previous research where the study of Vasiljevic et al., 2018 [30] used calorie labeling in six worksite cafeterias, and only one site showed a statistically significant effect, whereas Levy et al., 2012 [35] and Thorndike et al., 2014 [40] used color-coded food labeling, and both studies had an impact on food choices. While the study by Seward et al., 2016 [39] did not demonstrate any effect by using traffic-light labels. Nine studies used presentation but only Cohen et al., 2015 [27] used presentation alone as a nudge, which was their first condition (A). This had an effect on short-term dietary consumption. Sizing can be both reducing plates and portions, and it is an easy way to reduce consumption and energy of food, but only three studies included reduction of portion size. These studies showed mixed results. The study by Hollands et al., 2018 [29] did not show any significant effect. The effect, where significant, might be due to what Geier et al., 2006 [49] proposed to be unit bias. Unit bias refers to that one single portion, within a reasonable range of size, is seen as a unit to consume. A side effect of a sizing nudge can be reduced food waste as found in Kallbekken and Sælen, 2013 [50]. Hollands et al., 2015 [51] found a clear relation between people being exposed to larger sized portions, such as individual units or tableware, and consuming larger quantities of food compared with people exposed to smaller sizes or units. Pricing is a well-used marketing strategy but only three studies used pricing as a nudge, and always in combination with other nudges. Pricing is also a traditional financial incentive, and one can discuss whether that counts as a nudge according to the original definition by Thaler and Sunstein, 2008 [23].

4.2. Primarily Alter Placement of Objects or Stimuli

Availability refers to how accessible an object or stimuli are, and rearranging the positions of food is a common nudge, for instance, in food stores. Seven studies used an availability nudge. Placing healthy food near the cash register increase the sale of these food because people are prone to pick up something in the "last-minute" as done in the study by Van Kleef et al., 2012 [45]. However, in the study of Kroese et al., 2015 [34] the customers did not buy fewer unhealthy products. In the study done by Lowe et al., 2010 [36] the dietary intake improved but there was no difference in the total energy intake. Replacing unhealthy food with healthier options does not necessarily mean a reduction in total energy intake, which is needed to reduce weight. Proximity nudges were used in 11 studies and the majority of these studies made healthier options easier to choose. Van Kleef et al., 2012 [45] used both availability and proximity which resulted in a significant effect on the purchasing of healthier food. Sometimes, availability and proximity can be overlapping nudges, depending on how it is interpreted.

4.3. Alter Both Properties and Placement of Objects or Stimuli

Priming is, according to Marteau et al. (2012) [9], a promising strategy to reduce consumption, but there are few studies so far to evaluate the effectiveness. Priming is used in only four studies, and alters both properties and placement of objects or stimuli. These are incidental cues in the environment that influences us. The effects were mixed, but the studies also used multiple nudges. Prompting refers to labels, signage, or other elements such as placemats used in Anzman-Frasca et al.,

2018 [26], but in this study it did not have any effect on dietary consumption. However, in the study by Kroese et al., 2015 [34], an additional sign did not seem to have any added benefit to healthy choice. A prompt can also be verbal, as done in the study by Van Kleef et al., 2015 [43] which resulted in increased fruit purchases.

The results of this systematic review show that the majority of the studies include traffic-light labeling, and that may be a promising strategy. The results suggest that the majority of the interventions were effective. Thirteen studies measured effects on purchasing healthier food, and nine of them, plus one site in the study of Vasiljevic et al., 2018 [30], showed significant effects. Ten studies measured healthier dietary consumption. Only four of the studies measured long-term effect, and with varying results. The dietary intake did not necessarily in all studies affect positive total energy balance that is needed to challenge overweight or obesity. Few of the studies examined how participants altered their purchasing behavior or the side effects of the intervention, for instance whether healthier lunches resulted in increased calorie intake later in the day. Lowe et al., 2010 [36] did examine the effect pre- and post-intervention but argued that the results could be a Hawthorne effect. Therefore, to gain further insight into whether a nudge intervention has an effect, it is important to record and examine changes in individual choices before and after a nudge intervention.

In most of the field experiments, the participants were not aware that they were part of an experiment. This limited social influence regarding desirable behavior and observer reactivity [52]. The field nature in the majority of the studies (e.g., workplaces, cafeterias, and lunchrooms) represents an important strength of the research within the nudging field. It is a challenge to obtain experimental control and replication of studies since real-life settings are complex. However, field studies, together with lab experiments, are important for building convincing evidence for interventions. The lack of control groups and small sample sizes are limitations that diverge from more traditional healthcare research where the gold standard is randomized control studies. The lack of blinding and randomization might be necessary to enable a realistic choice setting in natural field-experiments. This systematic review included six RCT studies compared to fifteen non RCT. Nudge interventions are context specific and the difference in gender, age, ethnicity, and education limit generalizability from one study to another.

4.4. Implications for Research and Practice

Despite the tremendous interest and studies on nudging and choice architecture regarding public health, it is still a relatively new and under-explored field. Many of the studies reviewed during this systematic review lacked definitional and conceptual clarity that might lead to poor methodology and unclear effects. A benefit of nudging is that it does not requires any additional actions for the individual or the targeted audience. Furthermore, the interventions are usually no cost or low cost, and that makes it easier to implement. Another important issue is that our environment, whether we like it or not, influences our behavior. Then it makes sense to alter the environment in a way that we make better choices that will be beneficial in the long run [10]. Many of the nudging or choice architecture interventions as shown in this review have potential to be scaled up to a higher population level. Nudging, though, is not necessarily a salvaging concept as viewed across many disciplines [16]. Therefore, it is important to have a continuous scientific evaluation, since it affects many citizens throughout the world and interventions might not have any effect, a perverse effect, or even backfire.

4.5. Strengths and Limitations of This Study

This systematic review was executed independently by both authors to minimize errors and bias. When there was discrepancy regarding a study, the study was thoroughly discussed based on the inclusion criteria and the quality check list. We prepared a checklist for measuring study quality based on the Downs and Black validated checklist from 1998 [19]. Consumption of sugar-sweetened beverages (SSB) is cited as a major contributor to the obesity epidemic [53], but research regarding SSBs only was not included in this review, since the objective of this paper was food. The data source

in this systematic review was limited to PubMed. This might have had an impact on the number of included studies. Another limitation that is relevant to this systematic review is that nudging or choice architecture studies usually examine more than one intervention at a time, and this makes it difficult to draw conclusions on the effects of each single nudge.

Nudging and/or choice architecture alone will not solve the worldwide health challenges caused by poor health choices. Although behavioral economics can provide great benefits if appropriately used, it is still necessary with an underlying political fundament [47]. In other words, nudge interventions should complement, rather than substitute for, more forceful and traditional policies (e.g., Liu et al., 2014 [54]; Vecchio et al., 2019 [11]). A threat raised by Marteau et al., 2012 [9] is posed to economics that are built on excessive consumption. Successful behavioral-based efforts to prevent diseases caused by overweight and obesity would reduce the consumption of food, and that again would have a great impact on a lot of stakeholders. Nudging again is only one part of behavioral economics, and should be regarded as one more tool to prevent noncommunicable diseases. The results of this systematic review, as in the review by Hummel et al., 2019 [16], indicate that the evidence is rare. In this review, for instance, the study of Olstad et al., 2014 [38] did not result in any effect in the full sample population. They emphasize that nudging is a subtle technique and that choices are influenced by other factors such as marketing and food preferences. Another issue is the publication bias—that studies without any significant effects are not published [16], so the studies by Holland et al., 2018 [29], Olstad et al., 2014 [38], and Seward et al., 2016 are rare.

Moving forward, nudging and choice architecture would benefit from a better conceptual clarity and a more systematic approach. There are no "quick fix" or "magic bullets" when it comes to changing people's behavior. Additionally, even though it might be challenging, nudging interventions should be compared to more traditional interventions such as information campaigns and educational strategies. Future research should have longer study durations such as Thorndike et al., 2014 [40], and include a follow up study to see if the nudge or choice architecture have a long-term impact. It also adds value to include pictures of the nudges, as some studies do, to easier understand the actual intervention and to evaluate the study, and not least to easier access replication. In addition, to cope with the challenges regarding overweight and obesity other interventions might be needed. Modern society fuels the prevalence of unhealthy diets by increasing the accessibility and availability of unhealthy food with, for instance, conveniently located fast-food restaurants [19].

5. Conclusions

The results of this systematic review show that the effect sizes are very diverse and also low. Many of the studies included traffic-light labeling that might be a promising strategy. Moreover, this study also highlights the challenges that must be addressed when experimental studies concerning nudging are conducted. According to Marteau et al. (2012) [9], we live in an environment that is exerting strong negative impacts on our health, and it remains to be seen whether we can turn the negative trend. Retailers, cafes, restaurants, cafeterias, and canteens all play an important role in shaping our food habits because they decide which products to sell [55]. Using traffic-labeling to guide us, reducing portion sizes in restaurants and cafes, smaller plates in lunch buffets, healthier options in the workplace canteen, healthier school meals, and some "nudged" choices each day with less calories and healthier nutrition, small cumulative consequences or the "peanuts effect" [56] might have an effect on our health in the long run.

Author Contributions: This work was carried out in collaboration between the authors C.T. and H.M. Conceptualization, C.T.; Methodology, C.T. and H.M.; Validation, C.T. and H.M.; Formal analysis, C.T., and H.M.; Investigation, C.T., and H.M.; Resources, C.T., and H.M.; Data curation, C.T., and H.M.; Writing—original draft preparation, C.T., and H.M.; Writing—review and editing, C.T., and H.M.; Visualization, C.T., and H.M.; supervision, C.T.; Project administration, C.T.; Funding acquisition, C.T. Both authors read and approved the final manuscript and take full responsibility for the final content.

Funding: This research received no external funding.

Acknowledgments: The costs to publish in open access have been received from Oslo Metropolitan University, Oslo, Norway.

Conflicts of Interest: The authors declare no conflict of interest.

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Article 2

Mobekk, H., Hessen, D. O., Fagerstrøm, A. & Jacobsen, H. (2020). For your eyes only: A field experiment on nudging hygienic behavior. *Frontiers in Psychology*.
DOI: https://doi.org/10.3389/fpsyg.2020.603440

frontiers in Psychology

ORIGINAL RESEARCH
published: 04 December 2020
doi: 10.3389/fpsyg.2020.603440

For Your Eyes Only: A Field Experiment on Nudging Hygienic Behavior

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These days many gyms and fitness centers are closed to reduce transmission of the SARS-CoV-2 virus in society. The gym is an environment rich in microorganisms, and careful hygiene is a necessity to keep infections at bay. Exercise centers strive for better hygiene compliance among their members. This effort has become essential in light of the current pandemic. Several experimental studies show that others' physical presence, or the "illusion" of being watched, may alter behavior. This article reports on a natural field experiment testing one specific social nudge intended to increase gym members' hygienic behavior. The study was conducted before the SARS-COV-2 pandemic. A picture of "observing eyes" was attached to paper dispensers and cleanser spray bottles at two different gyms in Norway. A reversal design, also called an ABA design, with and without the nudge's presence, was used to investigate the impact on gym members' hygienic behavior. A follow-up study was conducted in one of the centers to investigate whether the nudge stimuli would function over time. The study included 254 individual choice situations during nine observation sessions conducted over 9 weeks. The results from both centers provide evidence of a strong effect of the nudge. However, the effect decreased during the follow-up study. These findings support previous research indicating that human behavior is influenced by the presence of implicit observation cues – in this case – observing eyes. However, insights into the long-term effect of implicit observation cues are still needed since the salience of the stimuli faded over time.

Keywords: field experiment, nudging, sanitizing, cooperation, observing eyes

OPEN ACCESS

Edited by:
Francesco Aletta,
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Reviewed by:
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Specialty section:
This article was submitted to Environmental Psychology, a section of the journal Frontiers in Psychology

Received: *06 September 2020*
Accepted: *17 November 2020*
Published: *04 December 2020*

Citation:
Mobekk H, Hessen DO, Fagerstrøm A and Jacobsen H (2020) For Your Eyes Only: A Field Experiment on Nudging Hygienic Behavior. Front. Psychol. 11:603440. doi: 10.3389/fpsyg.2020.603440

INTRODUCTION

We are exposed to potential sources of infection every day. The transmission of microorganisms happens through direct and indirect contact with people, animals, and through contact with objects. Many pathogens, such as viruses, bacteria, and fungi, are easily transmitted through close contact, and some can survive in the environment for days (e.g., Institute of Medicine, 2011; Centers for Disease Control and Prevention, 2019). The most significant human death tolls have historically been infectious diseases (Van Bavel et al., 2020). Situations that increase transmission of pathogenic microorganisms include living or working with other people, nursing, sharing items, or visiting public areas. Insufficient hygiene can contribute to elevated infection rates, particularly in pandemic situations (Aiello and Larson, 2002; Curtis and Cairncross, 2003).

The risk of infection at premises and meeting places varies with individual and contextual factors, not the least by the type of infectious agent. Interventions to improve hygienic behavior in public places can decrease the transmission of viruses and other infections agents and further increase general health and well-being. Therefore, infection prevention measures should, like vaccines, be a shared responsibility in society.

Exercise and training are important for health and well-being. The numbers of people using gyms and fitness centers have steadily increased over the last decade. By 2019, over 64 million people in the United States were members of one of the 41,000 health clubs in the United States (Statista, 2020). Many people use the workout equipment available in the gyms during the day. Numerous members sweat and are in contact with the exercise equipment with bare skin. Cleaning is an efficient and effective way of reducing microorganisms that can survive on surfaces (e.g., Centers for Disease Control and Prevention, 2019). Still, the frequent shifting of tools and equipment among users at the gym implies a significant risk of pathogen transmissions. The increased risk of transmission of microorganisms makes gyms and fitness centers a vital place to improve hygienic behavior, which would greatly benefit individuals, the fitness center community, and the society.

We see today, with the SARS-CoV-2 pandemic, the simple key advice to combat infectious diseases is hygienic behavior such as frequent handwashing. This is a straightforward and powerful means to reduce or avoid contagious diseases. According to Chriss (2016), several studies indicate that we frequently make choices that negatively affect our quality of life. This reflects a preference for innate behavior, the "thinking fast" vs. "thinking slow" dilemma, which may run counter to long-term rational decisions (cf. Kahneman, 2011). Simple hygiene measures in everyday life can help prevent infection-related implications for others in society. The facilitation of individual contributions in the community will thus be a prerequisite for altruistic choice behavior, improving public health (Ekström, 2012). Altruistic choice behavior is related to the "common goods" – what is done out of a concern for others' good; in other words, for their well-being. Altruism (or social cooperation) is a conflict between short-term self-interest vs. longer-term collective interest (Van Bavel et al., 2020). Altruistic choices are shaped by our verbal community, which includes eye communications. Much of our behavior is under the control of others' presence. The ways that society punishes or reinforce altruism often involve some kind of "eye" interaction.

Humans, and other animals, have a dedicated neural architecture for detecting facial features, including the presence of eyes (e.g., Burnham and Hare, 2007; Ernest-Jones et al., 2011). This built-in system, also known as "gaze detection," is fast and automatic and served as a crucial evolutionary tool in ancestral environments (e.g., detecting lurking enemies and predators). Eye-like mimicry is a common anti-predator feature in nature, pointing to the strong signaling effect of glance (e.g., Stevens et al., 2008; Janzen et al., 2010). This is phylogenetically selected but is further shaped during our learning history. Humans' social interaction depends on our ability to respond to stimuli conveyed by facial expressions and by the eyes of others, so the eyes are highly salient to humans (Vaish et al., 2017). Merely the elicited emotional responses of being watched may modify our behavior (Dear et al., 2019). The facial interpretation system is very robust. In experiments where humans are instructed not to respond to gazes, people are unable to suppress their natural response (e.g., Burnham and Hare, 2007; Frischen et al., 2007; Dear et al., 2019). Therefore, it is also possible to play the system by using images of human eyes to alter social behavior.

Several studies have addressed whether individuals' behavior is altered by being observed by others in recent years. In fact, this may tap into the evolved "thinking-fast" responses driven by strong visual cues as the proximate cause and social acceptance as the ultimate factor. Previous research, such as Haley and Fessler (2005; generosity), Bateson et al. (2006; voluntary payment system), Ernest-Jones et al. (2011; clean-up of garbage), Ekström (2012; charitable donations), King et al. (2016; hand hygiene compliance), and Pfattheicher et al. (2018; hand hygiene compliance), illustrates that displaying images of human eyes is sufficient to alter real-life social behavior in a variety of contexts. Even small indications of observation increase individuals' altruistic behavior (Ekström, 2012) and enhance cooperation (Sparks and Barclay, 2013). However, the literature based on both laboratory and field studies presents mixed results of artificial observation cues (e.g., Haley and Fessler, 2005; Matland and Murray, 2016; Shinohara and Yamamoto, 2018). In a meta-analysis, including 117 papers, Bradley et al. (2018) identified a small but statistically significant connection between observability and prosociality. The effect was stronger in the presence of passive observers than under conditions of perceptions of being watched. While the two meta-analysis conducted by Northover et al. (2017) found no evidence to support the claim that the "watching eyes" have effect on generosity.

Pfattheicher et al. (2018) emphasize that an individual's behavior, such as hand washing, can be influenced by simple social nudges. According to Van Bavel et al. (2020), there is a way to leverage norms to use "nudges" in the contexts where people make choices (Mobekk and Stokke, 2020). An overall goal of nudging is to improve people's health, happiness, and living conditions (Thaler and Sunstein, 2009). Nudge theory introduces contextual changes that, at the same time, preserve freedom of choice. Behavioral research with nudging as a method will thus help to reveal how preferences change in choice situations. Understanding how choice behavior is shaped and changed in a social environment is essential for facilitating effective action in society (Thaler and Sunstein, 2009).

Changing the context of decisions with a "simple nudge" may sway people in healthier directions toward more preferred choices. Based on previous research and the evolutionary perspective on the impact of the presence of eyes, we interpret that a picture of a pair of eyes is attention-grabbing and that the sensation of being observed will encourage a local cooperative norm – in this case, sanitizing workout equipment after use. Hence, will there exist a bidirectional link between a person's "illusion of being watched" and the person's hygienic behavior?

MATERIALS AND METHODS

Study Design, Setting, and Participants

We conducted a natural field experiment where we measured if one specific social nudge – a picture of "observing eyes" (see **Figure 1**) – would affect the hygienic behavior of gym members. The study took place at two different gyms, Center 1 and Center 2, belonging to the same chain in Oslo, Norway. The participants in the study were gym members that attended group workout sessions at the two gyms. All observations were carried out in agreement with the center managers, and consent was given from the company to use obtained data. No personal information was collected regarding members of the gyms, and no registrations are traceable to individuals participating in the study. Ethical guidelines have been considered in all the phases of the study. The research was conducted before the SARS-CoV-2 pandemic.

The observation of the number of workout participants that cleaned the exercise equipment after use was carried out during spinning sessions at Center 1 and treadmill sessions at Center 2. The study is categorized as a "within-group design," where the two centers function as their own control group (Cooper et al., 2007). The study's observation phases were constructed as an ABAB design, also called a reversal design. A is a baseline phase, and B is an intervention phase. During the first phase, A, a baseline was established for the cleaning behavior (dependent variable). This is the level of responding before any intervention is introduced. Hence, the baseline phases function as control conditions. Two baseline phases (A1 and A2) and two intervention phases (B1 and B2) were conducted at both centers. The baseline phases (A1 and A2) contain choice situations in the absence of experimental manipulation. Individual behavior from session to session, if a participant happened to take part in several sessions, was not recorded.

At the beginning of the study, all information and prompts encouraging cleaning the exercise equipment after use were removed. This was also verified throughout the experiment. Before all observations, instructors were asked to hold the workout session as usual. The instructors were also informed about and reminded, not to mention cleaning routines during the workout sessions included in the study. At Center 1, four paper dispensers and nine spray bottles were available during all the observations compared to five paper dispensers and seven spray bottles at Center 2. The spray bottles and paper dispensers were in plain sight from the workout stations. All observations at both centers were performed on the same day of the week and at the same time.

FIGURE 1 | Picture of the stimulus used in the interventions in both centers, and for all sessions.

In the intervention phases (B1 and B2), images of "observing eyes" were attached to spray bottles and paper dispensers and were meant to function as a nudge in the choice situation (see **Figure 2**). The pictures were arranged visible to gym members. The cleaning equipment was located next to the exit. No gym members were in the exercise area when the pictures were attached and removed. At Center 1, the images were placed when the center opened and removed after the workout session. At Center 2, the pictures were placed in the morning and removed the next morning when the center opened. In the four observation sessions at Center 1, between 31 and 39 people were participating. At Center 2, 23 people were participating in each of the four observation sessions.

In addition to the ABAB design study, a follow-up study was carried out after 5 weeks at Center 2. The purpose was to investigate whether the effect of nudging would sustain over time since previous research of the "the watching eyes" phenomenon shows mixed results. The exercise area was prepared for this by *not* removing the images of "observing eyes" after the B2 session. Daily checks were carried out to ensure that the pictures were not damaged or altered. Five pictures were replaced throughout this period. In the follow-up study at Center 2, 23 people were participating.

Data Recording

The dependent variable was the number of gym members choosing to use the sanitizing spray and paper dispenser to clean the exercise equipment – spinning bicycles/treadmills – after use. Data were recorded manually on a predesigned observation form by two observers. The observation form mapped the exercise area with spinning bicycles/treadmills drawn in the correct positions. When conducting the observations, the observers participated in the workout sessions, using spinning bicycles or treadmills at the back of the room. The observers washed their spinning bicycles/treadmills after all other members had left the area. In each session, the observer recorded if a position was used and whether the user cleaned the spinning bicycle/treadmill. The observations were transferred to digital representation for data analysis. The level of significance was tested by the standard Chi-square test. A limitation associated with using a Chi-square test with an ABAB design, where participants are not randomly allocated to each condition, is that we cannot guarantee that each participant only contributed data to one and only one condition. This violates one of the assumptions of the Chi-square test (McHugh, 2013).

RESULTS

There were significant differences between the A (baseline) and B (intervention) phases at both centers. At Center 1, the results are based on 140 individual choice situations from two baseline phases (38 and 31 participants) and two intervention phases (35 and 36 participants). In the two baseline phases, 17 participants washed the equipment compared to 29 in the two intervention phases. In the A1 baseline phase, the hygienic

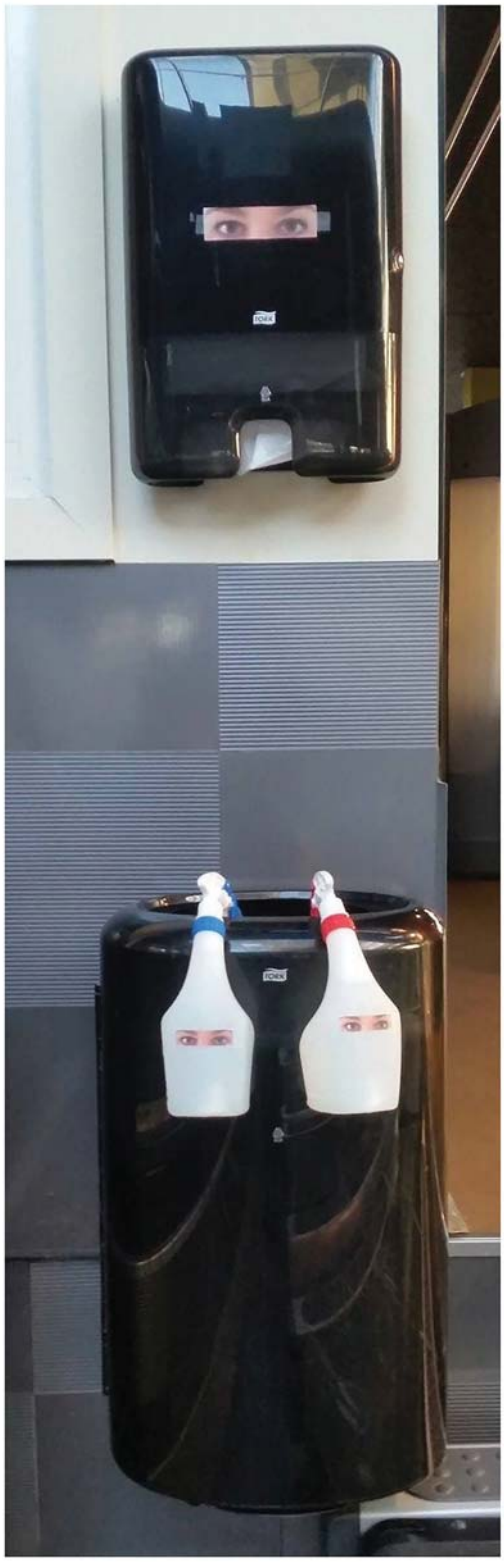

FIGURE 2 | Intervention stimulus displayed on paper dispensers and spray bottles during the intervention phase. The distance between the paper dispensers and spray bottles are approximately the same in the whole fitness area and for both centers.

behavior of one participant was not recorded due to a lack of observation by the observer. The results from the intervention phases show an increase in the number of members who washed bicycles after use, compared to the baseline phases. While targeted behavior during baseline responses ranged from 45 to 55%, the intervention increased the positive responses to 81–83% (**Figure 3**; **Table 1**). Chi-square tests revealed significant differences between baselines and interventions [X^2 (1, N = 140) = 16.32, $p < 0.001$] but neither within the baselines nor the interventions.

At Center 2, the results are based on 92 individual choice situations from the two baseline phases and two intervention phases. In all phases, there were 23 participants. The results from the intervention phases show an increase in the number of members who washed treadmills after use, compared to the baseline phases. We found 39–41% positive baseline responses and 65–73% intervention responses (**Figure 4**; **Table 2**). Chi-square test revealed significant differences between baselines and interventions [X^2 (1, N = 92) = 6.31, p = 0.012] but neither within the baselines nor the interventions. Thus, the results were consistent with those from Center 1, yet with somewhat lower intervention responses.

The results from the follow-up study, with 22 individual choice situations, did not show an increase in the number of members who washed treadmills after use compared with the baseline phases. In the follow-up phase, the hygienic behavior of one participant was not recorded due to a lack of observation by the observer. With follow-up responses of 41%, no significant difference was revealed between baseline and follow-up responses.

Interobserver agreement (IOA), calculated as a trial-by-trial IOA (Cooper et al., 2007), was between 94 and 100% in all eight observation sessions.

DISCUSSION

Simple hygiene measures in everyday life can help prevent infection-related consequences for others in society. Unfortunately, many people fail to engage in public health behaviors, like handwashing, which can spread infectious diseases. Finding strategies and solutions for overcoming these blunders is crucial for the health and well-being of people. A focus on individual actions and altruistic and prosocial behavior in society will thus facilitate better public health and well-being. With the SARS-CoV-2 experience, this has shown to be more critical than ever. The purpose of this study was to investigate whether a specific social nudge can improve hygienic behavior and further contribute to better health. In the present study, we build on past research showing that a picture of observing eyes, or the sensation of being watched, increases socially desirable and anticipated behavior. We wanted to investigate if a picture of observing eyes could increase the use of sanitizer and hygienic behavior among gym members. The data show that more people sanitized their workout equipment during the intervention phases than the baseline phases.

We used a reversal design, an ABAB design. One challenge with this design is that if the dependent variable changes after the intervention are introduced, it is possible that an extraneous

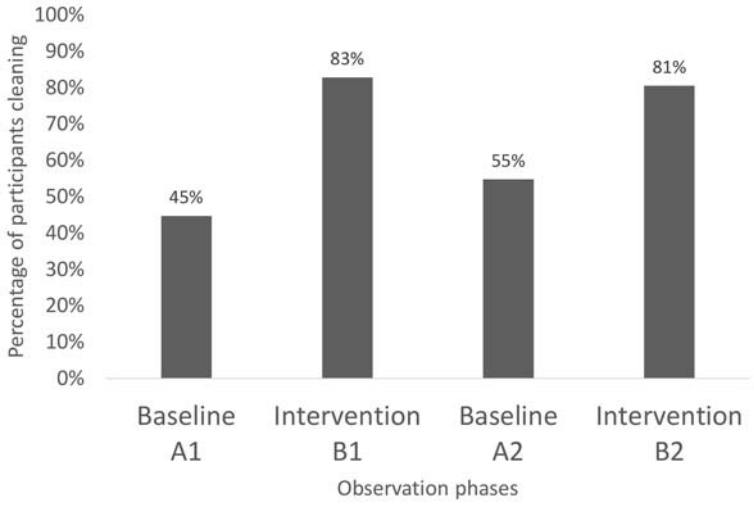

FIGURE 3 | Percentage representation of cleaning behavior from Center 1 – spinning.

TABLE 1 | Results from the spinning sessions at Center 1.

	Baseline A1	Intervention B1	Baseline A2	Intervention B2
Participants	39	35	31	36
Washed	17	29	17	29
Did not wash	21	6	14	7
Not observed	1	0	0	0

TABLE 2 | Results from the treadmill sessions at Center 2.

	Baseline A1	Intervention B1	Baseline A2	Intervention B2	Follow-up
Participants	23	23	23	23	23
Washed	9	16	10	15	9
Did not wash	14	7	13	8	13
Not observed	0	0	0	0	1

variable is responsible for the change in the dependent variable. But, if the dependent variable changes with the introduction of the intervention, a picture of observing eyes – and then changes back with the removal of the stimuli, increases the reliability that the intervention is the cause of the behavior change. In other words, the reversal greatly increases the study's internal validity, which was the case in this experiment. This supports the hypothesis that images of eyes prompt more prosocial behavior and that people behave altruistically (Oda et al., 2011). Another critical issue that the data revealed was that under half of the members cleaned the workout equipment in the baseline phases.

Our study confirms the positive and immediate response to "being watched." Further, the findings extend previous research on eye images in joint responsibility of hygienic behavior such as the studies by King et al. (2016) and Pfattheicher et al. (2018). As the follow-up study revealed, this is not a long-lasting trigger but a transient effect in support of Sparks and Barclay (2013). There might be several reasons for the absence of long-term effects, such as habituation as exposure to the stimulus increases and/or social influence by other gym members' hygienic behavior.

The results of Bateson et al. (2013) support our findings, where the phenomenon that the "eyes" seek to influence is individuals' contribution to shared responsibility. Their findings show that images of eyes induce more prosocial behavior, independent of local norms. Ekström (2012) reveals the effect of the "eyes" on people's generosity in a field study, while Haley and Fessler (2005) show a similar effect on generosity in a laboratory study. The "eyes" effect on people's conscience/ethical attitudes is shown in Nettle et al. (2012), where bicycle theft decreased in areas where images of "observing eyes" were introduced. On the other hand, an increase in bicycle theft was recorded in other areas nearby, suggesting a limited effect of the intervention. The results of Nettle et al. (2012) indicate that more people adhere to ethical and moral guidelines when the illusion of being observed is introduced. However, it suggests that rule-governed behavior does not change, as the propensity to steal is maintained outside the observed range. The ultimate driver linking eyes to prosocial behavior is presumably reputation (e.g., Feinberg et al., 2012; Exley, 2018) since gossip originates from observations, and reputation has bearings on fitness.

Consequences of our actions can occur immediately or after some time. The value of delayed outcomes is often weakened over time (Critchfield and Kollins, 2001). Also, consequences that are highly likely to occur are given more value compared to more uncertain outcomes (Green and Myerson, 2004). Another issue is that people also often display an "optimism bias," which means that bad things are more likely to befall others than oneself (Van Bavel et al., 2020). This has implications for health issues, such as infection risk, since the probability of getting an infection may be considered low. In addition, there is a delay between the time of contagion and when you become sick. At the point of choice, the cost

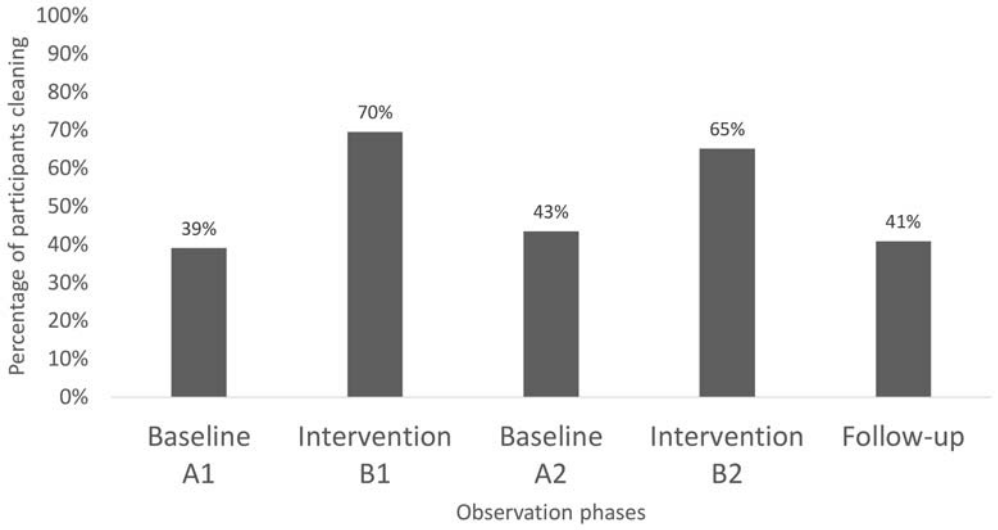

FIGURE 4 | Percentage representation of cleaning behavior from Center 2 – treadmill.

of the seemingly trivial but unpleasant and time-consuming cleaning of the exercise equipment is higher than the risk of sanctions by the other gym members or the chance of getting an infection. This can also be viewed as a social dilemma of maximizing one's immediate well-being or maximizing the well-being of a group of people (Rachlin, 2016). By influencing people in the point of choice with nudging, we can bridge the gap between immediate sub-optimal decisions and more optimal long-term outcomes. Small significant effects can have profound cumulative effects on our health and well-being when there is a lot at stake, such as transmitting contagious diseases.

Knowing how different nudges affect us in both the short- and long-term is the key to change behavior and to create new and better habits in the long run. This suggests that other means are needed to maintain the desired effect, e.g., flickering eyes, shifting cues, or other not static nudges. The challenge, though, is what happens when the novelty wears off? Maybe what we need to build new and better hygienic habits is an interdisciplinary approach combining nudging strategies with more traditional economic incentives and regulations.

Strengths and Limitations

The results of this research were generated outside of the laboratory. Field experiments give added value since it documents naturally occurring behavior. The underlying idea behind most field experiments is to use randomization in an environment that captures the important characteristics of the real world (List and Reiley, 2010). This provides greater confidence that the results obtained are not merely an artifact of experimentation. In a natural field experiment, the subjects do not know that they are in an experiment (Harrison and List, 2004). The gym members do not know that they are participants in an experiment; this minimizes the challenges of experimentally confounding effects. Since this is a natural field experiment conducted over time, including several conditions, no manipulation checks were included since this could have influenced the next condition.

Experimental control is challenging in field experiments. The advantage is high ecological validity, but there is no random allocation of participants, and extraneous variables can influence the results. For instance, we cannot rule out that some participants were influenced by other gym members' hygienic behavior and not by the "observing eyes." Decisions are made by individuals who are shaped by and implanted in social environments. This means that humans, as social species, are highly sensitive to others' influence and follow the norms of the group, especially when their reputation is at stake (Vaish et al., 2017). People tend to behave differently – are more willing to cooperate – publicly than anonymously (Oda et al., 2011).

To increase the study's reliability, we used an ABAB design – two measures in both baselines – and intervention phases. Using an ABAB design, experimental control will be shown by the results in the different A phases (baseline) being as similar as possible and by the B phases (intervention) being as similar as possible. Our data reveal this pattern, and by including two centers, there is implicit a replication within the study. A disadvantage of using an ABAB design is that there might be a carryover effect from the B1 intervention to the A2. Most studies, especially lab studies, do not usually last long enough to study repeated behaviors and the possible decay of effects over time. The follow-up study after 5 weeks showed that the effect of the nudge has diminished.

No data about the participants were collected except for their participation and cleaning in the workout sessions. At the time of the experiment, it was not common practice at these exercise centers to register the participants. Therefore, the demographics of the participants or whether they participated in multiple sessions are not known. Introducing registration could have revealed the experiment, created

questions from the participants, and added a potential bias. However, some degree of continuity can be expected, as some members of gyms have fixed exercise days and hours. Suppose the same members were present in all observations and exposed to the nudge. In that case, this might increase the confidence in the data that the intervention had an effect. Heterogeneity is a threat to internal validity (Shadish et al., 2002). To strengthen the study's internal validity, we included two different centers with geographical distance and two different workout classes.

Since the robustness of the "watching eyes" phenomenon is still questionable, as also this study reveals when it comes to the long-term effect, further studies are needed (Oda, 2019). Behavior is context-dependent, and every intervention is unique. This requires an experimental approach to test, learn, and inform how theory translates into practice. The use of "watching eyes" is a low-cost intervention, and to some extent, it has a high impact in real-world settings, at least when there is a short time exposure. Further, carefully designed field studies, including follow-up studies and replications, are needed to draw definite conclusions of the effects of images of eyes in different situations, contexts, and populations and for how long the effect lasts.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

HM and HJ developed the study concept and analyzed the experimental data. HJ collected the data. HM drafted the manuscript. DH, HJ, and AF contributed to the article. All authors approved the submitted version.

FUNDING

This work has been financially supported by OsloMet – Oslo Metropolitan University. Article Processing Charge funded by OsloMet – Oslo Metropolitan University (project number 415016).

ACKNOWLEDGMENTS

We are grateful to Kalliu Carvalho Couto for his valuable comments on the drafts of this article. We would also like to thank the reviewers for their helpful comments.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Article 3

Mobekk, H., Karevold, K. I., Tran, H., & Stjernen, K. (2018). Fish versus meat: Nudging the healthier choice of food in hotel lunch buffets. *Norsk Tidsskrift for Ernæring*, *16*(3), 6–13. DOI: **https://doi.org/10.18261/ntfe.16.3.2**

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Fish versus Meat – Nudging the Healthier Choice of Food in Hotel Lunch Buffets

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ABSTRACT

Background One of the objectives of the Norwegian National Action Plan for Healthy Diets (2017-2021) is to increase the intake of fish. The aim of this study was to encourage hotel guests to choose more fish and less meat by altering the choice architecture of hotel lunch buffets with the use of placement and labeling nudges.

Methods An experimental study was conducted with three conditions: meat before fish (A), fish before meat (B), and fish before meat including a sign with the text "Eat Smart" placed on the fish dish (C). Conference guests at three hotels were observed during lunch. The number of entrées taken, and the average portion size, was measured.

Results The percentage of guests selecting meat decreased in both condition B (48.5%) and condition C (56.1%) compared to condition A (60.3%). The percentage of guests selecting fish increased in both condition B (27.9%) and condition C (34.9%) compared to condition A (23.8%). However, the average amount of fish consumed per guest decreased in condition B (154 grams) and C (159 grams) compared to condition A (238 grams). The effect of the two nudges varied between the hotels.

Conclusions Rearranging food order and using signs can nudge conference attendees toward healthier choices. Differences between the hotels might be due to the different designs of the buffets. It is therefore crucial to include the microenvironment when doing interventions.

Background

The World Health Organization (WHO) claims that 80 % of heart attacks, 90 % of cases of type 2 diabetes, and more than 30 % of cancer cases could be prevented with dietary changes and exercise [1]. To cope with these challenges, one of the Norwegian health authorities' recommendations is to eat more fish and less red meat [2]. In recent years the fish consumption in Norway has fallen sharply [3]. The reasons for the decrease in fish consumption is multifaceted: prices, trends and concern regarding farmed fish are among the variables that might influence the intake. One of the objectives of the Norwegian National Action Plan for Healthy Diets (2017-2021) is to increase the intake of fish and seafood by 20 % before the end of 2021. To increase the consumption of fish it is recommended to eat fish for dinner two to three times a week. Additionally, it is recommended to use more fish and fish products for breakfast and lunch to accompany bread.

A recent WHO report [4] suggests that changing the food environment is a promising preventive solution. In recent years, there has been increasing interest in how changes in context can stimulate consumers to make healthier choices. Although most people value their health, they still make choices every day that undermine it. Immediate and/or certain reward is more valued than less certain and delayed rewards [5]. The chocolate bar glimpsed at the cashier and the sweets and desserts at a lunch buffet are both opportunities for immediate satisfaction that can result in weight gain. Such temptations are everywhere, and one way to change a person's unhealthy behavior is to alter the environmental cues to

prompt healthier choices. One approach to do this is to utilize nudging. Nudging is defined by Thaler and Sunstein [6] as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (p. 6). The use of nudging implies structuring the choice architecture to stimulate people towards more optimal outcomes without relying on any rational reasoning process [7]. The idea is based on behavioral science research showing that many decisions are made fast, intuitively and instinctively [8]. Poelman [9] completed a study showing that individuals with lower BMI (< 25 kg/m2) make use of behavioral strategies to avoid buying and eating unhealthy foods or over eating. This is an indicator that slim people already deploy nudge-like methods for themselves in food-related situations [10].

Previous studies show that rearranging the food order [11], plate size [12], menu-order [13], availability [14], and a wide range of other environmental factors can influence choice behavior [15]. While the effect of a nudge may appear small - eating a few less bites at each meal or engaging in 15 additional minutes of physical activity each day [16] - the accumulated effect of well-implemented nudges can make a noticeable difference over time. The aim of this study was to encourage hotel guests to choose to eat more of the healthier fish options and less meat.

The research questions are twofold:

1. Will the order of food matter when encouraging people to make a healthier food choice?
   - If people see fish first, will they choose fish more frequently?
   - Will a sign on the fish dish encourage people to choose fish more frequently?
2. Will the order of food affect the amount consumed?
   - If people see fish first, would they consume more fish?
   - Will a sign on the fish dish encourage people to consume more fish?

Method

Participants and Research Setting

Conference guests at three hotels belonging to the same chain in Oslo, Norway, participated in this

Buffet at hotel 1. Foto: Knut Ivar Karevold

Buffet at hotel 3. Foto: Knut Ivar Karevold

field experiment. The three hotels were one airport hotel (hotel 1), one city hotel (hotel 2), and one suburban hotel (hotel 3). All guests (3825 guests at hotel 1, 3710 guests at hotel 2, and 2167 guests at hotel 3) attending the hotels lunch buffets on Monday through Friday from April to June in 2015, corresponding to a total of 47 days, were observed.

Procedure

Study Design. The intervention included two nudges: placement and sign. During the placement intervention, the fish dish was moved to the first position in the buffet. The labeling intervention involved a small sign suggesting to "Eat Smart" on the fish dishes (Picture 1). There were three conditions: In condition A, the meat was placed first; in condition B, the fish was placed first; in condition C, the fish was placed first and the "Eat Smart" sign was placed next to the fish. Each condition was set up for one month in each hotel. The order of the conditions was counterbalanced across the hotels to ensure that guests had not been influenced by seasonal effects and confounding factors.

Buffet at hotel 2. Foto: Knut Ivar Karevold

The order was: hotel 1: A, B, C; hotel 2: C, A, B; hotel 3: B, C, A.

Measures. In hotel 1 (Picture 2), the buffet was placed in the center of the room with dishes displayed on open trays, allowing guests to approach and see the food options from all directions. In hotel 2 (Picture 3), the dishes were placed in open trays on a buffet that could only be approached from one direction and the guests queued up in a line. In hotel 3 (Picture 4), the dishes were placed under lids on a buffet that could only be approached in a line from one direction, and the guests had to open each lid to see and take the dishes.

Using a pen, trained observers recorded the number of guests taken meat and fish on an observation form developed for this experiment. Tallying was used to record the number of servings, and the tally was counted and recorded at the end of each day. There was one observer per buffet, and the observers were placed as discretely as possible in a corner of the buffets. It was close enough to record, but far enough not to interfere with the guests. An inter-observer agreement test was conducted during one 90-min meal in the first week of observation, showing an inter-rater reliability of 92%. The total weight in grams of all fish and meat entrées available on each buffet was registered before and after lunch to calculate the total amount consumed. The total serving amount was then divided by the total number of guests to compute the average amount consumed per guest.

Data Analysis. At each hotel the percentage of guests who selected fish and meat was calculated. In addition, the amounts consumed of the two dishes were calculated in grams per guest per day at each hotel. SPSS® version 24 was used for the statistical calculations. To control for the differences in the total number of participants, we replicated the average consumptions and average selection percentages in corresponding to total participants at each hotel and each observed day. The statistical significance of difference between conditions was tested using ANOVA F-test.

Results

During the study, the average percentage of guests selecting fish was 29 %, while 54 % selected meat across all conditions at the three hotels. The average amounts of fish consumed per guest varied from 111 to 253 grams, while the average amounts of meat per guest varied from 71 to 317 grams, over the three conditions.

In hotel 1 there was a 21.8 % decrease in guests selecting meat when condition B was implemented versus condition A (34.3 % vs. 56.1 %, $p < 0.01$), while the percentage of guests selecting fish increased by 1.6 % (31.2 % vs. 29.6 %, $p < 0.01$). However, the effect disappeared when the "Eat Smart" sign was added in condition C where the percentage of guests selecting meat went back to 54 % ($p < 0.01$). See Table I for the percentage of guests selecting fish and meat. In addition, hotel 1 experienced an increase in the average amount of meat consumption when condition B was implemented compared to condition A; from 173 to 317 grams ($F(1, 995) = 860.943$, $p < 0.01$). Hotel 1 experienced a small decline in the average amount of fish consumption from condition A through condition C (253 vs. 182 vs. 165 grams; $F(2, 1{,}451) = 89.749$, $p < 0.01$), as presented in Table II.

Hotel 2 experienced a significant increase in selections of fish when condition B was implemented

Table I *Proportions of guests who selected fish and meat entrées at hotel lunch buffets.*

	CONDITION			F TEST			
	A Mean (SD)	B Mean (SD)	C Mean (SD)	A vs. B[a] (p-value)	B vs. C[a] (p-value)	A vs. C[a] (p-value)	ABC[b] (p-value)
Hotel 1							
Fish Entrée %	29.6 (13.8)	31.2 (11.9)	49.7 (19.2)	8.397 (0.01)	977.766 (<0.001)	741.517 (<0.001)	688.577 (<0.001)
Meat Entrée %	56.1 (16.1)	34.3 (11.7)	54.0 (29.0)	1431.114 (<0.001)	576.121 (<0.001)	3.976 (0.05)	433.145 (<0.001)
Hotel 2							
Fish Entrée %	19.4 (8.2)	28.3 (6.0)	28.2 (8.4)	717.392 (<0.001)	0.189 (0.66)	781.056 (<0.001)	514.592 (<0.001)
Meat Entrée %	69.2 (14.4)	56.2 (8.8)	53.2 (11.4)	538.518 (<0.001)	46.377 (<0.001)	1101.226 (<0.001)	655.056 (<0.001)
Hotel 3							
Fish Entrée %	23.9 (8.2)	21.7 (8.6)	20.7 (7.0)	24.086 (<0.001)	6.446 (0.01)	60.625 (<0.001)	28.141 (<0.001)
Meat Entrée %	48.5 (13.0)	65.6 (18.8)	66.7 (21.3)	369.96 (<0.001)	1.196 (0.27)	334.687 (<0.001)	198.478 (<0.001)
All Three Hotels							
Fish Entrée %	23.8 (11.3)	27.9 (10.5)	34.9 (17.9)	206.821 (<0.001)	369.809 (<0.001)	809.672 (<0.001)	522.01 (<0.001)
Meat Entrée %	60.3 (17.0)	48.5 (19.1)	56.1 (22.2)	612.992 (<0.001)	233.314 (<0.001)	68.025 (<0.001)	269.858 (<0.001)

Note. Condition A, the meat entrée was placed first; condition B, the fish entrée was placed first; condition C, the fish entrée was placed first with a "Eat Smart" sign placed next to the fish. SD: Standard Deviation.

[a] These data were analyzed with one-way ANOVA to examine the effect of placements and signage on the average proportion of guests who selected meat entrée and fish entrée between each pair of conditions: A vs. B, B vs. C, and A vs C.

[b] The one-way ANOVA was conducted to examine the effect of placements and signage on the average proportion of guests who selected meat entrées and fish entrées among all three conditions.

compared to when condition A was implemented (28.3 % vs. 19.4 %; $p < 0.01$). However, in hotel 2, there was no significant change in the percentage of guests selecting fish when condition C was set up compared to condition B (28.3 % vs. 28.2 %; $p > 0.05$). Hotel 2 experienced a decrease in the percentage of guests selecting meat in both condition B (56.2 %) and condition C (53.2 %) compared to condition A (69.2 %), as presented in Table I. In addition, hotel 2 experienced a decline of more than 20 % in the average amount of fish consumption (-41 grams) from condition A (182 grams) to condition C (141 grams) ($F(1, 700) = 20.180$, $p < 0.01$). In hotel 2, the average amount of meat consumed was low compared to the other two hotels, but the average grams consumed increased slightly throughout all three conditions (95 vs. 109 vs. 124 grams; $F(2, 2,189) = 101.157$, $p < 0.01$).

In hotel 3, the percentage of guests selecting meat increased in both condition B (65.4 %) and condition C (63.8 %) compared to condition A (48.5 %). Furthermore, compared to condition A, when the percentage of guests selecting fish was 23.9 %, there was a small decline in fish selection in both condition B (21.7 %) and condition C (20.7 %), as presented in Table I. Condition B led to a decrease in average consumption of fish, while in condition C the average consumption increased closer to the baseline level. The average consumption of fish was 205, 122, and 164 grams in condition A, B, and C, respectively ($F(2, 472) = 91.569$, $p < 0.01$) while the average consumption of meat was 160, 199, and 71 grams in the condition A, B, and C respectively ($F(2, 1,302) = 320.508$, $p < 0.01$).

In all three hotels, the percentage of guests selecting meat decreased in both condition B (48.5 %) and condition C (56.1 %) compared to condition A (60.3 %). Furth-

Table II *Average consumption of fish and meat entrées at hotel lunch buffets.*

	CONDITION			F-TEST			
	A Mean (SD)	B Mean (SD)	C Mean (SD)	A vs. B[a] (p-value)	B vs. C[a] (p-value)	A vs. C[a] (p-value)	ABC[b] (p-value)
Hotel 1							
Fish Entrée (gram)	253,03 (138,91)	182,52 (108,46)	165,45 (48,97)	56,989 (<0,001)	13,728 (<0,001)	217,982 (<0,001)	89,749 (<0,001)
Meat Entrée (gram)	172,8 (67,39)	317,3 (86,94)	210,12 (50,84)	860,943 (<0,001)	771,584 (<0,001)	126,762 (<0,001)	633,266 (<0,001)
Hotel 2							
Fish Entrée (gram)	182,05 (170,84)	110,97 (27,07)	140,88 (71,29)	40,179 (<0,001)	39,005 (<0,001)	20,18 (<0,001)	30,215 (<0,001)
Meat Entrée (gram)	94,61 (15,33)	109,26 (37,7)	123,9 (59,45)	97,659 (<0,001)	23,612 (<0,001)	190,75 (<0,001)	101,157 (<0,001)
Hotel 3							
Fish Entrée (gram)	204,96 (53,18)	121,86 (48,02)	164,33 (62,2)	213,59 (<0,001)	49,352 (<0,001)	36,322 (<0,001)	91,569 (<0,001)
Meat Entrée (gram)	160,31 (60,94)	198,91 (116,65)	71,2 (26,17)	27,305 (<0,001)	555,84 (<0,001)	790,373 (<0,001)	320,508 (<0,001)
All Three Hotels							
Fish Entrée (gram)	238,47 (168,8)	153,56 (101,01)	159,43 (62,93)	555,951 (<0,001)	8,843 (<0,001)	712,742 (<0,001)	509,998 (<0,001)
Meat Entrée (gram)	131,53 (57,4)	234,77 (127,2)	151,59 (80,25)	1505,61 (<0,001)	1113,358 (<0,001)	124,327 (<0,001)	1051,36 (<0,001)

Note. Condition A, the meat entrée was placed first; condition B, the fish entrée was placed first; condition C, the fish entrée was placed first with a "Eat Smart" sign placed next to the fish. SD: Standard Deviation.

[a] These data were analyzed with one-way ANOVA to examine the effect of placements and signage on the average consumption among guests who selected meat entrée and fish entrée between each pair of conditions: A vs. B, B vs. C, and A vs C.

[b] The one-way ANOVA was conducted to examine the effect of placements and signage on the average consumption among guests who selected meat entrée and fish entrée among all three conditions.

ermore, compared to condition A when the percentage of guests selecting fish was 23.8 %, there was an increase in both condition B (27.9 %) and condition C (34.9 %) as presented in Table I. Condition B led to a decrease in average consumption of fish; similarly, in condition C, consumption decreased compared to the baseline level. The average consumption of fish was 238, 153, and 159 grams in condition A, B, and C respectively ($F(2, 9699) = 509.998$, $p < 0.01$) while the average consumption of meat was 132, 235, and 151 grams in condition A, B, and C respectively ($F(2, 9699) = 1051.360$, $p < 0.01$).

Discussion

Main findings of this study

This study investigated the effects of two well-known and well-tested nudges [17] – placement and labeling – on food choices in three conference lunch buffets. The results show that the effects of the intervention varied between the three sites. In hotel 1, placing fish first did not increase the number of guests who chose fish, but adding the sign led to a significant increase in the number of selections. In hotel 2, placing the fish first did increase the number of guests who selected fish, but adding the sign had no additional effect. In hotel 3, neither food order nor labeling influenced the number of choices. At first glance, this may seem like a random pattern. To further understand how the guests might have been influenced, the microenvironment, buffet layout and design, and guest behavior were all analyzed.

In hotel 1, where food order depended on perspective and the direction of approach, there were no ordering effects on number of guest choices. Here the labels influenced more guests to take fish, suggesting that the sign had a focusing-effect drawing more guests towards the labeled alternative. In

hotel 2, where the dishes were placed in open trays on a buffet that could only be approached from one direction, there was a clear order effect. Adding the sign did not increase serving frequency beyond the ordering effect. In hotel 3, where the dishes were placed under lids, neither the food order nor the label influenced the number of guests who took fish.

This suggests that the micro-design of the buffets influenced the guests' choices. In buffets where dishes are equally visible from all perspectives (like hotel 1), no ordering effects can be expected, but simple signs might catch the guests' attention and influence more guests to take labeled dishes. In buffets where guests queue up and all dishes are easily visible (hotel 2), more guests try the first option, but adding a sign on the first option does not increase the frequency of choices. In buffets where guests queue up, but the dishes are not visible (hotel 3), causing guests to judge each option individually, neither placement nor labeling seems to influence how many guests select the healthier option.

The effects on portion sizes showed a different pattern than the frequency of fish choices. In hotel 1, the portion sizes decreased when fish was placed first and became even smaller when the sign was added. In hotels 2 and 3, the portion sizes also decreased when fish was first, but increased somewhat when the fish was labeled. Thus, in all three hotels portions decreased when fish was placed first, suggesting that more guests sampled less of the first fish options. In Nordic countries, meat is typically the most popular dish at conference lunches. The results suggest that placing the less dominant fish option first can stimulate guests to try a smaller amount of this alternative, while still leaving space for their most preferred meat dish. Further, adding a label might prompt some guests to increase portion size somewhat. The labels influence portion size only in the hotels where the guests form lines, suggesting that signs can interact with placement when people determine how much food they believe they need.

This study aimed at nudging the number of healthier choices and portion sizes of healthier fish options. As a consequence of the intervention, changes in the meat options were also implemented; the meat dishes were moved from the first to second position. Based on the discussion of microenvironments above, we observed no ordering-effects on meat choices in hotel 1 where guests could approach the buffet from all directions. In hotel 2 with a line of guests that could see all options, significantly fewer guests selected meat when this was placed as the second choice, while in hotel 3 the number of guests who selected meat increased significantly when meat was placed in the second position and hidden under a lid. In hotel 1 and 3, the meat portions varied independently of where the meat was placed, while in hotel 2 we observed the same sampling effect for meat in first position as for fish in first position. In hotel 2 with the open buffet and a clear queue of guests, more guests tried the first dish, but took less of it, for both fish and meat in the first position.

What is already known?

Knowledge and traditional ways of dieting do not appear to influence the large changes that are needed to get a slimmer, healthier population. Many nudges appeal to the unconscious chooser, and the effect is persistent since no active choice is being made. Examples of this are smaller plates that lead to smaller meals [18] and that the most available option is picked more often [19]. Previous studies show that nudge interventions in restaurants show variable effects. A recent review of the literature [20] found that 45-60 % of these studies reported significant effects while 17-22 % of the studies reported variable effects depending on design of the interventions and target groups. In general, and independent of consumption context, this review showed that placing could sway food choices in 80-100 % of such interventions, while 25-61 % of the studies of signs and labels showed that these influenced significant changes in choice. Thus, the effects of restaurant nudges are not unanimous and further studies are needed to determine their effects.

What this study adds

The results from the present study suggest that micro-design of lunch buffets influence how well-known and well-studied nudges influence guest choices. The effects of food order can vary depending on how guests are guided to form queues, and whether the available options are visible when the guests line up. When guests are influenced by food order, the additional effects of signage seem to be limited. When guests do not form lines and can approach the alternative dishes from several different directions, signs and labels might influence more guests to select the healthiest options. Guests seem to take smaller samples of the first option, particularly when they can visually observe the forthcoming alternati-

ves later in the buffet, perhaps taking less to ensure sufficient variety in their meal.

Limitations of this study

The present study was an experimental study with three conditions in three locations with a counterbalanced order at the three sites. The study used two complementary dependent variables, number of guest choices and average portion sizes. A limitation of the study was that it did not control for any third variables that might have influenced the choices, such as the attractiveness and taste of the healthy options and how the "Eat Smart" label was interpreted. In addition, no data about the characteristics of the guests – such as age, gender, health and nutritional habits – that might have influenced the outcomes are known.

Conclusions

This intervention was consistent with Norwegian health authorities' recommendations to eat more fish and less red meat [2]. The results suggest that variations in the physical design of restaurants can influence how frequently healthier options are sampled. Consistent with previous research, placement might have a relatively stronger effect than labeling. This study suggests several research questions that can be investigated in future intervention studies, for example how first foods might be sampled in smaller portions when the other alternatives are visually available, and how ordering-effects and signage effects are reduced when the options are hidden and perhaps judged individually. The present study can be considered a smaller scale testing and replication of interventions that previous studies suggest can be effective, where the added value is a more detailed understanding of how local conditions and variations of restaurant design can influence the effectiveness of nudges.

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[Article not attached due to copyright]

Article 5

Simon, C., & Mobekk, H. (2019). Dugnad: A fact and a narrative of Norwegian prosocial behavior. *Perspectives on Behavior Science*, *42*(4), 815–834.
DOI: https://doi.org/10.1007/s40614-019-00227-w

Perspectives on Behavior Science
https://doi.org/10.1007/s40614-019-00227-w

CULTURAL AND BEHAVIORAL SYSTEMS SCIENCE

Dugnad: A Fact and a Narrative of Norwegian Prosocial Behavior

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Published online: 13 November 2019

Abstract

Evolved mechanisms of phenotypic plasticity, which are evolutionary processes in their own right, enable species to respond adaptively to their environments. The Scandinavian countries, and Norway in particular, have for many years scored exceptionally high on lists of life quality, economic indicators, and measures of happiness. We propose that learning prosocial and cooperative behavior, which is central in a particular Norwegian cultural practice, *dugnad*, plays a role in the country's success story. *Dugnad* is a Norwegian term for a type of voluntary work carried out as a community or collective and traditionally involving a social gathering. *Dugnad* has a long history in Norway, and it is a well-established cultural practice that has led to and still maintains significant social benefits. *Dugnad* is arranged in virtually all communities such as kindergartens, neighborhoods, schools, and organizations. Participation in *dugnad* gatherings is generally expected. Children from a young age are involved in *dugnad*. *Dugnad* activities are based on cooperation and can include anything from arranging a spring cleaning in the local community to building a club house for your children's sports club. This paper discusses *dugnad* as a cultural practice that creates an environment that nurtures prosocial and cooperative activities. From a behavior analytic, selectionist perspective, we propose a non-domain-specific learning mechanism for *dugnad*-typical prosocial and cooperative behavior analogous to the phylogenetic evolutionary mechanism of group selection. Contingencies can lead to and maintain *dugnad* activities when extended behavioral patterns are selected as wholes.

Keywords *Dugnad* · Prosociality · Nurturing environment · Nordic model · Patterns of behavior · Evolution

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Published online: 13 November 2019

In 2017, Norway was granted the title "The Happiest Place to Live" (Helliwell, Layard, & Sachs, 2017). Norway has, for many years, scored exceptionally high on lists of life quality and economic indicators, such as the United Nations Human Development Index matrices (United Nations [UN], 2015). How and why have Norwegians achieved this? Scholars (Eklund, 2011; Witoszek & Midttun, 2018) explain Norway's success with the so-called *Nordic Model.* The Nordic countries, Norway, Sweden, Denmark, Finland, and Iceland are societies with both high economic productivity and an unequaled quality of life. Core elements of the Nordic Model are comprehensive social cooperation, economic governance, public welfare, and organized work. The economy is open with a high per capita income. All five countries have a rather large public sector, high taxes, and an inclusive welfare state with benefits such as free or affordable public services, health care, and education. Also, the Nordic countries have a strongly regulated labor market policy. Despite these similarities, the Nordics have different histories and unique structures (Witozsek & Midttun, 2018). Over the last years, international interest in the Nordic Model has rekindled (Eklund, 2011).

The hallmarks of the Nordic cultures are their consistent and strong advocacy of the ideal of a cooperative, tolerant, and inclusive community, which is regarded as superior to a competitive, hierarchic culture (Witozsek & Midttun, 2018). Norway is one of the richest and most egalitarian democracies in the world. No doubt, the oil resources have played a major role in accumulating wealth, but the reason that the Nordic model generates so much research interest (e.g., Christiansen, 2006; Dølvik, 2013; Greve, 2007; Hilson, 2008; Knutsen, 2017; Kvist, 2012; Midttun et al., 2011; Simon, 2017; Wilson & Hessen, 2018) is the proposition that also high degrees of equality and reciprocity significantly contribute to the success of the Nordic nations. The question motivating many analyses of the Nordic Model is whether other countries could benefit from an implementation of its characteristics. Cultural and social values are not easily transferable across borders (Eklund, 2011), but behavior analysts may foster such transfer by use of their tools and knowledge allowing them to perform functional analysis on a cultural level (Couto & Sandaker, 2016).

Wilson, Hayes, Biglan, and Embry (2014) argue that evolution must be at the center of any science of change given that the study of evolution is the study of how organisms change in relation to environmental events. Thus, they conclude, in line with the ideas that form the basis of Skinner's (1948) novel *Walden Two,* that we need to become wise managers of evolutionary processes selecting behavior to avoid unmanaged processes taking us where we would prefer not to go. *Walden Two* portrays a world combining the best of both Paleolithic and modern culture (Glenn, 1988). The novel illustrates that the evolutionary processes selecting behavior that we are to be aware of include those occurring at a phylogenetic level, and those we are to manage include those on an ontogenetic and a cultural level. Skinner portrays, in particular, the potential of managing the ubiquitous selection of behavior during ontogeny, which is not to be confused with eugenics, a set of practices attempting to improve the genetic quality of the human population by artificial breeding of—what its proponents regard to be—superior genetic groups (Galton, 1904).

Natural selection is based on relative fitness. Hence, the behavior that maximizes the fitness of individuals, relative to members of their group, is often different from the behavior that maximizes the fitness of the group as a whole. The arising conflict between self-interest and behaving for the good of the group has occupied evolutionary

biologists since the 1960s. These evolutionary dynamics of cooperation indicate, on the one hand, an advantage of societies relying on many groups that successfully manage their common pool resources. On the other hand, they point to the vulnerability of these groups to self-interested defectors. Wilson and Hessen (2014) proposed a solution of this conflict between self-interest and mutual benefits by suggesting that the social dynamics that take place naturally and spontaneously in smaller groups can be scaled up to prevent the ethical transgressions that routinely take place at larger scales. Wilson and Hessen (2014) summarize their view as follows:

> The success of the so-called "Nordic Model" is commonly attributed to factors such as income equality, a high level of trust, and high willingness to pay tax, which is tightly coupled to strong social security (health, education), a blend of governmental regulations and capitalism, and cultural homogeneity. These and other factors are important, but we think that viewing them through an evolutionary lens is likely to shed light on why they are important. Our hypothesis is that Norway functions well as a nation because it has successfully managed to scale up the social control mechanisms that operate spontaneously in village-sized groups. Income equality, trust, and the other factors attributed to Norway's success emanate from the social control mechanisms. . . . The most strongly regulated groups in the world are small groups, thanks to countless generations of genetic and cultural evolution that make us the trusting and cooperative species that we are. The idea that trust requires social control is paradoxical because social control is not trusting. Nevertheless, social control creates an environment in which trust can flourish. When we know that others cannot harm us, thanks to a strong system of social controls, then we can express our positive emotions and actions toward others to their full extent: helping because we want to, not because we are forced to. (pp. 125–128)

In the search for the causes of Norwegian well-being, this evolutionary perspective suggests turning the spotlight to the traditions of cooperation, reflected in a particular Norwegian cultural practice—*dugnad* ['d :gnɑd]—which has been central to the development of the welfare society. In their reflections on Witozsek and Midttun's (2018) edited volume on the Nordic Model, Kildal and Bjerke (2018) write that Nordic "knowledge and thinking have created inbuilt reflexes of cooperation in the Nordic societies. The tradition of cooperation, for instance, reflected in the Norwegian institution *dugnad,* has been central to the creation of the Nordic welfare societies."[1]

Even if Kildal and Bjerke (2018), who do not have a background in a behavioral science, use the term *reflex* technically inappropriately—possibly metaphorically or as an exaggeration—they deserve credit for explicitly drawing attention to the very connection between well-being and cooperation in Norway and the cultural practice of *dugnad,* which we discuss further.

The main dictionary of the Norwegian written language Bokmål, *Bokmålsordboka*, describes the heritage of the Norwegian word *dugnad* as an amalgamation of *duge* and the suffix *nad*. *Duge* means "to be good enough" or "useful," while *nad* corresponds to the Latin *atus* that is suffixed to a noun to designate passive qualities. The term *dugnad*

[1] Online source without page numbers that we edited for grammar.

refers to a sort of voluntary work done as a community or collective. Traditionally, *dugnad* is a way of solving local,[2] common tasks by means of collective efforts from the community.

The cultures of the Scandinavian nations Denmark, Sweden, and Norway are so similar that Scandinavians moving between these countries are not regarded as immigrants to the same extent as immigrants from other countries. Swedish, Norwegian, and Danish are mutually understandable, overlapping in much of their vocabulary. Reference to "different languages" is politically motivated; from a linguistic perspective, they are dialects. However, *dugnad* is a Norwegian word lacking understandability and counterparts in any other language, including Swedish and Danish. In 2004, the Norwegian national broadcasting service (NRK), elected *dugnad* as "Norway's National word of the year" in their TV series *Typisk norsk* (Eng. "Typically Norwegian"). Researchers (e.g., Kraglund & Enjolras, 2017; Lorentzen & Dugstad, 2011) agree on the importance and uniqueness of dugnad in Norwegian culture, but there is little documentation of the development of this cultural practice. Sometimes, *dugnad* and *voluntary work* are used interchangeably, but there are distinctions between the two terms. Traditionally, the core elements of dugnad are 1) unpaid work, 2) people meet face-to-face, and 3) they join in tasks with a defined start and end point. Work is followed by 4) a social gathering such as a meal (Lorentzen & Dugstad, 2011). Not all voluntary work is *dugnad*, in the sense that not all voluntary work needs to be face to face or include a social happening (Lorentzen & Dugstad, 2011).

Participants in dugnads engage in prosocial behavior, which Biglan (2015) defined as "behaviors that benefit individuals and those around them"[3] (p. 16) and consisting of "behaviors . . . that have to do with helping others, contributing to the community . . . , [are] associated with greater personal well-being, . . . [and are] beneficial to the group" (Wilson et al., 2014, p. 445). Biglan (2015) and Biglan, Flay, Embry, and Sandler (2012) argue that promoting and reinforcing prosocial behavior is one of the ways in which interventions make environments more nurturing. That is, fostering our successful development and preventing the development of psychological and behavioral problems. Dugnad may be understood as a means of realizing nurturing environments that fuel prosocial behavior in Norway. Systems and policies that have proved to work well might serve as an inspiration for others (Eklund, 2011).

If the tradition of dugnad plays a role in Norway's success, it solicits the questions *How?* and *Why?* If all human behavior is a function of environmental events that have occurred during the history of our species and environmental events we experience during our lifetime, how and why do people who live in a "dugnad society" behave differently from those who do not?

By discussing the Norwegian cultural practice of dugnad, this article exemplifies how traditions can be understood from a behavior analytic perspective and how such understanding may guide action. Dugnad is a *cultural practice* in the sense that *culture* consists of behavior patterns acquired as a result of group membership (Boyd & Richerson, 1985), and that *practices* are behavioral patterns that are not

[2] In the following, we omit italics when referring to the cultural practice of dugnad, instead of the term *dugnad*.

[3] We omit "a constellation of values [and] attitudes" (Biglan, 2015, p. 16), which are part of both of Biglan's definitions, but which we regard to be inseparable from behavior.

idiosyncratically acquired by individuals. Thus, these behavioral patterns are available for replication—for example, contrary to Dawkins's (1982) dead-end replicators (Baum, 2000). Skinner (1981) suggested that the unit of culture is a contingency of social reinforcement (i.e., arranged by other people) that is characteristic for a group. In this article, we attempt to investigate dugnad as a unit of culture by discussing its social context and socially mediated consequences. First, we suggest a historical account of a cultural practice that has led to and maintained significant social benefits. Second, we propose behavioral processes that support the cultural practice of dugnad. Different from the perspective expressed by the biologists Wilson and Hessen (2014) in the quote above, we argue that an outline of the dynamics of prosocial behavior, such as dugnad organization and participation, is not based exclusively on genetic and cultural evolution, and is incomplete without an outline of the role of the selection of behavior during an individual's lifetime.

Skinner (1981) argued that behavior change might be caused by selection processes at three levels: genetic, operant, and cultural. In this article, we attempt to fill that gap created by analyses limited to genetic and cultural selection of prosocial behavior. After all, the three levels of selection are interdependent. As Skinner (1981) pointed out, the "operant condition is an evolved process, of which cultural practices are special applications" (p. 502), and operant and cultural selection processes ultimately need to be adaptive from a natural selection point of view. The question about which adaptive function dugnad may perform translates to the questions of what is learned and why this might be useful. To be beneficial, behavioral patterns must make contact with consequences that affect the copying of genes, which we will discuss in Baum's (2012) terminology of *Phylogenetically Important Events* (PIEs).

In this present contribution to the special section of *Perspectives on Behavior Science: Cultural and Behavioral Systems Science*, we discuss how operant selection may contribute to bringing about the cultural practice of dugnad. We discuss this interdependence of operant and cultural phenomena by broaching that consequences (Baum's PIEs) may be produced by 1) several people together, which Glenn (2004) termed *cumulative effects* or *aggregate products* (Glenn et al., 2016), 2) temporally extended behavioral patterns correlating with long-term consequences, and 3) short-term social consequences, which are effective due to our long history of living in groups. Because long-term consequences have little effect on behavior, an adaptive practice—that is, a practice that pays in the long run—is strengthened in the short term by social reinforcers delivered by rule givers. A behavioral analysis focuses on environmental events that are observable and, therefore, susceptible to research. Thus, when we speak of "self-control," this refers to such observable adaptive practices, which pay in the long run (Baum, 1995; Rachlin, 2004). This includes what Borba, Tourinho, and Glenn (2014) term *ethical self-control*, denoting situations in which "a person's behavior produces long-term consequences to many members of the culture . . . [and where] the delayed effect is central to the definition" (p. 69).

In this article, we explore how this dynamic of the effects of long- and short-term consequences on behavior can contribute to the maintenance of and the threat to dugnad-practices. The susceptibility of behavior to all three ways of contacting consequences enables the formation of extended patterns, extended in an individuals' time or across several individuals, such as when participating in dugnad activities. This article suggests that these are how operant selection maintains dugnad activities.

In the following, we first provide a primer to the history of dugnad and then outline our understanding of the workings of operant selection in initiating and maintaining dugnad activities by interpreting this cultural practice in the light of a behavioral analysis of prosociality, self-control, and altruism, before concluding with final remarks.

The History of Dugnad

Norway has a long tradition of dugnad in terms of unpaid voluntary work where people gather to accomplish a task often involving manual labor that requires many workers (Beier, 2011; Klepp, 2001). Dugnad is based on egalitarian relationships among the participants. Today, dugnads are scheduled in almost all community contexts such as in kindergartens, neighborhoods, schools, and sports clubs. In general, when you are informed about a dugnad, the other participants expect you to participate and spend time contributing to the common good of the community. Dugnad activities today range from baking a cake for your children's school band lottery to helping build a clubhouse for the local sports club. A social gathering often follows the utilitarian event. For example, a barbeque or waffles and coffee gathering may follow indoor and outdoor spring cleaning in housing cooperatives.

The origin of dugnad dates back to a broad period between the beginning of Christianity and the 19th century (e.g., Lenk, 2011; Lorentzen & Dugstad, 2011). According to the Institute for Social Research in Norway, dugnad activities can be traced back to rural communities of the 14th and 15th centuries. Voluntary organizations later adopted dugnad as they emerged after the 1850s (Institute for Social Research, 2008).

It is likely that special Norwegian conditions such as the spread settlement in a landscape with fjords, forests, and mountains led to the growth of small isolated communities that favored the development of the dugnad tradition. Because they lived in small and detached villages, people depended largely on one another's help. In contrast to Sweden, for example, nobility has been almost nonexistent in Norway. This may have fostered a culture of emphasizing equality and social democracy that has nurtured the dugnad practice. Norway has a long history of relatively small social differences. Long before oil was discovered, the population was relatively poor. With little or no money to share with others, people instead contributed work power. Dugnad activities were often limited to small communities, and in the 19th century, dugnad was an important part of farming (Lenk, 2011). Members of the community joined forces to help each other with work they could not accomplish alone. Actions were voluntary and collective. They did not necessarily result in any tangible benefit for the individual apart from a meal served by the host at the end of the dugnad. Farming was based on reciprocity, and noncooperative farmers could not expect any help in return. Farmers were dependent on each other.

In 1905, after becoming independent of Sweden, Norway was one of Europe's poorest countries. Conflict arose between capitalist and communist forces. An agreement of cooperation between employers and the Labor Party was eventually signed in 1935. This agreement is still the backbone of Norwegian economic life and represents the union of traditional egalitarian individualism and communal values (Haugestad, 2003).

After the Second World War, Norway had a large housing shortage, and the country needed to be rebuilt and modernized. This became a national dugnad initiated by the Labor Party led by Prime Minister Einar Gerhardsen. He was soon nicknamed the "dugnad general." In the years after 1945, the Parliament reached a consensus that aimed at enabling people to build and own homes. The strategy was based on joint voluntary work, with the state providing affordable bank loans, the municipality providing reasonably priced land, and the private sector working through cooperatives pulling together to overcome the housing crisis. The homeowners contributed by maintaining their buildings together to reduce cost and sustain social relationships through dugnad. The long-lasting Norwegian tradition of dugnad, which people were familiar with from farming, now flourished in the context of house building.

The more the welfare state took over the responsibility for people's well-being, the more dugnad practices entailed civil engagement beyond the sphere of government and the profit-based business community (Lorentzen & Dugstad, 2011). With the emergence of the welfare state and increased regulations and quality requirements for solving tasks in the communities, it became more difficult to rely on the work of amateurs. Through history, dugnad has had diverse forms and has not been limited to small groups such as a sports team or an apartment block. Politicians and other authorities or organizations call for dugnads to mobilize the Norwegian people in one direction or another. Rebuilding the country after the Second World War is one example. Another example is that the Norwegian Food Safety Authority wanted everyone to join forces against the Iberian slug in 2008. All stakeholders in communities, from politicians to homeowners, were mobilized through an information and media campaign to implement preventive measures—chemical, biological, and mechanical—to reduce the population of the Iberian slug. As this example did not involve a scheduled gathering for common physical work followed by a social event, it shows how modern dugnad is adapting in a changing world.

Despite deep historical roots, dugnad, like any other cultural practice, evolves due to environmental changes. Over the past few decades, modern technology has had a huge impact on civil society. Globalization and new technology make it possible to engage across borders and national conditions, and boundaries between states, markets, and societies are being broken down. Modernization brings along incremental individualization that fundamentally changes the relationships between civil societies and their organizations. Dugnad adapts to modernity and finds new expressions, which we discuss in the section "Status Quo of Dugnad." First, we propose an explanation of how prosocial behavior, such as dugnad participation, may have evolved.

Ontogenetic Selection of Behavior

Had our behavior changed only by means of natural selection, we would be in trouble as soon as we face an environment that does not match our ancestral environment. Learning, or behavior change during our lifetime, is risky. If behavior is not innate, maladaptive behavior may be acquired. However, when learning is beneficial on average and in the long run, for example, when the environment changes, genes for learning are selected. These genes make our behavior susceptible to events that occur during our lifetime. This means that natural selection has

brought about another selection process, a process that allows our behavior to change as a consequence of changes in the environment we contact throughout our lifetime (Skinner, 1981).

Phylogenetically Important Events: The Drivers of Ontogenetic Evolution

Our environment changes all the time, but not all environmental changes influence our behavior. During the history of our species, those individuals whose behavior changed when contacting food, predators, warmth, mates, and so on contributed more to the next generation's gene pool than those whose behavior was less affected by such events. This means that those whose behavior changed as a function of contact with certain events had higher biological fitness. Baum (2012) called these events, which affect safety, nutrition, shelter, and ultimately—and on average—reproductive success, *Phylogenetically Important Events* (PIEs). PIEs acquired the effect they have on behavior today in the course of phylogeny, that is, the history of the species. To put it in Skinner's (1981) terms, the reinforcing or punishing function of certain events is naturally selected. A PIE, such as the occurrence of a predator, is "phylogenetically important" in the sense that it affects fitness. Thus, susceptibility of behavior to such events was passed on as a genetic setup that enables operant learning. Those whose behavior did not change (e.g., from foraging to escaping) when a predator appeared (PIE) were less likely to reproduce and to pass on their ignorance of predators to descendants.

Selection by Contingencies

A contingency between behavior and PIEs selects behavior through ontogeny because the affectability of behavior by such events has been advantageous for fitness in the organism's phylogeny. A contingency between two events, such as behavior and a PIE, exists when the probability of event A depends on event B (Baum, 2012; Rescorla, 1968, 1988). These events may either coincide or occur at different points in time, but for behavior to become susceptible to a probability of events, there need to be several occurrences of the events. This makes accidental contingencies rare, as the accidental conjunction would have to occur at least twice (Baum, 2012). If the probability of, say, being praised is the same regardless of performance, then no contingency exists between praise and performance. Thus, praise would not select performance. The temporal relation between the two events influences the susceptibility of behavior to the contingency. Hence, a contingency relates or connects behavioral and environmental events. It links a PIE to an activity and results in an increase or decrease in the activity. Contingencies between activities and PIEs are ubiquitous.

Cross-generational selection of organisms can occur naturally (as in the evolution of wolves) or artificially (as in breeding dogs). In the same way, the selection of behavior during ontogeny occurs naturally, such as when searching for mushrooms in certain areas, contrary to other areas, goes along with finding mushrooms. It can also occur artificially, such as when we swap the position of the mushrooms and the steak at a buffet to nudge people's filling up their plates with mushrooms before getting to the steak (Mobekk, Karevold, Tran, & Stjernen, 2018).

Some events do not affect fitness directly but tend to cooccur or correlate with events that affect fitness. Money, for example, correlates with resources; smiles correlate with safety or with mating opportunities. Also these proxies of PIEs can affect behavior during our lifetime. Because humans have largely evolved living in groups (Diamond, 2012), many of these events are social (Richerson & Boyd, 2005). When people cooperate, their common behavior pattern can produce advantageous PIEs that each individual's behavior could not have produced. Glenn (2003, 2004) termed these *cumulative effects* or *aggregate products*, which enables distinction from PIEs produced by the behavior of one organism from those produced by several organisms together.[4] Dugnad is a cultural practice characterized by such cooperative behavior.

Together, dugnad participants show a behavioral pattern that correlates with PIEs. Each individual's behavior would not have produced these PIEs alone. For example, a dugnad in a rowing club usually involves maintenance of large boats and their storage space. One person alone cannot move the boats, but a group easily achieves relocation of the boats required for their maintenance. All group members will eventually benefit from well-maintained boats and storage space. Consequences to the group as a whole can select the group's practice (Biglan & Glenn, 2013). Other PIEs such as a lower danger of infection by removing rusty nails from children's play areas or removing other dirt from common areas could, in theory, have been produced by a single individual's more extended work. However, correlations with other PIE-proxies, such as money, would have to be in place to induce someone's spending a week cleaning on their own instead of engaging in a dugnad lasting for one evening and entailing PIE-proxies such as social interactions. Activities compete for an organism's time, and the outcome of this competition is decided by the correlation between the activity and a PIE or PIE-proxy (Baum, 2016). The correlation between clean common areas (in addition to social PIEs) and a few hours of cleaning may select cleaning and outcompete alternative evening activities. The correlation between a week's lonesome cleaning and a clean common area, however, does not out-compete alternative activities such as paid work or relaxing spare-time activities.

Dugnad goes along with trust, which plays an essential role in the Nordic Model. Behavior that we call *trusting* fosters prosocial collective arrangements (Witozsek & Midttun, 2018). Even if most movements to preserve human freedom aim at limiting punitive means for influencing behavior (Skinner, 1972), social control creates the conditions in which trust can thrive (Wilson & Hessen, 2014). To cooperate often means to invest without being sure that the others will invest too, which can be a prerequisite to ensure that your behavior will lead to PIEs. If you grew up in a society where paying taxes does not correlate strongly with PIEs such as good infrastructure, you are less likely to pay taxes. If you experience that mostly PIEs that are

[4] Further vocabulary that Glenn et al. (2016) specifically developed for describing cultural selection processes includes *metacontingency, macrobehavior, macrocontingency, culturo-behavioral lineage*, *culturant*, and *cultural cusp.* Our analyses are compatible with processes that might describe such a cultural level of selection (see Krispin, 2016, 2017, for an application of the metacontingency vocabulary). However, a conceptualization of dugnad as a result of cultural level selection in terms of metacontingencies would here distract from our goal to outline the contribution of natural and operant selection to the cultural practice of dugnad. An analysis in terms of these cultural selection concepts seems inept for our present purposes of 1) discussing the contribution of operant selection of less-extended acts to the maintenance of the cultural practice of dugnad and 2) suggesting that, in dugnad participation, both selection of temporally extended behavior of individuals and that produced by several group members together is likewise selected by PIEs.

advantageous for your health, childcare, or safety correlate with you paying taxes—and evading taxes leads to disadvantageous social PIE-proxies such as disapproval by your friends, you are more likely to pay your taxes than if you have reason to believe that your money will be embezzled (a disadvantageous PIE).

In Norway, trust in the state, businesses, and other people is high (Berggren & Trägårdh, 2011; Edlund, 1999). In general, smaller class differences tend to go along with lower levels of criminality and corruption. The average Norwegian is not likely to have experienced major disappointments as a consequence of trusting, for example, in the government's promises on how taxes will be used. Participation in direct debit, which allows companies to withdraw money you owe them directly from your bank account, is among the highest in Norway (European-Central-Bank, 2015). If you do not have to be afraid of misuse, giving others access to your bank account saves you time that you can spend on other activities. Also, if you have experienced other community members avoiding dugnad participation and, thus, not doing their fair share of the activity required for bringing about the (shared) PIE, you are also more likely to freeload, especially if this is not followed by withdrawal of social approval or punishment (Rachlin & Locey, 2011). In the following, we argue for an analysis of naturally occurring contingencies between PIEs and dugnad activities, which can guide the design of new contingencies fostering cooperative and prosocial behavior.

Contingencies Selecting Participation in Dugnad

Following Rachlin and Locey's (2011) thesis that altruistic behavior can be ontogenetically selected, we propose that their arguments also apply to cooperative or prosocial behavior of organisms, an example of which is participation in dugnad.[5] The dynamics of dugnad parallel in many ways the so-called *tragedy of the commons* scenarios that come about when individuals overuse a common resource. Whereas the ecologist G. Hardin (1968) phrased tragedy of the common scenarios in terms of individuals' "taking too much," problems with dugnad contributions arise if people are "not giving enough." "Taking too much" and "not giving enough" amount to the same conflict, whose dynamics behavior analyst H. Rachlin has modeled extensively using multiperson prisoner dilemma games (e.g., Rachlin & Locey, 2011). Behavior that creates a tragedy of the commons (such as driving instead of using public transport) is selected and controlled by the contingencies between an individual's choice (to drive) and PIEs, but it has a cumulative effect (such as traffic jams; Glenn, 2004).

Tragedy of the commons scenarios, such as those of pollution leading the world into a climate crisis, emerge if people do "the opposite" from what they do in dugnad participation. This underlines the potential impact an increase of dugnad typical prosocial behavior could have. We propose an explanation of how organisms can learn to cooperate and to behave prosocially. This explanation relies neither on a special inherited altruistic tendency, as proposed by Wilson and Sober (1998), nor on an innate

[5] We regard so-called altruistic behavior and prosocial or cooperative behavior as gradually different in their cost-benefit distribution and in the temporal distance between the cost and the benefit, but not as different in kind. Prosocial and altruistic behavior would be categorically different only if altruistic behavior were defined as nonreinforced behavior—a definition that would defy behavior analysis (Rachlin & Locey, 2011).

sense of fairness, as proposed by Fehr and Fischbacher (2003).[6] Instead, the crucial inherited tendency maintaining participation in dugnad activities is the same that enables the formation of other patterns of self-controlled behavior: the sensitivity of temporally extended patterns of behavior to PIEs (Baum, 2018; Rachlin & Locey, 2011; Simon, 2016; Simon & Hessen, 2019). If potential parts of extended patterns enter into a contingency with relatively immediate social PIEs, this helps to build the pattern that PIEs then can maintain as a whole. Even if an individual prosocial act, say cleaning the bathrooms of your sports club (as part of your dugnad participation) instead of going to the movies (as part of skipping dugnad participation), correlates with disadvantageous PIEs, an advantageous PIE can act on the whole pattern of which this act (cleaning) is a part. The whole dugnad evening or your pattern of regular dugnad participations correlates with access to a well-functioning affordable sports club, positive social interactions, absence of negative social interactions, and being able wholeheartedly to call yourself a good person. However, to agree to show up to clean the bathrooms (as part of a more extended pattern) may constitute a self-controlled act just like refusing a dessert if you are on a diet (for a nonmentalistic account of self-control, see Rachlin, 1995, 2004; Rachlin & Green, 1972; for a behavior-analytic approach to ethnical self-control, see Borba, Tourinho, & Glenn, 2014, 2017). The extended diffuse consequences (e.g., access to an affordable socially pleasant sports club or losing weight) compete with more immediate and concrete consequences (e.g., smell and sight of a disgusting bathroom or the pleasant taste of a dessert) for control of your behavior (Locey et al., 2013). This is why eating a healthier diet, stopping smoking and drinking, and getting people to engage in more prosocial behavior such as participation in dugnad, is not easy—though it is often possible. There are sooner consequences for parts of these behavior patterns (e.g., withdrawal symptoms after refusing a drink, having a relaxing evening after refusing to participate in a dugnad versus social approval for refusing a drink or participating in a dugnad) as well as more delayed consequences for the more extended behavioral pattern (e.g., good health, a well-functioning inexpensive sport's club versus their absence). These different consequences compete for our time, challenging the development and maintenance of self-controlled, prosocial behavioral patterns. Understanding the power of these sooner and more extended consequences carries the potential to influence choice in the way that prosocial behavior patterns can be built.

Baum (2013, 2016) argued that activities with different levels of complexity may be selected as wholes. Parallel to Wilson and Sober's (1998) phylogenetic multilevel selection model, the units of selection in Baum's ontogenetic multiscale model are nested into each other. Despite these similarities, the possibility of phylogenetic group selection, which is widely disputed (Krasnow & Delton, 2016; Krasnow, Delton, Cosmides, & Tooby, 2015; Richerson et al., 2015; West, Griffin, & Gardner, 2007), and the selection of behavioral patterns do not depend on each other. Extended behavioral patterns may be selected as wholes even if the possibility of multilevel selection should turn out to be inadequate (Rachlin, 2019). Innate behavior such as

[6] This is not to claim that inheritance of altruistic tendencies is impossible or to deny that babies are more likely to reinforce the behavior of a person they have observed to cooperate (which Biglan, 2015, uses as evidence of "wired-in tendencies" [p. 16]). However, here we would like to spread hope by outlining how prosocial behavior can be learned just as we can learn self-control (Locey, Jones, & Rachlin, 2013).

eating, sleeping, or sexual activity is often patterned, and ontogenetic selection can evolve them into new forms (Locey & Rachlin, 2015; Rachlin, 1995; Teitelbaum, 1977). Since the 1960s, researchers have accumulated evidence suggesting that patterns of responses can be selected by PIEs as whole units. Wolff (1968) found that infants do not alter pauses between individual sucks but between bursts of sucks, that is, groups of sucks as wholes. Grunow and Neuringer (2002) and Neuringer (2004) created contingencies that selected sequences of rats' lever presses as wholes. Studies on commitment and self-control with both human and nonhuman subjects show that organisms increase patterning if increased access to advantageous PIEs is contingent on patterning.

How do the dynamics of selection of behavioral patterns help to illuminate why Norwegians every so often spend their Sunday afternoon freezing, standing next to a skiing track waiting for the end of a children's skiing competition instead of at their cozy fireplace? To understand why someone may choose to engage in an activity that will (proximately) lead to disadvantageous PIEs instead of alternative activities that may (proximately) lead to advantageous PIEs, it is important to consider that every choice occurs within a context. A decision for or against participation in dugnad does not occur in a vacuum. Having grown up in Norway, you are likely to have started to gather experiences with dugnad from early childhood, which you did not do if you moved to Norway at a later age. However, independent of your dugnad-specific experiences, you are likely to have experienced situations with similar dynamics. You may have experienced that you get to work quicker if you are one of the few people driving, whereas everybody else uses public transport, even though everyone goes slower when everyone chooses to drive. You may have heard about emergencies where you are quickest and best equipped if you grab your stuff and elbow your way through the exit, but if everyone did so, all would get out more slowly. Maybe you have experienced other situations where it was best for you as an individual if you, and (almost) only you, add more to pollution, use more energy, jump queues, break agreements, be the soldier who turns and runs or be the peasant who has more children using overcrowded land. All these experiences build the context for the likelihood of your prosocial behavior in a dugnad context, such as contributing to a children's skiing competition on one of your scarce free Sunday afternoons.

Borba, Da Silva et al. (2014) investigated individuals' choices in concurrent contingencies involving conflicts of consequences for the individual and consequences for the group. Individuals had to choose between options producing advantageous individual consequences and disadvantageous group consequences and vice versa. Participants made their choices either alone or in the presence of other group members, where they could either access each other's choices or not, and where group members could either talk to each other or not. Being able to talk to each other increased unselfish choices (benefitting the group rather than the individual) more than merely seeing what the others chose. Although Borba, Da Silva et al. did not analyze what participants said to each other, they interpreted the increase in unselfish choices when verbal communication was possible to support Skinner's (1953) proposal that verbal behavior can function as an immediate consequence maintaining behavior when other consequences are delayed. Borba, Da Silva et al. assume that other participants' verbal behavior may have reinforced self-controlled choices, that is, choices that are advantageous for the group. Borba, Da Silva et al. also suggest that their participants made more self-controlled choices when talking because verbal communication helps individuals to

predict what other people will do (Brown & Rachlin, 1999; Rachlin, 2004). The absence of direct communication is presumably one of the contributors to car traffic scenarios.

Applied to dugnad participation, the results of Borba, Da Silva et al. (2014) make it likely that verbal PIE-proxies are sooner consequences that aid in building the more extended self-controlled pattern of participation in dugnad. In part, the participation is reinforced later by the dugnad's concrete aggregate product, and in part it is reinforced by the more diffuse tightening of social bonds, a part of which is an increase in the likelihood that the other participants will reciprocate in the future. Having grown up in a dugnad society, you have experienced that social approval, inclusion, explicit reciprocity, and the shared outcome of the dugnad event are advantageous PIEs that are, in the long run, in a contingency with your prosocial behavior, of which dugnad participation is a central part. Thus, you have learned that defectors or freeloaders contact disadvantageous PIEs. The driver passing the traffic jam in the bus lane is punished, and the fisherperson who consistently overfishes is shunned by the other fisherpersons. Over time, people learn to recognize situations in which it is advantageous to cooperate because the pattern of cooperation is often selected by advantageous PIEs, even if individual cooperative acts, say, participation in a particular dugnad event, may lead to aversive PIEs. An example of this would be spending a cold and dark Sunday afternoon helping out at your child's skiing race instead of relaxing at the fireplace with your family.

Rachlin and Locey (2011) have proposed another reason why self-controlled behavior, such as participation in dugnads, can develop and be maintained. They argue that it might not be beneficial in the long run to attempt fine discriminations between situations in which cooperation ultimately leads to advantageous PIEs and those in which it does not. Most of us do not shoplift or drive past red traffic lights, independent of how small the chance is that we will be caught. In most dugnad contexts, participation is not anonymous but well observed by the other group members. Locey and Rachlin's (2015) results from social discounting tasks show that people tend to engage in considerably more prosocial behavior (forgo more hypothetical money for the benefit of others) when the receivers know the giver's identity. Today, social media are used to draw even more attention to who contributed to dugnads, ensuring the effectiveness of social control mechanisms.

According to Wilson's group selection supposition (Wilson, 1975, 2015; Wilson & Kniffin, 1999), which is part of his multilevel selection theory, selfish individuals outcompete altruistic or cooperative individuals, but altruistic groups out-compete selfish groups. Altruistic or cooperative dugnad group activities can make for the success of the group, but selfish freeloaders threaten these group activities. Freeloaders who do not participate in the house cooperative's spring cleaning would still get access to the advantageous PIEs that the group's activities produced. If no contingency that ensures that freeloading is punished by disadvantageous PIEs such as social disproval, fines, or exclusion from further access to the group benefits is in place, selfish behavior will eventually outcompete cooperative behavior (Wilson, 2015). Disadvantageous PIEs need to correlate with selfish behavior to maintain cooperation.

Problems arise when dugnad provides advantageous PIEs that are in a contingency with selfish behavior. If people place their washing machines in front of the emergency exit instead of disposing of them properly and rely upon (other's) dugnad activity to

remove them, this will lower the likelihood that other community members will participate in future dugnads. If you both have to carry a washing machine and (just like everyone else living in the building) have to pay for the skip in which the washing machine is disposed of, you are unlikely to be fond of participating in future dugnad events—in which your participation is punished twice by others' selfish behavior.[7] According to group selection theory (Wilson, 1975), cooperative groups out-compete selfish groups. This suggests that society would benefit from minimizing freeloading to ensure that no one takes unfair advantage of the collective efforts of others. To be sure, prosocial behavior may be fostered by a variety of interventions not resembling dugnad, but in Norway, dugnad traditionally provides a significant context in which children grow up learning to engage in prosocial activities.

As mentioned briefly at the beginning of this section, dugnad participation is influenced not only by the behavior of others (say shunning or appreciation by neighbors or other sports club members contingent on your dugnad participation). Dugnad participation is also influenced by our behavior in similar situations. If I have a history of contacting advantageous PIEs contingent on prosocial behavior, I am unlikely to break this pattern even if nothing signals a beneficial cost–benefit relation between my participating in a particular dugnad and PIEs. Now, my dugnad participation is part of a larger pattern of self-controlled behavior like brushing my teeth twice a day and stopping at red lights even if no cars are coming. It is easier to reflect upon my behavior pattern ("I am a good person") than to take all choices on an individual basis. Moreover, previous choices in individual situations might have proven disadvantageous, and their negative consequences (e.g., being hit by a car) are much more serious than the costs involved in adhering to the established behavior pattern (e.g., stopping at all red traffic lights; Rachlin & Locey, 2011).

Given dugnads are by definition voluntary, Norwegian law does not enforce dugnad attendance. Organizations and housing cooperatives are not allowed to fine those members who do not participate in dugnad work. Because no one is legally obliged to participate in dugnad, one cannot be legally punished either. Widespread participation is expected, though, and dugnad participation is perceived as a vital part of belonging to neighborhoods, organizations, and workplaces. This expectation is manifested in the availability or nonavailability of social PIE-proxies such as gratefulness, welcoming words, or smiles. On a long-term basis, nonparticipation is socially unacceptable. The shared meal topping off virtually all traditional dugnad events may be an important factor inducing participation. Access to pleasant and convenient shared meals could itself be a social PIE-proxy selecting behavior. Such behavior may include dugnad participation upon which the shared meal—and, thus, the food and pleasant interactions—are contingent.

Jones and Rachlin's (2009) experiments on public good games show that the closer you feel to other people, may they be your relatives or not, the more likely you are to cooperate with them or to choose options not immediately advantageous for you but those that are advantages to the group to which you and the others belong. It is easy to imagine that one feels closer to one's neighbors after a collective spring cleaning

[7] Note that paying your share for the skip is independent of your actual dugnad participation. Carrying the washing machine is part of participation, but both activities are independent of whether it was you who "disposed" of the washing mashing by placing it in front of the exit in the first place.

topped off with a barbeque evening than when one only passes them in the stairwell. It is likely that you have talked to each other during the dugnad, which appears to increase the likelihood of prosocial acts towards each other (as in Borba, Da Silva et al., 2014, described above). In sum, not only the aggregate product of a clean building but also being more familiar with each other after a dugnad may induce future participation in dugnads and, thus, contributes to the maintenance of this cultural practice.

Status Quo of Dugnad

Norway, like the rest of the Western world, is a society undergoing a fast transformation. It is evolving from an industrial society to a postmodern society, which leads to changes in relations between civil groups and individuals. Western societies are changing from caring local citizens to global consumers. Along with that, people's willingness to engage in voluntary collective work such as dugnad has declined (Lenk, 2011). The essence of dugnad, reflected in the egalitarian Norwegian culture, is a consensus that everyone, independent of income or heritage, participates. Everybody benefits from dugnad activities, but in the long run, it is disadvantageous for every individual to contribute significantly more than others. According to the Institute for Social Research (2008), there are three trends in modern society that have an impact on participation in dugnad: individualization, the emergence of the social network community, and increasing cultural diversity. The standard of living in Norway has changed dramatically since the postwar period. Norwegians are no longer directly dependent on each other. The matching relation (Baum, 1974; Herrnstein, 1970) would predict that if more activities are competing for an individual's time today, the "payoff" of dugnad participation (the cost–benefit relation of PIE-proxies resulting from dugnad participation) needs to be proportionally more favorable as well. Otherwise, dugnad participation will decrease. Over time, people tend to participate when the cost of contribution is less than the cost of the noncooperative behavioral pattern. The cost of dugnad contribution is experienced immediately, whereas the cost of noncontribution is more remote and often less concrete. If the selective pressure on groups of acts (i.e., dugnad participation in the long run) is more fierce than that on individual acts of dugnad participation, prosocial unselfish participation may increase (cf. Boyd, Gintis, Bowles, & Richerson, 2003; Rachlin, 2019; Soltis, Boyd, & Richerson, 1995). When long-term consequences have little effect on behavior, an adaptive practice such as dugnad participation can be strengthened in the short run by social PIE-proxies provided by other participants. In the absence of data, we can only cite anecdotal evidence from the first author's experience with dugnad organization, which supports that increased emphasis on the possibility to access immediate advantageous PIE-proxies, such as pleasant social interactions, increases dugnad participation. Housing cooperative dugnads announced as invitations to social gatherings with popular food and drinks and in a pleasant setting that involve an explicitly voluntary common clearance of shared space have attracted an increased number of participants, even including former residents of the building.

Given that housing cooperatives are not allowed to fine people for not participating in dugnad, some cooperatives have attempted to encourage dugnad participation by introducing a fee that all owners must pay every month. Those who participate in

dugnad will be reimbursed the fee. Whether this has any effect on the attendance in dugnad is unknown. Personal benefits of noncooperative behavior may outcompete the disadvantages of paying the fee and being reimbursed may not reinforce dugnad participation. In Norway, many activities in schools and sports clubs are based on dugnad, and often the survival of a sports club is dependent on voluntary work. Often, the same people do the lion's share of the dugnad activities. To reverse this negative trend, some clubs have updated their membership rules to state that it is expected that all members (or their parents) contribute to different organizational activities throughout the year. Instead of merely asking who would like to join in or taking for granted that people will contribute to arranging, for example, a sporting competition, membership is now sometimes contingent on participation in such activities.

The increased number of choices challenges traditional voluntary organizations because the members' activities are also in contingencies with social PIE-proxies that do not require physically meeting. Examples of such PIE-proxies are "likes" in social media. The emergence of the social network community also contributes to new forms of individual involvement and participation. Crowdsourcing and crowdfunding are the modern offspring of dugnad. Wikipedia is an example of dugnad (Sejersted, 2010) that involves neither physical work nor meeting other people face-to-face. The use of the term *dugnad* in Norwegian has, during the last few decades, been extended to include digital cooperation, where the physical and social aspects are different from those in community gatherings. Not only is no face-to-face meeting involved, but there is not necessarily a predefined beginning or endpoint for the activity. Today, the use of the term *dugnad* in such new areas of application coexists with the traditional use (Kagge, 2019). It is possible that voluntary work that does not traditionally meet the criteria of *dugnad* is now often advertised as *dugnad* due to the positive association of the term with Nordic values.

Increasing cultural diversity due to globalization and immigration brings multiple challenges, including challenges for dugnad and other kinds of voluntary work. Newcomers to Norwegian society who did not grow up with Norwegian values and norms reflected in dugnad may have difficulty understanding why one should participate in this unfamiliar practice.

Final Remarks

Dugnad is often mentioned as a core practice in Norwegian culture, having roots back to early Christianity. Despite this, there has been little research on the topic (Lorentzen & Dugstad, 2011). Almost all Norwegians, including immigrants, have a relationship to dugnad and a spontaneous understanding of what it means, and many people take initiation and participation for granted. This may be one of the reasons for the lack of research on dugnad. Despite changing societal conditions, dugnad is still important in Norwegian culture. Modern society, characterized by globalization and information technology, implies both threats and opportunities for the dugnad tradition. This development creates major challenges for some of today's organizations, which must adapt to changes in both dugnad participation and form.

Paying attention to ontogenetic processes of behavior selection enables us to recognize the complexity of the dynamic and flexible processes that construct social systems. This approach prevents us from taking one of two extreme positions. First, it circumvents a mere focus on a behavior–environment mismatch (as evident in Buss, 2005, a representative textbook on evolutionary psychology). Focus on the behavior–environment mismatch depicts evolved behavior as rigid in an ontogenetic timeframe. Second, the ontogenetic selection approach presented here prevents viewing individual organisms as creator-like agents who freely cause their own behavior in unpredictable ways (as evident in, e.g., Lindholm, 2012).

Scholars (e.g., Sennett, 2012; Turchin, 2007; Wilson, 2015) have suggested that a lack of cooperation between and among societies lies behind many crises of the 21st century. If this is true, further interpretation of structures inducing cooperative behavior in well-working societies is a promising endeavor. Contrary to regarding individual organisms as freely acting initiators of their behavior, the analysis of variables that affect behavior during ontogeny carries the potential of predicting and changing behavior. Dugnad is associated with values of generosity and collective care. It is possible that the dugnad tradition can contribute to the search for tools for nurturing environments. Everyone benefits from a well-cared-for community, and participation in dugnad might strengthen bonds, maintain communities, and nurture a nation. An analysis of these variables may generate hypotheses about what environmental aspects induce cooperation. For example, we hypothesize that access to relatively immediate advantageous PIEs, such as those available at "really tempting" social events, may increase participation in dugnad. It can be tested empirically whether the increase of prosocial activities requires an increase of access to immediate advantageous PIEs at the outset.

In this article, we have described dugnad and its origin as an example of a nurturing environment that promotes prosocial behavior. We have concentrated on the identification of functional relations between dugnad activities and PIEs and discussed dugnad in a behavioral analytic perspective.

Acknowledgements We thank David Sloan Wilson, Anthony Biglan, Ingunn Sandaker, Nina Witoszek, Kalliu Carvalho Couto, and Asle Fagerstrøm for their review and feedback on earlier drafts of this article.

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Article 6

Tengstedt, M. Å., Fagerstrøm, A., & Mobekk, H. (2018). Health interventions and validity on social media: A literature review. *Procedia Computer Science*, *138*, 169–176.
DOI: https://doi.org/10.1016/j.procs.2018.10.024

Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 138 (2018) 169–176

Procedia Computer Science

www.elsevier.com/locate/procedia

CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN/HCist 2018

Health interventions and validity on social media: A literature review

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Abstract

Social media changes the way people and organizations communicate with each other. Health interventions on social media are, however, a relatively new phenomenon. This article includes a review of health intervention studies done via social media. The review is divided into four different validity types: (a) statistical conclusion validity, (b) internal validity, (c) construct validity, and (d) external validity. Findings show that health interventions on social media have validity challenges because of small sample size, geographic area, level of reductionism, measurement instruments, participants memories and experience, and a lack of experimental control. The conclusion is that health intervention on social media is possible—and needed. However, a focus on validity is important. Guidelines for social media intervention are suggested, and implications for future research are given.

Keywords: Health; intervention; social media; validity types

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10.1016/j.procs.2018.10.024

1. Introduction

Traditionally, health organizations distribute recommendations and other information to the public. Social media has changed the way organizations and citizens communicate [9] and enabled more interactive communication. Social media makes it possible to have a dialogue and provides an opportunity for immediate feedback. It is possible to reach more people and gather and share health related information more quickly and directly than at any other time in human history. A message from Twitter can spread faster than any influenza virus. Taken as a whole, social media comprises an important element for improving public health. Individuals can find an instant stream health information that they can like, comment, and share with others. As a consequence, social media may play a role in achieving a new and better level of public health [9]. Social media can be used by health workers to create a dialogue with the public by initiating a positive and professional interaction, to acquire information from the public, and to make interventions [6].

Health workers around the world face different challenges in preventing and clarifying epidemic and lifestyle diseases. According to the World Health Organization [21], low-income countries score high on deaths attributed to risk factors such as low weight among children, unsafe water, risky sexual behavior, sanitation, hygiene, and vitamin A and iron deficiencies. Middle- and high-income countries are over-represented among lifestyle diseases such as high blood pressure, substance abuse, overweight, and obesity. Effective communication between professionals in health-care organizations and the public is, therefore, of great importance. In this context, intervention has an obvious advantage in that it provides an opportunity to demonstrate a change by using feedback systems and tracking features. Health-related intervention can be defined as policies and programs that attribute health risk to factors such as social, economic, and environmental conditions [6]. However, when designing a health-related intervention, it is important to identify and evaluate validity issues.

Validity refers to how likely an approximation of a causal relationship is to be true or false [3]. It is important to use the word “approximated” because the truth is unknown. Cook and Campbell [3] describe four validity types: (a) statistical conclusion validity, (b) internal validity, (c) constructed validity, and (d) external validity. Statistical conclusion validity describes the chances of making two types of mistakes: (I) to conclude that an intervention has an effect, when—in truth—it does not, or (II) to conclude that the intervention has no effect, when it, in truth, does. Internal validity refers to the cause and effect. Constructed validity is about “confounding,” and refers to the construction of a study and an operation representing a cause or effect. External validity refers to whether the relationship between the variables can be generalized to other groups of people, time perspectives, and settings.

The purpose of this study is to highlight validity challenges in relation to health interventions on social media. The following question will be answered: What are the validity challenges in health-related interventions on social media? This study is structured as follows: First, there will be a presentation of the method that has been used for the literature search. Second, examples will be presented of how researchers have used social media in health interventions together with validity issues. This will be followed by a discussion and conclusion of the validity challenges when doing health interventions via social media.

2. Validity and health intervention on social media

Based on a rapid structured literature review research strategy [1], findings includes 44 studies on health interventions on social media conducted between February 2015 and March 2018. Query terms included “Facebook,” “health,” “intervention,” and “social media.” The collection of data was done by searching the databases Scopus, PubMed, Medline, PsycINFO, and Web of Science. The keywords can be used in a broad sense, and there were many hundreds of “hits.” “Facebook” was selected over YouTube and Twitter because Facebook is the biggest platform on social media [17]. The inclusion criterion was that the health topic should be related to the World Health Organization’s [22] definition of health: “Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity,” p. 100. The purpose was to review validity challenges in different kinds of health-related interventions on social media. Full-text articles and articles used for worldwide conference committees were included to give variations in order not to exclude relevant information. Six of the 44 articles were health-related literature reviews done on social media. Reviews were included to provide information about what already has been evaluated and discussed regarding social media and health. The last 38 articles were health studies done on social

media. A concepts matrix was designed, and articles were structured according to sample, intervention, results, and validity issues.

Most of the studies reviewed for this article have been conceptual in that they discuss interventions via social media [15, 18, 19], while a few have tried to do interventions via social media in relation to different kinds of health topics [2, 4, 5, 7, 13, 14, 16, 20, 23]. Tables 1a, 1b, and 1c describe nine of the studies included in this review. These studies are selected because they are the most relevant empirical studies with the use of social media where validity is challenged [1]. They are further discussed in more depth in relation to the overall validity in this review study.

Table 1a. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Young, Harrell, Jaganath, Cohen and Shoptaw [23]	Sixteen peer leaders among men who have sex with men were recruited for either an HIV prevention or general health intervention using social media.	The participants received training on using social media for public health discussions.	No change was found in the level of comfort in discussing various health items on social media after the training, except an increased level concerning discussions on sexual positions.	Small sample size, real-life setting, self-reported data.
Hansen and Johnson [5]	1,022 users who downloaded the Facebook FactCheck: HPV App.	The FactCheck: HPV app was designed for younger women with the intent to educate about HPV. A person received a message from a friend, without revealing the identity of the friend.	It was five times more likely that the user would download the FactCheck: HPV app if they received an invitation from an anonymous friend rather than a known friend.	Large sample size, self-selection, lack of experimental control.
Bull, Levine, Black, Schmiege and Santelli [2]	1,578 participants recruited through newspaper ads, online, face-to-face, and invited friends.	This study aimed to determine whether a message delivered on Facebook prevents an increase in sexually risky behavior. The participants were exposed for 2 months to either Just/Us, a Facebook page developed with youth input or, to control, content on 18–24 News, a Facebook page with current events.	Seventy-five percent of participants completed at least one study follow-up. Time by treatment effects were observed at two months for condom use, and the result was 68% in the intervention group vs. 56% in the control group. The result of sex acts protected by condoms was 63% in the intervention group vs. 57% in the control group.	Large sample size, self-selection, self-reported data.

Table 1b. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Pope, Lee, Zeng, Lee and Gao [14]	Ten breast cancer survivors recruited via flyers in the University's Cancer Hospital and surrounding medical buildings, University-wide mass emails, online postings, and word of mouth.	The aim was to improve breast cancer survivors' physical activity and health by employing a mobile health application, MapMyFitness, and a social cognitive theory-based, Facebook-delivered health education intervention.	Ten participants enrolled, but two dropped out due to changes in health status. Average use of MapMyFitness per week was 3.75 times. The app was experienced as an encouraging prompt but challenging to use. Health education tips were posted twice a week on Facebook. Participants contributed to 16 posts where 11 were regarding workout. Average weight loss was 2.4 kg.	Small sample size, real-life setting, self-reported data, lack of randomization, 10-week duration, and combined multifaceted interventions.
Jane et al. [7]	Participants in the target group were recruited via advertisement in the newspaper. Data from 67 participants were used in the analysis.	This study aimed to understand the impact of using social media to augment the delivery of a weight-management program. Participants were randomly divided into two intervention groups or a control group. A weight-management program, along with a support network with the group, was given to intervention group 1. Intervention group 2 received the same program in a booklet. The control group was given standard care.	Intervention group 1 reported a 4.8% loss in initial weight, significant compared to the control group only ($p = 0.01$). Moreover, intervention group 1 show numerically greater improvements in body mass index, waist circumference, fat mass, lean mass, and energy intake compared to the intervention group 2 and the control group.	Small sample size, participant burden since a large amount of data was collected.
Pechmann, Pan, Delucchi, Lakon and Prochaska [13]	Forty adults who wanted to quit smoking were recruited using Google AdWords.	Automessage was delivered online on Twitter to two groups of 20 participants for 100 days. The first type of Automessage should encourage group members to engage in a group discussion of an evidence-based, cessation-related or community-building topic. The second type of Automessage should deliver an individualized feedback message to all participants on their past 24 hours tweeting.	Seventy-eight percent of the participants, when combining the two groups, had sent at least one tweet and, on average, the participants sent 72 tweets during 100 days. The tweets after an Automessage were all related to a given topic. The tweets were related to dates for quitting, use of nicotine patches, obstacles when wanting to quit, and motivation factors. Out of all tweets, 22.78% were a response on the Automessage, and 77.28% were spontaneous tweets.	Small sample size, self-selection, self-reported data.

Table 1c. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Haines-Saah, Kelly, Oliffe and Bottorff [4]	Sixty young adults aged 19-24 years were recruited to participate in the study. The participants identified themselves as current smokers or had quit smoking in the last year.	The purpose of this study was to motivate critical reflection on one's own tobacco use with the use of an intervention called Picture Me Smokefree. A goal was to find out if there were gender-related factors among participants that could influence and, at the same time, explore gender-related topics in an online forum and gain knowledge about how to design future interventions.	The result revealed Facebook as a good platform for young adults to reflect on their tobacco use and the benefits of quitting. The use of Facebook made it easy to develop person-to-person support across a mixed group of participants.	Small sample size, some participants were couples, mixed intervention groups, low participation rate, many dropouts.
Rote, Klos, Brondino, Harley and Swartz [16]	The participants totaled 63 college freshmen.	This study aimed to increase physical activity (steps per day) among young women. The participants were randomized into two groups: A Facebook Social Support Group or a Standard Walking Intervention. Both groups were informed every week about the steps goal. The women in the Facebook group were asked to post information about their goal for daily steps and to support other members of the group.	After eight weeks of intervention, the result for both groups was an increase in the number of steps. The women in the Facebook group had increased their steps to 1.5 miles per day compared to the standard walking group.	Small sample size, self-reported data, difficult to know whether social support or self-registration was the cause of physical activity.
Wang, Leon, Scott, Chen, Acquisti and Cranor [20]	Twenty-eight Facebook users attended this study.	The researcher wanted to nudge the users to think twice before posting statements on Facebook. Three privacy nudges were designed. The first picture nudge was designed to help the participants consider the audience for their posts. The second nudge was used to delay the post, so participants could think twice before posting. The third sentiment nudge should help the participant not post sensitive information.	Two of the three nudges had a delaying effect because before posting information on Facebook the user could see how other Facebook users viewed the information. It had a positive effect on the users Facebook behavior.	Small sample size, natural environment, lack of control.

3. Discussion

The purpose of this study is to highlight validity challenges in relation to health interventions on social media. Findings from a literature review show that there are challenges when it comes to validity in health intervention studies on social media. Validity is challenged when health intervention studies use only surveys and interviews to measure a dependent variable because participants can over- and under-report, misunderstand questions, and have subjective perceptions [e.g., 3]. Data based on participants' experience and memory makes it difficult to draw generalizable conclusions. However, knowledge from these types of interventions can help researchers to improve and target future

designs of health interventions on social media. Statistical and external validity are challenged in the studies of Haines-Saah, Kelly, Oliffe and Bottorff [4], Jane, Hagger, Foster, Ho, Kane and Pal [7], Pechmann, Pan, Delucchi, Lakon and Prochaska [13], Pope, Lee, Zeng, Lee and Gao [14], Rote, Klos, Brondino, Harley and Swartz [16], Wang, Leon, Scott, Chen, Acquisti and Cranor [20], Young, Harrell, Jaganath, Cohen and Shoptaw [23] because the sample size is small and, therefore, it is difficult to make a general conclusion. Statistical and external validity were better in the Hansen and Johnson [5] study due to a large sample size. However, the study of Hansen and Johnson [5] lacked internal and construct validity because of the lack of experimental control. This illustrates the complexity of doing health intervention on social media to demonstrate a change.

Studies included in this review should focus on how the experiment was designed and accomplished. For example, it is desired to know researchers' reflections on methods of recruiting participants and the motivation participants may have to be a part of the intervention. The researchers should carefully evaluate whether the participants included in the intervention are representative of the population about which they want to say something. In this early phase of studying health interventions on social media as a new phenomenon, all details in the design process are important so that studies can be replicated, researchers can learn from each other, and designs for conducting future health interventions on social media can be improved.

Sample size and type of measurement are factors which can be discussed in every study, regardless of scientific direction. Researchers in the humanities and social sciences who try to combine qualitative and quantitative methods with big data find achieving validity in health intervention on social media very challenging [8]. Big data is a term that describes unstructured data sets so big that only software tools can manage and process them. Big data has expanded the conditions for doing scientific work, especially for the humanities and social science [8]. Since the world is becoming more digital, new computationally-based research methods are needed so researchers can navigate and use the information in a big dataset optimally. So far, most studies in the humanities, where datasets are published as large, cannot even be compared to the datasets published in computer science. The difference is that the large dataset from the humanities and social science studies can be controlled and manage by a desktop computer and computers using standard software, whereas studies in computer science require supercomputers [8]. This gap will disappear sooner or later, and a new platform will be created for studies in humanities and social science. It would then be possible to access information about billions of uploaded pictures, create metadata as tags, and access transaction data.

3.1. Managerial implications

This review indicated the important relationship between studies and real-life practice. The researchers try to implement their study in different practical settings [16, 20, 23]. As of today, the United States uses 8% of its gross domestic product on public health expenditures [11]. This means a huge amount of money is invested in public health every year, and it is important that this benefit the population. This review provides health-worker contributions to health studies done on social media and their validity. Health workers can be inspired by how social media can be used in public health, and they can evaluate challenges in validity relative to the amount of money and time an intervention using social media will cost.

This review provides the researcher an overview of health interventions on social media and challenges in validity which can be used for future research. Researchers remain very optimistic toward the benefits of using social media in health interventions. However, the effect is still unclear. One reason why the effect remains unclear can be assigned to the fact that most studies are based on descriptive statistics. Descriptive statistical analysis is useful in providing updates on available information, but it is impossible for these types of studies to give clear answers as to why, how, and when an effect may occur due to health intervention on social media.

3.2. Limitations and directions for future research

Because of the huge number of studies done on social media and health, the review risks missing relevant articles. Most studies done in health on social media are based on descriptive statistics [10]. Studies using experimental designs are very limited so far, but they would be useful to show experimental control of variables and increased validity. Researchers should, in the future, try to determine the connection between the cause and effect. Combining qualitative

and quantitative methods with data analytics may give researchers more knowledge about conducting health interventions on social media. As shown in this review, some researchers use data analytics and technical devices to conduct interventions and combine that with a survey or interviews. Wang, Leon, Scott, Chen, Acquisti and Cranor [20] designed a nudge to help Facebook users delay posts that they might regret later, Pechmann, Pan, Delucchi, Lakon and Prochaska [13] used Automessages to help smokers quit cigarettes, and Rote, Klos, Brondino, Harley and Swartz [16] used pedometers to measure steps taken by participants in another study. Technology on social media is emerging, [12] and researchers should continue their creativity and use that technology when designing interventions in the future. Anyhow, a discussion about the concepts of validity is needed. Researchers interact with the environment, which today is influenced by technological innovations. Future studies should discuss whether validity concepts used in this study are useful for future health interventions on social media.

4. Conclusion

The literature review demonstrates validity challenges in health interventions on social media. It seems evident that health intervention on social media is in its early phase, where knowledge about how to design interventions is limited. The interventions are mostly explorative and combined with surveys or interviews to gain knowledge about the participants' opinions of the intervention. Validity is challenged because the researchers must experiment with new designs to measure behavior on social media. Most interventions are done in the participants' natural environment, which limits the experimental control of variables and, therefore, threats to validity. However, this can be positive too since a natural setting can give a more realistic result and, therefore, increase external validity. Most health interventions on social media are based on descriptive statistics and cannot give researchers a clear answer as to the true effect of using social media in health work. Very few health-related studies are based on experimental designs, but researchers remain optimistic about using social media in health interventions.

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POSTADRESSE:
OsloMet – storbyuniversitetet
Pilestredet 46
Postboks 4, St. Olavs Plass
0130 Oslo

OsloMet Avhandling 2021 nr 35
ISSN 2535-471X
ISBN 978-82-8364-337-4