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DOI
10.3390/mti4040071

Publication date
2020

Document Version
Final published version

Published in
Multimodal Technologies and Interaction

Multimodal Technologies and Interaction

MDPI

Article

Design for Sustained Wellbeing through Positive Activities—A Multi-Stage Framework

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Received: 29 May 2020; Accepted: 22 September 2020; Published: 29 September 2020

Abstract: In this paper, we introduce a framework that conceptualizes a multi-stage process through which technology can promote sustained wellbeing. Intentional wellbeing-enhancing activities form the centerpiece linking direct product interaction to, ultimately, wellbeing. The framework was developed following a bottom-up–top-down approach by integrating theoretical knowledge from positive psychology, behavioral science and human–computer interaction (HCI)/design with empirical insights. We outline (a) the framework, (b) its five main stages including their multidisciplinary theoretical foundations, (c) relations between these stages and (d) specific elements that further describe each stage. The paper illustrates how the framework was developed and elaborates three major areas of application: (design) research, design strategies and measurement approaches. With this work, we aim to provide actionable guidance for researchers and IT practitioners to understand and design technologies that foster sustained wellbeing.

Keywords: human–computer interaction; positive design; wellbeing; positive activities; behavior change

1. Introduction

The quest to improve wellbeing for individuals and society at large has become one of the most ambitious missions of our time. In 2015, the United Nations (UN) proclaimed a list of 17 goals, ratified by all UN member states, to foster prosperity and transform the world in a sustainable manner by 2030 (https://sdgs.un.org). Among these goals, they list the promotion of wellbeing and mental health worldwide. In a similar vein, positive psychologist Martin Seligman [1] demands that 51% of the world population should be flourishing by 2051. His mission is supported by empirical evidence suggesting that it is possible for humans to become and remain lastingly happier [2], and a wealth of knowledge on how this can be achieved (e.g., [3–5]).

In order to foster wellbeing on a global scale, this knowledge needs to be shared and acted on as widely as possible. Besides obvious avenues such as psychotherapy, public education, policymaking, academic and self-help literature, design researchers also believe that our daily interactions with technology pose a promising opportunity to contribute to this goal and promote global human flourishing (e.g., [6,7]). One of the main arguments is the widespread availability and adoption of technologies in our professional and private lives. There is hardly any (daily) activity that is not—or cannot be envisioned to be—shaped by technology. Interactive systems wake us up in the morning, manage our appointments, help us stay in touch with family and friends, influence our decisions as consumers and help us promote our professional careers. The emerging challenge is how to (re)design these daily interactions so that they foster *sustained wellbeing*. Digital technologies in the form of smartphones or portable gadgets are particularly well-suited to master this challenge as

they are often multi-purpose, i.e., offer a broad range of functionalities that are suitable to support multiple (daily) activities, and context-sensitive, i.e., flexibly adaptive to a person's lifestyle.

Over the past two decades, human–computer interaction (HCI) research has demonstrated that designed artefacts can create pleasurable moments and stimulate positive emotions, i.e., foster *hedonic wellbeing* [8] in the short term (see [9] for an overview). The question of whether and how these artefacts can be designed to also make people's lives more meaningful, enable them to grow as a person or behave in morally good ways, i.e., support more enduring aspects of *eudaimonic* or psychological wellbeing [10], is, on the contrary, a fairly recent one (e.g., [11–13]). While hedonic or subjective wellbeing (feeling good) focuses on maximizing positive experiences, eudaimonic or psychological wellbeing (functioning well) emphasizes a way of living that promotes the fulfillment of human potentials and self-actualization, even if this may be challenging or accompanied by negative feelings (for a more thorough definition see Section 3.3.3).

The claim that design can contribute to individuals' psychological wellbeing (at all) might evoke skepticism at first glance. Often, this skepticism is grounded in a limited view of products as material objects. Materialistic value orientations have been found to be linked to lower levels of life satisfaction [14,15], and material purchases reportedly lead to smaller increases in wellbeing than experiential purchases (see [16] for an overview). In order to become lastingly happier, it seems wise to invest in positive activities and experiences rather than accumulating material goods [17]. Research in positive psychology confirms the relative advantage of intentional positive activities over changes in one's life circumstances (such as material acquisitions) when aiming to maintain boosts in wellbeing over time [2,18]. In the remainder of this paper, simple, intentional activities and strategies that have been found to enhance wellbeing will be referred to as *positive activities* (see also [18]). Here, the term "activities" not only includes activities that are clearly manifested in behavior, but also mental activities, such as thought patterns or attitudes (e.g., being optimistic, savoring). Positive activities were first observed in exceptionally happy people [19] and were later on also empirically validated in so-called positive psychological intervention studies (e.g., [5,20]), in which people who are not exceptionally happy deliberately engage in certain activities known to increase wellbeing. Examples of positive activities include expressing gratitude, adopting a more optimistic perspective on life, strengthening personal relationships, savoring a positive life change and contributing to something greater than oneself [3,21,22].

Drawing from these findings, design researchers believe that one promising way to foster sustained wellbeing is to support wellbeing-enhancing activities through technology (e.g., [13,23–25]). However, technology has also been associated with detrimental effects on individuals' wellbeing such as technology addiction [26], increased feelings of loneliness [27] and reduced mental health [28]. These adverse effects have become a topic of growing public interest (e.g., https://humanetech.com) and have impelled the IT industry to take preventative steps to reduce harm, e.g., by introducing features to monitor and reduce screen time (e.g., https://wellbeing.google.com). We argue that in addition to (only) preventing negative outcomes, activity-supportive technology offers a proactive entry point to design for sustained wellbeing. To some extent, contemporary technologies already feature wellbeing-enhancing activities. For instance, expressing gratitude can take the form of endorsing a colleague in a professional network (e.g., Microsoft Yammer, LinkedIn) or leaving a positive rating for a service provider (e.g., AirBnB host). Reminiscence, an aspect of savoring, can be fostered by sharing meaningful past experiences with a group of friends via a social network (e.g., "memories" on Facebook) or browsing through old pictures in a photo app (e.g., "rediscover this day" on Google Photos).

There are two ways positive activities can be stimulated by technologies [29]. First, existing technologies or services whose main purpose is not to promote wellbeing can be enriched with wellbeing-enhancing features, e.g., a social networking platform that encourages their users to post respectful comments. Second, a technology or application can be built deliberately to foster a particular activity or intervention that increases wellbeing, e.g., an app that teaches people to be more mindful. Calvo and Peters [29] call the former "Active Design" and the latter "Dedicated Design" (p. 90). In both

cases, the technology itself is not the direct source of (sustained) wellbeing but rather it promotes it indirectly through the support of wellbeing-enhancing activities. The direct product interaction thus becomes just one step in a chain of events, with activities at its center, that ultimately fosters wellbeing. The way in which technologies support positive activities can take on many different forms. For instance, technology can inspire (e.g., personalized content), trigger (e.g., context-dependent and well-timed cues), motivate (e.g., feedback on task performance) or facilitate (e.g., clear guidance) engagement in activities (see [7]). The "rediscover this day" feature in Google Photos, for example, reminds users to reflect upon past experiences (captured in the form of digital photos and video) and encourages them to share these memories with their loved ones—thereby facilitating positive activities like savoring and reminiscence.

There is extensive knowledge on (a) people's experiences while interacting with a technology, from work in user experience (UX) design and HCI, on (b) sustained wellbeing, from research in positive psychology, and on (c) possible ways to impact people's behavior (including their daily activities), from literature in behavioral science. However, to our knowledge, these individual perspectives have not been explicitly combined to date, i.e., how to design interfaces in a way that they optimally foster specific kinds of activities that, in turn, boost sustained wellbeing. Understanding these relationships requires interdisciplinary cross-fertilization that is currently mostly lacking (e.g., [24,30]). Therefore, we have outlined a process which combines the individual pillars, as seen in Figure 1, in a sequence of stages. The elements within each stage have been specified by integrating theoretical and empirical knowledge from a broad range of disciplines to describe the respective phenomenon in more depth. As a result, we derived a multidisciplinary conceptual framework consisting of five distinct stages (referred to as "pillars" in the visual framework of Figure 1).

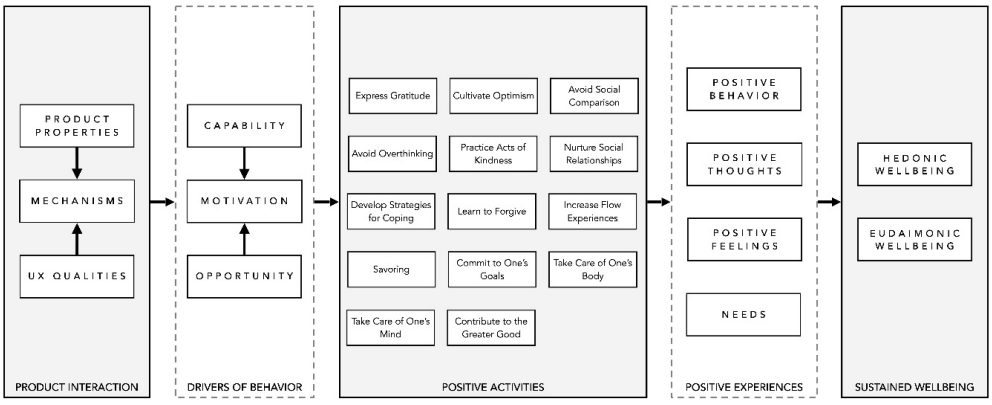

Figure 1. The multi-stage framework for sustained wellbeing promoted by technology. Pillar 2 (drivers of behavior) and pillar 4 (positive experiences) have a dashed outline to indicate they represent mediating stages in the process (see text for explanation).

2. Design for Sustained Wellbeing

Wellbeing Design Frameworks

Design for sustained wellbeing aims to create a lasting positive impact on people's lives and society [31]. Theoretical contributions in this field comprise work on positive technologies [32], experience design [33], positive design [6,7] and positive computing [29]. These frameworks are grounded in (positive) psychology [1,34] and delineate how design can foster wellbeing and human flourishing. They enumerate determinants of (sustained) wellbeing that can be supported by design. For instance, Desmet and Pohlmeyer [6] advised to foster (a) pleasure, (b) personal significance and (c) virtue, preferably at the same time, through design. Calvo and Peters [29] addressed nine factors that are known to increase wellbeing in empirical studies, e.g., gratitude, empathy, mindfulness and self-awareness. Drawing from the literature in positive and clinical psychology,

they further specified evidence-based strategies on how to shape these determinants, e.g., through gratitude visits or perspective taking exercises, and enumerated validated measures for their assessment. The authors also specified the METUX model [24], which considers psychological need satisfaction such as autonomy, competence and relatedness [35–37] as the most basic determinant of wellbeing [36,37]. Similarily, in their framework on experience design, Hassenzahl et al. [33] emphasize that positive and meaningful experiences with technology are created by fulfilling basic psychological needs during the product interaction. For instance, they propose to study exceptionally positive examples of people's practices, i.e., everyday routine activities such as brewing coffee, and to classify related experiences based on the most salient need they satisfy (e.g., relatedness experiences) [38]. This information is used to redesign embedded technologies in a need-fulfilling way in order to increase a user's wellbeing. Lastly, positive technologies [32] are meant to stimulate (a) affective quality, (b) engagement/actualization and (c) connectedness of personal experience. Meanwhile, positive technology has mainly been popularized in the domains of virtual and augmented reality as well as online therapy, whilst other frameworks (e.g., [6,29]) explicitly advocate to embed wellbeing principles into the design of all physical and digital products including everyday consumer technologies.

In the context of HCI, wellbeing can be fostered (a) directly, during human–product interactions [33], and (b) indirectly, by creating products that stimulate positive and/or meaningful experiences [13,23,24,31]. Accordingly, wellbeing design frameworks differentiate between nuanced levels of product impact [23] or spheres of experience [24] when interacting with a product. The model of product impact [23] looks at a wide range of experiential and behavioral effects resulting from human–product interactions. It formulates two levels: (a) the direct product interaction level and (b) the overall effect level (2). At the overall effect level, the model distinguishes more immediate, direct consequences of product usage on individuals' behavior, experience, knowledge and attitude from more far-reaching, indirect effects on people's life and society. The METUX model [24] details five distinct spheres of experience including direct product interactions and technology-supported behavior. Both models highlight the importance of differentiating direct and indirect effects of technology usage at multiple levels. One main argument is that beneficial wellbeing effects at one level, e.g., a pleasurable and engaging experience while interacting with a technology, might be accompanied by harmful effects in other areas of people's lives, e.g., reduced face-to-face interactions or technology addiction.

While existing frameworks can undoubtedly stimulate design, they provide little detail on how to influence the respective wellbeing determinants at an interface level, i.e., "*which functionality to support and how to implement such functionality*" [39] (p. 3309). For instance, it is unclear how and when to reward users for intended changes in their behavior [30]. As outlined above, wellbeing design frameworks often focus on a small number of theory-based determinants, i.e., they are reductionist to some extent and oftentimes not validated empirically in the context of human–technology relationships. This makes existing frameworks hard to compare and leaves the designer with the challenging task to decide which model is appropriate for tackling a given design problem. Remarkably, one of the most promising determinants of sustained wellbeing based on the literature has so far not been scrutinized in detail by wellbeing design frameworks: positive activities. Thus, the exact nature of these activities in relation to technology and the nuanced mechanisms to promote them by means of design remain relatively unclear.

The framework proposed in this paper extends existing work in several ways. First, the current framework focuses on how to increase and sustain wellbeing over time by means of stimulating positive activities through design. Second, the framework provides a typology of stages that lead up to sustained wellbeing and specifies a process through which these factors are logically connected. Starting with interaction patterns, the framework further illustrates clear ways for the designer to influence this process. Positive activities, a strong determinant of wellbeing based on the positive psychology literature, are posed to be the central element directing the effects of the product interaction on sustained wellbeing. Third, rather than choosing one theory and focusing on a limited set of

determinants, the framework takes an interdisciplinary approach that considers theoretical insights from various fields and enriches them with empirical data.

3. The Framework for Sustained Wellbeing Promoted by Technology

We begin by illustrating how the framework (Figure 1) was developed and by describing (a) its structure, (b) its main process stages including their theoretical foundation and (c) the relations between these as part of a process from direct *product interaction* to indirect wellbeing outcomes. Lastly, we elaborate three major areas of application, namely (a) design research, (b) design strategies and (c) measurement approaches. The overall purpose of this framework is to enhance the understanding of the relationships between the product interaction, wellbeing determinants and wellbeing outcomes, and consequently provide actionable guidance for researchers and IT practitioners to design technologies that foster sustained wellbeing.

3.1. Framework Development

The framework was developed following a bottom-up–top-down approach, integrating theoretical and empirical insights. Specifically, we performed a comprehensive scan of the literature across multiple relevant fields and synchronized this existing knowledge with insights from a previous laddering study [25] that investigated the relationships between products and sustained wellbeing. This bottom-up–top-down approach was chosen for several reasons: First, when studying the wellbeing literature, we noticed a considerable lack of conceptual and terminological clarity, such as an abundance of conceptual frameworks, a multitude of (partially overlapping) definitions of wellbeing determinants and outcomes and inconsistent use of terminology (see [40,41] for an overview). Instead of selectively focusing on one theoretical framework, we sought to take an open approach and prioritize wellbeing concepts based on their empirically determined relevance for the field of HCI.

Second, theoretical knowledge is fragmented between the fields of design/HCI, positive psychology and behavioral science, i.e., each discipline has its nuanced focus but also shares similar goals. One objective was therefore to take an interdisciplinary approach and integrate findings from various disciplines into one overarching framework. As this is not a trivial task, we wanted to validate theory-based assumptions with empirical data.

Third, the range of possibilities for technology to contribute to sustained wellbeing and behavior change has so far been conceptualized in a rather limited way in positive psychology and the behavioral sciences (see [30] for an overview). For instance, face-to-face interventions are often simply translated into digital instructions and behavioral intervention technologies focus on cognitive behavior change mechanisms such as goal setting, planning and sending reminders rather than on emotional or motivational aspects of the behavior change process [30,42–44]. We wished to gain a better understanding of the various ways through which designed artefacts can foster sustained wellbeing and behavior change. For this purpose, we previously studied links from product interaction patterns to wellbeing outcomes in an exploratory laddering study including a wide array of products [26]. In addition to dedicated wellbeing designs, such as behavioral intervention technologies or health-oriented consumer technology (e.g., self-trackers), we are particularly interested in active design solutions that foster wellbeing. These have in-built features or functionalities that foster wellbeing but serve otherwise a different overall goal (e.g., professional networks, email clients or video conferencing tools).

The literature study consolidated work from three major disciplines: (a) HCI/design, (b) positive psychology and (c) behavioral science. Each discipline has significant contributions to make to design for sustained wellbeing but also has its own, specific focus. Positive psychology explores how individuals can become and stay lastingly happier [2–5]. Previous research suggests that this is not an easy undertaking but typically requires effort to initiate and maintain positive changes to one's daily routines and activities [2,4,45]. Behavioral science, in turn, provides well-studied taxonomies of strategies that can be applied to help people change their behavior for the better (see [46]

for an overview). However, these strategies have mostly been studied in the context of specific domains, such as physical and mental health, as well as sustainability, e.g., keeping a nutritious diet, exercising regularly [47,48], managing a chronic disease [49] or changing recycling behavior [50]. While it is undoubtedly worthwhile to improve people's behavior in these domains, there are many additional activities known to contribute to the wellbeing of individuals and society that are usually not in the focus of behavioral science, e.g., trying to become a kinder and more understanding person, practicing to look at the bright side of every situation and pursuing meaningful personal goals [3]. Finally, HCI/design has gained a thorough understanding of people's experiences when handling designed artefacts [11,51–53], e.g., how to make product interactions pleasurable, engaging and aesthetically pleasing. This knowledge is crucial when attempting to support any kind of behavior (change) through design. Despite this rich knowledge and the potential for collaboration, synergies and shared efforts between disciplines are scarce so far [24,30].

In a previous empirical study [25], we investigated how physical (e.g., sports equipment, household items) and digital products (e.g., social networks, communication services, meditation apps) shape a variety of wellbeing determinants and (sustained) wellbeing outcomes. In order to understand the pathways from specific product attributes to (sustained) wellbeing, qualitative laddering interviews [54] were conducted. Laddering constitutes a combined interviewing and data analysis technique that aims to identify means–end chains (MEC), i.e., hierarchical sequences (the so-called "ladders") consisting of product attributes, perceived consequences and personal values within the interview data [54]. Reports of twelve participants and a total of 115 individual product experiences (related to 36 personal products and one meditation app used by all participants) were analyzed using (qualitative) content analysis and several steps of (quantitative) data aggregation as advised for the laddering method [54,55]. The interview probed for past product experiences. All captured data are thus based on retrospective self-reports. With regard to emotional experiences, i.e., the affective component of wellbeing, it is important to note that this kind of memory-based assessment might rather reflect beliefs about one's emotions than details of the original emotional experience. Robinson and Clore [56] provided an in-depth discussion of potential biases related to emotional self-reports depending on different reporting conditions. For further details on the empirical study, we refer the reader to the original paper [25].

During content analysis, recurring themes (i.e., categories) were identified based on the interview data. Whenever possible, category definition and terminology were adopted from established theoretical frameworks. For each product experience, we further captured whether reported increases in wellbeing were momentary (short-term) or persisted over longer periods of time (long-term). This categorization was performed based on self-reports. For instance, if participants indicated that a product helped them to change their behavior in a sustainable way, e.g., by supporting them to establish a habit (e.g., regular meditation practice) or by leading to a lasting change in perspective (e.g., through self-reflection), we classified the impact as long-term. If participants reported one-time increases in wellbeing that did not persist or brief moments of pleasure derived from product usage, we coded this as short-term. Again, assessing the temporal dynamics of psychological effects through self-reported data may be subject to biases (e.g., memory effects, lack of awareness) and results should thus be interpreted with caution.

Figure 2 depicts the original MEC (left), an adapted version of an MEC (middle) and a specific example (right) from the laddering study. In the example shown in Figure 2, the participant reported about her experience using a meditation app. The app provides clearly structured meditation packages (i.e., clear rules) that differ in terms of theme and duration. This clear structure helped the participant to get a good overview of the available content and to decide efficiently (i.e., ease of use) which session to take on a particular day—depending on what is important to her in that moment and how much time she has to practice meditation. Consequently, she was not overwhelmed with the decision-making process (i.e., competence) and felt encouraged to engage herself in meditation (i.e., taking care of the body and mind). The meditation exercise itself helped her to accomplish her personal goal to feel calmer

and more relaxed (i.e., relaxation) and thus to derive a sense of inner peace (i.e., comfort). The first two steps of the adapted MEC (from bottom to top), i.e., concrete product attributes (1) and experience qualities (2), specify technology-based mechanisms that increase a person's motivation (3) to engage in an activity (4) which, in turn, are in line with intrapersonal orientations, e.g., goals, needs and values (5), and thus ultimately affect wellbeing (6).

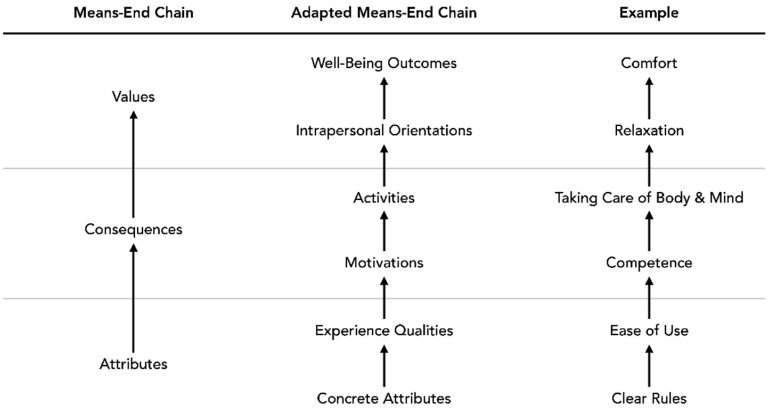

Figure 2. Means–end chain, MEC (**left**), adapted MEC used in the laddering study (**middle**) and example MEC (**right**); visualization adapted from Wiese et al. [46,57].

To arrive at the current framework, the six different levels of the adapted MEC (see Figure 2) were hypothesized to form the main stages of the framework. Prominent (i.e., the most frequent) elements within each stage were included in a first version of the framework. Since the framework is thought to describe ingredients of, and pathways to, sustained wellbeing promoted by technology, we only considered elements that were linked to long-term wellbeing outcomes. A total of 95% of these pathways included positive activities. We therefore conceptualize positive activities as being at the heart of design for sustained wellbeing and the key determinant in the current framework (see Figure 1).

The resulting taxonomy of interaction patterns (i.e., concrete attributes, experience qualities), wellbeing determinants (motivations, activities, intrapersonal orientations) and wellbeing outcomes had two shortcomings: it was (a) too granular and (b) based on a small participant sample. In a last step, we thus leveraged input from the laddering study again with the literature and iteratively refined the framework structure and taxonomy of elements within each stage. Upon further inspection, the first (i.e., product properties), the second (i.e., experience qualities) and the third stage (i.e., motivations) were not well differentiated. For instance, clear rules, classified as product properties in the example above, represent a combination of true properties, i.e., structured meditation packages, and experienced qualities, i.e., clear. Another example is rewards which were classified as motivations but rather represent a mechanism that fosters motivation. When reviewing taxonomies of behavior change techniques [46,57], that were initially not included in the literature study, it became apparent that they overlap significantly with concepts identified at the first three levels of the extracted MECs in the laddering study but are at the same time distinct from product properties and experience qualities.

We therefore added *mechanisms* as a separate element to the first pillar of the framework (Figure 1). Specifically, the way these mechanisms were implemented (=*product properties*) in a specific product, e.g., in the form of visuals, functions and interactive elements, resulted in nuanced user experiences (=*UX qualities*), e.g., were perceived as exciting, appealing or surprising, which moderated their effectiveness to motivate action. It is thus the interplay of mechanisms, product properties and UX qualities that determines the overall effect of the direct product interaction on individuals' behavior. Furthermore, when revisiting behavior change models, we realized that effects of interacting with a product (initially classified as motivations) not only comprised motivational aspects but also ways to facilitate and/or trigger wellbeing-enhancing activities. We therefore introduced a

dedicated stage, i.e., drivers of behavior, that is based on prevalent behavior change models [57,58] and comprises psychological and/or context factors that determine whether (any kind of) behavior is performed. Intrapersonal orientations subsumed factors that describe why a certain activity is linked to wellbeing, i.e., because they are in accordance with an individuals' personal goals, needs and values. When revisiting the literature on positive activities, we noticed that other factors (apart from needs) mediate the relationship between those activities and wellbeing, e.g., positive behaviors, thoughts and feelings that can be stimulated by positive activities [18]. We therefore decided to extend the framework with these aspects. Results and implications of this iterative process are presented below (Section 3.2) and depicted in Figure 1.

3.2. Framework Structure

As discussed above, the link from product interactions to sustained wellbeing is not clear-cut but thought to involve several, also indirect, routes [7,13,23–25]. The current framework introduces a multi-stage process from product interaction (1), drivers of behavior (2), positive activities (3) and positive experiences (4) to sustained wellbeing (5).

The main trajectory (bold lines, highlighted in grey) runs from product interaction to positive activities to wellbeing. The effects of interacting with a designed artefact support specific positive activities that are, in turn, linked to sustained wellbeing. The framework explicitly posits positive activities as a central bridging factor. The intermediary pillars (dashed outlines in Figure 1), in turn, mediate the relationships between the three main pillars: Firstly, *drivers of behavior* comprise psychological factors influenced by design and context factors that determine whether an activity is performed, and secondly, *positive experiences* encompass intrapersonal consequences of engaging in (product-supported) activities which ultimately lead to wellbeing. Put differently, while product interaction, positive activities and sustained wellbeing constitute stages that define the what, i.e., what is designed and what to achieve, drivers of behavior and positive experiences represent stages of the how, i.e., they mediate how stages to and from positive activities are connected.

The process can be conceived as a logical, interdependent chain of determinants and outcomes. Each stage is a determinant/consequence of the following/previous stage. Stages 3 and 4 represent direct wellbeing determinants based on the literature. Stages 1 and 2 describe how products affect these determinants.

3.3. Framework Stages

The following section describes the framework stages in more detail. Since the framework is centered around positive activities, we start with these activities and outline how they are linked to sustained wellbeing, i.e., we focus first on the right-hand side of the framework (positive activities → positive experiences → sustained wellbeing). We then explain how positive activities can be stimulated by designed artefacts, i.e., we address the left-hand side of the framework in reversed order (positive activities ← drivers of behavior ← product interaction).

The relations on the right-hand side of the framework are well-established in the literature of positive psychology. We do not intend to validate this part of the framework empirically but rely on the literature instead. The first part of the chain integrates insights from the three disciplines: HCI/design, behavioral science and positive psychology. This integration of knowledge is novel in two ways: (a) we combine distinct framework stages from different disciplines and thereby outline a unifying process direction to sustained wellbeing. Secondly (b), we take an exploratory approach to study the many different ways in which designed artefacts can shape behavior and detail promising categories/components in the respective stages.

3.3.1. Positive Activities

Positive activities are at the core of the framework. The main reason for positioning them at the center is their reported link to sustained wellbeing in the literature ([4,5] for recent meta-analyses).

The sustainable happiness model [2] postulates that individuals' wellbeing is not only determined by genetic predispositions or life circumstances but, to a certain extent, also by deliberate engagement in wellbeing-enhancing activities. This implies that we are, at least in part, in control of our own wellbeing by choosing which activities we engage in on a regular basis. The model originally claimed that 50% of inter-individual differences in wellbeing can be attributed to genetics, 10% to life circumstances and 40% to intentional positive activities. Even though recent research has shown that the effect of positive activities on wellbeing might be less substantial than initially assumed [59,60], the broader premise that positive activities pose one of the most promising pathways to sustained wellbeing is still believed to hold [61]. Consistent with this premise, in the laddering study, 95% of long-term wellbeing effects that were brought about by technology were linked to positive activities [25]. We therefore view technology to be an important medium in fostering wellbeing-increasing activities. With regard to the three postulated determinants of wellbeing according to the sustainable happiness model, they can also be perceived as an evolving part of our life circumstances that pave the way for activity-supportive design promoted by modern technologies. It is therefore the interaction of both determinants, i.e., life circumstances, and activities that can be shaped through design [31].

However, not any kind of activity holds the potential to increase wellbeing in a sustainable way. Research has identified specific categories of positive activities and strategies that embody this quality and are based on empirical evidence, i.e., shown to be effective in positive psychological intervention studies [3–5]. Positive activites are aimed at cultivating positive behavior, positive feelings and positive cognition [4]. Each category of positive activities listed in Table 1, e.g., practicing acts of kindness, contains a large set of potential activities, e.g., taking the dog of a sick friend for a walk, share overheard compliments, get groceries for an elderly neighbor or surprise your loved one with a small note.

For maintaining engagement in positive activities, it is beneficial to have a good fit with a person's interests, values and lifestyle [18]. An outgoing person might benefit from activities that involve other people, e.g., volunteering, whereas an introverted person may thrive when performing contemplative or reflective activities, e.g., loving-kindness meditation. In order to enhance wellbeing, these activities typically need to be performed intentionally and require repeated or habitual practicing [18,45,61]. What is needed to become and stay happier, it seems, is that people strive to continuously create engaging, satisfying, connecting and uplifting positive experiences [61]. With (digital) technologies having pervaded numerous areas of our professional and personal lives, design can and perhaps even should facilitate such experiences.

A comprehensive taxonomy of positive activities is provided by Lyubomirsky [3]. She describes twelve categories of positive activities that have been shown to be effective (see Table 1). Activities that were found to be supported by products in the empirical study [25] overlapped to a signficant degree with this taxonomy; five out of seven product-mediated activities matched Lyubomirsky's classification. One additional activity that we observed in the study and that has also reportedly shown to enhance sustained wellbeing in the literature [21,22] is "contributing to the greater good". Furthermore, for a better differentiation, we decided to split the activity "taking care of your body and mind" as defined by Lyubomirksy [3] into two separate activities, i.e., "taking care of your body" and "taking care of your mind", considering that we found distinct pathways leading up to these types of positive activities in the laddering study. As a result, 14 different categories of positive activities were considered for the framework. Seven of these activities were both based on theory and empirical data. The remaining seven activities were solely derived from theory. To investigate whether all 14 activities can potentially be supported by design, we conducted an informal exploratory online study with a convenience sample of $n = 54$ participants who were digital literate. Each participant was interviewed about four or five out of fourteen positive activities that they reported to engage in on a regular basis, resulting in a total of 252 individual user narratives. For each of the selected activities, participants were asked to think of products that were involved in these activities and to describe these products and/or their features in as much detail as possible. Our findings suggest that there is no reason to discard any of the activities since designed artefacts were found to support all of them

in one way or another. Consequently, we include 14 (categories of) positive activities as promising determinants of sustained wellbeing promoted by technology. These activities cover a broad range of life domains (see Table 1).

Table 1. Wellbeing-enhancing activities [3,21,22] supported by designed artefacts (including examples of digital technologies).

Positive Activity	Definition [1]	Digital Technologies
1. Express Gratitude	Express gratitude for what you have and/or convey your appreciation to one or more individuals whom you have never properly thanked.	Host ratings (AirBnB), seller feedback (eBay, Etsy), endorsements (Yammer), "Say Thanks" videos (Facebook), gratitude apps (e.g., Grateful)
2. Cultivate Optimism	Imagine the best possible future for yourself and/or practice to look at the bright side of every situation.	Listen to encouraging music, watch inspiring documentaries, journaling
3. Avoid Social Comparison	Attempt to cut down on how often you compare yourself to others.	Reduce passive browsing on social networks, set time limits, "You're All Caught Up" (Instagram)
4. Avoid Overthinking	Attempt to cut down on how often you dwell on your problems.	Reduce obsessive information seeking ("Doctor Google")
5. Practice Acts of Kindness	Do good things for others, whether friends or strangers, either directly or anonymously, either spontaneously or planned.	Encouraging kind comments on social media platforms
6. Nurture Social Relationships	Work on a relationship in need of strengthening, and/or invest time and energy in healing, cultivating, affirming and enjoying it.	Communication with friends (WhatsApp), joining a local community (e.g., Facebook), team collaboration (e.g., Slack), "Online Movie Nights" (Netflix), online dating platforms, video calls
7. Develop Strategies for Coping	Learn or practice ways to endure or surmount a recent stress, hardship or trauma.	Managing a chronic disease with an app, online therapy, online forums, self-help groups on social media, "School of Life" (educational videos)
8. Learn to Forgive	Work on letting go of anger and resentment towards one or more individuals who have hurt or wronged you.	Journaling, notetaking
9. Increase Flow Experiences	Increase the number of experiences at home or at work in which you "lose" yourself, which are challenging or absorbing.	"Mute" notifications, white noise apps, online hackathons, adaptive learning platforms (e.g., Coursera)
10. Savoring	Pay close attention, take delight and go over life's momentary pleasures and wonders—through thinking, writing, drawing or sharing with another.	"Your Upcoming Trip" (AirBnB), "Rediscover The Day" (Google photos), "Memories", "On This Day"(Facebook), journaling apps
11. Commit to One's Goals	Select significant goals that are meaningful to you and/or devote time and effort to pursuing them.	Time management (e.g., Trello), budget planning
12. Take Care of One's Body	Take care of your body, e.g., exercise, keep a healthy diet.	Running apps, nutrition apps, activity trackers
13. Take Care of One's Mind	Meditate, relax, laugh and get plenty of rest	Meditation apps (e.g., Headspace), sleep trackers
14. Contribute to the Greater Good	Giving back to society, e.g., protect the environment, support one's local community, volunteering, charitable giving	Eco-friendly shopping, offset carbon emissions for flights or online purchases, "Birthday Fundraiser" (Facebook)

[1] Definitions adapted from the Berkeley Greater Good Science Center (https://ggsc.berkeley.edu/).

It is not our aim to merely create digital or online versions of specific positive psychological interventions from research studies, e.g., present written instructions to "write a gratitude letter" in an app (see also work on behavioral intervention technologies for mental health, e.g., [62]). Instead, we understand positive activities as the overarching patterns that underlie the concrete manifestations of positive psychological interventions. In other words, positive activities are everyday activities and strategies that range across different life domains and that have theoretical and empirical support regarding beneficial effects on people's happiness [3]. We also do not want to limit design efforts to dedicated solutions that have the primary function to support wellbeing-enhancing activities, e.g., meditation apps. Instead, we see great potential in technology-based forms of positive activities that make use of platforms and products with a different primary function (see also [29,63]). (Re)designing (existing) technology with wellbeing principles in mind can reach more people and can do so in a context-sensitive manner [7]. For instance, the activity "expressing gratitude" can be performed by "endorsing a colleague" in a professional network (e.g., Microsoft Yammer) or by "leaving a positive rating" for one's AirBnB host. Reminiscence, an aspect of savoring, can be fostered by "sharing meaningful past experiences" with a group of friends via a social network or by the "On this Day" feature on Facebook. Further technology-based examples of positive activities are provided in Table 1.

We acknowledge that the set of positive activities proposed in this framework does not necessarily represent an exhaustive list and might need to be extended in the future. It is also important to bear in mind that most technologies listed in Table 1 were neither developed nor evaluated with respect to wellbeing. Furthermore, they support variations of the original interventions that were thoroughly tested with regard to efficacy. Without further evaluation, it remains unclear whether these versions of positive activities will have the same beneficial effects on wellbeing. Despite this limitation, we believe that the examples listed in Table 1 provide a valuable source of inspiration for how positive activities can be incorporated into everyday technology.

To summarize, the third stage in the framework encompasses wellbeing-increasing activities that can be promoted by design. These activities represent a set of behavioral, cognitive and emotional strategies that are fairly simple and can be integrated in everyday practices [2,3,21,22].

3.3.2. Positive Experiences

Positive experiences mediate the relationship between positive activities and sustained wellbeing [18]. More precisely, positive activities stimulate (a) further positive behaviors, (b) positive thoughts, (c) positive emotions and (d) the fulfilment of basic psychological needs which, in turn, boost wellbeing. For instance, Frederickson et al. [64] showed that meditation (i.e., "taking care of one's mind") increases people's daily experiences of *positive emotions* which leads to improved personal resources such as social relationships and physical health. These gains in personal resources then ultimately bring about increases in wellbeing. Other positive activities such as "practicing gratitude" prompt an individual to *think* about life *in a more positive way* [65] which again results in higher levels of wellbeing. "Practicing gratitude" also stimulates further *positive behaviors* such as exercising more [66] which then promotes wellbeing through improved physical health. In a similar vein, charitable behavior (i.e., "contributing to the greater good") reportedly *satisfies* people's *needs* for relatedness and ultimately increases both hedonic and eudaimonic wellbeing [67].

Other examples of positive experiences that can result from positive activities are reflected in the list of wellbeing determinants specified in the positive computing framework [29,63], e.g., increased levels of self-awareness, gratitude, mindfulness, empathy, compassion, altruism and resilience. Calvo and Peters [29] (p. 85) suggested to use these determinants as starting points for wellbeing design efforts and list examples of strategies (including positive activities) that could inform design. While very similar in its approach, the current framework proposes to focus the design process directly on the activities that lead up to those positive experiences, i.e., to go one step back in the logical chain presented in Figure 1. There are several advantages of this approach: First, activities are more tangible and concrete than experiences and mindsets at the "positive experience" level. They typically follow

a clearly defined structure that can guide design strategies in a more actionable way, e.g., "listing three good things" or "writing thank you notes" as examples of "practicing gratitude", or "setting realistic goals" as a way to support "committing to one's goals". Second, positive activities are more closely linked to the product interaction itself, i.e., further on the left in the proposed framework. It is therefore easier to determine how concrete design decisions (stage 1) affect drivers of behavior (stage 2) and thus ultimately foster engagement in an activity (stage 3). Focussing on the left-hand side of the logical chain when designing for sustained wellbeing also facilitates measurement along those pathways. More specifically, we hypothesize that respondents can attribute effects at the activity level (e.g., how often they are practicing the activity or how much they enjoyed the activity) more easily to specific interface components, e.g., how effectively the technology reminded them to practice or to which extent it triggered their interest in the activity. Third, effects at the activity level will manifest earlier than effects at the positive experiences level as those typically take time to build up. For instance, we can evaluate how often a person engages in a positive activity shortly after adopting a specific technology or new feature, e.g., how often they communicate in a kind (vs. unkind) way on social media platforms. Whether a kinder way of communicating strengthens their relationships with others and makes them feel more connected to their friends and family (in the long run) may not become apparent immediately but takes some time to establish.

3.3.3. Sustained Wellbeing

Sustained wellbeing represents the ultimate design goal in the proposed framework. One reason positive activities are thought to have such favorable, longer-lasting effects on individuals' wellbeing is related to a phenomenon called "hedonic adaptation" [68]. Researchers have observed that even after very desirable changes in people's lives, e.g., winning the lottery [69], getting married [70] or starting a new job [71], the initial boost in happiness cannot be maintained. On the contrary, people seem to revert to their individual happiness baseline level, i.e., are as happy as they were before these positive events took place. Different from changes in one's life circumstances, individuals adapt to positive changes related to activities less quickly since activities are naturally more transient and can be practiced in various ways [2]. While activities slow down adaptation processes for longer, they cannot inhibit them altogether. This is mainly related to decreased positive emotions resulting from an activity over time and increased aspirations after experiencing initial gains in wellbeing [72,73]. Consequently, the attempt to maintain increases in wellbeing over extended periods of time, i.e., sustained wellbeing, needs to counterbalance hedonic adaptation processes [72–74], and continued engagement in wellbeing-enhancing activities [18].

Established wellbeing theories and frameworks in psychology can be divided into two broader groups, i.e., (a) subjective or hedonic wellbeing [8,75] and (b) psychological or eudaimonic wellbeing [10,76,77]. This distinction stems from hedonistic (e.g., Aristippus, Bentham, Mill) and eudaimonic philosophical traditions (e.g., Aristotle, Nichomachean Ethics, 4th century BCE/1985) that make different assumptions on what constitutes a "good life". The hedonistic perspective considers striving for pleasure and an enjoyable life as the ultimate goal. However, while positive emotions can lead to beneficial outcomes such as increased creativity, more satisfying social relationships and better physical health (see [78] for a review), research has shown that focusing excessively on the positive and trying to achieve happiness above all else can be counterproductive, e.g., promote risk-taking behavior or even have detrimental effects, e.g., decrease happiness overall due to higher expectations [79]. Eudaimonic philosophers have long argued that it takes more than being happy to live a full life. They equate wellbeing with a state of self-actualization and the fulfillment of human potential.

In accordance with these philosophical viewpoints, hedonic or subjective wellbeing is conceptualized as experiencing frequent positive and infrequent negative affect and evaluating one's life as good overall [8,75]. Psychological or eudaimonic wellbeing comprises six aspects of self-actualization: autonomy (i.e., being self-determined and independent in thought and action),

personal growth, self-acceptance, life purpose, mastery (i.e., working towards and reaching meaningful personal goals) and positive relationships with others [10,77].

Most wellbeing researchers agree that both ingredients of wellbeing are necessary in order for individuals to flourish [41]. In their view, subjective and psychological wellbeing are not mutually exclusive but rather complementary psychological functions [41]. Accordingly, Dolan [80] (p. 3) defines wellbeing as the combination of "*experiences of pleasure and purpose over time*". Both hedonic and eudaimonic aspects of wellbeing are considered in the proposed framework and were found to be fostered by design in previous empirical work [25].

3.3.4. Drivers of Behavior

However, how do people change their daily routines and their lives for the better? Behavioral science offers a wealth of knowledge on this question. In the behavioral change literature, we can find a plethora of models describing the antecedents of behavior (change). According to the influential COM-B model [57], any kind of behavior occurs through the interplay of three basic components: (a) capability, i.e., a person's psychological and physical capacities to perform the behavior, (b) motivation, i.e., intrapersonal processes, including goals, values and deliberate decision making, that stimulate behavior and (c) opportunity, i.e., external or context factors that enable or prompt behavior. These three components can be further subdivided into more fine-grained drivers of behavior. For example, for the motivation component, the equally popular stages of change model [81] subdivides individuals in five categories that represent different "levels of motivational readiness". Since individuals at the same stage should face similar problems and barriers [82], designers of technology should take these stages into consideration when promoting a particular activity [83].

Along similar lines, Fogg [58] posed that three factors must be present at the same time to evoke a specific behavior: (a) motivation, (b) ability and (c) a trigger. Motivation and ability are interrelated in an indirect proportional manner, i.e., lower ability requires higher motivation and vice versa. Triggers are particularly effective if a person's ability outweighs their motivation. The COM-B model and the Fogg behavior model overlap significantly regarding the assumed basic components of behavior. A given technological intervention might change one or more components in the behavioral system. These components also provided a concise way of classifying the activity-promoting effects of the direct product interaction observed in our earlier laddering study [25].

The framework thus subdivides the stage "drivers of behavior" into three components, namely (a) *capability*, (b) *motivation* and (c) *opportunity*, as specified by the COM-B model [57]. Drivers of behavior thus comprise the set of psychological and context factors that determine whether an activity is actually performed. For a given activity in a given context, it provides a way of identifying how far changing particular components or combinations of components could promote the desired activity.

In the proposed framework, drivers of behavior are conceptualized to be activated by specific mechanisms during the product interaction (stage 1).

3.3.5. Product Interaction

Wellbeing design frameworks emphasize the activity-supporting role technology can take to foster sustained wellbeing, e.g., they can "stimulate", "facilitate" or "inspire" activities (e.g., [7]). In other words, they can foster capabilities, motivation and opportunities as defined by the second stage in the framework. However, most existing wellbeing design frameworks do not specify the exact mechanisms by which technologies can accomplish that [13,23,24]. The framework proposed here explicitly addresses such links, and we list a multitude of such mechanisms based on theoretical and empirical insights in Table 2.

In our framework, *mechanisms* represent specific ways, processes or techniques to stimulate psychological and contextual drivers of behavior. Typical—and much-used—examples of such mechanisms are feedback, coercion, rewards, goal setting, priming and social support (see Table 2). Mechanisms are realized through combinations of product properties and user experience (UX)

qualities (see Figure 1) and are therefore directly related to the technology and the product interaction. *Product properties* refer to observable or tangible aspects of a technology such as colors, visuals, icons, images, functions, typography and interactive elements like controls, gestures or alerts. *UX qualities* reflect a person's subjective perceptions while interacting with a technology, i.e., how the technology and its attributes are experienced by an individual [51–53,84]. According to ISO 9241-210 [84], these perceptions include affective and cognitive reactions, e.g., beliefs, preferences as well as behavioral responses. Hassenzahl [52] differentiated hedonic UX qualities, i.e., how pleasant/enjoyable it is to interact with a technology, from pragmatic UX qualities, i.e., how efficient and easy it is to use a technology, illustrating direct links to drivers of behavior. Desmet and Hekkert [53] conceptualized UX qualities as consisting of three sub-components: (a) product aesthetics, i.e., the extent to which a product delights or irritates the human sensory system, (b) product emotions, i.e., positive and negative emotions evoked by a product, and (c) product meaning, i.e., semantic interpretations or associations ascribed to a product.

Table 2. Mechanisms rooted in behavior change and positive psychology literature as well as in empirical findings from Wiese et al. [25].

Mechanism	Goal?	Literature	Examples
Education	Enhance knowledge and understanding needed to perform the activity [2]	Michie et al. [46,57]	Mood tracking, metaphors
Training	Support a person to build up necessary skills to perform the activity [2]	Michie et al. [46,57]	Teach meditation techniques through tutorial videos
Persuasion	Use communication to prompt positive or negative feelings or trigger the activity [2]	Michie et al. [46,57]	Daily affirmations or mantras provided by a meditation app
Rewards	Provide positive incentives (e.g., material, social) for showing effort and/or progress in performing the activity [2]	Michie et al. [46,57]	Receive supportive comments for a post in a special interest social media group
Modeling	Introduce a role model to aspire to or imitate [2]	Michie et al. [46,57]	Personally introduce the teacher in a meditation app
Goal setting	Define favorable (e.g., specific, realistic, intrinsic) goals related to performing the activity [2]	Michie et al. [46,57] Sheldon and Elliot [85]	Break goals down into subgoals with the help of checklists (e.g., Trello)
Action planning	Support detailed planning of the activity, e.g., duration, frequency, context, intensity [2]	Michie et al. [46,57] Schwarzer [86]	Structure activity in different (learning) modules
Feedback	Provide (helpful, informative) feedback on the performance of an activity [2]	Michie et al. [46,57]	Indicate progress and achievements, e.g., through badges, levels, etc.
Monitoring	Provide opportunity to track and record the outcomes of an activity [2]	Michie et al. [46,57]	Provide opportunity to track frequency, duration and/or outcome of an activity, e.g., through timelines, dashboards, statistics, etc.

Table 2. *Cont.*

Mechanism	Goal?	Literature	Examples
Social support	Provide support or praise from close social contacts for performing the activity [2]	Michie et al. [46,57] Lyubomirsky and Layous [18]	Practice meditation together with a "meditation buddy"
Prompts/Cues	Define a stimulus to prompt/cue the activity [2]	Michie et al. [46,57]	Reminders, notifications
Variation [3]	Allow to practice the activity in varied ways	Sheldon et al. [72] Lyubomirsky and Layous [18] Bao and Lyubomirsky [73]	Themed meditation packages
Frequency, Timing [4]	Allow to adjust frequency and duration of the activity	Lyubomirsky and Layous [18]	Create training schedules and/or choose duration of a training session
Personal relevance	Allow to align the activity with a person's goals and values	Lyubomirsky and Layous [18]	Personalization, customization, offer a broad variety of content, modules, etc., to choose from
Early positive reactivity	Early onset of pos. emotions after starting to practice an activity	Cohn and Frederickson [87] Lyubomirsky and Layous [18] Proyer et al. [88] Diefenbach [30]	Make activity fun or playful, e.g., by adding humor, visually appealing design
Efficacy beliefs	Promote a person's belief in their ability to perform the activity	Lyubomirsky and Layous [18] Schwarzer [86] Bandura [89]	Differentiate beginners vs. expert levels

[2] Descriptions are based on definitions formulated by Michie et al. [46,57] and the BCT website [90]; [3] originally called "variety" by Lyubomirsky and Layous [18]; [4] originally called "dosage" by Lyubomirsky and Layous [18].

In the context of the framework, product properties and UX qualities together shape mechanisms that drive human behavior, i.e., positive activities: any mechanism is implemented into a technology by means of specific product properties that the designer is in control of. For instance, in order to support a person to keep track of their daily calorie intake (=mechanism), a designer can ask them to (a) enter the amount of calories manually as numeric values, (b) make them select the food items they consumed from a predefined list or (c) let them scan the bar code on the product package to automatically register the respective amount of calories (=product properties). Depending on the chosen implementation, the interaction may be perceived as more or less efficient, engaging, pleasant or appealing (=UX qualities) and motivate or facilitate (=drivers of behavior) engagement in the positive activity of "taking care of one's body" to varying degrees.

We consider mechanisms from both behavioral science as well as from positive psychology to be relevant for our framework. When attempting to foster positive change through digital technologies, these need to be translated into "technological features" or "interaction patterns" by choosing a specific implementation (=product properties) that ultimately determines how a mechanism is experienced by the individual (=UX qualities). One and the same mechanism can thus have nuanced effects on the individual, based on the chosen technological realization—including negative outcomes. One example of such negative outcomes is Facebook's "On This Day" feature that reminds users of past experiences they have shared on their timeline. While this can serve as a prompt (=mechanism) for savoring in the case of positive experiences, the feature also inappropriately forces painful memories about personal losses and traumatic events upon users without their consent ("algorithmic cruelty"). So, despite good intentions, designers cannot necessarily assume that their designs will result in the intended positive effects which calls for thorough evaluation.

The behavioral science literature offers extensive taxonomies of mechanisms shown to be effective in promoting behavior change [46,57]. Some behavior change mechanisms have been studied in HCI before, e.g., effective ways to provide feedback and monitor behavior (e.g., [91]). For instance, ubiquitous technologies such as smartphones make it possible to provide positive feedback (=mechanism) right after

a user accomplished an activity-related goal leading to stronger feelings of competence (=motivation) and thus increased activity adherence.

Mechanisms rooted in behavioral science often focus on cognitive and educational strategies, but disregard emotional as well as motivational aspects of behavior change and long-term engagement [30,42–44]. Due to hedonic adaptation processes, long-term engagement is an important concern for sustaining wellbeing increases over time. For instance, a study by Diefenbach et al. [92] showed that participants stopped using self-improvement technologies mainly because they did not feel motivated in the right way by the technology but instead perceived it as bossy, demanding or too dominant.

We argue that behavior change techniques can be complemented by emotional and motivational mechanisms rooted in (positive) psychology. A number of variables were found to influence the effectiveness of positive psychological interventions [18,73,74]. On the one hand, there are characteristics of the activity itself that moderate its success, e.g., practicing an activity in diverse ways, with different people or in combination with other activities (i.e., variation), choosing an activity that resonates with a person's value system (i.e., personal relevance), practicing at the appropriate frequency and timing and receiving encouraging feedback by close others (i.e., social support). For instance, Sheldon et al. [74] found that performing different acts of kindness increased individuals' level of wellbeing more substantially than repeatedly engaging in the same kind acts. On the other hand, there are intrapersonal variables that moderate the effects of positive activities on wellbeing, e.g., a person's affective state (i.e., positive emotions) and their perceived capacity to perform an activity (i.e., efficacy beliefs). For instance, a fast and strong increase in positive emotions after an attempt for positive change (i.e., early positive emotional reactivity) was shown to be a valid predictor of long-term adherence to the corresponding intervention [87,88]. These findings can inform design decisions in such a way that technological realizations of these mechanisms ideally facilitate, motivate or trigger (stage 2) engagement in positive activities. For instance, social support can be implemented in the form of "likes" for having completed an activity or by encouraging the user to choose a partner to practice the activity with. Depending on the specific user and the context, these implementations will be perceived as more or less helpful or encouraging and thus make the user feel connected to others to differing degrees [76]. In the laddering study, participants reported that variation in the themes of meditation packages and the option to decide for how long and how frequently they wanted to practice meditation enabled them to adapt their meditation sessions to their current needs and integrate them flexibly into their daily lives, i.e., context sensitivity). Table 2 shows the most prevalent mechanisms that are based on theory and were empirically found to be linked to (digital) products in the laddering study [25]. Since this list is based on empirical data from a small sample of participants and products, it potentially needs to be expanded in the future.

It should be noted that the relationship between components in the first stage depends on the chosen perspective. From a design point of view, the designer may first decide on the mechanism (e.g., provide feedback) to next determine the properties (e.g., a timeline, a dashboard or a notification) by which they will make the mechanisms work. However, from a users' point of view or when analyzing an existing interactive technology, one may first describe the properties to discover the mechanisms applied. For the visualization of the framework, we chose the latter perspective.

3.4. Relationships between Stages

As outlined above, the five stages can be understood as a logical, interdependent process linking product interaction and their immediate effects to a series of wellbeing determinants (i.e., activities, positive experiences) and wellbeing outcomes. The proposed direction runs from left to right, i.e., each stage influences the next. The final stage is wellbeing itself. We therefore understand the general tendency of direct technology involvement—and therefore the potential to predict its effect—to decrease from left to right. In addition, we postulate an underlying temporal continuum from short-term (left) to rather long-term (right) effects in the framework. Short-term

determinants, e.g., direct product experiences, can serve as early predictors for later (i.e., long-term outcomes) such as positive experiences from the activity. Thereby, stages further on the left are more tangible/concrete and more directly under the influence of a designer than stages further on the right.

Even though the logical direction of the process is thought to proceed from the product interaction to sustained wellbeing, i.e., from left to right, we acknowledge the occurrence of feedback loops and effects in the opposite direction. For instance, indirect positive experiences (stage 4), e.g., higher levels of competence or self-esteem resulting from engagement in wellbeing-enhancing activities (stage 3), may increase a person's motivation (stage 2) to practice the activity. Lastly, we acknowledge that the strength of relationships between individual aspects along the five stages, i.e., individual pathways, depend on (a) the activity type and (b) the stage of behavior change, e.g., whether an activity is supposed to be initiated or maintained. For instance, cues or prompts represent important mechanisms to initiate an activity, while rewards or social support are potentially more relevant for adherence to an activity. In a similar vein, activities such as savoring might only need a reminder or trigger to be practiced more frequently, while other activities such as developing strategies for coping potentially require more extensive skill building.

4. Discussion

Frameworks can make three major contributions to the field of HCI: they can (a) advance the understanding of a phenomenon, (b) illustrate ways to design for it and (c) provide opportunities to measure it. In this section, implications of the current framework will be drawn for each of these areas.

4.1. Understanding Technologies' Contribution to Sustained Wellbeing

The framework promotes the understanding of technologies' contribution to sustained wellbeing in multiple ways. It argues for positioning positive activities as the stepping stone from product interaction to sustained wellbeing and introduces related mediating factors, i.e., drivers of behavior and positive experiences. It thereby deconstructs the complex phenomenon of wellbeing by design into a process of five stages and specifies logical relations between them. In addition, the framework positions these factors on a continuum of short- and long-term effects.

Furthermore, the framework discriminates different components/elements within each stage that inform the field of HCI/design, e.g., which positive activities to support or possible mechanisms to apply to foster engagement in these activities. Such tangible information has been largely missing in existing wellbeing design frameworks [24,39]. Distinguishing between a mechanism itself (e.g., prompt), its specific implementation in a given technology (=product properties, e.g., push notification) and how this implemented or technological mechanism is perceived by an individual (=UX qualities, e.g., helpful, annoying, patronizing) fosters cross-disciplinary understanding and consistent use of terminology. Mechanisms in the first stage are based on the literature study and our own empirical findings, but it is possible that the list presented in Table 2 will be expanded in further studies and applications. In a similar vein, elements within the remaining stages may need to be extended or revised in the future as well.

More (design) research is required to establish the nuanced relationships between individual elements across the different stages. Based on the literature in positive psychology and our own empirical findings, we have reasons to believe that such nuanced pathways across stages exist. For instance, the laddering study [23] has shown that in order to foster strategies for coping, individuals need to develop appropriate skills (i.e., capability) to do this effectively, whereas activities aimed at contributing to the greater good can rather be promoted by appealing to an individual's set of personal values (i.e., motivation). Once a deeper understanding of individual pathways is achieved, it can be used to derive targeted design strategies.

4.2. Designing for Sustained Wellbeing

Theoretical conceptualizations need to be translated into hands-on design strategies that can be applied efficiently in academic and industrial settings in order to create real-world impact. Most existing wellbeing design frameworks provide relatively loose guidance by specifying determinants of (sustained) wellbeing that can be tackled by design (e.g., [6,29]). Oftentimes, these frameworks remain descriptive and do not explain how exactly a particular (set of) determinant(s) can be addressed in the design process, nor what brings about or mediates an intended psychological effect. While descriptive frameworks are useful due to their simplicity and inspirational potential, they are harder to transform into concrete action in everyday design practice. For this reason, we developed a framework that outlines the process from design to wellbeing with its intermediary stages. This basic yet detailed overview will hopefully equip designers to (a) devise clearer design goals, e.g., which determinant to design for and how to design for it, and (b) make more educated predictions regarding the intended impact of their designs at different points in time.

Furthermore, theoretical wellbeing design frameworks often propose to foster ingredients further on the right through design, e.g., mindfulness or empathy [29] and psychological needs [11], within positive experiences or wellbeing outcomes directly, e.g., pleasure, personal significance and virtue [6]. We argue that the design process does not always need to address the whole chain but can focus on positive activities to ultimately bring about lasting changes in wellbeing. More generally, we propose that design for sustained wellbeing can tackle any stage in the proposed framework. Starting from the targeted stage, the designer can follow the flow backwards to the direct product interaction (i.e., from right to left) to determine how to influence this stage through design. In order to facilitate and guide this process, we added more granular information on how to shape each stage, e.g., which types of activities evidently increase wellbeing (stage 3), what drives human behavior in general (stage 2) and how behavior can be shaped through specific mechanisms (stage 1).

In our view, a design strategy consists of at least four parts: (a) which positive activity to foster, e.g., acts of kindness, (b) which driver of behavior to influence, e.g., motivation, (c) which (combination of) mechanism(s) to apply, e.g., modeling, and (d) how to implement these mechanisms, e.g., social media post showing a friend donated money for a good cause. One can further widen the scope by integrating specific positive experiences of stage 4 in the design goal, which could, in turn, influence the choice and implementation of mechanisms. Once we gain a better understanding of the nuanced pathways between individual elements across stages, the outlined approach to design can become even more targeted.

4.3. Measuring Sustained Wellbeing in Relation to Products

Design research and practice alike would benefit from assessment strategies to capture a technology's impact on wellbeing. Measuring long-term effects of technology usage is, however, not an easy endeavor. Established measurement scales for the assessment of short-term pleasure and positive emotions evoked by products in direct product interactions exist (e.g., PrEmo, [93]; AttrakDiff, [94]; Aesthetic Pleasure in Design Scale, [95]). In contrast, less attention has been paid on how to measure long-term wellbeing effects (beyond pleasure) associated with technology-supported experiences and activities [6,96].

Klasnja et al. [97] described major obstacles when evaluating digital technologies aimed at fostering sustained behavior change in the context of HCI. First, changing one's behavior might take a considerable amount of time [98]. Consequently, long-term effects related to technology-supported changes in behavior may only manifest years from when a person initially started using a technology. Second, becoming lastingly happy is not a straightforward process but involves setbacks and relapses. Multi-year, longitudinal studies including repeated follow-ups are required to reliably capture long-term effects. Third, in order to demonstrate that changes in wellbeing can be attributed to one particular technology, intervention studies, ideally with randomized controlled trails, need to be performed. This evaluation method, where participants are randomly allocated to different

intervention or control conditions, is commonly applied in behavioral science to prove that a specific health-related intervention has been effective. However, within HCI, this is often not feasible, especially when evaluating early or novel technologies, e.g., due to fast-paced product development cycles (see also [39]). Fourth, for designers of technologies, it is not only important to know that a product contributed to sustained increases in wellbeing but also why and how. This includes gaining a thorough understanding of how the respective technology is used, which experiences it elicits and which barriers hinder adoption of or engagement with the technology [39]. HCI researchers [24,39] therefore call for the development of alternative measurement approaches to study long-term effects of technology usage on individuals' behavior and wellbeing.

Based on the specified relations within the framework, we propose a rationale for assessing long-term wellbeing effects of technology usage that attempts to overcome existing measurement challenges. The basic idea that we would like to promote here is to measure short-term predictors (i.e., stages 2 and 3) rather than long-term effects (stage 4) and wellbeing outcomes (stage 5) directly. We can infer these effects according to the logical relations mapped out in the framework. For instance, we can explore to which extent a given feature (e.g., a reminder in the form of a push notification) triggers participants' interest (i.e., opportunity) to start their daily meditation practice (i.e., positive activity). Determining whether a technology triggers or motivates a desired behavior (stage 2) can be assessed real time, i.e., either while interacting with the technology or in a short time interval after the interaction took place. Evaluating whether continuous engagement in wellbeing-enhancing activities through design makes a person more grateful, optimistic or prosocial over time (stage 4) requires, by contrast, longer measuring intervals and multiple check-ins. Real-time assessment of short-term predictors may also reduce measurement biases related to retrospective (memory-based) assessment of wellbeing outcomes including emotional experiences [56]. They are further under the direct control of the designer which makes insights derived from measurement more actionable. Lastly, we argue that the closer an entry point to the measurement is to the direct product interaction (i.e., the further to the left in the framework), the easier it is for a respondent to attribute a probed effect to using (aspects of) a particular technology. Consequently, we consider stages 2 and 3 to be especially well-suited as starting points for measurement. Although there is a chance that positive experiences and wellbeing might not be supported in the end, we consider this to be a suitable approach for early stages of product development.

With regard to selecting and optimizing design strategies, an opportunity for measurement is thus to assess how a specific implementation of a mechanism is perceived by an individual, e.g., if a technology teaches skills (i.e., training mechanism) in an efficient and comprehensive way, helps to plan the activity (i.e., action planning = mechanism) in a way that fits into one's daily life or to which extent a designed feedback feature (=mechanism) makes the product appear to be optimally challenging. This approach can be used to compare early prototypes that feature a specific mechanism in different ways. At the activity level (stage 3), we can measure the level of engagement (e.g., frequency, duration, immersion) with a target activity. For a more complex technology, we can also assess to which extent a product promotes each of the 14 categories of positive activities, e.g., how much a social networking platform fosters acts of kindness, optimistic thinking, nurturing social relationships or contributing to the greater good.

Once the feature or technology has been matured and rolled out, products' impact on sustained wellbeing should also be measured directly at the wellbeing level (stage 5) or at the level of positive experiences (stage 4). For both options, designers can draw from established and validated measurement scales in positive psychology. For different aspects within stage 4, such scales would, for instance, assess a person's level of gratitude (e.g., Gratitude Questionnaire [99]), mindfulness (e.g., Mindfulness Attention Awareness Scale [100]) or empathy (e.g., Empathy Quotient [101]). For the components within stage 5, measurement tools that capture hedonic wellbeing, e.g., Satisfaction with Life Scale [102] and Affect Balance Scale [103], and eudaimonic wellbeing, e.g., Scales of Psychological Wellbeing [10,104], can be used. As outlined above, measuring long-term wellbeing effects (stages 4–5) is associated

with a number of challenges—especially in relation to products and within fast-paced product development cycles.

In sum, assessment of short- and long-term effects along the process described in the proposed framework poses valuable entry points to measure technology-supported sustained wellbeing. In design practice, short-term effects (stages 2 and 3) might be more suitable when a technology is still being built and refined (i.e., in the early stages of product development), while long-term measurement options become more relevant once the technology is fully rolled out to track its actual impact on sustained wellbeing. In design research, both advance our understanding of whether and how precisely (novel as well as existing) technologies impact people's wellbeing.

5. Conclusions

Positive activities are at the centerpiece of this framework for wellbeing by design. These activities broadly cross major life domains and are quite specific at the same time. They cover a rich set of targets for designers while being reliable predictors of sustained wellbeing. We find this to be a promising combination of broad applicability and refined actionability.

The framework integrates and organizes knowledge from multiple disciplines that is typically scattered across a wealth of publications. In doing so, it makes this broad knowledge more accessible to designers and reduces some of the conceptual and terminological obscurities that we observed in the literature. We hope this will help designers to approach projects with more clarity, to systematically explore pathways, and possibly inspire interdisciplinary collaboration. Ultimately, our framework could contribute to a designed world that fosters the wellbeing of future generations.

Author Contributions: Conceptualization, L.W., A.E.P., P.H.; methodology, L.W., A.E.P., P.H.; investigation, L.W.; data curation, L.W.; writing—original draft preparation, L.W.; writing—review and editing, A.E.P., P.H.; visualization, L.W.; supervision, A.E.P., P.H.; project administration, L.W.; funding acquisition, L.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by brands4friends/Private Sale GmbH, Berlin.

Acknowledgments: The authors thank Michael Speek for his assistance in examining the potential of all activity categories. The authors further thank the reviewers for their very useful comments.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Seligman, M.E.P. *Flourish: A Visionary New Understanding of Happiness and Well-Being*; Free Press: New York, NY, USA, 2011.
2. Lyubomirsky, S.; Sheldon, K.M.; Schkade, D. Pursuing happiness: The architecture of sustainable change. *Rev. Gen. Psychol.* **2005**, *9*, 111–131. [CrossRef]
3. Lyubomirsky, S. *The How of Happiness: A Scientific Approach to Getting the Life You Want*; Penguin Press: New York, NY, USA, 2007.
4. Sin, N.L.; Lyubomirsky, S. Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *J. Clin. Psychol.* **2009**, *65*, 467–487. [CrossRef] [PubMed]
5. Bolier, L.; Haverman, M.; Westerhof, G.J.; Riper, H.; Smit, F.; Bohlmeijer, E. Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health* **2013**, *13*, 119. [CrossRef] [PubMed]
6. Desmet, P.M.A.; Pohlmeyer, A.E. Positive design: An introduction to design for subjective well-being. *Int. J. Des.* **2013**, *7*, 5–19.
7. Pohlmeyer, A.E. How design can (not) support human flourishing. In *Positive Psychology Interventions in Practice*; Proctor, C., Ed.; Springer International Publishing: Cham, Switzerland, 2017; pp. 235–255.
8. Kahneman, D. Objective happiness. In *Well-Being: The Foundations of Hedonic Psychology*; Kahneman, D., Diener, E., Schwarz, N., Eds.; Russell Sage Foundation: New York, NY, USA, 1999; pp. 3–25.

9. Diefenbach, S.; Kolb, N.; Hassenzahl, M. The "Hedonic" in Human-Computer Interaction: History, Contributions, and Future Research Directions. In Proceedings of the 2014 Conference on Designing Interactive Systems (DIS'14), Vancouver, BC, Canada, 21–25 June 2014; ACM: New York, NY, USA; pp. 305–314.
10. Ryff, C.D. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *J. Pers. Soc. Psychol.* **1989**, *57*, 1069–1081. [CrossRef]
11. Hassenzahl, M.; Diefenbach, S.; Göritz, A. Needs, affect, and interactive products—Facets of user experience. *Interact. Comput.* **2010**, *22*, 353–362. [CrossRef]
12. Desmet, P.; Hassenzahl, M. Towards Happiness: Possibility-Driven Design. In *Human-Computer Interaction: The Agency Perspective. Studies in Computational Intelligence*; Zacarias, M., de Oliveira, J.V., Eds.; Springer: Berlin/Heidelberg, Germany, 2012; Volume 396, pp. 3–27.
13. Pohlmeyer, A.E. Design for happiness. *Interfaces* **2012**, *92*, 8–11.
14. Richins, M.L.; Dawson, S. A consumer values orientation for materialism and its measurement: Scale development and validation. *J. Consum. Res.* **1992**, *19*, 303–316. [CrossRef]
15. Kasser, T. *The High Price of Materialism*; MIT Press: Cambridge, MA, USA, 2002.
16. Carter, T.J.; Gilovich, T. Getting the most for the money: The hedonic return on experiential and material purchases. In *Consumption and Well-Being in the Material World*; Tatzel, M., Ed.; Springer: Dordrecht, The Netherlands, 2014.
17. Nicolao, L.; Irwin, J.R.; Goodman, J.K. Happiness for sale: Do experiential purchases make consumers happier than material purchases? *J. Consum. Res.* **2009**, *36*, 188–198. [CrossRef]
18. Lyubomirsky, S.; Layous, K. How do simple positive activities increase well-being? *Curr. Dir. Psychol. Sci.* **2013**, *22*, 57–62. [CrossRef]
19. Lyubomirsky, S. Why are some people happier than others? The role of cognitive and motivational processes in well-being. *Am. Psychol.* **2001**, *56*, 239–249. [CrossRef] [PubMed]
20. Seligman, M.E.P.; Steen, T.A.; Park, N.; Peterson, C. Positive psychology progress: Empirical validation of interventions. *Am. Psychol.* **2005**, *60*, 410–421. [CrossRef] [PubMed]
21. Dunn, E.; Aknin, L.; Norton, M. Spending money on others promotes happiness. *Science* **2008**, *319*, 1687–1688. [CrossRef] [PubMed]
22. Borgonovi, F. Doing well by doing good. The relationship between formal volunteering and self-reported health and happiness. *Soc. Sci. Med.* **2008**, *66*, 2321–2334. [CrossRef]
23. Fokkinga, S.; Hekkert, P.; Desmet, P.; Özcan, E. From product to effect: Towards a Human-Centered Model of Product Impact. In Proceedings of the 6th Design Research Society Conference (DRS'14), Umea, Sweden, 16–19 June 2014; pp. 71–83.
24. Peters, D.; Calvo, R.A.; Ryan, R.M. Designing for motivation, engagement and wellbeing in digital experience. *Front. Psychol.* **2018**, *9*, 797. [CrossRef]
25. Wiese, L.; Pohlmeyer, A.; Hekkert, P. Activities as a Gateway to Sustained Subjective Well-Being Mediated by Products. In Proceedings of the 2019 Conference on Designing Interactive Systems (DIS'19), San Diego, CA, USA, 23–28 June 2019; ACM: New York, NY, USA; pp. 85–97.
26. Kuss, D.; Griffiths, M.; Karila, L.; Billieux, J. Internet addiction: A systematic review of epidemiological research for the last decade. *Curr. Pharm. Des.* **2014**, *20*, 4026–4052. [CrossRef]
27. Burke, M.; Marlow, C.; Lento, T. Social Network Activity and Social Well-Being. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'10), Atlanta, GA, USA, 10–15 April 2010; ACM: New York, NY, USA; pp. 1909–1912.
28. Keles, B.; McCrae, N.; Grealish, A. A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. *Int. J. Adolesc. Youth* **2020**, *25*, 79–93. [CrossRef]
29. Calvo, R.A.; Peters, D. *Positive Computing: Technology for Well-Being and Human Potential*; The MIT Press: Cambridge, MA, USA, 2014.
30. Diefenbach, S. The potential and challenges of digital well-being interventions: Positive technology research and design in light of the bitter-sweet ambivalence of change. *Front. Psychol.* **2018**, *9*, 331. [CrossRef]
31. Pohlmeyer, A.; Desmet, P. From good to the greater good. In *Routledge Handbook of Sustainable Product Design*; Chapman, J., Ed.; Routledge-Taylor & Francis Group: London, UK, 2017; pp. 469–486.
32. Riva, G.; Baños, R.M.; Botella, C.; Wiederhold, B.K.; Gaggioli, A. Positive technology: Using interactive technologies to promote positive functioning. *Cyberpsychol. Behav. Soc. Netw.* **2012**, *15*, 69–77. [CrossRef]

33. Hassenzahl, M.; Eckoldt, K.; Diefenbach, S.; Laschke, M.; Lenz, E.; Kim, J. Designing moments of meaning and pleasure. Experience design and happiness. *Int. J. Des.* **2013**, *7*, 21–32.
34. Seligman, M.E.P.; Csikszentmihalyi, M. Positive psychology. An introduction. *Am. Psychol.* **2000**, *55*, 5–14. [CrossRef] [PubMed]
35. Sheldon, K.M.; Elliot, A.J.; Kim, Y.; Kasser, T. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *J. Pers. Soc. Psychol.* **2001**, *80*, 325–339. [CrossRef] [PubMed]
36. Ryan, R.M.; Deci, E.L. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* **2000**, *55*, 68–78. [CrossRef] [PubMed]
37. Ryan, R.M.; Deci, E.L. *Self-Determination Theory: Basic Psychological Needs in Motivation Development and Wellness*; Guilford Press: New York, NY, USA, 2017.
38. Klapperich, H.; Laschke, M.; Hassenzahl, M. The Positive Practice Canvas: Gathering Inspiration for Wellbeing-Driven Design. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction (NordiCHI'18), Oslo, Norway, 1–3 October 2018; ACM: New York, NY, USA; pp. 74–81.
39. Hekler, E.B.; Klasnja, P.; Froehlich, J.E.; Buman, M.P. Mind the Theoretical Gap: Interpreting, Using, and Developing Behavioral Theory in HCI Research. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'13), Paris, France, 27 April–2 May 2013; ACM: New York, NY, USA; pp. 3307–3316.
40. Huta, V.; Waterman, A.S. Eudaimonia and its distinction from hedonia: Developing a classification and terminology for understanding conceptual and operational definitions. *J. Happiness Stud.* **2014**, *15*, 1425–1456. [CrossRef]
41. Huta, V. An overview of hedonic and eudaimonic well-being concepts. In *The Routledge Handbook of Media Use and Well-Being: International Perspectives on Theory and Research on Positive Media Effects*; Reinecke, L., Oliver, M., Eds.; Routledge-Taylor & Francis Group: New York, NY, USA, 2017; pp. 14–33.
42. Conroy, D.E.; Yang, C.H.; Maher, J.P. Behavior change techniques in top-ranked mobile apps for physical activity. *Am. J. Prev. Med.* **2014**, *46*, 649–652. [CrossRef]
43. Hollis, V.; Konrad, A.; Whittaker, S. Change of Heart: Emotion Tracking to Promote Behavior Change. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'15), Seoul, Korea, 18–23 April 2015; ACM: New York, NY, USA; pp. 2643–2652.
44. Yang, C.-H.; Maher, J.P.; Conroy, D.E. Acceptability of mobile health interventions to reduce inactivity-related health risk in central Pennsylvania adults. *Prev. Med. Rep.* **2015**, *2*, 669–672. [CrossRef]
45. Lyubomirsky, S.; Dickerhoof, R.; Boehm, J.K.; Sheldon, K.M. Becoming happier takes both a will and a proper way: An experimental longitudinal intervention to boost well-being. *Emotion* **2011**, *11*, 391–402. [CrossRef]
46. Michie, S.; Richardson, M.; Johnston, M.; Abraham, C.; Francis, J.; Hardeman, W.; Eccles, M.P.; Cane, J.; Wood, C.E. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Ann. Behav. Med.* **2013**, *46*, 81–95. [CrossRef]
47. Michie, S.; Williams, S.; Sniehotta, F.; Dombrowski, S.; Bishop, A.; French, D. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychol. Health* **2011**, *26*, 1479–1498. [CrossRef]
48. Bull, E.R.; McCleary, N.; Li, X.; Dombrowski, S.U.; Dusseldorp, E.; Johnston, M. Interventions to promote healthy eating, physical activity and smoking in low-income groups: A systematic review with meta-analysis of behavior change techniques and delivery/context. *Int. J. Behav. Med.* **2018**, *25*, 605–616. [CrossRef]
49. Cradock, K.; ÓLaighin, G.; Finucane, F.; McKay, R.; Quinlan, L.; Ginis, K.; Gainforth, H. Diet behavior change techniques in type 2 diabetes: A systematic review and meta-analysis. *Diabetes Care* **2017**, *40*, 1800–1810. [CrossRef] [PubMed]
50. Gainforth, H.; Sheals, K.; Atkins, L.; Jackson, R.; Michie, S. Developing interventions to change recycling behaviors: A case study of applying behavioral science. *Appl. Environ. Educ. Commun.* **2016**, *15*, 325–339. [CrossRef]
51. Jordan, P.W. *Designing Pleasurable Products: An Introduction to the New Human Factors*; Taylor & Francis: London, UK, 2000.
52. Hassenzahl, M. The thing and I: Understanding the relationship between user and product. In *Funology: From Usability to Enjoyment*; Blythe, M., Overbeeke, K., Monk, A., Wright, P., Eds.; Kluwer Academic Publishers: Norwell, MA, USA, 2005; pp. 31–42.

53. Desmet, P.; Hekkert, P. Framework of product experience. *Int. J. Design* **2007**, *1*, 57–66.
54. Reynolds, T.J.; Gutman, J. Laddering theory, method, analysis, and interpretation. *J. Advert. Res.* **1988**, *28*, 11–31.
55. Gutman, J. A means-end chain model based on consumer categorization processes. *J. Mark.* **1982**, *46*, 60–72. [CrossRef]
56. Robinson, M.D.; Clore, G.L. Belief and feeling: Evidence for an accessibility model of emotional self-report. *Psychol. Bull.* **2002**, *128*, 934–960. [CrossRef]
57. Michie, S.; van Stralen, M.M.; West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implement. Sci.* **2011**, *6*, 42. [CrossRef]
58. Fogg, B. A behavior model for persuasive design. In Proceedings of the 4th International Conference on Persuasive Technology (Persuasive '09), Claremont, CA, USA, 26–29 April 2009; ACM: New York, NY, USA; pp. 1–7.
59. Brown, N.J.L.; Rohrer, J.M. Easy as (happiness) pie? A critical evaluation of a popular model of the determinants of well-being. *J. Happiness Stud.* **2020**, *21*, 1285–1301. [CrossRef]
60. White, C.A.; Uttl, B.; Holder, M.D. Meta-analyses of positive psychology interventions: The effects are much smaller than previously reported. *PLoS ONE* **2019**, *14*, e0216588. [CrossRef]
61. Sheldon, K.M.; Lyubomirsky, S. Revisiting the sustainable happiness model and pie chart: Can happiness be successfully pursued? *J. Posit. Psychol.* **2019**, 1–10. [CrossRef]
62. Mohr, D.C.; Burns, M.N.; Schueller, S.M.; Clarke, G.; Klinkman, M. Behavioral Intervention Technologies: Evidence review and recommendations for future research in mental health. *Gen. Hosp. Psychiatry* **2013**, *35*, 332–338. [CrossRef] [PubMed]
63. Calvo, R.A.; Peters, D. Design for Wellbeing—Tools for Research, Practice and Ethics. In Proceedings of the Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (CHI EA'19), Glasgow, Scotland, UK, 4–9 May 2019; ACM: New York, NY, USA; pp. 1–5.
64. Fredrickson, B.L.; Cohn, M.A.; Coffey, K.A.; Pek, J.; Finkel, S.M. Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. *J. Pers. Soc. Psychol.* **2008**, *95*, 1045–1062. [CrossRef] [PubMed]
65. Dickerhoof, R.M. Expressing Optimism and Gratitude: A Longitudinal Investigation of Cognitive Strategies to Increase Well-Being. Ph.D. Thesis, University of California, Riverside, CA, USA, 2007.
66. Emmons, R.A.; McCullough, M.E. Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. *J. Pers. Soc. Psychol.* **2003**, *84*, 377–389. [CrossRef] [PubMed]
67. Jiang, J.; Zeng, T.; Zhang, C.; Wang, R. The mediating role of relatedness need satisfaction in the relationship between charitable behavior and well-being: Empirical evidence from China. *Int. J. Psychol.* **2018**, *53*, 349–355. [CrossRef]
68. Frederick, S.W.; Loewenstein, G. Hedonic adaptation. In *Well-Being: The Foundations of Hedonic Psychology*; Kahneman, D., Diener, E., Schwarz, N., Eds.; Russell Sage Foundation: New York, NY, USA, 1999; pp. 302–329.
69. Brickman, P.; Coates, D.; Janoff-Bulman, R. Lottery winners and accident victims: Is happiness relative? *J. Pers. Soc. Psychol.* **1978**, *36*, 917–927. [CrossRef]
70. Lucas, R.E.; Clark, A.E.; Georgellis, Y.; Diener, E. Reexamining adaptation and the set point model of happiness: Reactions to changes in marital status. *J. Pers. Soc. Psychol.* **2003**, *84*, 527–539. [CrossRef]
71. Boswell, W.R.; Boudreau, J.W.; Tichy, J. The relationship between employee job change and job satisfaction: The honeymoon-hangover effect. *J. Appl. Psychol.* **2005**, *90*, 882–892. [CrossRef]
72. Sheldon, K.M.; Lyubomirsky, S. The challenge of staying happier: Testing the hedonic adaptation prevention model. *Pers. Soc. Psychol. Bull.* **2012**, *38*, 670–680. [CrossRef]
73. Bao, K.J.; Lyubomirsky, S. Making happiness last: Using the hedonic adaptation prevention model to extend the success of positive interventions. In *The Wiley Blackwell Handbook of Positive Psychological Interventions*; Parks, A., Schueller, S., Eds.; John Wiley & Sons, Ltd.: Chichester, UK, 2014; pp. 371–384.
74. Sheldon, K.M.; Boehm, J.; Lyubomirsky, S. Variety is the spice of happiness: The hedonic adaptation prevention model. In *The Oxford Handbook of Happiness*; Oxford University Press: New York, NY, USA, 2013; pp. 901–914.
75. Diener, E. Subjective well-being. *Psychol. Bull.* **1984**, *95*, 542–575. [CrossRef]
76. Ryan, R.M.; Deci, E.L. On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annu. Rev. Psychol.* **2001**, *52*, 141–166. [CrossRef]

77. Ryff, C.D.; Singer, B.H. Know thyself and become what you are: A eudaimonic approach to psychological well-being. *J. Happiness Stud.* **2008**, *9*, 13–39. [CrossRef]
78. Lyubomirsky, S.; King, L.; Diener, E. The benefits of frequent positive affect: Does happiness lead to success? *Psychol. Bull.* **2005**, *131*, 803–855. [CrossRef] [PubMed]
79. Gruber, J.; Mauss, I.; Tamir, M. A dark side of happiness? How, when, and why happiness is not always good. *Perspect. Psychol. Sci.* **2011**, *6*, 222–233. [CrossRef] [PubMed]
80. Dolan, P. *Happiness By Design: Change What You Do, Not What You Think*; Hudson Street Press: London, UK, 2014.
81. Prochaska, J.; DiClemente, C. Stages of change in the modification of problem behaviors. *Prog. Behav. Modif.* **1992**, *28*, 183–218.
82. Nisbet, E.K.L.; Gick, M.L. Can health psychology help the planet? Applying theory and models of health behaviour to environmental actions. *Can. Psychol. Can.* **2008**, *49*, 296–303. [CrossRef]
83. Ludden, G.D.S.; Hekkert, P. Design for Healthy Behavior Design Interventions and Stages of Change. In Proceedings of the 9th International Conference on Design and Emotion 2014: The Colors of Care, Bogota, Colombia, 6–10 October 2014; pp. 482–488.
84. ISO 9241-210 (2019). Available online: https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en (accessed on 30 August 2020).
85. Sheldon, K.M.; Elliot, A.J. Goal striving, need satisfaction, and longitudinal well-being: The self-concordance model. *J. Pers. Soc. Psychol.* **1999**, *76*, 482–497. [CrossRef]
86. Schwarzer, R. Self-efficacy in the adoption and maintenance of health behaviors: Theoretical approaches and a new model. In *Self-Efficacy: Thought Control of Action*; Hemisphere Publishing Corp.: Washington, DC, USA, 1992; pp. 217–243.
87. Cohn, M.A.; Fredrickson, B.L. In search of durable positive psychology interventions: Predictors and consequences of long-term positive behavior change. *J. Posit. Psychol.* **2010**, *5*, 355–366. [CrossRef]
88. Proyer, R.T.; Wellenzohn, S.; Gander, F.; Ruch, W. Toward a better understanding of what makes positive psychology interventions work: Predicting happiness and depression from the person × intervention fit in a follow-up after 3.5 years. *App. Psychol. Health Well-Being* **2015**, *7*, 108–128. [CrossRef]
89. Bandura, A. Self-efficacy: Toward a unifying theory of behavioral change. *Psychol. Rev.* **1977**, *84*, 191–215. [CrossRef]
90. BCTs Taxonomy. Available online: http://www.bcts.23.co.uk/ (accessed on 21 May 2020).
91. Hermsen, S.; Frost, J.; Renes, R.J.; Kerkhof, P. Using feedback through digital technology to disrupt and change habitual behavior: A critical review of current literature. *Comput. Hum. Behav.* **2016**, *57*, 61–74. [CrossRef]
92. Diefenbach, S.; Niess, J.; Mehner, B. Technologies for self-improvement: The right communication between product and user. In *Technologies for Self-Improvement: The Right Communication between Product and User*; Meschtscherjakov, A., De Ruyter, B., Fuchsberger, V., Murer, M., Tscheligi, M., Eds.; Salzburg Center for Human-Computer Interaction, University of Salzburg: Salzburg, Austria, 2016; pp. 10–13.
93. Desmet, P. Measuring emotion: Development and application of an instrument to measure emotional responses to products. In *Funology: From Usability to Enjoyment*; Kluwer Academic Publishers: Boston, MA, USA, 2005; pp. 111–123.
94. Hassenzahl, M.; Burmester, M.; Koller, F. AttrakDiff: Ein Fragebogen zur Messung wahrgenommener hedonischer und pragmatischer Qualität. In *Mensch & Computer 2003. Interaktion in Bewegung*; Ziegler, J., Szwillus, G., Eds.; B.G. Teubner: Stuttgart, Germany, 2003; pp. 187–196.
95. Blijlevens, J.; Thurgood, C.; Hekkert, P.; Chen, L.-L.; Leder, H.; Whitfield, T. The Aesthetic Pleasure in Design Scale: The development of a scale to measure aesthetic pleasure for designed artifacts. *Psychol. Aesthet. Creat. Arts* **2017**, *11*, 86–98. [CrossRef]
96. Kamp, I.; Desmet, P.M.A. Measuring Product Happiness. In Proceedings of the Extended Abstracts of the 2014 CHI Conference of Human Factors in Computing Systems (CHI EA'14), Toronto, ON, Canada, 26 April–1 May 2014; ACM: New York, NY, USA; pp. 2509–2514.
97. Klasnja, P.; Consolvo, S.; Pratt, W. How to Evaluate Technologies for Health Behavior Change in HCI Research. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'11), Vancouver, BC, Canada, 7–12 May 2011; ACM: New York, NY, USA; pp. 3063–3072.
98. Prochaska, J.O.; Johnson, S.; Lee, P. The transtheoretical model of behavior change. In *The Handbook of Health Behavior Change*; Springer Publishing Co.: New York, NY, USA, 1998; pp. 59–84.

99. McCullough, M.E.; Emmons, R.A.; Tsang, J.-A. The grateful disposition: A conceptual and empirical topography. *J. Pers. Soc. Psychol.* **2002**, *82*, 112–127. [CrossRef] [PubMed]
100. Brown, K.W.; Ryan, R.M. The benefits of being present: Mindfulness and its role in psychological well-being. *J. Pers. Soc. Psychol.* **2003**, *84*, 822–848. [CrossRef] [PubMed]
101. Lawrence, E.J.; Shaw, P.; Baker, D.; Baron-Cohen, S.; David, A.S. Measuring empathy: Reliability and validity of the Empathy Quotient. *Psychol. Med.* **2004**, *34*, 911–919. [CrossRef] [PubMed]
102. Diener, E.; Emmons, R.; Larsen, R.; Griffin, S. The satisfaction with life scale. *J. Pers. Assess.* **1985**, *49*, 71–75. [CrossRef]
103. Bradburn, N.M. *The Structure of Psychological Well-Being*; Aldine: Oxford, UK, 1969.
104. Ryff, C.D.; Lee, C.; Keyes, M. The Structure of Psychological Well-Being Revisited. *J. Pers. Soc. Psychol.* **1995**, *69*, 719–727. [CrossRef]