Perception matters:  
Perceived behavior change and trust  
in domains of health risk

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Summary

Researchers and practitioners aim to decrease individual risks by changing human behavior in many domains, for instance in health-related areas, where risks are either accumulating over long periods of time, or appear suddenly at acute circumstances, such as crisis situations. In order to better understand individuals’ behaviors in relation to risks, it is necessary to inquire about their perceptions of the world. Eventually, it is the individual’s perception that the person will base judgments and decisions on. Hence, only by investigating and understanding (mis)perceptions and their relations to reality can we improve people’s behaviors and decisions in the future. Accordingly, the overarching research aim of the present dissertation was to investigate the role of perception for domains of health risk.

The present dissertation approaches this aim in two ways. First, the relationship between perceived and actual behavioral change for two health behaviors is investigated. The exploration of individual perception of behavior change should inform behavior change interventions, such as information campaigns. Second, perceived trust toward information sources is examined in the context of risk communication. To effectively change peoples’ behavior, it is crucial to investigate how to disseminate the respective information (e.g. information about preventive behavior). For many people, the internet has become one of the most important sources for obtaining risk-related information, especially via social media. Therefore, the present dissertation focuses on social media as a means for risk communication and addresses the question of what factors lead people to perceive social media channels as trustworthy in domains of risk. Thus, the present dissertation connects the topics of perceived behavior change and perceived trust in domains of health risk.

In chapters 2 and 3, the relationship between perceived behavior change and actual behavior change was investigated. Specifically, it was examined how much behavior change is necessary for people to perceive that they have changed. This was carried out for two different health
behaviors, namely physical activity (chapter 2) and dietary behavior (chapter 3). To replicate findings, identical studies were conducted twice for each behavior at different measurement points (physical activity study 1: $N = 605$, study 2: $N = 382$; dietary behavior study 1: $N = 743$, study 2: $N = 489$). Data for chapters 2 and 3 were collected under the Konstanz Life Study, an ongoing longitudinal multiple-cohort study.

Results show that people need to exhibit rather large and comprehensive behavioral changes in order to perceive to have changed. Specifically, for physical activity, only substantial changes in vigorous physical activity were taken into consideration, whereas changes in moderate physical activity were neglected. Also, for dietary behavior, the consumption of five food categories changed between measurement points for those who perceived a change. Furthermore, those who perceived a change shifted from a ‘regular’ to an ‘optimal’ dietary pattern. These findings indicate that rather extensive behavior changes were needed for people to perceive they have changed.

The findings suggest, that public health interventions might benefit from emphasizing the positive effects of small behavioral changes (‘baby steps’). Health interventions are most successful when these insights into perceived behavior change and their implications for recommendations are brought together with an effective and trusted way of disseminating these information to the public.

Accordingly, in a second step (chapter 4), the focus of this dissertation shifts toward possible media channels, as these may serve as the hub for disseminating information. In chapter 4, perceptions of trust toward social media as transmitter of risk information were addressed. More specifically, perceived trust toward social media in crisis situations was investigated in a sample of $N = 430$ European Facebook users in a cross-sectional online survey.

Findings show that people who use Facebook more regularly perceive it as more trustworthy and that this perceived trust also predicts trust in a crisis situation. Thus, the general use of and
general trust toward a medium are important factors that influence whether people trust this medium with regard to risk-related information.

In sum, the present dissertation brings together two kinds of perceptions (i.e. perceived behavior change and perceived trust) and considers how both might play a role in behavior change approaches: To effectively change people’s behavior, it is helpful to know how much change is necessary for people to feel they have changed, and also, how to disseminate information for behavior change. Therefore, to influence behavior effectively, we need to fully understand how people evaluate their own behavior changes as well as the medium on which informational advice is distributed most effectively. Risk communication should be executed via channels that people use and trust in general, as they will trust these channels also when it is about their physical well-being and safety.
Zusammenfassung

Forscher und Praktiker zielen darauf ab, individuelle Risiken zu verringern, indem sie das menschliche Verhalten in vielen Bereichen ändern, z.B. in gesundheitsbezogenen Bereichen, in denen sich Risiken entweder über lange Zeiträume akkumulieren oder plötzlich unter akuten Umständen, z.B. in Krisensituationen, auftreten. Um das Verhalten des Einzelnen in Bezug auf Risiken besser zu verstehen, ist es notwendig, seine Wahrnehmung der Welt zu erfragen. Letztlich ist es die individuelle Wahrnehmung der Welt, auf der die Person ihre Urteile und Entscheidungen gründen wird. Nur wenn wir (Fehl-)Wahrnehmungen und ihre Beziehungen zur Realität untersuchen und verstehen, können wir das Verhalten und die Entscheidungen von Personen in der Zukunft verbessern. Dementsprechend war das übergreifende Forschungsziel der vorliegenden Dissertation die Untersuchung der Rolle der Wahrnehmung für verschiedene Bereiche von Gesundheitsrisiken.

Zusammenfassung

die vorliegende Dissertation die Themen der wahrgenommenen Verhaltensänderung und des wahrgenommenen Vertrauens in Bereiche von Gesundheitsrisiken.

In den Kapiteln 2 und 3 wurde der Zusammenhang zwischen wahrgenommener Verhaltensänderung und tatsächlicher Verhaltensänderung untersucht. Insbesondere wurde untersucht, wie viel Verhaltensänderung notwendig ist, damit Personen wahrnehmen, dass sie sich verändert haben. Dies wurde für zwei verschiedene Gesundheitsverhaltensweisen durchgeführt, für körperliche Aktivität (Kapitel 2) und Ernährungsverhalten (Kapitel 3). Um die Ergebnisse zu replizieren, wurden zwei identische Studien für jedes Verhalten zu verschiedenen Messpunkten durchgeführt (Studie 1 zu körperlicher Aktivität: \( N = 605 \), Studie 2: \( N = 382 \); Studie 1 zum Ernährungsverhalten: \( N = 743 \), Studie 2: \( N = 489 \)). Die Daten für Kapitel 2 und 3 wurden im Rahmen der Konstanzer Life Studie, einer andauernden längsschnittlichen Multikohortenstudie, erhoben.


Gesundheitsempfehlungen mit einem wirksamen und vertrauenswürdigen Weg zur Verbreitung dieser Informationen in der Öffentlichkeit zusammengeführt werden.


Zusammenfassend bringt die vorliegende Dissertation zwei Arten von Wahrnehmungen zusammen (d.h. wahrgenommene Verhaltensänderung und wahrgenommenes Vertrauen) und untersucht, wie beide bei Ansätzen zur Verhaltensänderung eine Rolle spielen könnten: Um das Verhalten der Menschen wirksam zu ändern, ist es hilfreich zu wissen, wie viel Veränderung notwendig ist, damit die Menschen das Gefühl haben, dass sie sich geändert haben, und auch, wie Informationen für eine Verhaltensänderung verbreitet werden können. Um das Verhalten wirksam ändern zu können, ist es notwendig zu verstehen, wie Menschen ihre eigenen Verhaltensänderungen bewerten und auf welchem Medium Informationsratschläge am effektivsten verbreitet werden. Risikokommunikation sollte über Kanäle erfolgen, die die Menschen im Allgemeinen nutzen und denen sie vertrauen, da sie diesen Kanälen auch vertrauen werden, wenn es um ihr körperliches Wohlbefinden und ihre Sicherheit geht.
1 General Introduction

Modern lifestyle is characterized by a high degree of sedentary behavior as well as an oversupply of energy-dense food. Both factors contribute to an increasing “obesity epidemic” (Kleinert & Horton, 2015; Swinburn et al., 2011) and an associated increase in cardiovascular diseases, which are the leading cause of death worldwide (World Health Organization (WHO), 2020). Understanding and changing unhealthy patterns in physical activity and dietary behavior are major contemporary topics for health authorities.

Despite intensified attempts by public health authorities worldwide to increase population levels of physical activity (Sallis et al., 2016), it has declined even further in high-income Western countries between 2001 and 2016 (Guthold et al., 2018). Similarly, obesity rates continue to rise despite numerous public awareness campaigns and guidelines for healthy eating (e.g. Herforth et al., 2019; Walls et al., 2011). According to the World Health Organization (WHO), the global prevalence of obesity nearly doubled between 1980 and 2008 (World Health Organization, 2020).

Evidently, there is a discrepancy between an increase in problem-awareness and public health campaigns on the one hand, and an increase (or lack of decrease) in problematic behavior on the other hand. This tendency is even more remarkable since access to health information has never been easier than in the digital age, as people increasingly seek health information via the internet, especially via social media platforms (e.g. Debbeler et al., 2020; Jiang & Street, 2017; Rice, 2006; X. Wang et al., 2020). Thus, improving our understanding of behavior change processes and exploring possibilities to support behavioral change, e.g. through communication via social media, is an important issue.

The present dissertation aims to contribute to a better understanding of the process of behavior change by focusing on the perception of individuals regarding their health behavior change. The topic of perception is then broadened by examining the perception of social media
as media for imparting relevant information. This dissertation comprises three studies on the role of perception in the context of risk-related behaviors. The first two studies focus on the perception of health behavior. Up to now, health behavior goals have mostly been defined by third parties, for example, in the form of official recommendations regarding minimum physical activity levels or intake levels for food groups, such as fruits and vegetables (Herforth et al., 2019; Warburton & Bredin, 2016). Also, in the context of interventions, goals are most often defined by the researcher (e.g. Foster et al., 2009, for a review on interventions promoting physical activity). The perception of change of individuals appears to have been neglected to some extent. Chapters 2 and 3 aim to address this topic by examining behavioral change from the individuals’ point of view. A further important issue in the digital age of ‘information overload’ and fake news is the question of which factors are relevant for people to trust online information, specifically on social media (Bawden & Robinson, 2020; Beldad et al., 2010; Rains et al., 2015). Thus, the approach of chapters 2 and 3 is complemented by the investigation of which factors are relevant for people to trust risk-relevant information on social media in chapter 4.

1.1 Health behavior theories

Theories of health behavior aim to describe, explain, and predict health behavior, and also provide a basis for health behavior change approaches (Lippke & Ziegelmann, 2008). A variety of psychological health behavior theories exist. They can be subdivided into continuum models and stage models (e.g. Brinkmann, 2014; Conner & Norman, 2005; Lippke & Renneberg, 2006). Prominent examples for stage models are the Precaution Adoption Process Model (Weinstein et al., 1998, 2008) and the Transtheoretical Model (Prochaska, 2013; Prochaska et al., 1992; Prochaska & DiClemente, 1983; Velicer et al., 2006). The underlying assumption for stage models is that the behavior change process is characterized by subsequent stages. These stages are distinct and defined by qualitatively different processes. People will pass through these different phases during the behavior change process (see also Schwarzer, 2008; Sniehotta
& Aunger, 2010; S. Sutton, 2005). For example, the Transtheoretical Model (TTM) describes five discrete stages of behavior change: Precontemplation, contemplation, preparation, action, and maintenance (Prochaska et al., 1992). The motivational “mindset” of a person is different in the contemplation stage, in which the person is undecided about whether to act, as opposed to the action stage, when volitional processes are more prominent (see Marshall & Biddle, 2001, for a meta-analysis on the application of the TTM to physical activity).

In contrast to stage models, continuum models, such as the Protection Motivation Theory (Rogers, 1975; Rogers & Prentice-Dunn, 1997), the Health Belief Model (Janz & Becker, 1984; Strecher et al., 1997), the Theory of Planned Behavior (Ajzen, 1991, 1998), or the Social Cognitive Theory (Bandura, 1997, 1998, 2004; Luszczynska & Schwarzer, 2005), assume that the behavior change process can be conceptualized as the movement along a continuum, where the continuum represents the likelihood to perform a particular behavior. Social-cognitive components, such as risk-perception, self-efficacy, or social norms, influence the likelihood of the behavior, or the development of an intention to perform a certain health behavior. Despite being distinct theories, there is considerable conceptual overlap between them (e.g. Bandura, 2004; Brinkmann, 2014; Sheeran et al., 2017).

The Health Action Process Approach (Figure 1.1; Schwarzer, 1992, 2004, 2008; see Zhang et al., 2019 for a meta-analysis on the HAPA) is a ‘hybrid model’ which incorporates both the contention of qualitatively distinct phases as well as the idea of individuals moving along continuums (Lippke & Renneberg, 2006). Importantly, it elaborates on processes after goal formation during the volitional phase. It includes planning as a self-regulatory strategy, and it differentiates between the initial adoption (initiation) of a new behavior and its maintenance. Maintenance is especially crucial for health behaviors that need to be engaged in continuously, such as physical activity or dietary behavior (e.g. Fjeldsoe et al., 2011; Nigg et al., 2008; Rothman, 2000; Schwarzer et al., 2007).
Once an intention to change is developed, many theories propose a direct link to behavior, conceptualizing intention as a proximal antecedence of behavior (Gollwitzer & Sheeran, 2006; Rhodes & De Bruijn, 2013). However, translating intentions into action is a significant obstacle for many people, a phenomenon known as Intention-Behavior-Gap (Rhodes & Dickau, 2013; Sheeran, 2002; Sheeran & Webb, 2016; Webb & Sheeran, 2006). Sheeran (2002) reported in a “meta-analysis of meta-analyses” of the intention-behavior relationship, that just about 25% of the behavioral variance is explained by intentions. Likewise, Rhodes & De Bruijn (2013) found in their meta-analysis on “how big is the physical activity intention-behavior gap?” that among the identified studies only 54% of the intenders (i.e. those who formed an intention to change their physical activity behavior) showed a corresponding successful change. This finding lets the authors conclude that “the overall intention behavior gap was 46%” (Rhodes & De Bruijn, 2013, p. 296). Thus, creating risk awareness and providing information about desirable behavior
change is not sufficient to ensure successful behavior change. After an intention has been formed, individuals enter a volitional phase, which is complex and dynamic.

The volitional phase of the behavior change process can also be described as a self-regulatory process (Carver, 2004; Carver & Scheier, 2001; Mann et al., 2013; Schwarzer, 1998) where the discrepancy between current behavior and aspired goal guides behavior change attempts. The success or failure of behavior change and maintenance of aspired behavior is determined by a significant degree of goal-characteristics, such as specificity, the proximity of end state (near vs. distant), or goal-difficulty (Locke & Latham, 1996, 2006; Mann et al., 2013; Strecher et al., 1995).

In sum, theories of health behavior often propose a direct link from intention to behavior. However, research indicates that this assumption is oversimplified. Volitional processes, as described in the HAPA, are important to consider. For instance, one should consider characteristics of goal intentions as possible mediators for the intention-behavior gap, such as specificity or goal difficulty. Thus, intention formation (i.e. goal setting), is an important variable, as it includes the characteristics of the goal. The kind of goals people set for themselves are important as “choosing or accepting a goal or standard is the central act of willing in the pursuit of goals” (Gollwitzer et al., 2004, p. 211). Therefore, the goals people have in mind when they enter the volitional phase will impact success or failure of behavior change during the volitional phase.

1.2 Goal setting

Health goals are a central component of most health behavior theories. Generally speaking, goals are mental representations of desired outcomes to which people are committed (e.g. Gollwitzer & Moskowitz, 1996). They motivate self-regulatory efforts when people perceive a discrepancy between their current health behavior and their goals. Goals should be realistic, yet demanding enough to foster motivation and sustained behavior change (Avishai et al., 2019; Gollwitzer & Oettingen, 2012, 2019; Locke & Latham, 2006; Oettingen, 2012; Rothman,
When goals are too challenging, however, this most likely results in demotivating experiences and failure to maintain a desired (‘ideal’) level of behavior (Locke & Latham, 1996). For instance, Avishai et al. (2019) showed in a series of studies that ‘goal realism’ (i.e. the degree of alignment between the intention to act and the expectation of action) moderates the intention behavior relationship for several health behaviors, including physical activity. That is, realistic intentions were stronger predictors for behavior change when goal realism was high. Thus, the difficulty of health goals which people perceive as desirable is a crucial variable in the health behavior change process.

Strecher et al. (1995) state that self-set goals could “result in poorer outcomes than provider-assigned goal settings. Self-set goals might be off base – either too easy or too difficult” (p. 194). However, little is known about the level of difficulty people would set for themselves as criteria for judging success. Therefore, it is important to investigate what kind of goals for behavior change people have in mind when they intend to change their behavior.

Up to date, health behavior change goals have mostly been defined by third parties, e.g. public health authorities. In behavior change interventions, ‘successful’ behavior change is usually defined by researchers, not participants. For instance, goal criteria in intervention studies are often based on objective data, whereas the perception of individuals is neglected. Shilts et al. (2004) found in a review on ‘goal setting as a strategy for dietary and physical activity behavior change’ that only four of the 28 included studies used self-set goals. In contrast to behavior interventions, most health behavior change attempts will occur without professional guidance through self-set goals and self-set criteria for judging one’s own success.

To summarize, despite the centrality of goals and goal setting in most health theories and intervention programs, individuals’ perception concerning successful behavior change has been largely neglected. So far, successful behavior change has often been defined by third parties, such as researchers or public health officials. However, actual change will only be effective and motivating if it is perceived as a significant change by an individual. It is therefore important
to understand the magnitude of behavioral change that is required for people to be perceived as desirable. The present dissertation addresses this topic by investigating two of the most common lifestyle health behaviors: Physical activity and dietary behavior.

1.3 Perception of health behavior change

In order to gain a more thorough understanding of individual goal setting and expectations regarding ‘successful’ behavioral change, it is necessary to ascertain how much change is necessary to be perceived as a success by the individual. This task is especially challenging since health behaviors differ widely, from dietary behavior, cigarette smoking, alcohol consumption, and physical activity to vaccination behavior and dental flossing. What do people expect when they form the intention to change their behavior? Is there a common tendency across behavioral domains for overburdening oneself with overly demanding goals? Or does it depend on the particular behavior one tries to change?

Even though the perception of behavior and behavioral change is important, psychological research on health behavior change is mostly concerned with actual (i.e. objective) behavior, whereas individuals’ perception of behavior change often remains unexplored. For instance, it is worthwhile noting that a distinction between perceived behavioral control and actual behavioral control is emphasized in the Theory of Planned Behavior (e.g. Conner & Sparks, 2005), but no such distinction is mentioned concerning behavior. This neglect could be an indication of an implicit understanding that people are able to assess their behavior accurately and that no such distinction is needed. However, perception might be flawed (i.e. inaccurate) and should be considered separately.

This notion of inaccurate perception can be exemplified by a study on perceived behavior by Variyam, Shim, and Blaylock (2001), who found that 40% of their sample misperceived their actual diet as being of higher quality than it actually was (‘optimists’). The authors argue that it is hard for people to accurately perceive dietary quality due to the complexity of dietary behavior and that more nutritional education is needed (i.e. need to correct misperception
through communication). Similarly, Dijkstra et al. (2014) reported that nearly 20% of their Dutch sample overestimated their adherence to vegetable guidelines. It is vital for people to accurately perceive their health behavior to evaluate whether behavioral adjustments are necessary. In the case of Variyam et al.’s (2001) study, ‘optimists’ could be unaware of nutritional deficits in their diet and thus not initiate necessary behavior change. Thus, there is evidence for the misperception of actual behavior by individuals with respect to dietary quality.

For physical activity, Lechner et al. (2006) found that the participants of their study “who did not meet the guideline for physical activity, 48% had a misperception of their physical activity, as they estimated their physical activity to be sufficient or high” (p. 107), and conclude that many people regard their behavior as more healthy than it really is (Lechner et al., 2006). Likewise, Visser et al. (2014) reported that about 30% of their sample of older adults reported adhering to physical activity recommendations while – based on accelerometry data – they actually did not. Hence, similar to research on the perception of one's dietary quality, there is evidence that individuals misperceive their level of actual physical activity when evaluating it against prevalent norms. These findings underscore the need to investigate the perceptions of behavioral change, and the relations of these perceptions with actual change.

Apart from perceiving and evaluating one’s current state of health behavior correctly, it is also important to perceive and evaluate behavior change as accurately as possible. Thus, perceptions become an essential topic for health behavior, especially when they deviate from actual, objective facts. It is important to investigate individuals’ perceptions of health behavior change to be able to compare these perceptions to current scientific recommendations. If there are discrepancies between behavioral perceptions and health behavior advice, it is crucial to identify such discrepancies and correct them through health communication. Ultimately, it is peoples’ perceptions of their behavior that will impact their evaluation of behavioral success and ‘how they are doing’.
As a starting point to think about perceived behavior change, it is reasonable to assume that official guidelines on health behavior will influence individuals’ perceptions. Official guidelines, e.g. on physical activity or dietary behavior, usually formulate desired end-points for healthy behavior (i.e. threshold messages; Knox et al., 2014). These end-points will be recognized as behavioral norms by the public (Zahrt & Crum, 2017). For instance, the WHO recommends 150 min of moderate or 75 min of vigorous physical activity for adults per week (World Health Organization, 2018). For dietary behavior, complex rules often define the healthy composition of overall food intake (e.g. Deutsche Gesellschaft für Ernährung (DGE) [German Nutrition Society], 2019). Such thresholds could influence the perception of individuals concerning how much behavioral change is desirable to attain health benefits. These accessible behavioral norms might influence perceptions about ‘the right thing to do’, ultimately influence behavior. Thus, it is likely that expectations regarding desirable behavior change will be shaped by official threshold communication to a large extent (Zahrt & Crum, 2017), which might lead to rather high expectations of what successful change means. If this is the case, then this should occur across health behaviors with existing and well-known ‘threshold-guidelines’, such as physical activity or dietary behavior.

To summarize, when people evaluate their behavior or set goals for themselves, perceptions are based on the information which is available and familiar to the individual. That would mean that official guidelines concerning healthy behavior, e.g. by the WHO or DGE, are most impactful in shaping perceptions since they are best known. Overall, people might be guided by evaluating behavior change by what they know, which are guidelines and behavioral norms. More research is needed to investigate how people perceive their behavioral change to be able to compare this perception with current standards.

1.4 Disseminating relevant information to the public

Influencing (i.e. ‘correcting’) perceptions is a logical step for health officials if these perceptions are flawed. To improve peoples’ perceptions regarding health behavior change
goals, relevant information needs to be disseminated to the public via various communication channels. Thus, it might become necessary to disseminate ‘new’ health information to the public. If people perceive relevant behavioral changes even there are none or too little to be of significant impact on health (similar to ‘optimists’ in Varyam et al., 2001), this should be addressed. Likewise, if people need extensive changes in health behavior to perceive change, this also needs to be made aware publicly. Ideally, this will be accompanied by information about alternatives, such as informing on recent approaches on behavior changes that point out the merits of smaller behavioral changes (Fogg, 2020; Hill, 2009; Hills et al., 2013) or recommending the use of health apps to support behavior change attempts (e.g. Bhuyan et al., 2016; Kay et al., 2011; König et al., 2018; Villinger et al., 2019).

In general, social media offer a low-cost and economical way of spreading information, such as behavioral advice. Research shows that social media are used by people in situations of personal risk, such as seeking health advice (e.g. Betsch et al., 2012; Gabarron & Wynn, 2016; Maher et al., 2016; Neighbors & Lewis, 2016) as well as in more direct situations of risk, such as emergencies (e.g. Luna & Pennock, 2018; Maresh-Fuehrer & Smith, 2016; Rains et al., 2015; Simon et al., 2015). Both situations, health-risk communication as well as risk communication in the context of emergencies, can be conceptualized together. For instance, Lachlan et al. (2014) argue that “risk communication can be conceptualized as a subcomponent of health communication, as it focuses on information and preventative steps that can be taken in order to minimize the harm of an event that has not yet occurred. By constructing and disseminating compelling risk messages, health care organizations can prevent harm from future health risks” (Lachlan et al., 2014, p. 377). Thus, health communication and risk communication in the context of emergencies share many similarities, such as a focus on prevention and behavioral advice, or that the issues they address are relevant to the health and well-being of individuals.

A central issue when it comes to risk communication on social media is what factors influence whether people will trust the information they encounter online. The present
dissertation will extend previous research on social media use for risk and crisis communication (e.g. Lachlan et al., 2016; Rains et al., 2015; Simon et al., 2015) by investigating the role of the general use of and general trust towards social media channels. To be able to influence people’s perceptions and behavior, it is necessary to use social media channels that are trusted in those situations of risk. Using trusted media channels is important to increase the likelihood that a message is perceived as trustworthy (e.g. Beldad et al., 2010; Bilgihan, 2016; Y. Kim & Peterson, 2017; McLuhan, 2006; Metzger & Flanagan, 2013). Therefore, it is crucial that people trust the sources of information. The third part of this dissertation focuses on the topic of the perception of the trustworthiness of particular social media channels. The context is hereby shifted from health to the context of risk communication in emergencies. The medium for this investigation is Facebook, as it is the largest social network worldwide (Facebook Newsroom, 2016; Simon et al., 2015; Statista: The Statistics Portal, 2016, 2020).

1.5 Which information channels to trust?

Due to the internet, it has never been easier to get access to all sorts of information. As people increasingly use the internet, the ubiquitous Web 2.0 has considerable influence on peoples’ behaviors and world views (e.g. Boyd & Ellison, 2008; Laranjo et al., 2015; Newman et al., 2016). Social media platforms are a particularly important medium for information attainment and communication, where information on health is also easily accessible (X. Wang et al., 2020).

Even though people may habitually use social media for communication, entertainment, and information attainment, it is not sure whether they would trust these media in situations that are characterized by personal risks, such as health behavior advice or emergencies. Thus, it is necessary to investigate whether people who use these media in their everyday life would trust them in more consequential, risk-related contexts. If this would be the case, social media such as Facebook could be used effectively for this kind of communication. Therefore, one goal of
this dissertation is to investigate whether habitual use and general trust translate into trust in situations with direct personal risk involved.

Whenever people interact, they do so against a background of trust. Trust is a “social reality,” which permeates interaction on all levels of society (Lewis & Weigert, 1985; Mayer et al., 1995; Rousseau et al., 1998). This is also true for the internet and associated online interaction. According to Luhmann (1973) trust is necessary for society to function because it reduces complexity and uncertainty inherent in human interactions (see also Brandstädtter, 2015; Giddens, 1991). Considering the complexity and uncertainty of the internet, it is no surprise that trust is an important and regulating force in this realm as well (Beldad et al., 2010; Blöbaum, 2016; Westphal & Blöbaum, 2016). Many risks are also associated with the use of online media, such as data protection and privacy issues, the risk of false or misleading information, information overload, harassment and identity theft, cybercrime, and malware, to name just a few (e.g. Bawden & Robinson, 2020; Dwyer et al., 2007; Gordon & Ford, 2006; Jan-Hinrik Schmidt, 2013; Malby et al., 2013; Wiederhold, 2014). To successfully navigate the digital world, perception of trust plays a crucial part (Beldad et al., 2010; Metzger & Flanagan, 2013).

Perceived trust is also crucial when it comes to information selection. In a digital world that is characterized by ‘information overload’ (Bawden & Robinson, 2020; Hiltz & Plotnick, 2013), it is impossible to monitor all the necessary information. As a consequence, other factors influence information-seeking behavior, such as the perception of media, e.g. in terms of trustworthiness (Lewicki & Brinsfield, 2011). When deciding which media channels to use, people will predominantly select, consume and follow the information which is distributed via a trusted channel (Beldad et al., 2010; Lewicki & Brinsfield, 2011; Metzger & Flanagan, 2013).

Lack of knowledge is still a barrier to change in physical activity and change of dietary behavior (S. Kelly et al., 2016). For instance, Caperchione et al. (2012) conclude in their study that “although [the participants] had some knowledge of healthy eating, they were regularly
confused by the mixed messages presented by the media” (p. 456). Confusing and mixed media messages create uncertainty within individuals. This uncertainty might have adverse effects on the individual when it refers to essential areas, such as their own health.

In case of conflicting information or uncertain situations, people will revert to trustworthy and familiar sources of information. These will be sources known from other contexts, such as everyday communication. If people trusted information on social media platforms, which they usually use in everyday communication and risk situations, public health officials could use these channels to raise awareness of new health information. It is therefore important to investigate whether the general use and trust of certain media will extend to situations of personal risk, such as health risks, or more imminent risks, as emergencies.

Known media channels may appear as trustworthy agents in situations of risk. Familiarity and general use could serve as peripheral cues for credibility. It has been shown that peripheral cues on websites that signal trust, such as layout, readability, or a logo/brand (Metzger & Flanagin, 2013; Sbaffi & Rowley, 2017), serve as facilitators for health behaviors. For instance, Kelley et al. (2016) report in their review that “fast and easy” websites are perceived as facilitators for health behavior change (S. Kelly et al., 2016, pp. 10–11). “Easy to use” is one of the many features associated with online trust (see also Beldad et al., 2010; Grabner-Kräuter & Bitter, 2015).

1.6 Outline and research aims

The present dissertation addresses the role of individuals’ perception in domains of health risk. In the first part (chapters 2 and 3), the perception of health behavior change will be investigated across two behavioral domains, namely physical activity and dietary behavior. Most research up to date has focused on actual behavior change, while the perception of individuals is relatively understudied. However, it is ultimately the perception of people that will guide their future behavior and impact their motivation. Consequently, it is necessary to also focus on the perceptions of the induvial regarding their behavior change. Discrepancies
between behavioral perceptions and health behavior advice need to be uncovered. Investigating these (mis)perceptions is an important first step for understanding behavior change. Thus, the first part of this dissertation aims to investigate the relationship between actual behavioral change and individuals’ perception of this change. To this end, it was investigated how much behavioral change is perceived by individuals as ‘successful’ change and whether this complies with current findings on the health benefits of smaller changes. Data of three measurement points of a longitudinal study (Konstanzer Life study waves 1 to 3) were analyzed.

To have an impact on public health, misperceptions need to be publicly addressed and thus corrected. This communication should be done through information campaigns. New information should be presented in a way that will be trusted by the public, especially when this information will contradict existing views on behavior. Also, when behavioral advice is directly related to personal risk, people might be more reluctant to follow it. Thus, the second part of this dissertation (chapter 4) is concerned with the question of what social media channels could be used for disseminating information for situations of personal risk. The aim was to examine the role of the general use of Facebook and general trust toward Facebook for risk communication in emergencies. For this part of the present dissertation, an online study was conducted to ascertain whether the use of Facebook and general trust towards this platform predict trust towards Facebook in situations of risk, namely crisis situations.
An increase in vigorous but not moderate physical activity makes people feel they have changed their behavior.


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2.1 Abstract

Objective: While behavioral recommendations regarding physical activity commonly focus on reaching demanding goals by proposing ‘thresholds’, little attention has been paid to the question of how much of a behavioral change is needed to make people feel that they have changed. The present research investigated this relation between actual and felt behavior change.

Design: Using data from two longitudinal community samples, Study 1 and 2 comprised 614 (63 % women) and 398 participants (61 % women) with a mean age of 40.9 years (SD = 13.6) and 42.5 years (SD = 13.4), respectively. Using a stage-approach, participants were classified into four groups by asking them at the respective second measurement to indicate whether they had become more physically active since their last participation six months ago (“Changers”), had tried but did not succeed in becoming more physically active (“Attempters”), were already physically active on a regular basis (“Regular Actives”), or had not tried to become more physically active (“Non-Attempters”). Physical activity was measured using the International Physical Activity Questionnaire (IPAQ), and fitness level was assessed as physical working capacity (PWC) via bicycle ergometry. Mixed ANOVAs including Time and Perceived Change as within and between factors were conducted, followed up by simple effect analyses.

Results: Participants stating to have become more active in the past six months (Changers) showed a significant increase in vigorous physical activity but not in moderate physical activity, with an average of 6.8 (Study 1) and 10.6 (Study 2) MET-h per week in vigorous activity. Corroborating these findings, objective fitness also significantly increased in the group of Changers. No systematic change in moderate or vigorous physical activity was observed for the three other ‘non-changer’ groups (regular actives, attempters, non-attempters).

Conclusion: The intensity of physical activity is the crucial variable for people’s perception of change in physical activity. Moderate physical activity seems not to be perceived as an
effective means for behavior change. It thus might fail to unfold sufficient motivational impact, despite its known positive effects on health.

**Keywords:** Physical Activity, Health Behavior, Behavioral Goals, Change, Beliefs
2.2 Introduction

There is strong evidence for the health benefits of regular physical activity (Ekelund et al., 2016). Research suggests regular physical activity to be an effective primary and secondary prevention measure with beneficial effects on more than 25 medical conditions and premature mortality (Warburton & Bredin, 2018). While the awareness about how important physical activity can be for both health promotion and chronic disease prevention has increased in key stakeholders and end-users, levels of physical activity have not increased markedly and are often below recommended thresholds (Schwartz et al., 2019). The World Health Organization (WHO; 2018) estimates that such physical inactivity is widespread, affecting 1 out of 4 adults and 4 out of 5 adolescents worldwide. A recent survey in 28 European countries showed that nearly half of the Europeans report that they never exercise or play sports in a given week, and about half do not engage in any moderate or vigorous physical activity (European Commission, 2017a).

Increasing physical activity has become a public health priority, with national and international health organizations implementing mass-media campaigns to communicate recommendations detailing the desired ‘threshold’ level of physical activity (Knox et al., 2015; Schwartz et al., 2019). Physical activity guidelines by the WHO (2010) and national health institutions, that is, in the United States (U.S. Department of Health and Human Services, 2018), Canada (Canadian Society for Exercise Physiology, 2019; Tremblay et al., 2011), Australia (Australian Department of Health, 2014a, 2014b), United Kingdom (National Health Service, 2011; U.K. Department of Health, 2011) and Germany (Bundeszentrale für gesundheitliche Aufklärung, 2017), have been harmonized. It is recommended that adults engage in a minimum of 150 min a week of moderate-to-vigorous physical activity (MVPA). Guidelines provide essential information on the minimum level of physical activity needed for health benefits; they are essential for monitoring efforts, planning interventions, and public policy (Knox et al., 2014).
From a psychological perspective, such guidelines as 150 min of MVPA per week qualify as assigned behavioral goals. These can lead to appropriate action as postulated in discrepancy-reduction based models such as control theory (Carver & Scheier, 1998) and goal-setting theory (Locke & Latham, 2013). A high desirability and feasibility of the aspired-to goal positively affect goal strength (also referred to as goal commitment), and high goal commitment is assumed to promote goal attainment. Moreover, the self-regulation approaches to goal setting and goal striving highlight that it matters how people prospectively think about goal setting and goal implementation. For goal setting it is important that people contrast their desired outcomes with the present hindrances (see the mental contrasting theory by Oettingen, 2012, 2014), and for goal striving it is important that people plan out when, where, and how they want to act in order to reach their goals (see the mindset theory of action phases, Gollwitzer, 1990; the model of if-then planning, Gollwitzer, 1993, 1999; Gollwitzer & Sheeran, 2006; and the health action process approach, Schwarzer, 1992, 1999, 2008, 2011).

In general, the link between goal commitment on the one hand and actual taking action on the other has been shown to be weak to moderate only (referred to as the ‘intention-behavior gap’; e.g., Rhodes & Dickau, 2013; Sheeran, Gollwitzer, & Bargh, 2012; Sheeran & Webb, 2016), and this is true even when individuals perceive a need for change (e.g., Baldwin & Sala, 2018; Bandura, 1997; Nigg et al., 2008; Schwarzer & Renner, 2000). As a consequence, theories and research on the self-regulation of goal setting and goal striving have become very popular in recent years (e.g., Avishai, Conner, & Sheeran, 2019; Chang, Webb, Benn, & Stride, 2017; Gollwitzer & Oettingen, 2012, 2019; Thürmer, Wieber, & Gollwitzer, 2017), as they try to elucidate what kind of strategies people can use to enhance both goal commitment and the translation of goals into action. Importantly, when the desired target behavior is not a one-time action but requires building a habit towards reaching long-term goals and permanent change (e.g., ‘I want to become a physically active person’), accumulating smaller behavioral steps becomes an important strategy (e.g., ‘baby steps’; Fogg, 2015, 2009a, 2009b). Hence,
recognizing such small behavioral changes (‘baby steps’) as meaningful building blocks for long-term sustainable change should help people to arrive at substantial behavior change.

Considering the current physical activity level of many people, the normative ‘threshold’ of 150 minutes of MVPA per week might represent a rather challenging behavior change goal. Furthermore, Slotterback, Leeman, and Oakes (2006) coined the phrase ‘no pain, no gain’ to capture the finding that people might erroneously believe that physical activities must be intense to be of benefit. However, the emphasis on normative time and high-intensity goals may actually deter some people from becoming physically active because the difference between these normative recommendations and the actual physical activity level (‘reality-norm gap’) is big and may thus be demotivating (Knox et al., 2014; Schwartz et al., 2019; Slotterback et al., 2006). In contrast, small but meaningful changes in behavior which are easily obtainable and associated with repeated incentives may quickly become part of a person’s self-regulation efforts, thereby achieving the desired ‘ultimate’ behavior change. This perspective however calls for research on the personal perception of behavior change. A critical issue concerns the needed amount or intensity of instrumental behaviors that allows people to feel that they have moved towards the desired goal. One hypothesis is that people only notice a behavior change when they substantially increase the intensity of their physical activity in line with the ‘no pain, no gain’ metaphor. Alternatively, people may already recognize comparably small increases (i.e., ‘baby steps’) in their physical activity as a behavior change, as a meta-analysis could demonstrate health benefits already for low-intensity physical activity (Warburton et al., 2016).

Although the question of how much people should change (normative goal or injunctive norm) and to what degree they attained normative goals (objective behavior change) has received considerable attention in research (Foster et al., 2009; Piercy et al., 2018; Shilts et al., 2004; U.S. Department of Health and Human Services, 2018; Wen et al., 2011), the question of how much behavior change is necessary to make people feel that they have changed their behavior (subjective behavior change) has rather been neglected (Zahrt & Crum, 2017).
Accordingly, the main aim of the present study was to shed light on the relation between the felt and actual behavioral change in order to examine whether subjective change is reflected in actual change and which kind of behavior is driving subjective feelings of change. For Study 1, data was taken from the Konstanz Life-Study, a longitudinal multiple-cohort study, including observations from two time points which were six months apart. To assess perceived behavior change, participants were asked to indicate if they had been more physically active over the past six months, attempted but failed to increase physical activity, were already high in physical activity, or did not attempt to increase physical activity; they were then classified accordingly in four groups of perceived behavior change (Changers, Attempters, Regular Actives, Non-Attempters, respectively). We furthermore assessed self-reported physical activity and objective fitness via ergometer tests at each time point, in order to find out what amount of change in physical activity corresponds to the perception that one has increased the level of physical activity. In a first step, we examined whether study participants who reported that they increased their physical activity in the past half year (‘Changers’) actually showed a significant change in their physical activity level compared to three other groups who did not report a change in their physical activity. Specifically, we hypothesized that ‘Changers’ reported a greater change in their activity behavior as compared to the three other groups. Further analysis analyzed levels of vigorous and moderate physical activity separately. According to the ‘no pain, no gain’ assertion, changes in vigorous physical activity level should be more impactful regarding perceived behavior change than changes in moderate intensity. The reproducibility of findings has become a central issue in the social sciences (Brandt et al., 2014; Open Science Collaboration, 2015; Simons, 2014; Wicherts, 2017). To follow-up the findings from Study 1, we conducted a second study providing a direct replication of the main findings of Study 1. Specifically, data were collected of a new but similar sample and holding all of the research methods and procedures constant (see National Science Foundation, 2018).
2.3 Methods

2.3.1 Procedure and participants for Studies 1 and 2

Data were collected under the Konstanz Life-Study, an ongoing longitudinal multiple-cohort study launched in spring 2012 (e.g., Gamp, Schupp, & Renner, 2018; Klusmann, Musculus, Sproesser, & Renner, 2016; Renner, Sproesser, Klusmann, & Schupp, 2012; see also www.uni-konstanz.de/life-studie). The overall goal of the Konstanz Life-Study is to investigate influences on health behaviors, such as physical activity and dietary behavior, across time. Measurements include fasting blood samples, questionnaires, anthropometric measures, as well as cognitive and physical fitness tests. People aged 18 years and older without acute infectious diseases were eligible for participation in the Konstanz Life-Study. For each time point, new participants were recruited via flyers, posters, and newspaper articles. Participants who took part in a preceding time point were re-invited via email.

In the present analyses, three time points (TP1 to TP3), which were each half a year apart, were included. For Study 1, participants who attended TP1 (Spring 2012) and TP2 (Autumn 2012) were examined. For Study 2, participants who took part in TP2 (Autumn 2012) and attended TP3 (Spring 2013) were analyzed. Since the reliability and validity of the International Physical Activity Questionnaire (IPAQ; C. L. Craig et al., 2003) has been demonstrated only for adults aged between 18 and 65 years, only these participants were eligible for analysis.

Ethics. For data processing and security, a register of processing operations was developed in cooperation with and approved by the Center for Data Protection of the Universities in Baden-Württemberg (ZENDAS) in 2012, and subsequently reviewed by the Commissioner for Data Protection in Baden-Württemberg. All participants gave written informed consent prior to participation. The study adhered to the guidelines of the German Psychological Society and the Declaration of Helsinki and was conducted in compliance with relevant institutional guidelines. The study protocol was approved by the University of Konstanz ethics committee.
**Study 1.** In total, 1,321 participants attended TP1 and out of these, 799 participants took also part in TP2 and thus, were eligible for analysis in Study 1. Of these 799 participants, 155 participants were excluded because of age, 29 due to missing data with regard to the IPAQ or the behavior change question, and 10 due to excessive physical activity values (Metabolic Equivalent Value - hours per week, MET-hours/week, over 200 which corresponds to more than 25 hours of vigorous or 50 hours of moderate physical activity). Therefore, the data of 605 participants (61.2% female) were included in the analysis for Study 1 (see Table 2.1). The sample had a mean age of 40.9 years (SD = 13.6), a mean body mass index (BMI) of 24.6 kg/m$^2$ (SD = 4.0, ranging from 17.5 to 45.2) and had completed on average 15.9 years of education (SD = 2.4, ranging from 10 to 20). Compared to the German population (Statistisches Bundesamt, 2017, 2018a), the sample was 3.4 years younger, comprised 10% more females, and had a slightly lower average BMI (the average BMI of the German population is 26 kg/m$^2$; Statistisches Bundesamt, 2018b).

Eligible ($n = 605$) and non-eligible participants ($n = 716$) did not differ significantly regarding BMI, $t(1257) = 1.56, p = .12$, or gender, $\chi^2 (1) = 1.28, p = .259, \phi = .032$. However, with a mean age of 46.4 (SD = 20.4) and an average education of 15.3 (SD = 2.5) years, the non-eligible participants were significantly older, $t(1272) = -5.65, p < .001$, and reported slightly fewer years of education, $t(1249) = 4.93, p < .001$, than the eligible participants. However, this is mostly because participants older than 65 had to be excluded because the IPAQ had not been validated for this age group.

**Study 2.** For Study 2, 883 participants attended TP2 and out of these, 587 participants also attended TP3 and thus, were eligible for analysis. Of these 587 participants, 140 were excluded because of age, 56 due to missing data with regard to the IPAQ or the behavior change question, and 9 due to excessive physical activity (MET-hours/week > 200). Therefore, the data for 382 participants (60.7 % female) were included in the analysis for Study 2 (see Table 2.1). The sample had a mean age of 42.5 years (SD = 13.4), a BMI of 24.4 kg/m$^2$ (SD = 3.8, ranging
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from 17.5 to 40.8) and had completed on average 16.2 years of education ($SD = 2.3$, ranging from 9 to 20). Compared to the German population (Statistisches Bundesamt, 2017, 2018a) the sample was 1.8 years younger, comprised 10% more females, and had a slightly lower average BMI (Statistisches Bundesamt, 2018b).

Eligible participants ($n = 382$) and non-eligible participants ($n = 501$) did not differ significantly regarding gender, $\chi^2(1) = 2.07, p = .15, \phi = .051$. However, they differed in age, BMI, and years of education. The non-eligible participants with a mean age of 52.9 ($SD = 20.1$), an average BMI of 25.2 kg/m2 ($SD = 3.9$), and an average education of 15.4 ($SD = 2.5$) years, were older, $t(814) = -8.14, p < .001$, had a higher BMI, $t(803) = -2.77, p < .01$, and reported slightly fewer years of education, $t(801) = 4.87, p < .001$, than the study sample.

Table 2.1

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>605 (61%)</td>
<td>382 (61%)</td>
</tr>
<tr>
<td>Sex (% female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>40.9 (13.6)</td>
<td>42.5 (13.4)</td>
</tr>
<tr>
<td>Years of education</td>
<td>15.9 (2.4)</td>
<td>16.2 (2.3)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.6 (4.0)</td>
<td>24.4 (3.8)</td>
</tr>
</tbody>
</table>

*Note. BMI: Body mass index; Age, Years of education, and BMI in Mean ($SD$).

2.3.2 Measurements

**Physical activity.** Physical activity was assessed using an adapted version of the Short Form of the International Physical Activity Questionnaire (IPAQ; C. L. Craig et al., 2003; Helmerhorst et al., 2012; The IPAQ Group, 2005; van Poppel et al., 2010). Participants reported their physical activity for each of the last seven days and the following domains: Vigorous physical activity, moderate physical activity, and walking. Level of physical activity is calculated as total MET-hours per week (MET = Metabolic Equivalent Value) which is a unit
for the metabolic cost of physical activity and thus an indicator of the intensity of physical activity (Ainsworth et al., 2000; U.S. Department of Health and Human Services, 1996). Based on the IPAQ guidelines (The IPAQ Group, 2005), MET-values of 8, 4, and 3.3 were assigned to vigorous physical activity, moderate physical activity, and walking, respectively. The sum of moderate and vigorous physical activity served as a measure of moderate to vigorous physical activity (MVPA).

Perceived change in physical activity. Perceived change was assessed at the respective second measurement used in both studies. After reading the item “Since your last participation in the Konstanz Life-Study, have you been more physically active than before?”, participants were asked to choose the one statement they would agree with the most regarding their physical activity behavior: [1] Changers: (“Yes, I became more physically active”), [2] Attempters: (“No, but I tried to become more physically active”), [3] Non-Attempters: (“No and I have not (even) tried”), and [4] Regular Actives: (“No, because I was already physically active on a regular basis before”). Each answer represents different stages of intention and behavior (cf. Klusmann et al., 2016).

Objective fitness. To assess the objective fitness level, Physical Working Capacity (PWC) was assessed via bicycle ergometry with pulse monitoring (see also Klusmann et al., 2016). Participants were instructed to try holding up the pedaling rate close to 60 min⁻¹. The test started at 25 W and the load was increased by 25 W every 60 s until either pre-determined maximum PWC value (adjusted for age) was reached or participants indicated to be exhausted. The PWC index refers to the physical performance of a person measured in watts at a specific heart rate (here: 130, i.e., PWC 130) divided by body weight (W/kg). The higher the PWC, the better a person's physical fitness. To be eligible for this test, participants’ blood pressure had to be in the normal range (systole below 150 mm HG and diastole below 100 mm HG). Participants who reported cardiovascular disease/events, lung disease, metabolic disorders, mental disorders with physical exercise counter indicated, epilepsy, multiple sclerosis, current antitumor therapy,
major intervention or surgery within the last 12 months, or other severe chronic or acute diseases were also excluded from this assessment, as were women who were pregnant. Hence, PWC analysis was based on data of 499 and 326 participants in Study 1 and Study 2, respectively.

### 2.3.3 Statistical Analysis

Data were analyzed using SPSS Statistics 25.0. For total physical activity and PWC, a mixed 4 between (Perceived Change: Changers vs. Attempters vs. Non-attempters vs. Regular Actives) × 2 within (Time: 1st vs. 2nd measurement) ANOVA was conducted. For follow-up analyses, post-hoc tests with Bonferroni correction for multiple comparisons (α = .0125) were conducted. To capture effect sizes, Cohen’s d for single mean comparisons is reported (Becker, 1988).

To determine differential effects as a function of the intensity of physical activity, a mixed 4 between (Perceived Change: Changers vs. Attempters vs. Non-attempters vs. Regular Actives) × 2 within (Time: 1st vs. 2nd measurement) × 2 within (Intensity of the physical activity: moderate vs. vigorous) ANOVA was conducted. Power analyses revealed that the sample sizes of Study 1 and 2 were able to detect interaction effects of f = 0.13 (d = 0.27) and f = 0.17 (d = 0.33), respectively (α = .05, power of .80). Follow-up analyses included separate ANOVAs for vigorous and moderate physical activity and the calculation of simple effects. In order to test the generalizability of our findings, all analyses for changes between T0 and T1 (i.e., Study 1) were replicated for examining changes between T1 and T2 (i.e., Study 2).

### 2.4 Results

#### 2.4.1 Total physical activity

The first string of analyses focused on the level of physical activity associated with the subjectively perceived behavior change and whether this relation only held for the group of Changers.
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**Study 1.** The significant main effect Perceived Change, $F(3, 601) = 12.51, p < .001, \eta^2 = .059$, was qualified by the significant interaction of Perceived Change and Time, $F(3, 601) = 2.74, p = .042, \eta^2 = .014$. As shown in Figure 2.1, Changers increased their level of physical activity by a value of 7.8 MET-hours per week from the first to the second measurement, $t(148) = -2.56, p < .05, d = 0.20$. No change in physical activity was observed for the Attempters, that is, participants who stated that they unsuccessfully tried to increase physical activity, $t(157) = -0.03, p = .973$, and the Non-Attempters, that is, participants who have not tried to change, $t(78) = 1.27, p = .207$. While the Regular Actives also increased their level of activity from first to second measurement, $t(218) = -2.11, p < .05$, the $p$-value exceeded the pre-determined $\alpha = .0125$ to correct for multiple comparisons.

**Study 2.** Overall, findings from Study 2 were similar to those of Study 1. Again, the main effect of Perceived Change, $F(3, 378) = 5.05, p = .002, \eta^2 = .039$, was qualified by the significant interaction of Perceived Change and Time, $F(3, 378) = 4.41, p = .005, \eta^2 = .034$. Again, the results show that the Changers significantly increased their level of activity. On average, they increased their physical activity by 11.8 MET-hours per week (Figure 2.1) from the first to the second measurement, $t(78) = -2.43, p < .01, d = 0.32$. Conversely, the group of Attempters and Regular Actives showed no significant change in their physical activity, $t(96) = 0.71, p = .481$, and $t(150) = 0.28, p = .78$, respectively. Non-Attempters showed a non-significant decline in their activity, $t(54) = 2.84, p < .01$, as the $p$-value exceeded the pre-determined $\alpha = .0125$ to correct for multiple comparisons.
2.4.2 Intensity of Physical Activity

In a second step, we added the factor of Intensity to increase the sophistication of our analysis by differentiating between vigorous and moderate physical activity. This allows differentiating effects of the intensity of physical activity on the perception of behavior change.

Study 1. Significant two-way interactions of Perceived Change and Intensity, $F(3, 601) = 11.13, p < .001, \eta_p^2 = .053$, and Perceived Change and Time, $F(3, 601) = 2.74, p = .042, \eta_p^2 = .014$, were qualified by a significant three-way interaction of Perceived Change, Intensity, and Time, $F(3, 601) = 2.68, p = .046, \eta_p^2 = .013$. To follow up on the three-way interaction effect, separate analyses were conducted for vigorous and moderate physical activity.

For vigorous physical activity, the significant main effect of Perceived Change, $F(3, 601) = 17.57, p < .001, \eta_p^2 = .081$, was qualified by the significant interaction of Perceived
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Change and Time, $F(3, 601) = 4.86, p = .002, \eta^2_p = .024$. As shown in Figure 2.2, Changers had increased their level of vigorous physical activity by 6.9 MET-hours per week from the first to the second measurement, $t(148) = -3.18, p < .01, d = 0.25$. No change in vigorous physical activity could be observed for the Attempters, $t(157) = 1.20, p = .234$, and the Non-Attempters, $t(78) = 1.58, p = .118$. Similar to the analysis of the total physical activity, the Regular Actives increased their level of vigorous physical activity from first to second measurement, $t(218) = -1.93, p < .05$, however, the $p$-value exceeded the pre-determined $\alpha = .0125$ to correct for multiple comparisons.

A different pattern of findings emerged for moderate physical activity. The significant main effect of Perceived Change, $F(1, 601) = 2.85, p = .037, \eta^2_p = .014$, was not further qualified by the interaction of Perceived Change and Time, $F(3, 601) = 0.25, p = .863$. Furthermore, exploratory analyses of simple effects showed no significant change in moderate physical activity for any of the four groups between time points (Figure 2.3), $F_s(1, 601) < 1, ps > .30$.

**Study 2.** The two-way interaction of Perceived Change and Time, $F(3, 378) = 4.41, p = .005, \eta^2_p = .034$, was qualified by the significant three-way interaction of Perceived Change, Intensity, and Time, $F(3, 378) = 3.72, p = .012, \eta^2_p = .029$. Accordingly, separate analyses were conducted for vigorous and moderate physical activity.

For vigorous physical activity, key findings from Study 1 were replicated. Specifically, the significant main effect of Perceived Change, $F(3, 378) = 4.92, p = .002, \eta^2_p = .038$, was qualified by the significant interaction of Perceived Change with Time, $F(3, 378) = 5.24, p = .001, \eta^2_p = .040$ (Figure 2.2). Noteworthy, the Changers had increased their level of vigorous physical activity on average by 11.5 MET-hours per week from the first to the second measurement, $t(78) = -3.2, p < .01, d = 0.39$. Furthermore, there were no significant effects for the Non-Attempters, $t(54) = 1.82, p = .075$, as well as the Regular Actives, $t(150) = -0.15, p = 0.882$. Similarly, no change in vigorous activity was observed for the Attempters who, if anything,
even showed a decline in vigorous physical activity that however was not statistically significant, \( t(96) = .143, p = .157 \).

For *moderate physical activity*, the interaction of Perceived Change and Time approached significance, \( F(3, 378) = 2.14, p = .095 \). Exploratory analyses of simple group effects indicated no change in moderate physical activity for Changers, \( t(78) = -0.1, p = .921 \), Attempters, \( t(96) = -0.76, p = .449 \), and Regular Actives, \( t(150) = 0.63, p = .521 \). Non-Attempters showed a nonsignificant decline in moderate physical activity from first to second measurement, \( t(54) = 3.17, p < .05 \), as the \( p \)-value exceeded the pre-determined \( \alpha = .0125 \) to correct for multiple comparisons.

### Table 2.2

*Changes in objective fitness (PWC) and walking as a function of Perceived Change between Baseline (B) and Follow-Up (F)*

<table>
<thead>
<tr>
<th></th>
<th>Changers</th>
<th></th>
<th>Attempters</th>
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<th>Non-Attempters</th>
<th></th>
<th>Regular Actives</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>B</td>
<td>F</td>
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<td>Study 1</td>
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<tr>
<td>PWC</td>
<td>1.58</td>
<td>1.69</td>
<td>1.58</td>
<td>1.60</td>
<td>1.59</td>
<td>1.55</td>
<td>1.82</td>
<td>1.84</td>
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<td></td>
<td>(0.45)</td>
<td>(0.44)</td>
<td>(0.42)</td>
<td>(0.41)</td>
<td>(0.46)</td>
<td>(0.44)</td>
<td>(0.44)</td>
<td>(0.49)</td>
</tr>
<tr>
<td>Walking</td>
<td>17.0</td>
<td>17.8</td>
<td>19.0</td>
<td>20.7</td>
<td>16.3</td>
<td>15.5</td>
<td>20.3</td>
<td>21.9</td>
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<td></td>
<td>(19.5)</td>
<td>(19.8)</td>
<td>(23.3)</td>
<td>(22.7)</td>
<td>(17.1)</td>
<td>(17.5)</td>
<td>(18.7)</td>
<td>(18.8)</td>
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<td>Study 2</td>
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<tr>
<td>PWC</td>
<td>1.68</td>
<td>1.72</td>
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<td>1.61</td>
<td>1.70</td>
<td>1.76</td>
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<td>(0.41)</td>
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<td>(0.51)</td>
<td>(0.52)</td>
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<tr>
<td>Walking</td>
<td>18.5</td>
<td>18.7</td>
<td>17.6</td>
<td>19.4</td>
<td>19.7</td>
<td>11.9</td>
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<td>(19.9)</td>
<td>(18.2)</td>
<td>(20.9)</td>
<td>(23.4)</td>
<td>(15.3)</td>
<td>(19.7)</td>
<td>(23.0)</td>
</tr>
</tbody>
</table>

*Note.* Study 1: Baseline (B; spring 2012) and Follow-Up (F; autumn 2012); Study 2 (Baseline (B; autumn 2012) and Follow-Up (F; spring 2013).
Figure 2.2. Mean Vigorous Physical Activity in MET-hours / week for Changers, Attempters, Non-Attempters, and Regular Actives. Error bars represent Standard Error of the Mean (SE). Statistically significant changes from Time 1 to Time 2 is indicated by asterisks (* indicates $p < .05$, *** indicates $p < .001$).
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**Figure 2.3.** Mean Moderate Physical Activity in MET-hours / week for Changers, Attempters, Non-Attempters, and Regular Actives. Error bars represent Standard Error of the Mean (SE). Statistically significant change from Time1 to Time 2 is indicated by asterisks (* indicates \( p < .05 \)).

### 2.4.3 Objective physical fitness (PWC 130 test)

To corroborate the findings based on self-reported physical activity behavior, the analyses of the results of the objective fitness test provide additional insights into changes in physical fitness over time.

**Study 1.** Significant main effects of Perceived Change, \( F(3, 495) = 11.14, p < .001, \eta_p^2 = .063 \), and Time, \( F(1, 495) = 4.32, p = .038, \eta_p^2 = .009 \), were qualified by a significant interaction of Perceived Change and Time, \( F(3, 495) = 6.64, p < .001, \eta_p^2 = .039 \). Accordingly, simple effects were calculated for the four groups of perceived change. A significant increase in physical fitness was observed for the Changers from the first (\( M = 1.58, SD = 0.45 \)) to the second measurement (\( M = 1.69, SD = 0.44 \)), \( t(123) = -4.33, p < .001, d = 0.25 \). In contrast, no significant effects emerged for the other three groups, \( Fs(1, 495) < 2.1, ps > .15 \) (Table 2.2).
Study 2. In contrast to Study 1, the significant main effect of Perceived Change, $F(3, 322) = 3.51, p = .016, \eta^2_p = .032$, was not qualified by a significant interaction of Perceived Change with Time, $F(3,322) = 1.18, p = .318$.

2.4.4 Control analyses

Several control analyses were undertaken to determine whether the observed findings were moderated by gender. No higher-order interaction involving Perceived Change, Time, and Gender was observed for total physical activity in Study 1 and 2, $F(3, 597) = 0.33, p = .804$, and $F(3, 373) = 0.12, p = .949$, respectively. This holds true for objective fitness (PWC) in Study 1, $F(3, 491) = 0.04, p = .990$, and Study 2, $F(3, 317) = 0.28, p = .837$. Similarly, the interaction of Perceived Change, Time, Intensity, and Gender was neither significant in Study 1, $F(3, 597) = 1.35, p = .26$, nor in Study 2, $F(3,373) = 0.67, p = .572$. However, commonly observed gender differences in physical activity were replicated (Bauman et al., 2012; Hallal et al., 2012; Ransdell et al., 2004). Men showed higher total physical activity levels than women, $F(1, 597) = 9.16, p < .01, \eta^2_p = .015$ and $F(1,373) = 12.74, p < .001, \eta^2_p = .033$, in Study 1 and 2, respectively. Furthermore, the two-way-interaction of Intensity and Gender was significant, $F(1, 597) = 13.10, p < .001, \eta^2_p = .021$, and $F(1, 373) = 14.07, p < .001, \eta^2_p = .036$, for Study 1 and 2, respectively. This indicates that men were more active in terms of vigorous activity, $F(1, 597) = 17.64, p < .001, \eta^2_p = .029$, and $F(1, 373) = 21.38, p < .001, \eta^2_p = .054$, in Study 1 and 2, respectively, but not in terms of moderate physical activity, $Fs < 0.8, ps > .78$. In addition, men had higher PWC-scores than women, $F(1, 491) = 46.83, p < .001, \eta^2_p = .087$, and $F(1, 317) = 56.50, p < .001, \eta^2_p = .151$, in Study 1 and 2, respectively.

Further control analyses examined whether the four change groups differed in walking which represents a light-to-moderate-intensive activity (see Table 2.2). Similar to moderate physical activity, no significant interaction between Perceived Change and Time was found, $F(3, 601) = .41, p = .749$, and $F(3, 378) = .69, p = .561$, for Study 1 and 2, respectively.
2.5 Discussion

Two studies examined individuals’ perceptions of their physical activity to answer the question of how much change is needed for people to feel that they have changed. Towards this end, self-reported physical activity and objective fitness levels were assessed in a group of participants who claimed that their physical activity levels had increased, and these were compared to three control groups: A group of attempters, a group of non-attempters, and a group of regular active individuals. The main finding is that participants who stated that they had become more active compared to six months ago, did indeed exhibit an overall increase in their physical activity. Importantly, however, further analyses revealed that this is driven by vigorous physical activity, with participants showing an increase of about 52 and 86 minutes of vigorous activity per week in Study 1 and 2, respectively. Combined with the fact that they did not exhibit any changes in moderate activity, this pattern of results suggests that an increase in intensive physical activity is the critical variable for perceiving a change in one’s physical activity.

Perceiving a change in behavior is a key element in the broad array of theories related to behavior change (Ajzen, 1991; Bandura, 1997; Carver & Scheier, 1998; Gollwitzer, 1990, 2012; Locke & Latham, 2013; Oettingen, 2012; Schwarzer, 2011). Perceived change indicates to people that their desired behavior change is feasible, which raises their commitment to actually achieve the desired behavior change and thus strive for it more persistently when hindrances are encountered. The question of how much and what type of behavior change is needed to make people feel that the desired change is feasible accordingly addresses a critical issue of promoting behavior change. The pattern of our findings suggests that people only feel that they have changed when they exhibited a substantial increase in vigorous physical activity; increases in moderate physical activity did not qualify. The group of participants who reported to have changed showed no increase in the level of moderate physical activity, which actually turned out to be at the level of people who reported failing to change. Thus, our findings strongly suggest that people do not take small increases (‘baby steps’) in physical activity into account.
when they judge whether behavior change has occurred with respect to heightening one’s physical activity.

**Vigorous versus moderate physical activity**

Our findings indicate that perceiving a positive change in physical activity is driven by an increase in vigorous rather than moderate physical activity. However, evidence accumulated in recent years suggests that moderately-intense physical activity does already have positive effects on health and well-being (Warburton & Bredin, 2016). For instance, Wen et al. (2011) concluded in their prospective cohort study with more than 400,000 individuals that 15 minutes a day or 90 minutes a week of moderate physical activity is already sufficient for marked health benefits. Similarly, focusing on people aged 60 years and older, a meta-analysis by Hupin et al. (2015) reveals that a low dose of moderate physical activity (1-499 MET-minutes per week) reduces mortality by 22%. However, the positive contribution of moderate physical activity to a person’s health as consistently and robustly detected in large cohort studies and meta-analyses, does not seem to be reflected in people’s subjective perceptions of how physically active they are.

This blind spot regarding the health effects associated with moderate physical activity might hinder people to adopt a healthier lifestyle. Usually, recommendations provided by the WHO are based on threshold messages suggesting, for instance, a minimum of 150 min of moderate physical activity or 75 min of vigorous physical activity for a typical week (WHO 2010, 2018). But even below these thresholds, moving from an inactive to a more active state is already associated with positive health effects, according to the epidemiological data. Hopefully, these findings will ultimately lead to the development of health campaigns valuing also moderate and low-volume physical activity.

**Long-term success**

While many people adopt the goal to increase physical activity, long-term success seems limited. Subjectively perceived behavior change may be an especially critical variable for
maintaining behavior change. In the present set of studies, the time interval of data collection was six months, an interval often chosen in intervention studies to identify participants successfully maintaining a behavior change (cf. Rhodes & Pfaeffli, 2010). Health models distinguish between adoption and maintenance of a desired behavior change (e.g. Kwasnicka et al., 2016). In the adoption phase, people are encouraged to gradually increase their physical activity, that is, to take baby steps (Fogg, 2009b), and a discrepancy between behavior and goal is mandatory. However, with increasing time, it becomes harder and harder for people to perceive a meaningful increase in physical activity as they are getting closer and closer to the goal. In other words, the discrepancy between the goal standard and the status-quo becomes smaller and smaller (e.g. Locke & Latham, 2006). In this maintenance phase, it will therefore be important that people are inventive in revising their goals in terms of content (e.g., try out new physical activities such as dancing, mountain climbing) and structure (e.g., set goals that specify not falling back as the desired outcome) so that experiences of success are still possible. In contrast, blind spots regarding low-intensity physical activity may undermine the experience of fruitful changes as will the setting of new but overly challenging goals.

**Goal standards and monitoring progress**

People’s subjective perceptions of success or failure of a change in behavior is crucial for self-monitoring progress towards goals. In one of the few studies taking self-perceived change into account, Bélanger et al. (2011) identified participants who have changed by the researchers’ criteria (actual change) but did not perceive themselves to have changed (subjectively perceived change). However, *how much* change would have been necessary for the participants to actually perceive change was not explored. Furthermore, Klusmann et al. (2016) used perceived change to distinguish between successful and unsuccessful intenders; still, the authors left the question unanswered of how much actual change (if any) had occurred for those who perceived to have changed. Thus, our finding that perceived change is related to
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an increase in vigorous physical activity adds relevant information to understanding the processes underlying people’s monitoring of their goal progress.

The fact that people ignore the potential beneficial effects of moderate physical activity may be based on the difficulties associated with taking notice of low volume physical activity. Mobile technologies such as smartphones, mobile body monitoring systems (e.g., movisense®, Actigraph®), and self-tracking tools (e.g., Fitbit®, Apple Watch®, quantifiedself.com) can help people to monitor goal progress with respect to small-scale changes in physical activity. Thus, it is comforting to see that innovative new means are developed that facilitate the monitoring of minor changes in physical activity, which as the present studies suggest would otherwise go by unnoticed (see Crum & Langer, 2007).

Perceiving a change in behavior is construed with respect to standards regarding the desired level of physical activity. Intervention programs usually define the target behavior explicitly, and the various aspects involved in effective goal setting are considered in health behavior change interventions (Strecher et al., 1995). Beyond structured interventions and fitness programs, people intending to increase physical activity can also benefit from social norms and/or the dissemination of fitness recommendations provided in mass media, books, and magazines. While the present research has not been designed to reveal the relationship of perceived change and the normative standards participants adhere to, it is important to note that the level of change shown by participants was substantial, going far beyond current recommendations from major organizations. Accordingly, future research is needed probing not only into perceived behavior change but also into considering how normative standards affect an increase in physical activity.

Limitations

The present studies are not without limitations. The focus in the present studies was on adults aged between 18 and 65 years because our measure of physical activity (i.e., IPAQ) is validated for this age group. However, when including all of the older participants, findings
were highly similar to the reported results for adults between 18 and 65 years of age. While sample size was too small to focus on older participants specifically, it would be highly interesting to explore in future research whether older people’s perception of behavior change is more sensitive than that of younger people (a hypothesis that is in line with a more sensitive adjustment of perceived risk across the lifespan; Renner, Spivak, Kwon, & Schwarzer, 2007).

Furthermore, the Konstanz Life-Study consists of a community sample volunteering to participate. Within this research paradigm, it is not feasible to examine the correspondence of change in physical activity with the perceived behavior change as a function of baseline physical activity. Thus, expanding on the current findings, future research is needed to address the relationship of actual change in physical activity with perceived behavior change as a function of the physical activity level at baseline (low, medium, high). Furthermore, reflecting public health concerns (WHO, 2018), the present research focused on perceived increase in physical activity. However, it would be interesting to also consider the issue of perceiving a decrease in physical activity, determining possible differences in the amount of change needed for a perceived decrease versus increase in behavior.

A further limitation of the present studies is that physical activity levels were assessed via self-report rather than objectively measured using mobile tracking. As a proxy, we assessed physical working capacity by using a bicycle ergometer test. Corroborating self-report data, we observed an increase in PWC in the group of participants who had been classified as Changers (i.e., people who perceived a change) in Study 1. Noteworthy, this group was the only of the four groups showing a significant change in PWC. However, data from the second study showed no such difference between groups, possibly reflecting the reduced power of the smaller sample of Study 2. Nevertheless, while acknowledging limitations of the PWC analysis the objective fitness data did substantiate our findings regarding perceived change in physical activity.
Conclusion

Some of our research participants felt that they succeeded in increasing their physical activity level while others did not. The present research determined what kind of actual behavior change was needed that people felt that they changed their behavior. Findings revealed that an increase in high-intensity physical activity is the critical variable for perceiving a positive change in physical activity. This might lead people to reduce their engagement in moderate intensity physical activity. We also observed that the duration of vigorous activity our participants engaged in was substantial in comparison to current health recommendations of international and national health organizations. The present findings thus speak for a change in current health recommendations. Not only vigorous but also moderate physical activity should be highlighted, given that extensive empirical research has shown that moderate physical activity does have enormous positive health consequences as well.
2.6 Declarations

Ethics approval and consent to participate

All participants gave written informed consent prior to the collection of data, and the local ethical review board (University of Konstanz) approved the study protocol.

Availability of data and material

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Disclosure statement

The authors declare that they have no competing interests.

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Competing interests

The authors declare that they have no competing interests.

Authors’ contributions

BR designed the study. HTS and BR coordinated the research. BR and HS conceived the analyses. HS and HTS drafted the manuscript. HTS and HS analyzed the data. BR, HTS and HS interpreted the data. LK and PG made substantial contributions to the design of the work. LK, LJD, JK, NCL, and PG revised the manuscript substantially. All authors read and approved the final manuscript.

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3 “I’m eating healthy now”: The relationship between perceived behavior change and diet

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Chapter 3: “I’m eating healthy now”

3.1 Abstract

Novel approaches on dietary change encourage small behavioral shifts rather than focusing on the often considerable gap between healthy eating norms and actual behavior. However, whether such small changes are noticed by individuals has rarely been studied to date. Therefore, the present research examined the relationship between felt and actual changes in healthy food intake. Food choice was assessed in two longitudinal studies (Study 1: N = 743; Study 2: N = 489) using a validated food frequency questionnaire. For assessing perceived healthy eating shifts, participants stated at a second measurement-point whether they had changed their eating pattern in the previous six months. Accordingly, participants were classified into four ‘Perceived Change’ groups: Changers, Attempters, Non-Attempters, and Healthy Eaters. In Study 1, participants who claimed they had made a healthy shift in their eating behavior (Changers) shifted from a regular to an optimal dietary pattern. Furthermore, Changers reduced their intake of five food categories: chocolate, cakes/pastries/biscuits, sausages/ham, meat, and eggs. No systematic changes were observed in the remaining groups. These results were replicated in Study 2. Participants perceived a change in their diet only if they had achieved a comprehensive healthy shift in their dietary pattern. Moreover, Changers in both studies exhibited a significant decrease in their BMI. These findings suggest that it is important for public health policies to emphasize that every food choice is an opportunity to move toward a healthy eating pattern. Small and incremental dietary changes make a difference even though they might fly under the radar.

Keywords: Nutrition, Diet, Healthy Eating, Behavior Change, Health Behavior, Food Choice, BMI
3.2 Introduction

Unhealthy eating represents a modifiable risk behavior for non-communicable diseases such as coronary heart disease, stroke, heart failure, and cancer (Bechthold et al., 2019; Key et al., 2002; Lavie et al., 2009). Cena and Calder (2020) recently summarized epidemiological studies and in line with other work concluded that adhering to a healthy diet reduces the risk of non-communicable diseases. Indeed, a healthy diet has been recognized worldwide as an important topic and food-based dietary guidelines have been published in 90 countries (Herforth et al., 2019), encouraging the consumption of vegetables and fruits while limiting sugar, fat, and salt intake.

There is evidence that the public is very well aware of such dietary guidelines. For instance, Bucher, Müller, and Siegrist (2015) asked participants to indicate how healthy they think various food items and meals were. It turned out that the perceived healthiness of food items was closely aligned with their actual nutrient profiles. Nonetheless, there seems to be a gap between this knowledge and the actual eating behavior. In many countries, individuals consume less than the ideal amounts of certain nutrients. For instance, in the European Union, only 62 % of women and 49 % of men report to consume fruits daily. Consumption of vegetables is even lower with only 56 % of women and 44 % of men reporting to daily eat vegetables (Robert Koch Institut, 2017). Noteworthy, low adherence to dietary recommendations does not seem to reflect a lack of motivation or effort; a recent meta-analysis estimates that 42 % of adults indicated that they tried to lose weight in the past year (Santos et al., 2017).

Considering the current diet of many people, recommendations provided by dietary guidelines such as eating four to five portions of vegetables and fruits daily represent a rather challenging behavior change goal. The discrepancy between the status quo and the desired outcome has been addressed by self-regulation approaches to goal setting and goal striving (Gollwitzer & Oettingen, 2012, 2019). For goal setting it is important that people contrast their
desired outcomes with the obstacles standing in the way (Oettingen, 2012, 2014). For goal striving it is important that people plan out when, where, and how they want to act in order to reach their goals (Gollwitzer, 1990, 2012; Gollwitzer & Sheeran, 2006; Schwarzer, 2008). However, when the desired behavior is not a one-time action but requires developing new habits in order to reach long-term goals and lasting behavior change, accumulating smaller behavioral steps becomes an important strategy (e.g., ‘baby steps’; Fogg, 2020, 2009a, 2009b). Indeed, Hills et al. (2013) emphasize the value of small and incremental changes in diet and physical activity for weight management. Similarly, the current Dietary Guidelines for Americans, produced by the U.S. Department of Health and Human Services (HHS) and U.S. Department of Agriculture recommend making small shifts in one’s daily eating habits to improve one’s health in the long run (U.S. Department of Health & Human Services (HHS), 2020).

The notion that small but meaningful behavior change efforts (‘small shifts’ or ‘baby steps’) are relevant to eventually change one’s behavior raises the question of when people feel that they have changed their behavior. In past research, dietary change has been primarily examined with a focus on the accuracy of the reported diet rather than whether participants themselves noticed a behavior change. While studies report that consumers on average tend to perceive the quality of their own diet to be better than the actual calculated diet quality (e.g. Bech-Larsen & Kazbare, 2014; O’Brien et al., 2000; Variyam et al., 2001) or the diet quality of their peers (Sproesser, Kohlbrenner, et al., 2015), perceptions of change in food intake have hardly been researched so far. An exception is a study by Arnold et al. (1996) in which the authors observed a stronger decrease in fat intake after 18 months among patients with diabetes who reported a change in their eating habits when compared to patients who did not report such a change. Moreover, Lake et al. (2004b) examined how participants perceived their own dietary change by surveying respondents twice, in their early teens and again 20 years later. The results showed an association between actual and felt change in food intake. Compared to individuals who perceived their current diet to be less healthy than 20 years ago, those who perceived it to
be healthier than in the past exhibited larger increases in their fruit and vegetables intake as well as larger decreases in fat or sugar intake. However, a time period of 20 years for perceived behavior change is going far beyond the time period relevant for small behavioral shifts and typical behavior change interventions (see e.g. Adriaanse et al., 2011; Fjeldsoe et al., 2011). Thus, it is currently unknown whether minor changes in diet do suffice for individuals’ noticing a behavior change in healthy food intake. In a recent study, we have addressed this issue in the domain of physical activity (Szymczak et al., 2020). The surprising finding was that people only felt that they become more physically active when a substantial increase in vigorous physical activity had occurred. Thus, in the domain of physical activity, the findings reported by Szymczak et al. suggest that people do not take small increases (‘baby steps’) into account when they judge whether their physical activity has improved. It is currently not known yet whether these results translate to the domain of eating.

The main aim of the present set of two studies was to investigate the relationship of actual and perceived change in eating habits. Specifically, we focused on individuals who perceived their current diet as being healthier compared to six months ago (‘Changers’), assessing the changes in their food intake. We compared these participants to three control groups: (1) ‘Attempts’, that is, participants who indicated that they had intended to change but did not succeed, (2) ‘Non-Attempts’, that is, participants who reported that they did not try to change their eating behavior, and (3) ‘Healthy Eaters’, that is, participants who indicated that they were already eating a healthy diet. To examine what degree of change participants perceive as a meaningful change, we considered both the overall quality of the food intake pattern (i.e., unfavorable, regular, optimal) and changes across several food categories. Our hypothesis was that people only notice a behavior change when they substantially and broadly change their intake pattern. Comparatively small and focused changes in their diet, that is, baby steps, should not be reflected in people’s judgements of behavior change, even though small changes are meaningful for reaching a healthy diet in the long run (Fogg, 2020; HHS, 2020;
Hills et al., 2013). Furthermore, we decided to conduct two studies in order to provide a direct replication of the main findings of the first study by collecting data with a second but similar sample and holding all the research methods and procedures constant (see National Science Foundation, 2018).

3.3 Materials and methods

3.3.1 Procedure and Participants of Studies 1 and 2

Data were collected as part of an ongoing longitudinal multiple-cohort study, the Konstanz Life-Study, launched in spring 2012 (König et al., 2018; Konstanzer Life Studie, 2019; Renner et al., 2012; Sproesser, Kohlbrenner, et al., 2015; Szymczak et al., 2020). The overall goal of the Konstanz Life-Study is to investigate influences on health behaviors, such as dietary behavior and physical activity across time. Measures include fasting blood samples, anthropometric measures, cognitive and physical fitness tests, as well as questionnaires. Eligible for participation in the Konstanz Life-Study were individuals aged 18 years and older from the general population without acute infectious diseases. For each time point of investigation, new participants were recruited via flyers, posters, and newspaper articles. Participants who took part in a preceding time point were re-invited via email. In the present analyses, we included three time points each half a year apart. For Study 1, participants who attended the Konstanz Life-Study in spring 2012 and autumn 2012 were examined. For Study 2, participants who took part in autumn 2012 and attended in spring 2013 were analyzed.

Ethics. For data processing and security, a register of processing operations was developed in cooperation with and approved by the Center for Data Protection of the Universities in Baden-Württemberg (ZENDAS) in 2012, and subsequently reviewed by the Commissioner for Data Protection in Baden-Württemberg. All participants gave written informed consent prior to participation. The study adhered to the guidelines of the German Psychological Society and the Declaration of Helsinki and was conducted in compliance with relevant laws and institutional guidelines. The study protocol was approved by the University of Konstanz ethics committee.
Chapter 3: “I’m eating healthy now”

Study 1. Out of 1,321 individuals who attended in spring 2012, 799 re-attended in autumn 2012 and therefore were eligible for analyses. Of these, 56 participants were excluded due to missing data on either dietary or perceived change measures. Thus, 743 participants (58% female) were included in the analyses for Study 1. Mean age was 46.4 years ($SD = 17.2$, range from 18 to 86). On average, participants had completed 15.8 years of education ($SD = 2.4$), and they had an average BMI of 25.0 kg/m² ($SD = 3.9$). Compared to the German population, the Study 1 sample was 2.1 years older, comprised 7% more females and had a slightly lower BMI by 1 kg/m² (Statistisches Bundesamt, 2017, 2018a, 2018b).

The eligible ($N = 743$) and non-eligible participants ($N = 578$) did not differ significantly regarding their BMI ($t(1305) = 1.15, p = .251$), or gender ($\chi^2(1) = .502, p = .478$) However, the non-eligible participants were significantly younger ($M = 40.6, SD = 17.8; t(1310) = 5.93, p < .001$) and reported slightly fewer years of education ($M = 15.3, SD = 2.5; t(1284) = 3.45, p < .001$).

Study 2. Out of the 883 individuals who attended in autumn 2012, 587 re-attended in spring 2013 and were thus eligible for analysis. Of these, 98 participants had to be excluded due to missing data. The remaining 489 participants (56% female) were on average 48.7 years old ($SD = 16.7$, ranging from 20 to 87), had an average BMI of 24.8 kg/m² ($SD = 3.8$), and had accumulated 15.8 ($SD = 2.5$) years of education. Compared to the German population, the study sample was 4.4 years older, consisted of 5% more women, and had a slightly lower BMI by 1.2 kg/m² (Statistisches Bundesamt, 2017, 2018b, 2018a).

Comparing eligible ($N = 489$) and non-eligible participants ($N = 394$) revealed no significant differences regarding BMI ($t(868) = 0.10, p = .921$), years of education ($t(826) = 0.982, p = .326$), age ($t(868) = 1.27, p = .205$), or gender ($\chi^2(1) = 2.47, p = .116$).

3.3.2 Measures

Actual food intake. At each assessment, actual food intake was assessed via a validated food frequency questionnaire (FFQ) sampling 24 food categories (e.g., vegetables, fruits,
chocolate, cake, meat, salty snacks; Winkler & Döring, 1995, 1998; see also Sproesser et al., 2015; Sproesser, Strohbach, Schupp, & Renner, 2011). Participants indicated how often on average they eat certain food items, ranging from 1 (almost daily) to 6 (never). A food frequency index (FFI) was computed by aggregating 15 food categories (see Table 3.1) reflecting dietary quality with a possible range from 0 to 30. In line with the recommendations of the German Nutritional Society and the norms for German samples on the basis of the WHO MONICA Augsburg Dietary Survey (Winkler et al., 1991; Winkler & Döring, 1995, 1998) (Winkler et al., 1991; Winkler & Döring, 1995), scores below 14 imply an ‘unfavorable’ dietary pattern, scores of 14 and 15 a ‘regular’ dietary pattern, and scores above 15 an ‘optimal’ dietary pattern (see also Sproesser et al., 2011; Sproesser, Kohlbrenner, et al., 2015).

**Perceived change in eating habits.** To assess perceived change, participants were asked the following question at the respective second time point of Studies 1 and 2: “Since your last participation in the Konstanz Life-Study, are you eating more healthily and balanced than before?” Participants were asked to choose the one statement they would agree with the most regarding their eating behavior and were classified accordingly: [1] Changers (“Yes, I eat more healthily and balanced now”), [2] Attempters (“No, but I tried to eat more healthily and balanced”), [3] Non-Attempters (“No, and I have not (even) tried”), [4] Healthy Eaters (“No, because I already ate healthily and balanced on a regular basis before”). Each answer represents a different stage of intention and behavior (cf. Klusmann et al., 2016; Szymczak et al., 2020).

**BMI.** Height and weight of the participants were measured by trained research staff following standardized procedures. Participants wore light indoor clothing and were asked to take off their shoes. Height was measured using a wall-mounted stadiometer. Weight was measured using a digital scale (Omron Body Composition Monitor, BF511). Measures were taken to the nearest 0.001 m and the nearest 0.1 kg, respectively (see e.g. Gamp et al., 2018; Sproesser, Kohlbrenner, et al., 2015). BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²).
3.3.3 Analytical Procedure

Data were analyzed using SPSS Statistics 25.0. For FFI and BMI, a mixed 4 between (Perceived Change: Changers vs. Attempters vs. Non-Attempters vs. Healthy Eaters) × 2 within (Time: 1st vs. 2nd measurement) ANOVA was conducted.

For analysis of food groups, a mixed 4 between (Perceived Change) × 2 within (Time) × 15 within (Food Groups) ANOVA was conducted. To follow up on the three-way interaction effect, repeated measures ANOVAs with Time and Food Groups factors were conducted separately for each of the four perceived change groups. Significant interactions were followed up by the calculation of simple effects. To replicate findings, analyses were performed analogously for Study 2.

When appropriate, the Greenhouse-Geisser procedure was used to correct for violations of sphericity, and the Benjamini-Hochberg procedure (BH, Benjamini & Hochberg, 1995) was applied to correct for multiple testing.

3.4 Results

3.4.1 Dietary Change

The first set of analyses focused on overall food intake as indicated by the food frequency index (FFI). We expected that only Changers would report a significant change in their food intake pattern. Figure 3.1 displays the mean FFI for the different groups, times, and studies.

**Study 1.** The significant main effect of Perceived Change ($F(3, 739) = 28.30, p < .001, \eta^2_p = .10$) was qualified by a significant interaction of Perceived Change and Time ($F(3, 739) = 4.70, p < .01, \eta^2_p = .02$). Simple effect analysis revealed that Changers increased their dietary quality ($F(1, 739) = 12.71, p < .001, \eta^2_p = .02$). In contrast, no change in dietary intake occurred in the other three groups, that is, Attempters ($F(1, 739) = 1.76, p = .185$), Non-Attempters ($F(1, 739) = 0.23, p = .634$), and Healthy Eaters ($F(1, 739) = 0.06, p = .814$).
**Study 2.** Again, a significant main effect of Perceived Change emerged \((F(3, 485) = 27.64, p < .001, \eta_p^2 = .15)\), which was qualified by a significant interaction of Perceived Change and Time \((F(3, 485) = 4.55, p < .01, \eta_p^2 = .03)\). Simple effects analysis showed that Changers exhibited a positive change in their food intake pattern \((F(1, 485) = 8.73, p < .01, \eta_p^2 = .02)\). Attempters and Healthy Eaters did not show a significant change in diet quality \((F(1, 485) = 0.58, p = .448; F(1, 485) = 0.01, p = .926)\). Non-Attempters showed a decrease in dietary quality \((F(1, 485) = 4.39, p < .05, \eta_p^2 = .01)\); this \(p\)-value exceeded the \(\alpha\)-level of .017 that was predetermined to correct for multiple comparisons.

*Figure 3.1.* Change in FFI Score: Mean Food Frequency Index (FFI) as a function of Perceived Change, Time, and Study. Error bars represent standard errors. Significant changes from Time 1 (black) to Time 2 (white) are marked with an asterisk (**: \(p < .05\); ***: \(p < .01\); ***: \(p < .001\)). The horizontal lines represent cut-off values for dietary quality: Scores below 14 signify an ‘unfavorable’ food intake pattern, scores of 14 and 15 a ‘regular’ dietary pattern, and scores above 15 an ‘optimal’ dietary pattern.
3.4.2 BMI Change

To validate the findings for eating behavior change based on the FFI with an objective indicator, changes in BMI were analyzed.

**Study 1.** Significant main effects for Perceived Change \((F(3, 764) = 10.78, p < .001, \eta_p^2 = .04)\) and Time \((F(1, 764) = 37.45, p < .001, \eta_p^2 = .05)\) were qualified by a significant interaction of Perceived Change and Time \((F(3, 764) = 11.93, p < .001, \eta_p^2 = .05)\). Simple effect analyses showed that Changers \((F(1, 764) = 63.98, p < .001, \eta_p^2 = .08)\) decreased their BMI from first to second assessment \((M = 25.6, SD = 4.2\) to \(M = 25.1, SD = 4.0\)). No change in BMI was observed in Attempters and Non-Attempters \((F(1, 746) = 2.61, p = .107, M = 26.0, SD = 4.5\) to \(M = 25.9, SD = 4.5\); and \(F(1, 764) = 0.04, p = .836, M = 24.4, SD = 3.2\) to \(M = 24.4, SD = 3.3\); for Attempters and Non-Attempters, respectively). Furthermore, like Changers, Healthy Eaters \((F(1, 764) = 8.45, p < .01, \eta_p^2 = .01)\) also decreased their BMI from first to second assessment significantly, \(M = 24.2, SD = 3.4\) to \(M = 24.0, SD = 3.4\).

**Study 2.** The significant main effect for Perceived Change \((F(3, 540) = 4.42, p < .01, \eta_p^2 = .02)\) was qualified by a significant interaction of Perceived Change and Time \((F(3, 540) = 4.17, p < .01, \eta_p^2 = .02)\). Simple effect analyses revealed that Changers decreased their BMI \((F(1, 540) = 6.27, p < .05, \eta_p^2 = .01)\); from \(M = 25.6, SD = 3.9\) to \(M = 25.4, SD = 3.7\); however, the \(p\)-value exceeded the pre-determined \(\alpha\)-level of .013. No change in BMI was observed in Attempters and Non-Attempters \((F(1, 540) = 1.30, p = .255, M = 25.3, SD = 4.2\) to \(M = 25.4, SD = 4.3\); and \(F(1, 540) = 1.32, p = .250, M = 24.3, SD = 3.5\) to \(M = 24.4, SD = 3.4\); for Attempters and Non-Attempters, respectively). In contrast to Study 1, Healthy Eaters increased their BMI slightly \((F(1, 540) = 5.27, p < .05, \eta_p^2 = .01)\); from \(M = 24.2, SD = 3.4\) to \(M = 24.3, SD = 3.5\); however, the \(p\)-value exceeded the pre-determined \(\alpha\)-level of .017.

3.4.3 Food Category Intake Change

The second aim of our study was to investigate the change in actual food intake for individual food categories as a function of perceived change.
Study 1. Table 3.1 displays the mean consumption frequency of food categories. A significant three-way interaction was found for Perceived Change × Food Category × Time ($F(3, 35.9) = 2.37, p < .001, \eta_p^2 = .01$). Thus, follow-up analyses were conducted for each of the four groups separately.

For Changers, the Food Category by Time interaction was significant ($F(1, 10.2) = 4.94, p < .001, \eta_p^2 = .03$). Results of subsequent simple effect analysis showed a significant decrease in consumption for the following food categories: (1) chocolate, chocolates $t(141) = -4.65, p < .001$, (2) sausages/ham, $t(141) = -4.10, p < .001$, (3) cakes, pastries, biscuits, $t(141) = -3.85, p < .001$, (4) meat (without sausages), $t(141) = -2.72, p < .01$, and (5) eggs, $t(141) = -2.44, p < .05$. Furthermore, intake of salted snacks (salted peanuts, crisps, and others) was also reduced ($t(141) = -2.17, p < .05$) but the $p$-value exceeded the pre-determined $\alpha$-level of .02.

The group of Attempters also showed a significant interaction of Food Category by Time ($F(1, 11.2) = 2.31, p < .01, \eta_p^2 = .01$). While consumption of (1) eggs, $t(214) = -2.45, p < .05$, and (2) sausages/ham, $t(214) = -2.84, p < .01$, tended to decrease; both $p$-values exceeded the respective $\alpha$-levels ($p = .003$ and $p = .007$, respectively), pre-determined to correct for multiple comparisons.

For Healthy Eaters, the significant Food Category by Time interaction ($F(1, 11.6) = 1.83, p < .05, \eta_p^2 = .01$) was associated with a decreased consumption of (1) chocolate, chocolates $t(285) = -3.83, p < .001$, (2) eggs, $t(285) = -2.28, p < .05$, and (3) sausages/ham, $t(285) = -2.02, p < .05$. When correcting for multiple testing, only the effect for chocolate remained significant.

No significant interaction was observed for Non-Attempters, $F(1, 11.3) = 0.68, p = .761, \eta_p^2 = .01$.

Study 2. A significant three-way interaction was found for Perceived Change × Food Category × Time, $F(3, 35.6) = 1.66, p < .01, \eta_p^2 = .01$. Again, the interaction was followed-up by separate analyses for each group.
For Changers, a significant Food Category by Time interaction emerged, $F(1, 11.1) = 3.34, p < .001, \eta_p^2 = .03$. Simple effect analysis indicated a decrease in consumption for (1) chocolate, chocolates ($t(103) = -2.81, p < .01$), (2) salted snacks ($t(141) = -2.49, p < .05$), and (3) sausages/ham ($t(103) = -1.99, p < .05$). In addition, Study 2 indicated an increased consumption of (4) fish ($t(103) = 2.45, p < .05$), and (5) rice ($t(103) = 2.40, p < .05$). However, none of these effects remained significant when correcting for multiple testing (see Table 3.2, Supplement).

For Attempters, there was a significant interaction of Food Category by Time ($F(1, 11.3) = 1.8, p < .05, \eta_p^2 = .01$) indicating the decreased consumption of (1) cooked vegetables ($t(133) = -2.54, p < .01$), and an increase in consumption for (2) eggs ($t(133) = 2.01, p < .05$). However, none of these effects remained significant after correcting for multiple testing.

There were no significant Food Category by Time interactions for Non-Attempters ($F(1, 9.4) = 1.18, p = .306, \eta_p^2 = .02$) and Healthy Eaters, $F(1, 10.7) = 0.54, p = .871, \eta_p^2 = .00$. 

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Table 3.1

Study 1: Changes within food categories as a function of Perceived Change between Baseline (B; spring 2012) and Follow-Up (F; autumn 2012)

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Changers B</th>
<th>Changers F</th>
<th>Attempters B</th>
<th>Attempters F</th>
<th>Non-Attempters B</th>
<th>Non-Attempters F</th>
<th>Healthy Eaters B</th>
<th>Healthy Eaters F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Meat (without sausages)</td>
<td>3.0 (1.3)</td>
<td>3.2 (1.3)</td>
<td>2.8 (1.2)</td>
<td>2.9 (1.2)</td>
<td>2.5 (1.1)</td>
<td>2.5 (1.1)</td>
<td>3.1 (1.4)</td>
<td>3.2 (1.4)</td>
</tr>
<tr>
<td>Sausages / Ham</td>
<td>3.0 (1.5)</td>
<td>3.3 (1.6)</td>
<td>2.7 (1.4)</td>
<td>2.9 (1.4)</td>
<td>2.4 (1.3)</td>
<td>2.4 (1.3)</td>
<td>3.2 (1.6)</td>
<td>3.3 (1.5)</td>
</tr>
<tr>
<td>Fish</td>
<td>3.8 (1.0)</td>
<td>3.8 (1.1)</td>
<td>4.0 (1.1)</td>
<td>4.0 (1.1)</td>
<td>4.0 (1.1)</td>
<td>4.1 (1.1)</td>
<td>3.7 (1.1)</td>
<td>3.7 (1.1)</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3.0 (1.2)</td>
<td>3.1 (1.1)</td>
<td>3.1 (1.1)</td>
<td>3.2 (1.1)</td>
<td>3.0 (1.1)</td>
<td>3.2 (1.1)</td>
<td>3.0 (1.1)</td>
<td>2.9 (1.1)</td>
</tr>
<tr>
<td>Pasta</td>
<td>2.6 (1.0)</td>
<td>2.8 (1.2)</td>
<td>2.7 (1.2)</td>
<td>2.6 (1.2)</td>
<td>2.3 (1.1)</td>
<td>2.3 (1.1)</td>
<td>2.7 (1.1)</td>
<td>2.7 (1.1)</td>
</tr>
<tr>
<td>Rice</td>
<td>3.3 (1.1)</td>
<td>3.3 (1.1)</td>
<td>3.4 (1.1)</td>
<td>3.5 (1.1)</td>
<td>3.3 (1.1)</td>
<td>3.3 (1.1)</td>
<td>3.2 (1.1)</td>
<td>3.3 (1.1)</td>
</tr>
<tr>
<td>Salad or vegetable, raw</td>
<td>1.9 (0.8)</td>
<td>1.8 (0.8)</td>
<td>2.1 (1.1)</td>
<td>2.1 (1.1)</td>
<td>2.1 (1.1)</td>
<td>2.1 (1.1)</td>
<td>1.6 (0.8)</td>
<td>1.7 (0.7)</td>
</tr>
<tr>
<td>Vegetable, cooked</td>
<td>2.1 (0.9)</td>
<td>2.0 (1.0)</td>
<td>2.3 (1.1)</td>
<td>2.2 (1.1)</td>
<td>2.4 (0.9)</td>
<td>2.3 (0.9)</td>
<td>1.9 (0.9)</td>
<td>1.9 (0.8)</td>
</tr>
<tr>
<td>Fresh fruit</td>
<td>1.6 (0.9)</td>
<td>1.6 (0.9)</td>
<td>1.8 (1.1)</td>
<td>1.9 (1.1)</td>
<td>2.0 (1.0)</td>
<td>2.2 (1.0)</td>
<td>1.4 (0.7)</td>
<td>1.4 (0.7)</td>
</tr>
<tr>
<td>Chocolate, chocolates</td>
<td>3.0 (1.4)</td>
<td>3.3 (1.4)</td>
<td>2.7 (1.3)</td>
<td>2.7 (1.3)</td>
<td>2.7 (1.3)</td>
<td>2.8 (1.3)</td>
<td>2.9 (1.4)</td>
<td>3.1 (1.4)</td>
</tr>
<tr>
<td>Cakes, pastries, biscuits</td>
<td>3.0 (1.2)</td>
<td>3.4 (1.2)</td>
<td>3.0 (1.2)</td>
<td>2.9 (1.2)</td>
<td>3.0 (1.2)</td>
<td>2.9 (1.2)</td>
<td>3.0 (1.2)</td>
<td>3.1 (1.2)</td>
</tr>
<tr>
<td>Salted snacks</td>
<td>4.2 (1.2)</td>
<td>4.4 (1.2)</td>
<td>4.0 (1.2)</td>
<td>4.0 (1.2)</td>
<td>4.0 (1.2)</td>
<td>4.0 (1.2)</td>
<td>4.3 (1.2)</td>
<td>4.4 (1.2)</td>
</tr>
<tr>
<td>Whole grain bread, black bread</td>
<td>2.0 (1.2)</td>
<td>2.1 (1.2)</td>
<td>2.2 (1.2)</td>
<td>2.3 (1.2)</td>
<td>2.3 (1.2)</td>
<td>2.3 (1.2)</td>
<td>2.1 (1.2)</td>
<td>2.2 (1.2)</td>
</tr>
<tr>
<td>Flaked oats, muesli, cornfl.</td>
<td>3.1 (1.7)</td>
<td>2.9 (1.7)</td>
<td>3.2 (1.8)</td>
<td>3.0 (1.7)</td>
<td>3.3 (1.7)</td>
<td>3.3 (1.7)</td>
<td>2.7 (1.7)</td>
<td>2.8 (1.7)</td>
</tr>
<tr>
<td>Eggs</td>
<td>2.9 (1.1)</td>
<td>3.1 (1.1)</td>
<td>2.9 (1.1)</td>
<td>3.0 (1.1)</td>
<td>3.0 (1.1)</td>
<td>3.1 (1.1)</td>
<td>3.0 (1.1)</td>
<td>3.1 (1.1)</td>
</tr>
</tbody>
</table>

Note. Scale from 1 (almost daily) to 6 (never); *** p < .001, ** p < .01, * p < .05 (corrected for multiple testing).
3.4.4 Control Analyses

**Gender.** Control analyses were conducted to determine whether the effects varied as a function of gender. Accordingly, gender was added to the mixed 4 between (Perceived Change) × 2 within (Time) ANOVA as an additional between-subjects factor.

For the FFI, no higher-order interactions were found in Studies 1 and 2 (Study 1: $F(3, 735) = 1.80, p = .146$; Study 2: $F(3, 481) = 0.84, p = .474$). As expected (Courtenay et al., 2002; Fagerli & Wandel, 1999; Wardle et al., 2004), a main effect for gender was found for diet quality in both studies (Study 1: $F(1, 735) = 7.95, p < .01, \eta^2_p = .01$; Study 2: $F(1, 481) = 4.38, p < .05, \eta^2_p = .01$). Overall, women (Study 1: $M = 15.6, SD = 3.3$; Study 2: $M = 15.7, SD = 3.4$) reported a healthier diet than men (Study 1: $M = 14.6, SD = 3.5$; Study 2: $M = 14.8, SD = 3.6$, respectively).

For BMI, no significant three-way interaction effect was observed in either of the two studies (Study 1: $F(3, 760) = 0.46, p = .711$; Study 2: $F(3, 536) = 0.83, p = .479$). However, in both studies a significant main effect of gender (Study 1: $F(1, 760) = 15.67, p < .001, \eta^2_p = .02$; Study 2: $F(1, 536) = 24.25, p < .001, \eta^2_p = .04$) was observed, indicating that women (Study 1: $M = 24.3, SD = 4.1$; Study 2: $M = 24.1, SD = 3.9$) had a lower BMI than men (Study 1: $M = 25.7, SD = 3.6$; Study 2: $M = 25.7, SD = 3.5$, respectively).

**Physical activity change.** Health behavior change in one domain might facilitate changes in other domains (“carry-over effects”, “spill-over hypothesis”; see e.g., Dohle & Hofmann, 2019; Fleig et al., 2014; Joo et al., 2019). Thus, decrease in BMI observed for Changers in Studies 1 and 2 and Healthy Eaters in Study 1 might also be a result of a concurrent change in physical activity. Physical activity was assessed using an adapted version of the short form of the International Physical Activity Questionnaire (Craig et al., 2003, The IPAQ Group, 2005) and the level of physical activity calculated as MET-hours per week of moderate-to-vigorous physical activity. A mixed 4 between (Perceived Change) × 2 within (Time) ANCOVA with physical activity change as covariate was conducted to ensure that the decrease
in BMI was not based on an increase in physical activity. This analysis revealed a significant interaction for Perceived Change by Time (Study 1: $F(3, 728) = 11.50, p < .001, \eta_p^2 = .05$; Study 2: $F(3, 476) = 4.47, p < .01, \eta_p^2 = .03$), even when controlling for physical activity.

### 3.5 Discussion

The presented studies examined the relationship between the actual change in eating behavior and how individuals perceive this change. Three main findings emerged: First, participants who feel that their diet has become healthier over the last six months (Changers) did show an actual improvement in their food intake pattern. This perceived change is justified in that participants’ average dietary pattern improved from ‘regular’ to ‘optimal’, as well as involved changes in food categories targeted by dietary guidelines and recommendations, that is, reducing the intake of sugary sweets and fatty meats. Second, consistent with the notion of small shifts and baby steps, Changers were already very close to the upper bound of a regular dietary pattern at baseline; they only had to enact modest changes in their diet to achieve a noteworthy improvement, moving from a regular to an optimal dietary pattern. In contrast, the gap between the actual and the optimal dietary pattern at baseline was much larger for Attempters compared to Changers. Thus, perceiving the need for substantial changes in one’s diet might actually contribute to failing attempts to improve diet quality. Third, consistent with their reported changes in eating behavior, changers successfully decreased their average BMI. Taken together, these findings provide evidence for the importance of small and incremental changes in eating behavior.

A main goal of the present study was to determine whether people already perceive small upward shifts in diet quality as meaningful behavior change; or, alternatively, whether they need to experience large shifts in eating behaviors to perceive a change. Focusing primarily on the classification of the diet, one may argue that Changers actually accomplished a rather substantial change, improving from a regular to an optimal dietary pattern. Indeed, Changers reached a similar level as compared to people perceiving themselves to be healthy eaters,
suggesting a shared norm of what constitutes healthy eating presumably informed by dietary recommendations. From a public health perspective, sustaining an optimal dietary pattern eventually should reduce the risk of non-communicable diseases for Changers.

Considering behavior change at the level of food categories provides a complementary perspective on the issue of small versus comprehensive behavior shifts. Participants in Study 1 significantly decreased their consumption of chocolate, sausages/ham, cakes/pastries/biscuits, meat, and eggs; the intake of salted snacks approached significance. Noteworthy, limiting food intake in these food categories aligns with dietary recommendations provided by professional organizations in Germany. Thus, changing food intake in five food categories that are key to a healthy diet is presumed to be a rather comprehensive shift in behavior. However, it must be noted that these findings were only partially replicated in Study 2, possibly reflecting reduced statistical power because of the smaller sample size. Furthermore, relying on self-reported food intake via a food frequency questionnaire may have limited the present research in its capability of precisely capturing the individual amount of change in eating behavior. In future research, mobile technologies should be used as they have the potential of improving the accuracy of assessment of eating behavior by, for instance, allowing individuals to take images of eating events. Various mobile applications based on sophisticated technology have been developed in recent years (e.g., TADA, My Meal Mate, PANDA, SMARTFOOD; for an overview see Boushey et al., 2017; Eldridge et al., 2019). These apps are increasingly used for assessing and changing eating behavior in different populations, including generally healthy adolescents and adults as well as patients (Boushey et al., 2015; Villinger et al., 2019), showing high adherence and low missing event rates (Ziesemer et al., 2020). Overall, we suggest that future studies should rely on such improved assessments of eating behavior thus rendering more objective data allowing to study more precisely how behavior change relates to people’s perceptions of success or failure.
There were major differences between the four groups at baseline with respect to the healthiness of their food intake patterns. While the food intake pattern of participants who perceived their diet as healthy (Healthy Eaters) was indeed classified as ‘optimal’, participants who did not attempt to change their diet (Non-Attempters) exhibited an ‘unfavorable’ pattern. Furthermore, both participants who felt that they have changed (Changers) and participants who felt that their attempts to change had failed (Attempters) fell in the ‘regular’ diet category, with the critical difference that Changers had a substantially higher score that already approached the ‘optimal’ level. These differences in food intake patterns may have profound psychological consequences for perceiving the need to change one’s eating habits and the experience of respective success or failure. Control theory (Carver & Scheier, 1998), goal setting theory (Locke & Latham, 2013), and the theory of planned behavior (Ajzen, 1991) share the assumption that the discrepancy between aspired-to goals and actual behavior is critical for taking action. If this gap is perceived as insurmountable, however, people may not even try to improve their diet (Non-Attempters).

The present findings indicate that goal commitment not only depends on a high desirability of the aspired-to goal but also on its feasibility. Thus, compared to Changers, Attempters face a larger discrepancy between the goal and the actual status, what may put too heavy a burden on the self-regulation needed to strive for their goals (e.g. Avishai et al., 2019; Chang, Webb, Benn, et al., 2017; Gollwitzer & Oettingen, 2012, 2019; Thürmer et al., 2017). For Changers in contrast, the comparatively smaller discrepancy might have been the key to success. This interpretation highlights once again the importance of emphasizing small and cumulative changes in health behaviors rather than focusing on challenging endpoints only, which may appear too demanding for most individuals.

A related study on physical activity observed that people only felt that they have changed their physical activity behavior when there was a substantial increase in vigorous physical activity (Szymczak et al., 2020). While the present findings on eating behavior
corroborate these findings regarding physical activity in many respects, there are also differences between these two domains of behavior. Most notably, while Szymczak et al. (2020) found Changers, Attempters, and Non-Attempters had approximately similar levels of physical activity at baseline, these groups in the present studies differed considerably in the healthiness of their eating behavior. One may speculate on the reasons for this difference between domains.

Both physical activity and a healthy diet have been the focus of public health campaigns and received similar attention in the media. Thus, it is likely that the public is well-informed about the need to improve these health behaviors and the relevant appropriate actions. However, health domains may differ with respect to the social embeddedness of the critical behaviors, the expected ratio of the positive consequences to the invested effort and time, or the painfulness of previous attempts to change these behaviors, to name only a few likely candidates. While differences between domains are important and need to be further investigated, the notion to highlight small and cumulative changes seems valid across various health domains.

Emphasizing the importance of small baby steps for achieving changes toward the attainment of long-term goals (endpoints emphasized in current physical activity and dietary guidelines and recommendations) seems instrumental for Changers reaching their goal, turning Attempters into Changers, and motivating Non-Attempters to become Attempters.
3.6 Declarations

Authors' contributions
BR and HTS designed the study and coordinated data collection with contribution from GS. LK and PG made substantial contributions to the design of the work. BR and HS conceived the analyses. HS and HTS analyzed the data and drafted the manuscript. HTS, HS, and BR interpreted the data. BR, LK, LJD, JK, NCL, GS, and PG revised the manuscript substantially. All authors read and approved the final manuscript.

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Declaration of interests
None.
### 3.7 Supplement

**Table 3.2**

*Study 2: Changes within food categories as a function of Perceived Change between Baseline (B: autumn 2012) and Follow-Up (F: spring 2013)*

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Changers</th>
<th></th>
<th>Attemplers</th>
<th></th>
<th>Non-Attemplers</th>
<th></th>
<th>Healthy Eaters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SD)</td>
<td>F (SD)</td>
<td>B (SD)</td>
<td>F (SD)</td>
<td>B (SD)</td>
<td>F (SD)</td>
<td>B (SD)</td>
<td>F (SD)</td>
</tr>
<tr>
<td>Meat (without sausages)</td>
<td>3.1 (1.3)</td>
<td>3.0 (1.3)</td>
<td>3.0 (1.1)</td>
<td>2.9 (1.1)</td>
<td>2.4 (1.1)</td>
<td>2.6 (1.2)</td>
<td>3.1 (1.3)</td>
<td>3.1 (1.3)</td>
</tr>
<tr>
<td>Sausages / Ham</td>
<td>3.1 (1.5)</td>
<td>3.3 (1.5)</td>
<td>2.9 (1.4)</td>
<td>2.9 (1.4)</td>
<td>2.4 (1.3)</td>
<td>2.5 (1.3)</td>
<td>3.2 (1.6)</td>
<td>3.2 (1.5)</td>
</tr>
<tr>
<td>Fish</td>
<td>3.9 (1.1)</td>
<td>3.7 (1.0)</td>
<td>3.9 (1.1)</td>
<td>3.8 (1.1)</td>
<td>4.0 (1.0)</td>
<td>4.0 (1.0)</td>
<td>3.7 (1.1)</td>
<td>3.6 (1.1)</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3.1 (1.1)</td>
<td>3.0 (1.1)</td>
<td>3.2 (1.0)</td>
<td>3.2 (1.0)</td>
<td>3.3 (1.0)</td>
<td>3.3 (1.0)</td>
<td>2.3 (1.1)</td>
<td>2.9 (1.1)</td>
</tr>
<tr>
<td>Pasta</td>
<td>2.6 (1.1)</td>
<td>2.8 (1.0)</td>
<td>2.6 (1.0)</td>
<td>2.7 (1.0)</td>
<td>2.3 (1.0)</td>
<td>2.5 (1.0)</td>
<td>2.8 (1.1)</td>
<td>2.8 (1.1)</td>
</tr>
<tr>
<td>Rice</td>
<td>3.3 (1.0)</td>
<td>3.1 (1.0)</td>
<td>3.5 (1.0)</td>
<td>3.4 (1.0)</td>
<td>3.3 (1.0)</td>
<td>3.4 (1.0)</td>
<td>3.4 (1.1)</td>
<td>3.2 (1.1)</td>
</tr>
<tr>
<td>Salad or vegetable, raw</td>
<td>1.8 (1.0)</td>
<td>1.9 (1.0)</td>
<td>2.0 (1.0)</td>
<td>2.1 (1.0)</td>
<td>2.2 (1.0)</td>
<td>2.3 (1.0)</td>
<td>1.6 (1.0)</td>
<td>1.7 (1.0)</td>
</tr>
<tr>
<td>Vegetable, cooked</td>
<td>2.1 (0.9)</td>
<td>1.9 (0.9)</td>
<td>2.2 (0.9)</td>
<td>2.4 (0.9)</td>
<td>2.3 (1.0)</td>
<td>2.3 (1.0)</td>
<td>1.9 (0.8)</td>
<td>1.8 (0.8)</td>
</tr>
<tr>
<td>Fresh fruit</td>
<td>1.5 (0.9)</td>
<td>1.4 (0.9)</td>
<td>1.9 (1.0)</td>
<td>1.8 (1.0)</td>
<td>2.2 (1.1)</td>
<td>2.3 (1.1)</td>
<td>1.3 (0.5)</td>
<td>1.3 (0.5)</td>
</tr>
<tr>
<td>Chocolate, chocolates</td>
<td>3.1 (1.5)</td>
<td>3.3 (1.4)</td>
<td>2.7 (1.3)</td>
<td>2.8 (1.3)</td>
<td>2.8 (1.4)</td>
<td>2.6 (1.4)</td>
<td>3.2 (1.3)</td>
<td>3.1 (1.3)</td>
</tr>
<tr>
<td>Cakes, pastries, biscuits</td>
<td>3.2 (1.3)</td>
<td>3.3 (1.2)</td>
<td>2.9 (1.2)</td>
<td>3.0 (1.2)</td>
<td>3.0 (1.1)</td>
<td>2.8 (1.1)</td>
<td>3.1 (1.2)</td>
<td>3.1 (1.2)</td>
</tr>
<tr>
<td>Salted snacks</td>
<td>4.2 (1.3)</td>
<td>4.4 (1.3)</td>
<td>4.1 (1.2)</td>
<td>4.2 (1.2)</td>
<td>3.8 (1.2)</td>
<td>3.8 (1.2)</td>
<td>4.5 (1.2)</td>
<td>4.5 (1.2)</td>
</tr>
<tr>
<td>Whole grain bread, black bread</td>
<td>2.0 (1.1)</td>
<td>2.1 (1.2)</td>
<td>2.2 (1.4)</td>
<td>2.2 (1.4)</td>
<td>2.8 (1.4)</td>
<td>2.8 (1.4)</td>
<td>2.2 (1.2)</td>
<td>2.1 (1.2)</td>
</tr>
<tr>
<td>Flaked oats, muesli, cornflakes</td>
<td>2.9 (1.7)</td>
<td>2.8 (1.7)</td>
<td>3.1 (1.8)</td>
<td>3.0 (1.8)</td>
<td>3.4 (1.7)</td>
<td>3.5 (1.7)</td>
<td>2.8 (1.7)</td>
<td>2.8 (1.7)</td>
</tr>
<tr>
<td>Eggs</td>
<td>3.1 (1.1)</td>
<td>3.1 (1.0)</td>
<td>3.0 (0.9)</td>
<td>2.9 (0.9)</td>
<td>3.1 (1.0)</td>
<td>2.9 (1.1)</td>
<td>3.2 (1.1)</td>
<td>3.1 (1.1)</td>
</tr>
</tbody>
</table>

*Note.* Scale from 1 (almost daily) to 6 (never); ***p < .001, **p < .01, *p < .05 (based on dependent t-tests for change from B to F, after correcting for multiple testing).
4 Trusting Facebook in crisis situations: The role of general use and general trust toward Facebook

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University of Greifswald

4.1 Abstract

An important concept that has been rather neglected in research on social media is the concept of trust. Although there is a considerable amount of research on online trust in general, little has been done in the area of social media. As a situation of risk is necessary for trust, the perceived trustworthiness of Facebook in crisis situations was examined in this study. A sample of 340 European Facebook users were questioned as part of a large European study about social media in the context of emergency situations. We found that participants’ general trust toward Facebook as a medium predicted to a significant degree how much they would trust Facebook in a crisis situation. General use of Facebook and dispositional trust were also significantly associated with trust toward Facebook in a crisis situation.
Chapter 4: Trusting Facebook in crisis situations

4.2 Introduction

During the last decade, the use of social media and social networking sites (SNSs) has increased immensely, not least the also rising availability of mobile Internet and smartphones has further facilitated this trend. Today, Facebook alone has more than 1 billion active users (Jin et al., 2013; Wells & Link, 2014).

People not only use social media as a tool for interpersonal relationship development and maintenance but also as a source of information for a diverse range of topics, such as travel information or general news (Luchman et al., 2014; Munar & Jacobsen, 2014). As they do offline, people naturally evaluate information they receive online to make judgments about its trustworthiness and consequently whether to act on it or not. However, trust processes in the online environment are somewhat different from trust offline. For instance, due to the unique characteristics of this environment, such as a lack of nonverbal cues, people tend to question online information more readily (Riegelsberger et al., 2007). The concept of “online trust” is used in research to address the special quality of trust when it is generated online (Beldad et al., 2010; Corritore et al., 2003).

Online trust can be understood as “an attitude of confident expectation in an online situation of risk that one’s vulnerabilities will not be exploited” (Beldad et al., 2010, p. 860). This definition captures the idea that trust in the online environment is different from offline trust. This is the case because the Internet introduces an additional layer of uncertainty, such as a lack of nonverbal cues in interactions or the risk of one’s personal data being misused (McKnight et al., 2002; Y. D. Wang & Emurian, 2005). Also, due to the open, public, participative, and often unregulated nature of social media (Kaplan & Haenlein, 2010; Kietzmann et al., 2011), information on social media may be false, intentionally misleading or outdated (Rains et al., 2015).

Although a large body of scientific findings has been generated on the construct of online trust (Corritore et al., 2003; D. J. Kim et al., 2008; Y. D. Wang & Emurian, 2005), to the best
of our knowledge, little research has yet been made to apply trust to social media. Moreover, most of online trust research has been done on e-commerce, whereas research on noncommercial contexts is lacking (Beldad et al., 2010; Riegelsberger et al., 2007). This study addresses both issues, as it investigates online trust on social media in a noncommercial context.

To conceptually develop a trust perspective toward social media, we follow Schultz et al., who found that the communication medium mattered more than the message (Schultz et al., 2011). They found the main effect of a medium (Twitter, blog, newspaper) on (a) reputation, (b) secondary crisis communication, and (c) reactions, whereas the manipulation of the message only effected secondary crisis communication significantly. McLuhan’s notion that “the medium is the message” refers to the phenomenon that both the medium and the message influence the perception and evaluation of information and that sometimes the medium is more powerful (McLuhan, 1967, 2006). In the present study, it was investigated whether this idea is applicable on the medium Facebook. Do people develop trust judgments toward this social media platform?

Inextricably linked to considerations about trust is the concept of risk. It is explicitly or implicitly contained in most definitions of trust (Das & Teng, 2004; Y. D. Wang & Emurian, 2005). Without uncertainty and the possibility of an unfavorable outcome, trust would not be necessary. In this research, the context of a crisis situation was used to create a sense of risk in a noncommercial context and make it therefore meaningful to ask about trust.

Social media and crisis situations

Online mobile communication and social media are not only an integral part of everyday life for most people but their use often extends beyond everyday matters, for instance, in crisis situations such as floods, hurricanes, terrorist attacks, and so on (Hiltz et al., 2012; Lindsay, 2011). Understandably, especially in situations of high risk, people have a high need for information to reduce uncertainty (Rains et al., 2015) and they often use social media as an
additional channel to acquire risk information (Procopio & Procopio, 2007; Shklovski et al., 2008).

For instance, Facebook is used for information exchange during disasters such as floods or hurricanes and as a means for social support after such incidents (Antoniou & Ciaramicol, 2013; Neubaum et al., 2014). Sutton et al. (2008) report how social media were used during the 2007 Southern California Wildfires to provide “backchannel” communication. They found that affected people used new media additionally to traditional media to gain and exchange information among each other. Also, during the “Norway Attacks” on July 22, 2011, many of the people on Utøya island used Twitter or Facebook to make contact with family and friends (Perng et al., 2013). Another example are earthquakes such as the Italian L’Aquila earthquake in 2009 or the Chilean Earthquake in 2010, in which social media such as Twitter or Facebook are used as an important source for relevant information (Casacchia et al., 2012; Mendoza et al., 2010).

In addition to the social media use among citizens during crisis situations, there is also evidence that people increasingly expect official responders to react to social media information and it is crucial that public safety organizations act on this expectation and incorporate social media in their official risk and crisis communication (Lindsay, 2011; Veil et al., 2011; Walter, 2009). It is therefore not only of academic interest to investigate trust processes in the context of crisis situations but also important for public safety organizations, public relations, as well as risk and crisis communication (Briones et al., 2011; Hallahan, 2008; Szymczak et al., 2015).

**Dispositional trust, general use of Facebook, and Facebook as a communication channel**

When it comes to risk and crisis communication, the reliability of the source, as well as the accuracy of the information, is crucial (Rains et al., 2015). However, as already argued, the channel of information distribution matters as well. McKnight et al. (2002) distinguish four “high-level constructs” of online trust, two of which are of relevance for this study, namely “disposition to trust” and “institution-based trust”. Institution-based trust refers to the medium
Internet and contains the following meaning: “Perceptions of the structural characteristics of the Internet, such as safety and security, can influence trusting beliefs and trusting intentions (...)” (McKnight et al., 2002, p. 334). Similarly, general trust toward Facebook refers to the medium of Facebook and its perceived characteristics as an object of trust.

Dispositional trust describes the individual propensity to trust other people (Y. D. Wang & Emurian, 2005). It is a personality characteristic and refers to the fact that “some people are just more trusting than others” (Beldad et al., 2010, p. 858). This proclivity to trust appears to be especially influential when little is known about the object of trust.

Another variable important for this research is the general use of Facebook. Research shows that use—and subsequently familiarity—and trust are linked (D. J. Kim et al., 2008; Wu et al., 2011). Therefore, we anticipated general use of Facebook being a reliable predictor for its perceived trustworthiness in a crisis situation.

To sum it up, the present article focuses on factors influencing the perceived trustworthiness of Facebook in a crisis situation. On the basis of the aforementioned considerations, three distinct and trust-related constructs were chosen as potential factors, namely dispositional trust, general use of Facebook, and trust in Facebook as a communication channel (i.e., general trust toward Facebook). Dispositional trust and general use of a certain medium have been shown in previous research to impact perceived online trust positively. For this research, the applicability of these findings was tested in the context of crisis situations. Furthermore, it is hypothesized that general trust toward Facebook exerts an effect independent of the aforementioned factors on the perceived trustworthiness of Facebook in a crisis situation.

**Research question:**

Which factors influence the perceived trustworthiness of Facebook in a crisis situation?

**H1:** General use of Facebook and dispositional trust predict trust toward Facebook in a crisis situation.
H2: General trust toward Facebook predicts trust toward Facebook in a crisis situation even when general use and dispositional trust are controlled for.

4.3 Methods

4.3.1 Sample and procedure

A cross-sectional online survey was conducted in the context of the iSAR+ project (Online and Mobile Communications for Crisis Response and Search and Rescue). This project is funded by the European Commission and aims to investigate the potential of social media in the context of emergencies. For the present study, only Facebook users were included. The answers of \( n = 340 \) participants were analysed (71 percent female; 142 United Kingdom, 118 Germany, 80 Ireland). The mean age was 34.5 years \((SD = 13.5)\).

4.3.2 Measures

Dispositional trust. Dispositional trust was assessed using a measure developed by Kim et al. who conceptualized this kind of trust identically to this study as a stable, personality-oriented characteristic (D. J. Kim et al., 2008). On a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree, participants indicated agreement with the following statements: (a) I generally trust other people, (b) I generally have faith in humanity, (c) I feel that people are generally reliable, and (d) I generally trust other people unless they give me reasons not to. The four items were then integrated into one global measure of individual disposition to trust by computing the sum score \((\text{Cronbach’s alpha} = 0.85, M = 13.9, SD = 3.3)\).

General trust toward Facebook. Trust toward Facebook in general was measured using three items adopted from the same study as dispositional trust (D. J. Kim et al., 2008). Items were adapted to address Facebook instead of a certain website. Items were as follows: (a) Facebook is trustworthy, (b) Facebook gives the impression that it keeps promises and commitments, and (c) I believe that Facebook has my best interests in mind. Participants rated their agreement with the statements on a five-point Likert scale from 1 = strongly disagree to 5
Trust toward Facebook in a crisis situation. Trust toward Facebook in a crisis situation was assessed on a five-point Likert scale (1 = not at all, 5 = very much) by a single-item measure: How much would you trust the following media in crisis situations? In the original survey, a list of various social media was presented after the question (e.g., Twitter, YouTube), including Facebook.

General use of Facebook. General use of Facebook was assessed by a single item: “How often do you use the following media?” After this question, the same list of social media was presented as for the previous measure of trust toward Facebook in a crisis. Answers ranged from 1 = not at all to 5 = very much on a five-point Likert scale, with $M = 4.35$ ($SD = 1.10$).

4.4 Results

In a first step, intercorrelations among the variables of interest were computed. Age was also considered, as it was included as a control variable into the regression model. Except for the three correlations between age and general use, age and dispositional trust, and general use and dispositional trust, all correlations were significant. Table 4.1 summarizes the intercorrelations among age, general use of Facebook, dispositional trust, general trust toward Facebook, and trust in Facebook in a crisis situation.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>-</td>
<td>0.07</td>
<td>0.03</td>
<td>0.27***</td>
<td>0.20***</td>
</tr>
<tr>
<td>2. General use of Facebook</td>
<td>-</td>
<td>-0.01</td>
<td>0.25***</td>
<td>0.23***</td>
<td></td>
</tr>
<tr>
<td>3. Dispositional trust</td>
<td>-</td>
<td>0.20**</td>
<td>0.19***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. General trust in Facebook</td>
<td>-</td>
<td>-</td>
<td>0.45***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Trust Facebook in crisis situation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 340; ***p < 0.001.*
To test the hypotheses, a hierarchical regression was conducted to estimate the influence of general use, dispositional trust, and general trust toward Facebook on the rating of the trustworthiness of Facebook in a flood. The results are summarized in Table 4.2.

Gender and age were entered as control variables in a first step. General use of Facebook was entered into the regression model in a second step and showed to be a significant predictor for the dependent variable ($R^2 \text{ Change} = 0.04$). Dispositional trust also had a unique influence on the rating of the trustworthiness of Facebook beyond the control variables and the general use of Facebook ($R^2 \text{ Change} = 0.04$). In the final step, general trust toward Facebook was entered into the regression model as a predictor. Even after controlling for the aforementioned variables, this variable explained the largest proportion of variance in the dependent variable ($R^2 \text{ Change} = 0.12$).

Table 4.2

<table>
<thead>
<tr>
<th>Step</th>
<th>$B$</th>
<th>$\beta$</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td>0.044***</td>
<td>0.044***</td>
</tr>
<tr>
<td>Gender</td>
<td>0.017</td>
<td>0.044</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.106</td>
<td>0.208***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td>0.088***</td>
<td>0.044***</td>
</tr>
<tr>
<td>General use of Facebook</td>
<td>0.288</td>
<td>0.217***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td>0.123***</td>
<td>0.035***</td>
</tr>
<tr>
<td>Dispositional trust</td>
<td>0.062</td>
<td>0.187***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td></td>
<td>0.241***</td>
<td>0.118***</td>
</tr>
<tr>
<td>General trust Facebook</td>
<td>0.172</td>
<td>0.375***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* $n = 340$; ***$p < 0.001$.

4.5 Discussion

Against the backdrop of social media’s "contemporary pervasiveness" (Walter, 2009, p. 111) and the related increasing use in crisis situations, this study aimed to further investigate the impact of social media, specifically Facebook, as an information source in the context of crisis situations. Although a considerable body of research on social media use in crisis situations already exists, the role of trust in this context has not yet explicitly been investigated.
in any of these studies. However, it seems evident that especially in such high-risk situations, trust is crucial. This research is meant to address this gap as well as the lack of online trust research on social media in general.

People from the United Kingdom, Ireland, and Germany were asked to what extent they would trust Facebook during crisis situations. It was proposed that this specific kind of situational trust (i.e., trust in the context of a crisis situation) can be predicted from the general use of Facebook and individual dispositional trust (Hypothesis 1), as well as from a general trusting attitude toward Facebook as a medium (Hypothesis 2). Both research hypotheses were supported by the statistical analyses.

The overall regression model explained about 24 percent of variance. As one would expect, trusting Facebook in a crisis situation depends on more than general use of this medium, dispositional trust, and trust toward Facebook in general. For instance, one could assume that personal experience with crisis situations or risk perception also affects perceived trustworthiness.

In this study, general trust toward Facebook was a global measure, focusing on the general attitude of people toward this SNS, without a specific context given. It could be shown that this measure is associated with a specific, contextual trust judgment of Facebook in a crisis situation. Future research should aim to investigate the relationship of this general trust measure to other specific contexts as well.

It also seems an interesting and promising idea that general trust toward Facebook might be an attitude of Facebook users that colors their perception of information consumed through this medium. Another question arising at this point is how people perceive other social media in this respect, for instance, if people also have such trusting attitudes toward Twitter or YouTube. If so, how do they differ between people with regard to the specific medium—in other words: do people hold differentiated trust evaluations for certain social media they use or do they rather maintain a global evaluation for social media in general?
Another question arising in this context is under which conditions the medium may be more or less influential. For instance, it seems reasonable to assume that the medium serves as a contextual, peripheral cue (Green, 2007; Yang et al., 2003). According to the Elaboration Likelihood Model, the influence of this type of cue should decrease with the motivation of individuals to process the content of the message more deeply (Petty et al., 1997; Petty & Cacioppo, 1986, 2012). Future research needs to address the question of how influential the ‘‘medium as message’’ (McLuhan, 1967, 2006) is under different conditions.

Practical implications concerning risk and crisis communications for government and public safety organizations are that officials should be aware of the effect the medium of information distribution might have (Rains et al., 2015; Schultz et al., 2011).

One limitation of this study is the fact that the presented situation was merely hypothetical and rather abstract. More experimental research is needed to explore the actual influence of information delivery through social media. In addition, our measure for the general use of Facebook was based on a subjective self-evaluation, rather than an objective measure. Future research should also obtain objective measures concerning individual usage patterns of social media platforms.

Another limitation concerns the sample and therefore the generalization of the results of this study. With Ireland, the United Kingdom, and Germany, the sample of this study was restricted to three Western European countries. It should be interesting to investigate cultural differences across other countries. For instance, in the EU Standard Eurobarometer (European Commission, 2014), an annual survey on media use in the European Union, requested by the European Commission, trusting online social networks was investigated. It was found that the United Kingdom, Ireland, and Germany are at the lower end of the spectrum in comparison with other European Union member states (between 12 percent and 17 percent of people from these countries stated that they tend to trust online social networks), whereas about 30 percent of Greek, Polish, or Bulgarian participants indicated their level of trust toward online social
networks on the higher end of the spectrum (European Commission, 2014). One would expect to find these differences reflected if one would ask participants from these countries about their trust toward Facebook in crisis situations. That is, trust toward Facebook in a crisis situation should be higher in countries with comparably high trust measures toward SNSs in general.

4.6 Declarations

Acknowledgments

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Author Disclosure Statement

No competing financial interests exist.
5 General Discussion

In order to better understand the behavior of individuals, it is necessary to inquire about their perceptions of the world. In the end, it is the individuals’ perception that matters to them and we can only improve their behaviors and decisions in the future by investigating and understanding (mis)perceptions and their relations to reality. Accordingly, the overarching research aim of the present dissertation was to investigate the role of perception for behavior change as well as of perceived trust in online information sources for domains of health risk. This aim was approached in a series of studies.

The relationship between actual and perceived behavior change was investigated in chapters 2 and 3 with multiple studies. Specifically, it was explored how much actual behavioral change is necessary for people to feel that they have changed. We addressed this question for two different health behaviors, namely physical activity (chapter 2) and eating behavior (chapter 3). Results show that participants needed a substantial and comprehensive actual change in behavior to perceive that they have changed. These results suggest that the magnitude of behavioral change, which is necessary for people to perceive a significant change, is comparatively demanding. It might be that this perception is partially rooted in well-known ‘threshold-messages’ about health behavior, which are often communicated in official recommendations (e.g. Deutsche Gesellschaft für Ernährung (DGE) [German Nutrition Society], 2019; World Health Organization, 2018). People might retort to these standards when setting goals or evaluating change.

In chapter 3, we used an online survey to investigate the perception of trust in social media in the context of risk situations. Specifically, it was investigated how the general use of Facebook and general trust towards this medium are connected to trusting this medium in a crisis situation. We found that the general use of and trust towards Facebook predicted the
decision, whether to trust this medium in crisis situations, as well. As with chapters 2 and 3, it appears that people will rely on what they know when making relevant decisions.

In sum, the present dissertation connects two related topics: Firstly, it investigates the perception of health behavior change. If expectations are too high, it is crucial to address this publicly by risk communication and the dissemination of relevant behavioral information. Accordingly, in the second part, the present dissertation addresses the topic of communication. Risk communication should be executed via channels that people in general use and trust, as they will also trust these channels when it comes to their physical well-being and safety. Table 5.1 summarizes the key aspects of each chapter.
Table 5.1
Aims, findings, and conclusions of the present dissertation.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Aims</th>
<th>Results</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>To explore how much actual change in physical activity is necessary for people to perceive that they have changed.</td>
<td>Participants have an accurate perception of actual behavior change. In terms of intensity, perception of change is driven by change in vigorous physical activity. In terms of duration, substantial changes in physical activity were necessary (more than 50 additional minutes per week).</td>
<td>Participants have high expectations of how much actual change is necessary. Moderate physical activity seems to fly under the ‘perception’ radar. Behavioral norms might impact perceived change.</td>
</tr>
<tr>
<td>3</td>
<td>To examine how much actual change in dietary behavior is necessary for people to perceive that they have changed.</td>
<td>Participants have an accurate perception of actual behavior change, as indicated by a food frequency index. 5 food groups out of 15 were necessary to change (actual change) to perceive a change shift in healthy eating.</td>
<td>Participants have high expectations of how much actual change is necessary. Behavioral norms might impact perceived change.</td>
</tr>
<tr>
<td>4</td>
<td>To assess the relationship between general use of and general trust towards Facebook concerning the perceived trustworthiness of this medium in a crisis situation.</td>
<td>Participants’ general trust toward Facebook as a medium predicted how much they would trust Facebook in a crisis situation. Dispositional trust and general use were also associated with trust towards Facebook in a crisis situation.</td>
<td>People use and trust the media they know in situations of risk. Facebook is suitable as a medium for risk communication. Behavioral norms might impact perceived change.</td>
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</table>
5.1 Health behavior change: Demanding expectations of individuals

The results of chapters 2 and 3 show that participants exhibited an accurate perception of behavioral change across behavioral domains. That is, those who perceived change showed a corresponding shift in actual eating behavior. For dietary behavior, these findings are in accordance with previous research on dietary change (e.g. Lake et al., 2004a; Metzner et al., 1988; Tsubono et al., 1995), although research showing that misperceptions of dietary change also exist (Arnold et al., 1996; Richardson et al., 1993). Furthermore, extending on previous research, we not only evaluated the mere accuracy of change but the accuracy of the evaluation in terms of healthiness (“I eat more healthily and balanced now”). This distinction is especially important concerning health goals, as people can be aware of a change in their diet but not necessarily perceive this change as contributing to a healthier diet.

For physical activity, no previous research evaluated the accuracy of perceived change. Thus, chapter 2 presents the first research to ascertain whether people who perceive a change in physical activity exhibited a corresponding actual behavioral change. We found that people can correctly ascertain a change in their physical activity level, as only those who perceived to have changed also changed their actual behavior between measurement points. No systematic change was seen in three groups of non-Changers that did not perceive a change. Thus, similar to dietary behavior, the perception to have changed in a ‘meaningful’ and desirable way (“I am more physically active now”), is accompanied by a respective change in actual behavior. Concerning health goal pursuit, becoming more physically active is a common health goal, and perception of change implies a positive evaluation of this change.

We argued that the substantial change in actual behavior necessary for people to feel that they have changed might reflect high expectations of what represents a desirable (or ‘meaningful’) behavioral change. These expectations could also contribute to the accuracy of perceived change. The more actual change is necessary to meet peoples’ expectations of a desirable change (i.e. change that is relevant to goal progress), the more likely it is that it will
be correctly perceived. Thus, when individuals reduce their expectations and begin to consider lower levels of behavioral change as desirable, the accuracy of perception might decrease. This possible ‘trade-off’ between lowering goals and lowered perception-accuracy had to be considered in behavioral interventions.

In sum, the results of chapters 2 and 3 indicate that people are able to accurately ascertain behavioral change for dietary behavior and physical activity in relatively short time periods (six months). Even though actual change was assessed only through self-report, the validation of self-reported change with a corresponding change in objective measures (increase in fitness in chapter 2 and decrease in BMI in chapter 3, respectively) supports this conclusion. Ensuring that perceptions of change were accurate (i.e. measurable) is a prerequisite for answering the main research question of chapters 2 and 3: How much change is necessary for people to perceive they have changed?

The comparatively high expectations which are suggested by our results occurred across behaviors, i.e. for physical activity as well as dietary behavior. As argued in both chapters, official recommendations are usually ‘threshold’ messages and likely to shape individuals’ perception of the extend of desirable behavioral change. In a sense, they may provide “anchors” for individuals’ expectations. Social psychological research has shown the influence of high anchors on subsequent decision making (e.g. Kahneman, 2011; Tversky & Kahneman, 1974; Wilson et al., 1996). For health behavior, this could mean that people will revert to what they know (i.e. official guidelines) and use this as an anchor for subsequent judgment of behavior change. Thus, desired end-points for behavioral change might serve as anchors for any behavior change goal setting and the evaluation of behavioral change. Thus, substantial expectations might be partly rooted in official recommendations that serve as ‘anchors’ to provide orientation to people.

Additionally, the confirmation bias (Jonas et al., 2001; Raymond S. Nickerson, 1998) could also contribute to entrenching established expectations and perceptions. People tend to seek and
attend to information that supports existing beliefs while avoiding conflicting information (for other biases in health behavior see e.g. M. P. Kelly, 2019; M. P. Kelly & Barker, 2016). Thus, there could be a reinforcing dynamic between perceptions of desirable change and demanding threshold communication by official guidelines.

A likely consequence of firmly established perceptions and expectations regarding behavior change, reinforced by a tendency to seek confirmatory information, is that changing expectations through health communication is a challenge. For instance, Meppeling et al. (2019) showed in a study on online health information seeking that people select more belief consistent than belief-inconsistent information and that belief-confirming information was perceived as being more credible, useful, and convincing.

To conclude, the results of chapters 2 and 3 suggest that individuals have comparatively demanding expectations when it comes to meaningful change for eating behavior and physical activity. Identifying these expectations is an important first step. However, addressing and changing these perceptions might be difficult. Chapter 4 connects to this issue by investigating which channel could be used for public communication so people will trust risk-relevant information.

### 5.2 Measuring health behavior

Assessing and quantifying health behavior accurately is not only complicated for individuals but also for researchers, more for some behaviors than for others. Since actual behavior change is one of the key variables in chapters 2 and 3, it is expedient to explore the issue of measuring health behavior in more depth.

In the case of physical activity, the activity can be described in intensity (MET) and duration (hours). Both metrics can then be combined to obtain the measure of MET-hours (Ainsworth et al., 2000; Helmerhorst et al., 2012). However, there is some controversy about the necessary duration of ‘bouts’ (i.e. minimum length of continuous physical activity) to be taken into account in the objective assessment of behavior (e.g. Hardman, 2001; Helmerhorst et al., 2012;
Macfarlane et al., 2006; Saint-Maurice et al., 2018). Furthermore, there is evidence that people tend to overstate physical activity in self-reports compared to objective measures, such as accelerometers (e.g. Cleland et al., 2014; Dyrstad et al., 2014; P. H. Lee et al., 2011). Yet, despite these criticisms, MET-hours are a suitable, intuitive, integrated, and unidimensional measure that is related to various health outcomes (e.g. Ekelund et al., 2016; P. Kelly et al., 2014).

In quantifying dietary behavior and evaluating it in terms of healthiness, more complexity is involved (e.g., Parmenter, 2002; Variyam et al., 2001). As a consequence, and in comparison with physical activity, there is less agreement on how to operationalize dietary behavior. Thus, it is possible to evaluate nutritional behavior (change) in various ways. In chapter two, actual dietary behavior change was quantified in two ways, (a) by looking at differences of an integrated Food Frequency Index (FFI; Sproesser et al., 2018; Winkler & Döring, 1995, 1998) and (b) by analyzing how many of the 15 food groups that were assessed have changed.

Regarding the FFI, other methods for computing dietary indexes to assess dietary quality are possible, such as the Healthy Eating Index (HEI) or the Alternate Healthy Eating Index (AHEI) (Guenther et al., 2013; Kennedy et al., 1995; McCullough & Willett, 2006; Schwingshackl & Hoffmann, 2015). Other indexes have also been used to assess the health benefits of diets. For instance, Buckland et al. (2010) used an 18-point linear scale composed of 9 key components to calculate a Mediterranean diet score (see also Romaguera et al., 2011). Thus, although the FFI is a validated and unidimensional measure for dietary quality (Winkler & Döring, 1995, 1998), there is more ambiguity to it than to physical activity, and various ways are possible to compose a dietary score.

Opinions about what constitutes a healthy and balanced diet also diverge among experts, making things even more complex. For instance, the consumption of meat and fish is optimal in a modest amount in the FFI. Consequentially, a vegetarian diet could not receive the highest score, even though it is viewed as just as healthy, or even healthier, as a diet with meat by many
experts (W. J. Craig, 2010; Marsh et al., 2012; Rajaram & Sabaté, 2000). For physical activity, there is general agreement regarding the question of what kind of behavior change is better, as “even a little is good; more is better” (M. Lee, 2007), as well as how to measure physical activity. For dietary behavior, however, there is more uncertainty and disagreement concerning the question of what kind of eating behavior (change) is more healthy.

The complexity of evaluating and monitoring one’s dietary behavior is also reflected in studies that find discrepancies between actual behavior and subjective self-evaluation concerning the healthiness of one’s diet (e.g. Dijkstra et al., 2014; Glanz et al., 1997). For instance, Glanz et al. (1997) found a lack of awareness of how healthy one’s current fat intake is. Of course, these data do not address the perception of change but the concurrent perception of one’s diet. However, they exemplify the problems associated with evaluating the healthiness of dietary behavior.

Despite the complexity involved in measuring lifestyle health behavior through self-report, the present dissertation found consistent results between actual behavior and (a) perception of behavioral change and (b) objective parameters for change (change in objective fitness and BMI, respectively). It is also a strength of this dissertation that – given the complexity of eating behavior – the change in eating behavior was operationalized in two ways, both as an aggregated overall measure of health (healthy eating index) and as an analysis of change in single food categories.

5.3 Challenges in evaluating actual behavioral change

Besides the issues of quantifying behavior (change), the topic of evaluating behavioral change is also an area of controversy. There is no agreement of what ‘small’ and ‘large’ changes are. As a consequence, we evaluated the magnitude of change by contrasting the actual behavioral change we found in our studies with findings from the literature. For PA, such an evaluation (in terms of ‘small’ and ‘large’ changes) is more straightforward. For instance, one can distinguish between light, moderate, and vigorous intensive activity (LPA, MPA, and VPA,
respectively). In accordance with Slotterback (2006), we found that MPA is mostly neglected. Likewise, no effect of walking – an example for LPA – on perceived behavior change was found in chapter 3. In contrast, research shows that MPA alone has health benefits (e.g. Hupin et al., 2015; Samitz et al., 2011; Wen et al., 2011). Moreover, Amagasa et al. (2018) report in their review on (objectively measured) light-intensity physical activity, that it alone has health benefits, even after adjusting for moderate and vigorous physical activity. Thus, one can conclude that the expectations are unnecessary high concerning current findings on the health benefits of MPA and LPA.

Another main finding regarding physical activity change was the increase in physical activity of 50 to 90 minutes per week. Recent research shows that physical activity levels below the recommended levels of the WHO (2018) have already tangible health benefits (Ekelund et al., 2016; Wen et al., 2011). For instance, David Spiegelhalter (2012, 2016) has reviewed epidemiological data on the relationship between physical activity and mortality for his concept “Microlives”. He concludes that the first 20 minutes per week of moderate exercise have already measurable effects on one’s life expectancy (see also Spiegelhalter, 2017). In the light of these findings, our results of 50 and 90 additional minutes per week required to report change appear comparatively demanding (chapter 2).

For dietary behavior, our conclusion that changes were substantial and maybe unnecessary demanding are also based on the idea that smaller and intermediate steps would already be beneficial (e.g. Hill, 2009; Hill et al., 2003; Hills et al., 2013). Even though the FFI is a validated measure for assessing the healthiness of peoples’ diet (Winkler & Döring, 1995, 1998), change is difficult to evaluate in terms ‘high’ and ‘low’ with such an integrated measure, especially since the intervals on the food frequency questionnaire are not equidistant (see chapter 3).

To adopt an additional approach for evaluating the magnitude of dietary behavior change, we looked at the number of food categories that changed. This might be a more fine-grained way to look at change and thus a well-suited addition to the metric change of the FFI. We found
that participants changed about a third of all food groups that were assessed in study 1. This magnitude can be viewed as a rather high rate for successful change, since a change of a single food category can also be counted as a success, for instance eating less red meat (e.g. Sinha et al., 2009; Spiegelhalter, 2012, 2017). Hill et al. (2003) even suggest that a decrease of 100 kcal of one’s daily energy balance could be sufficient to close the “energy gap” of excess energy that leads to gradual weight gain in population. This small change could be achieved by a reduction in portion size by 4-5% for a normal diet or by walking about 1 mile (2,000 steps) – which could be distributed throughout the day (Hill, 2009; Hill et al., 2003).

Thus, the findings of chapters 2 and 3 imply that expectations regarding behavioral change appear relatively demanding, as has been shown in physical activity and diet. In this regard, this dissertation revealed that individuals’ perceptions of desirable behavior change deviate from what one would expect when looking at current evidence for the health benefits of behavioral change. This is an important conclusion as it demonstrates the need to search for discrepancies between public perceptions and scientific findings.

5.4 Theoretical implications: Reference value

The adaption of behavior to reduce perceived discrepancies between desired outcome states (i.e. goals) and actual behavior is known as self-regulation. According to self-regulation theory (Carver, 2004; Carver & Scheier, 2001; Schwarzer, 1999), people regulate their behavior with regard to superordinate goals. Self-regulatory activity can be depicted as a negative feedback loop (Figure 5.1; Carver, 2004; Carver & Scheier, 2001). An input (actual behavior) is compared to a reference value (goal standard), and if a discrepancy is detected, an output function (behavior change) will be performed.
People hold behavioral standards in their minds (i.e. goals) and will continuously compare themselves to them. If there is a perceived discrepancy between the current and ideal state, action will be taken if the individual feels competent to do so (Locke & Latham, 1996, 2013).

Crucially, discrepancies can only translate intentions into behavior if they are not too large. If goals are too high to be reached or maintained (reference value) successful self-regulation is not possible. One way to enable successful self-regulation is to reduce the ‘reference value’. For behavior change, this could mean to break down an ideal state into intermediate goals in order to keep people on track, because repeated failure could result in a loss of self-efficacy (Bandura, 1997, 1998; Schwarzer, 1992) and thus hamper the emergence of a stable self-regulatory system as a basis for further improvements. Thus, to create a stable self-regulatory system, the reference values (i.e. goal standard) could be ‘temporarily’ lowered. This could be done, for example, by breaking down the ultimate goal into a temporal sequence of less demanding (lowered) sub-goals, thereby supporting habit development. Flexibility for self-regulation is introduced by adapting the reference value. As a consequence, people will remain capable of acting (self-regulation) and have alternatives to an ultimate goal standard.
Attempts in chapters 2 and 3 may have tried to overcome “their” discrepancy but eventually failed and did not attain any change at all. The finding that Attempts started with a less favorable level of health behavior indicates a more considerable discrepancy at baseline compared to Changers. This finding is one more indication that the first group in particular could benefit from intermediate goals instead of reaching an absolute level.

The emphasis of ‘baby steps’ or ‘tiny habits’ (Fogg, 2009b, 2020) is a related approach for behavior change. The central idea is to gradually move towards an overarching goal (i.e. target behavior, e.g. eating according to the nutritional guidelines, working out three times a week for at least 50 minutes per session) by increments, instead of exclusively focusing on this goal as the only benchmark for success. By gradually increasing the reference value, people will more likely approach the ideal goal, but also experience success along their way.

The results of this dissertation underline that it might be advisable to incorporate the idea of baby steps into theories of health behavior change by emphasizing the adaption and tuning of goals to the capabilities of the individuals. This way, Attempts might attain some actual behavior change, which they view as successful before they give up entirely. Thus, they would not be unsuccessful Attempts (in their own eyes) but be ‘on the right course’, somewhere between Non-Attempts and those who reached their ideal level. To accomplish this, theories of health behavior change should include a definition of goals that focus on change instead of fixed end-points.

5.5 Differences between groups of “non-changers”

Due to the leading research question for chapters 2 and 3, the focus of these chapters was on the group of Changers. However, the distinction of non-Changers into three different groups (Attempts, Non-Attempts, and regular actives / Healthy Eaters) merits a closer examination. It is worth considering these three groups as a representation of different stages of the health behavior process. Using the Transtheoretical Model briefly described in the introduction (Prochaska et al., 1992; Prochaska & DiClemente, 1983; Velicer et al., 2006), Attempts may
have started in the action phase but have fallen back into contemplation or pre-contemplation, whereas regular actives / Healthy Eaters are in the maintenance phase and Non-Attempters remain in the pre-contemplation or contemplation phase.

 Attempters are participants who intended to change but did not succeed, or rather did not perceive to have succeeded. Looking at the substantial increase of Changers, there was the possibility of the occurrence of smaller changes for Attempters. However, close inspection revealed that no change at all occurred. This absence of any change after six months, despite behavior change attempts, might indicate an underlying all-or-nothing attitude with a high set-point (and maybe nothing in between), across behavioral domains. We do not know whether Attempters improved at the beginning (initiation) but gave up eventually (failure to maintain behavior) or whether already the initiation of the aspired behavior change failed. If Attempters changed their behavior in an initial attempt but failed to maintain it, they dropped back to their baseline level rather than keep some smaller changes. Unsuccessful Attempters probably had the subjective experience of failure and did not improve their initial level after six months. This group might benefit most from baby steps.

 Similar to Attempters, Non-Attempters (i.e. participants who did not try to change even though they thought it would be necessary) tended to have lower levels in physical and healthy eating at baseline compared to Changers. Noteworthy, Non-Attempters even decreased total physical activity and dietary quality in the second study of each chapter, even below the threshold for an ‘unfavorable’ dietary pattern (Sproesser et al., 2011; Winkler et al., 1991; Winkler & Döring, 1995) in chapter 3. This group seems to be particularly at risk, as participants appear to lack the motivation to change. The Precaution Adoption Process Model (Weinstein et al., 1998, 2008) describes the stage of “decided not to act”, which might also apply to at least some participants in this group. It appears that Non-Attempters recognize the need to change their behavior, but decidedly do not act or are not able or motivated enough to enter the volitional phase in the behavior change process. Several reasons for lack of motivation are
conceivable, e.g. low self-efficacy or low risk-perception (Bandura, 1998; Luszczynska & Schwarzer, 2005; Schwarzer, 2008).

It is also a promising avenue for future research to investigate the dynamics between Attempters and Non-Attempters. One question, for instance, is (when) do Attempters become Non-Attempters? Repeated but failed attempts at changing dietary habits or exercise habits may result in such a transition. By altering perceptions of failure and success concerning behavior change, experiences of failure are less likely for Attempters, and Non-Attempters could be motivated for change.

Regular actives (chapter 2) and Healthy Eaters (chapter 3) had the highest values at baseline. This group perceived themselves to be on a healthy level and did not change accordingly (e.g. ‘No, because I was already physically active on a regular basis before’). These individuals have a realistic grasp of their healthy behavior and are aware of its maintenance. Interestingly, Changers caught up to the level of an ‘optimal dietary pattern’ of this group in all studies. This ‘catching up’ also supports the idea of normative behavioral norms in the sense of the desired end-state. Either one reaches an ‘optimal’ pattern and perceived this change as successful (Changers), or one does not, and the level drops back to baseline (Attempters).

Thus, none of the three groups of non-Changers exhibited systematic behavioral change. These findings indicate an accurate perception of behavioral maintenance of the three groups of non-Changers. However, the different groups of non-Changers showed a different pattern in their overall behavioral level. These patterns were coherent with regard to their reported perceptions, with regular actives / Healthy Eaters having the most favorable level, whereas Non-Attempters appear to be especially at risk for unhealthy behavior. Therefore, individuals seem to have a relatively accurate perception not only of their behavior change/maintenance but also of their relative level of physical activity and the healthiness of their diet.
Chapter 5: General Discussion

5.6 Perception of trust and risk communication

The current Covid-19 pandemic constitutes a health risk that requires large-scale behavior change interventions (van Bavel et al., 2020). To reduce uncertainty and obtain behavioral advice, people in such situations seek information online, as much health advice and discourse takes place on social media. In order to decrease the risk of Covid-19, individuals have to change their (health) behavior. They need to know how and turn to various sources for information (Debbeler et al., 2020; Dunwoody & Griffin, 2015).

Recent pandemic outbreaks also show that crisis situations are often caused by health risks. The relevance and interconnectedness of health behavior and crisis situations is also captured through the use of similar phrases, like ‘obesity pandemic’ (Swinburn et al., 2011) and ‘pandemic of inactivity’ (Kohl et al., 2012; Reis et al., 2016; Sallis et al., 2016). Pandemic implies a threat to individuals and society and also the need for immediate action. These parallels also illustrate the convergence of crisis situations and health behavior. In those circumstances, behavior change through risk communication is a cornerstone to increase public awareness and give behavioral advice.

For effective crisis communication, it is vital to know which communication channels are trusted by the public. It is crucial to be aware of the distribution channels and the attitudes people hold towards these channels since the aim is not only to provide new information but to counteract existing expectations regarding behavior change. Due to the ubiquity of the web 2.0 and its prominent role as an infrastructure for information distribution, we focused on social media.

Social media such as Facebook are used by both health organizations and individuals to inform about health risks (e.g. Gabarron & Wynn, 2016; Jacobs et al., 2016; Maher et al., 2016; Park et al., 2011; Ridout, 2016) as well as situations of risk such as emergencies or other crisis situations (Knuth et al., 2017; Kuecuekbalaban et al., 2015; Luna & Pennock, 2018; Simon et al., 2015; Szymczak et al., 2015). One key factor for information dissemination is the perceived
trustworthiness of social media channels that people use. Dunwoody and Griffin (2015) also highlight the importance of the perceived credibility of the channel of communication in their Risk Information Seeking and Processing Model, where they conclude that “the all-too-common focus in many campaigns on ensuring the credibility of sources may lead practitioners to neglect the critical importance of channel credibility” (Dunwoody & Griffin, 2015, p. 113).

Chapter 4 addresses the question of whether people in crisis situations would trust the social media channels they generally use. Thus, chapter 4 expands the study focus to a further context, namely crisis situations. As perceived trust in social media platforms is a crucial predictor for the evaluation of information (Grabner-Kräuter, 2009; Grabner-Kräuter & Bitter, 2015; Toma, 2010), we investigated whether perceived trust generally persists in serious situations that are relevant to one’s health and well-being.

The results of chapter 4 show that a general perception of trust seems to extend to trust for risk situations as well. People will rely on Facebook in crisis situations if they use it regularly and tend to trust it in general. This implication is not self-evident since social media are also a source of false information, such as ‘fake news’ (e.g. Bawden & Robinson, 2020; Rains et al., 2015). Situations of personal risk are of a different quality than everyday Facebook use. For this reason, it was essential to evaluate whether this medium is also trusted beyond everyday communication situations.

Even though ‘crisis situations’, as they are understood in chapter 4, differ from situations where people would seek health-related information (more closely related to chapters 3 and 4), the results of our online study on Facebook nevertheless provide insights into the viability of using social media for risk communication and the dissemination of actionable information. One can assume that regular Facebook users will perceive this medium as trustworthy in other situations of risk than a crisis, such as health risks. While this claim needs to be substantiated by further research, relying on social media such as Facebook for the dissemination of ‘critical’ information seems to be a promising strategy for public health officials, as recipients who
generally use Facebook will trust information of direct relevance to personal well-being to this medium.

However, relying exclusively on social media could be potentially dangerous if it prevents people from checking official web sites, such as the WHO webpage. Thus, even though reaching people through the channel they habitually use is indispensable, it needs to be ensured that the regular checking of official websites is also rewarded. Furthermore, in times of ‘information overload’ attention is a scarce resource (e.g. Bawden & Robinson, 2020; Beck, 2014; Hiltz & Plotnick, 2013) and it is uncertain how many people who have access to information will process it. It is also important to be aware that only a particular segment of the population will be reached through social media. Thus, it is imperative to use a multitude of channels (‘multichannel exposure’) for maximizing exposure in situations of risk (Hornik & Kelly, 2007; Rains et al., 2015)

Taken together, using social media for the dissemination of risk-related information is a promising strategy for health officials. People who generally use a social medium will also trust this medium in crisis situations as well. In times of “fake news” and conflicting information, people will retort to what they commonly use to reduce uncertainty. The current outbreak of the Coronavirus shows that crisis situations and health risks are often interrelated. Although the main findings of chapter 4 cannot be readily generalized to situations of health risks, parallels between crisis situations and health risk situations suggest that this presents a promising avenue for further research. In sum, it is important to consider social media as a resource for health officials communicating behavior advice to the public in crisis situations, and perhaps for health advice in general.

5.7 Practical implications: Health promotion and risk communication

In chapters 2 and 3, we consistently found that substantial changes were necessary across two health behaviors for people to feel that they have changed. This finding means that individuals who attempt to change their behavior might ‘aim high’ from the beginning. This
aim is higher than necessary with regard to health benefits and successful goal striving. The findings suggest that it is advisable to lower expectations and emphasize smaller changes. From a health promotion perspective, it is therefore necessary to create awareness of the merits of smaller changes, for instance by stressing the benefits of moderate-intensity physical activity or by focusing on one or two food groups. It follows that in addition to the established norms for desired ‘ideal behavior’, there might be a need to raise public awareness of behavioral norms for changing behavior. Perhaps a ‘paradigm shift’ of public opinion is required, by de-emphasizing the ideas of end-points and putting more weight on rewarding intermediate steps on the ladder towards these ideal states. Since high and rigid expectations might lead to the devaluation of actual change, more flexible patterns of evaluation should be encouraged, which depend on the current state of the individual and are not an absolute ideal. Lower expectations will signal to individuals that ‘baby steps’ (Fogg, 2009b) are worthwhile changes on the long road to ‘ideal goals’ and are desirable in themselves.

Lower expectations should be met by increased accuracy of perception of behavior change. It is crucial to ensure that people can accurately and consistently monitor smaller behavioral changes to build habits, since habit-building (or ‘automatization of behavior’; e.g. Gollwitzer, 1999; Gollwitzer et al., 2004) requires frequent repetition of the target behavior (Lally & Gardner, 2013). For instance, many app-based mobile interventions enable individuals to track their behavior and also gain feedback in many cases (e.g. König et al., 2018; Villinger et al., 2019). Tracking and attaining feedback will help to reliably track smaller changes and make them visible through feedback, feeding the ‘comparator’ in the feedback loop (Figure 5.1) of self-regulation with more accurate data.

Improving self-monitoring through technology can also make physical activity that is already occurring visible. Becoming aware of one’s physical activity throughout the day is especially important when the activity is not perceived as such. For instance, Crum and Langer (2007) showed that making people aware of the amount of physical activity they are already
engaged in, e.g. due to their job as hotel cleaning staff, is sufficient to increase objective health parameters, such as BMI or blood pressure (see also Zahrt & Crum, 2017). Thus, positive feedback for already existing physical activity levels, which are not perceived as such, could improve health and might also bolster motivation.

Thus, monitoring behavior more accurately, emphasizing small steps by making them visible and communicating the merit of these small steps will help to narrow the intention behavior gap. It will enable more people to change their behavior by fostering motivation and self-confidence (‘I do not have to make the big leap’), or by bolstering motivation by reassuring feedback on the value of baby steps. For example, one much-promoted physical activity goal are the 10,000 steps a day (Le Masurier et al., 2003; U.S. Department of Health and Human Services, 2018). Successively shaping progress towards this goal could help more people to reach it, by narrowing the gap between current state and goal, especially for inactive people. Thus, messages like ‘500 steps more per day every week’ or increasing the number of daily steps by a certain percentage (U.S. Department of Health and Human Services, 2018) could help gradually shaping behavior and building lasting healthy habits. Measuring and feeding back change could be accomplished or supported by technology, e.g. through sensors or health apps. Both approaches, address expectations and enhance behavior tracking, could occur in tandem. Tying all these steps together will enable more people to increase their health behavior and stay motivated by seeing their progress (feedback on actual change) and evaluating this change as impactful (value of feedback). Furthermore, social media channels provide an excellent opportunity to spread the message of smaller steps. Public health campaigns can use these channels to reach a broad audience (e.g. Betsch et al., 2012; Lachlan et al., 2014; Maher et al., 2016).

Since such new knowledge will be met with some resistance from existing knowledge and attitudes, it is all the more important to distribute information on a trusted channel in order to attract attention. Thus, besides health apps that support behavior change more directly, social
media could be used to support behavior change as more and more people turn to Facebook and other channels for health advice (Maher et al., 2016). As argued previously, the dissemination of fitness and nutritional information via mass media is one key factor in enabling successful behavior change for more people.

In sum, the communication of ideal states (e.g. through ‘thresholds’) might contribute to high expectations regarding behavior change, as these guidelines are essential factors for the establishment of behavioral norms. One implication of this line of argumentation is that in addition to established norms for desired ‘ideal behaviors’, behavioral norms for changing behavior need to be made publicly aware. To this end, disseminating information about unnecessarily high standards is one strategy. If trustworthy channels are used to get this message across, people might change their expectations accordingly.

To address the topic of trustworthy channels the focus in chapter 4 is shifted towards the investigation of possible media channels, as these are the connection point for the dissemination of information. Using social media appears to be a useful and low-cost way for risk communication. Thus, despite the potential for ‘fake news’ and other incorrect information, regular users appear to trust social media in situations concerning personal health and well-being. However, trust is a vulnerable good (Rousseau et al., 1998) and public authorities should take special care to maintain it.

According to the EU Standard Eurobarometer, trust in online social networks remains low in the 28 EU member states. In 2014, 21% of respondents stated that they trust social network sites, and in 2017, this number is nearly unchanged, with 20% of respondents stating that they do not trust social networks (European Commission, 2014, 2017b). Even though there is a relationship between general use and trust in social media, public health officials need to be aware that the majority of EU citizens state not to trust social networking sites. Thus, using social media for risk and crisis communication can only be an additional building block within
more comprehensive strategies to raise awareness for certain risks within the public and provide behavioral guidance.

5.8 Future research

Chapters 2 and 3 investigated two different health behaviors: physical activity and dietary behavior. Future research should investigate further health behaviors to investigate the generalizability of the findings of chapters 2 and 3. What remains unclear, for instance, is the question of what magnitude of change is necessary for people to report a reduced drinking behavior that positively affects their health. Actual changes might be substantial as well since no or very little alcohol is usually recommended by authorities, which constitutes another ‘threshold’ message (e.g., Babor et al., 2001; Seitz et al., 2008). One possible approach is to adopt the design of chapters 3 and 4 for alcohol consumption by assessing actual drinking behavior and ask participants after a period of time whether they perceive a change in their alcohol intake. Thus, future research should extend the topic of perceived change to other health behaviors and evaluate findings in the light of prevalent behavioral norms and current scientific evidence.

Other factors besides expectations do influence the perception of changes in health behavior as well. For instance, self-monitoring of one’s health behavior requires a certain magnitude of change, as small changes are likely to be overlooked. Thus, a certain minimum change in actual behavior is necessary to be reliably noticed. This notion of a required minimum of behavioral change should be especially true for activities, such as eating or walking, which is not always consciously planned, executed, and practiced regularly throughout the day. It is unlikely that individuals can detect any minuscule changes in their behavior. Thus, sensitivity to change needs to be taken into consideration when evaluating the perception of change. Future research should address this critical issue by examining the ‘sensitivity’ to change and exploring what is the smallest increment of change people reliably perceive for specific health behaviors. For instance, physical activity could be assessed objectively using accelerometry (actual behavior)
for several weeks and participants indicate at the end of each week whether they were less, the same or more physically active than the week before (perception of change). This way, the accuracy of perception can be estimated for various changes in actual physical activity between weeks. Such information on sensitivity to change are crucial for behavior change recommendations and intervention programs, as people need to be able to reliably notice suggested baby steps in their daily life.

Another aspect to consider is that magnitudes of actual change that are perceived as significant are likely to vary as a function of the time frame in question. We examined changes that take place within six months without any intervention. Compared to other non-intervention research, e.g. on perceived dietary change, our six months period is a comparatively short time interval. One can assume that expectations regarding behavior change for more extensive periods would be even larger than our findings. Likewise, shorter periods of time, e.g. ‘This week I am more active than last week’, will most likely result in less average actual change. Thus, researchers need to consider the time frame that participants are asked to consider in health studies.

A further topic for future research is the difference between increasing and decreasing health behavior. Magnitudes of change might be different for perceiving to be ‘less physically active’ or eating ‘less balanced and healthy now’. For instance, humans are more sensitive to adverse events, such as losses (e.g. Baumeister et al., 2001; Kahneman, 2011; Kahneman & Tversky, 1984; Rook, 1984; Schwarz, 1990). However, research also finds that people are motivated to avoid negative information regarding their health behavior (Chang, Webb, & Benn, 2017; Chang, Webb, Benn, et al., 2017; Renner & Schupp, 2011; Webb et al., 2013). For instance, Chang et al. (2017) found that people were less likely to monitor their progress when they thought their progress was poor. This avoidance of negative (or not-good-enough) feedback (Chang, Webb, & Benn, 2017; cf. “the ostrich problem”; Chang, Webb, Benn, et al., 2017; Webb et al., 2013) could mean that changes towards an unhealthier lifestyle have to be
even more significant to be perceived as a change. Future research needs to address this question since it has important implications for intervention campaigns.

A further issue related to the reported findings in chapters 2 and 3 is that health behavior changes do not occur in isolation. Instead, changes in one behavioral domain influence behavior in other domains as well, for instance in the form of compensatory health behavior (e.g. Inauen et al., 2018; Radtke & Scholz, 2012, 2016) or carry-over effects (Fleig et al., 2011, 2014, p. e.g.; Inauen et al., 2018). Both health behaviors in studies 2 and 3 are reported in isolation (although PA change was controlled for in Chapter 3). However, behavior change in physical activity might facilitate change in dietary behavior and vice versa (Fleig et al., 2014). This mutual influence could also be true for perception of change: People who notice a change in one domain could become more sensitive to health behavior (change) in another area and therefore more likely to notice change due to increased self-monitoring. Thus, the continuous interplay between various health behaviors needs to be investigated to increase ecological validity.

In chapter 4, the target question refers to a hypothetical situation (“How much would you trust the following media in crisis situations?”). However, people’s opinions about what they might do in hypothetical scenarios and what they actually do can divert. Thus, future research is needed to obtain behavioral data on this topic. For instance, online search behavior can be assessed in the laboratory using an experimental design by manipulating the situation between a risk and non-risk context (e.g. online shopping, or researching a certain topic) and suggesting various social media and non-social media sources. Subsequently, actual use of social media sites can be assessed for a risk context and compared to other situations.

The present dissertation investigated perception across two different domains of risk, namely health risks and crisis situations. Even though both situations concern risk communication and can be considered conceptually close, as argued above, this assumption
needs to be tested. Thus, the findings of chapter 4 on crisis communication need to be replicated for health communication.

5.9 Concluding Remarks: Perception matters

Ultimately, it is the individuals’ perception that matters to them, not the objective reality. Of course, perception must be rooted in reality to some degree to be adaptive, but misperceptions and cognitive biases are common nevertheless (e.g. Brewer et al., 2004; Kahneman, 2011; Tversky & Kahneman, 1974). Judgments and decisions can be flawed due to motivated information processing or reliance on incomplete or outdated information. Moreover, even if a person has all relevant information at his or her disposal, it is usually not possible to process it thoroughly due to a lack of time or limited cognitive capacity. Depending on the context, the consequences of flawed perception, biased judgment, or reliance on incomplete information can be more or less consequential for the individual. For instance, they are more consequential when it comes to contexts that might affect health and well-being, such as health behavior, or behavior concerning crisis (e.g. prevention behavior). It can contribute to adverse outcomes when relying on false assumptions in such contexts.

It has also been shown that perception alone can impact tangible health outcomes, above and beyond the objective, the ‘actual’ reality. Keth Payne summarizes the compelling evidence in his book “The Broken Ladder” (2017) by showing that one’s perceived social status rather than one’s actual status is associated with many poor health outcomes. For instance, Singh-Manoux, Adler, & Marmot (2003) show in their study how subjective social status is associated with measures of health after controlling for objective indicators of status. Individuals’ (mis)perception has real consequences, apart from the actual, objective ‘reality’. Thus, the subjective evaluation of actual events is a powerful force. For the domain of health behavior, Zahrt and Crum (2017) found that the mere perception of people’s level of physical activity influences health parameters and mortality, even when controlling for actual behavior (see also Crum & Langer, 2007). Similarly, research also indicates that the perception of physical fitness
might be more closely related to some measures of psychological health, such as positive mood or stress reactivity, than actual physical fitness (Plante et al., 1998, 1999, 2000). For instance, Plante et al. (2000) found in a study on daily coping that perceived physical fitness was associated with coping, whereas actual physical activity – measured by an activity monitoring device – was not.

In terms of behavior change, the evaluation of one’s actual behavior change should also have an independent effect apart from actual change. Investigating the perception of behavior change is critical. It is necessary to ascertain whether it is accurate and also how it relates to actual change. Taken together, perception is the individuals’ reality and has real consequences for behavior. It is, therefore, crucial for behavior change approaches to investigate perception.

The necessity to investigate perception applies to the perception and evaluation of behavior as well as the perception of media, which are an important source for behavioral advice and health information (Debbeler et al., 2020). It is essential to uncover peoples’ perceptions to be able to correct them if necessary. Thus, the basic idea of the present dissertation was to explore (1) people’s perceptions of health behavior change and (2) the perception of media platforms as sources of risk-relevant information.

To understand behavior change it is necessary to understand the relationship between peoples’ perceptions of their behavior and actual behavior. By uncovering (mis)perceptions and reality in tandem we can improve people’s future decisions and behaviors. The basic “conservative” make-up of the human mind enables us to integrate experience and predict the future. However, its inertia can prevent seeking new information. Behavior change approaches might be hindered by this inertia when trying to change ingrained attitudes. However, knowledge about this inertia can also result in benefits, e.g. tackling media channels people habitually use.

In conclusion, the way we perceive the world is the result of an imperfect learning process. Our perceptions are rigid and yet malleable, can be misconstrued and yet need to be grounded
in reality. It is vital to be aware of our perceptions and to check them regularly. This way, the behavioral consequences that resulting from our perception will gradually improve and bring us closer to our goals.
List of Contributions

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For chapters 2 and 3, BR and HTS designed the study and coordinated with contribution from Gudrun Sproesser (GS) data collection. Lucas Keller (LK) and Peter Gollwitzer (PG) made substantial contributions to the design of the work. BR and Hermann Szymczak (HS) conceived the analyses. HS and HTS analyzed the data and drafted the manuscript. HTS, HS, and BR interpreted the data. BR, LK, Luka J. Debbeler (LJD), Josianne Kollmann (JK), Nadine C. Lages (NCL), Gudrun Sproesser (GS), and PG revised the manuscripts substantially.

For chapter 4, Silke Schmidt (SS) designed the study and coordinated the research. HS conceived the analyses, analyzed the data, interpreted the analyses and drafted the manuscript. Sandra Lemanski (SL), Daniela Knuth (DK), and Pinar Kücükbalaban (PK) revised the manuscript substantially.

All authors approved the final manuscripts (applying to all chapters).
References


Australian Department of Health (2014a). *Australia’s physical and sedentary behaviour...*

Australian Department of Health (2014b). Make your move - Sit less Be active for life!
Canberra: Australian Department of Health.


Bech-Larsen, T., & Kazbare, L. (2014). Perceptions of healthy eating in transitional phases of


Bilgihan, A. (2016). Gen y customer loyalty in online shopping: An integrated model of trust,
user experience and branding. *Computers in Human Behavior, 61*, 103–113. doi:10.1016/j.chb.2016.03.014


Brinkmann, R. (2014). Theorien zum Gesundheitsverhalten. In *Angewandte...
References

Gesundheitspsychologie (pp. 53–121). Hallbergmoos, Germany: Pearson.


York, NY: Guilford Press.


themes, a model. *International Journal of Human-Computer Studies,* 58(6), 737–758. doi:10.1016/S1071-5819(03)00041-7


References

Union. Brussels: European Commission.


promoting physical activity. *Cochrane Database of Systematic Reviews, 1*, 1–86. doi:10.1002/14651858.CD003180.pub2.Interventions


enough, i will think about it: Information speed and trust in public health organizations. *Computers in Human Behavior, 33*, 377–380. doi:10.1016/j.chb.2013.08.014


Luchman, J. N., Bergstrom, J., & Krulikowski, C. (2014). A motives framework of social media...
References


Correspondence between perceptions of change in diet and 15-year change in diet reports in the Tecumseh diet methodology study. *Nutrition and Cancer, 11*(1), 61–71. doi:10.1080/01635588809513970


Plante, T. G., Chizmar, L., & Owen, D. (1999). The contribution of perceived fitness to


Schwingshackl, L., & Hoffmann, G. (2015). Diet quality as assessed by the Healthy Eating Index, the Alternate Healthy Eating Index, the dietary approaches to stop Hypertension Score, and health outcomes: A systematic review and meta-analysis of cohort studies.


References


Sproesser, G., Klusmann, V., Schupp, H. T., & Renner, B. (2017). Self-other differences in


References


References

http://www.ipaq.ki.se/scoring.pdf


Walter, L. (2009, August 17). Red Cross: Web users increasingly rely on social media to seek help in a disaster. *EHSToday*


