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Fostering Shared Decision Making with Health Informatics Interventions Based on the Boosting Framework

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Abstract. The accumulation of medical knowledge, technology and expertise has provided people with more and more options to improve their health and increase longevity. However, healthcare options typically come with benefits as well as harms and often involve important and complex, high-stakes trade-offs. The ideal of Shared Decision Making (SDM), where a healthcare provider and a patient exchange information, bring in their respective professional and existential expertise and consider the options in light of what matters most from the patient's perspective, is a paradigm that is increasingly viewed as a gold standard for high quality care nowadays. eHealth provides ample opportunities to foster personal health choices and SDM through digital information exchange and personal values clarification support. The boosting framework attempts to describe how to foster people's competences to make choices. Its vision is to equip individuals with competences, for instance improved risk literacy, to empower them to make well-informed choices when facing a difficult choice, such as decisions about health issues. Application of the boosting framework to personal health choices and the SDM process unveils new and promising horizons for future research and could inform the design and evaluation of health informatics interventions such as decision support systems.

Keywords. Personal Health Choices, Shared Decision Making (SDM), Decision Psychology, Boosting, Patient Decision Aids (PtDAs)

Learning objectives

After reading this chapter, the reader will be able to:

1. Understand how people's competence to make their own choices can be fostered according to the boosting framework.
2. Understand how the boosting framework can be applied to design and evaluate health decision support interventions, such as patient decision aids.
3. Understand the challenges and opportunities of the boosting framework in the context of health decision support design and evaluation.

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1. Fostering personal health choices and shared decision making: The boosting framework

Our health and well-being are affected by the choices we make and our ability to act in accordance with those choices. In this chapter, we focus on the competences people need to make and implement personal health choices that align with their values and life goals, and how health informatics interventions can foster those competences. The ultimate aim is to empower people to take a more active role in making choices that can help them to live a healthy and happy life. More specifically, we will focus on shared decision making (SDM): the joint decision-making process through which a patient and his or her healthcare provider exchange information and make a health choice about for example a medical treatment or test [e.g., 1].

SDM is increasingly receiving attention in theorizing about health care practice and is nowadays often viewed as the gold standard, most importantly because of its ethical imperative. However, its implementation in everyday healthcare practice is lagging behind [e.g., 2]. In this chapter, we focus on how health informatics interventions can "boost" the competences of patients and health care providers to make and implement better health choices that align with what matters to the patient. A core assumption in our chapter is that if we want to optimize the effectiveness of health informatics interventions, it is essential to understand the core competences needed to engage in SDM, as well as how to enhance those competences. We focus on a relatively new theoretical framework that is currently gaining traction in psychological science: the boosting framework [3]. Boosting has the potential to inform the design of health informatics interventions by explicating guiding principles for identifying and supporting the competences people need in order to put the widely embraced ideal of SDM into practice.

Boosting aims to empower people in decision making (i.e., to make more beneficial personal choices) by enhancing people's competences and knowledge, based on insights from behavioural science. It is often contrasted with nudging. To set the stage for the boosting framework in the domain of health informatics, we will first describe the concept of nudging before explaining the boosting framework in more detail. Although both approaches intend to change the way in which people behave and make decisions, with the ultimate aim of enhancing their well-being and health, they differ in several ways.

The nudging approach is based on insights from psychology and behavioural economics. With nudging, the choice architecture is changed in order to "nudge" (or gently push) people in the direction of what is considered the "best" option (e.g., the healthiest choice). Nudges change the choice architecture, without changing the reinforcement structure or excluding certain decision options [4]. This way, nudging is assumed to respect an individual's autonomy while making a choice. The nudging approach is based on a series of theoretical assumptions concerning human behaviour and decision making consistent with dual-process models [e.g., 5]. Those dual-process models share the general assumption that even though people are capable of rational and deliberate action, behaviour and decision making are mostly guided by automatic and error-prone psychological processes. Controlling or bypassing these automatic processes is possible, but it requires effort and is therefore considered to be the exception rather than the default process.

Nudging can be appropriate in situations where there is an objectively better option (e.g., quit smoking) and is less appropriate for many personal health care choices, where the "best option" can only be determined based on the physician's medical expertise and the patient's existential expertise. Nudging interventions use automatic processes by triggering automatic tendencies within the choice architecture that steer people towards the "right" direction. A classic example of nudging consists of the facilitation of healthy food choice. People have a strong and automatic preference for high calorie foods and the mere perception of such food items may trigger the automatic urge to buy and eat them. An intervention in canteens based on the nudging approach would place unhealthy products out of sight, even though these products would still be available (i.e., are not banned). Another example is changing the default option. Research has indicated that people tend to go along with the default, because it is easier, and it is pleasant to do what others do. Changing the default option may drastically change people's choices (e.g., the default to donate organs except when actively selecting opt-out). Interventions based on nudging have been widely and successfully used by various companies, organizations and governments. Nudging based Behavioural Insights Teams (BITs; also referred to as "Nudge Units") that assist companies and governments in achieving behaviour change have become increasingly popular the past ten years [e.g., 6].

The boosting framework has been recently introduced by Hertwig and colleagues [3]. It is based on the optimistic view that people are capable of learning new insights and skills. Whereas nudging focuses on changing people's automatic reactions within a specific setting, boosting aims to provide individuals with skills and competences that may help them across situations and time and potentially increases people's sense of autonomy [3]. Both boosting and nudging frameworks are not specific enough to refer to as a theory to explain specific phenomena, because it would entail to make very specific testable predictions in specific situations, whereas boosting and nudging are ways to approach behaviour change interventions. There are some assumptions within the frameworks that could be tested, and we refer to those ideas in the chapter (e.g., about well-being, long term effects), but these predictions are very general and not strong enough to warrant the label theory.

1.1. Theoretical background of boosting

According to the boosting framework, the human mind is malleable. The boosting framework acknowledges the bounds of the human decision maker, such as its vulnerability to cognitive biases and errors in e.g., risk assessment. Yet, it aims to identify existing competences and ways to foster them, for example through improving skills or knowledge, or by providing decision tools. Boosting's view of the human mind is "… that of an adaptive toolbox of ecologically rational heuristics." [3, p. 980].

The theoretical background for boosting is derived from various insights in decision making [e.g., 7]. At its core is the assumption that people's cognitive processes adapt to experiences and that they can rapidly learn to overcome potential errors. Several research traditions provide support for this idea. First, several scholars in decision making argue that human thought is based on experiences and subjective probability. That is, learned patterns may match emerging situations and thereby trigger behaviours that are relevant and useful in that situation [7]. Second, heuristics can be used as tools to make decisions, even under uncertainty. These heuristics help people to make smarter decisions because they are (generally) adaptive within the situation. These approaches largely converge with a Bayesian approach to decision making, in which people use priors (based on previous experiences and/or learning) to predict their environment (e.g., anticipated outcomes and associated experiences in a challenging decision task they are facing) on the basis of available information and resources. In this way people are often able to make smart decisions without elaborate deliberation, using intuitive processes that are based on learned patterns and relevant priors.

Boosts are tools that are based on this optimistic assumption that people have the capacity to learn, and support people in increasing their competence to make good decisions. These boosts can take various shapes, such as simply providing information (e.g., about illness); strategies to make information more easy to understand; tools or skills-training to help clarify the values of decision alternatives (e.g., how to integrate information according to your values); self-management skills (e.g., knowing when and how to act within treatment or revalidation; knowing how to make implementation intentions); social skills (e.g., how to approach another person during an important conversation) and others. These boosts can be domain specific (e.g., health information about a certain illness) or more general (e.g., strategies to improve statistical literacy). As we will explain in more detail in section 2, boosts can improve health related decisions. For example, these boosts increase competence by helping patients to understand risk information or to make decisions in line with one's core values.

1.2. Autonomy and well-being

Boosts make people more competent. Therefore, by definition, boosts are beneficial for the individual. In addition, increased competences have positive effects on psychological processes including motivation, autonomy and well-being. For example, improved knowledge enhances self-efficacy, i.e., the core belief in the ability to achieve self-relevant goals. Subsequently, people with high efficacy may display stronger motivation; e.g., persist longer in the face of obstacles [8]. More generally, this way, boosts may increase feelings of autonomy and well-being.

In contrast, autonomy is not fully respected in nudging. People are often not aware that they are being nudged. Instead, they depend on the good intentions of the "nudger", e.g., healthcare providers, the government, institutions and companies, acting as a so-called "benevolent dictator". The goals of nudgers are not necessarily consistent with the goals of the decision maker. This is crystal clear when nudging is used for commercial purposes, but even when the government or healthcare providers operate as nudgers, goals may not converge with the values of an individual, and hence, may have a negative impact on the well-being of those being nudged. Therefore, nudging may be considered the best approach only when 1) there is great consensus among individuals within society concerning the necessity of behaviour change and 2) individuals are not motivated or able to learn skills to change this behaviour [9].

When the values or preferences of individuals are highly heterogeneous and good choices fully depend on people's own values, boosting clearly outperforms nudging. In cases in which the values of the person are not known, nudging is like playing roulette, whereas boosting could help people to integrate their own values in a choice. Thus, as Hertwig [9] indicates, when individual values are at stake, boosting is strongly preferred to nudging. This is often the case in health-related decision making, where there is likely to be a balance between the benefits and harms of different options (decisional equipoise) and/or decisions are preference sensitive because of the variation of how people value attributes of different options. People may have strong feelings about decisions where the best option seems obvious, e.g., removing the contralateral breast in women with average breast cancer has no mortality benefit but an individual woman may still prefer it because she wants to feel balanced. Some scholars argue that all health decisions are potentially preference sensitive, implying that physicians should always consider the patient's perspective, even in cases of decisions about issues that may appear value-neutral at first glance [10].

Nudges are (mostly) restricted within the manipulated situation. That is, within the framework, there are no assumed spill-over effects of changes in one choice architecture to choices in other contexts. Even though nudges may potentially have a long-lasting effect within the manipulated context, such stable effects are rare, and unlikely as the behaviour will go back to the default mode when the nudge is removed from the situation.

1.3. Shared decision making (SDM)

Modern-day health care practice offers people an increasing amount of healthcare options, from preconception to end-of-life care. Advances in medical knowledge and health innovation have also resulted in increasingly complex decisions regarding personal health. Most (if not all) of us face some through personal health choices throughout our life courses. Not only do (preference-sensitive) medical decisions often involve high-stakes and trade-offs between potential benefits and harms of different options (such as between quantity and quality of life, or between treatment efficacy and treatment burden), as patients we also often face emotionally charged, unanticipated and novel situations. To optimize personal health choices, new information needs to be integrated with personal values, life goals and circumstances.

People vary widely in how they value the matters at stake in trade-offs. For each individual patient, the suitability of each of the medical treatment options depends on the individual patient's unique values, preferences and circumstances. This makes it essential to involve patients in the decisions that concern their life and well-being, as patients also indicate themselves – about 80% of people want to be actively involved in the medical decision-making process involving invasive medical procedures [11]. Another example that illustrates the need for more active patient engagement in treatment decision making comes from a recent study in the Netherlands, which revealed that one in three prostate cancer patients was dissatisfied with the amount of information they received about their treatment options [12]. Shared decision making is not only aimed at physical health, but also applies to mental health [13].

SDM is often characterized as a meeting between two experts: A medical and an existential expert. The medical expert, that is, the healthcare provider, can bring in professional expertise, such as information about the medical condition from which a patient is suffering, the medical treatment options for which a patient is eligible and the evidence about the pros and cons associated with those options, according to available medical evidence and the healthcare provider's own expertise. The existential expert, that is, the patient (and in some cases, such as in aged care, also their loved ones), can bring in information about his or her unique circumstances, personal values and (life) goals, which are essential for interpreting the medical evidence in light of what matters most from the patient's perspective. Even if a patient does not want to make a final decision, SDM can help a health care provider to make a decision that is sensitive to the patient's values and context. The ideal of SDM has been called "the pinnacle of patient-centered care" [14]. However, despite SDM being embraced as the gold standard, its implementation is lagging behind and health care practice still widely deviates from this norm. For example, in a study published in 2012, less than 50% of patients reported that their healthcare providers had considered their personal goals or concerns [15].

1.4. Using health informatics to foster personal health choices and the SDM process: The case of patient decision aids

One clear example where boosting applies to health informatics is the design of patient decision aids (PtDAs) aimed at supporting personal health choices and SDM. PtDAs are interventions that “support patients by making their decisions explicit, providing evidence-based information about options and associated benefits/harms, and helping clarify congruence between decisions and personal values” [16, page 1]. PtDAs can be used in preparation for the visit with a clinician, during the visit or individually by the patient, for example in the context of breast screening decisions. When used without input from the clinician, PtDAs aim to support informed choice rather than SDM per se. Even though, to the best of our knowledge, there is no existing case of a health informatics intervention aimed at fostering SDM that explicitly used the boosting framework to inform its design, many existing ways to foster SDM are consistent with the boosting framework. Throughout the remainder of this chapter, we will explicate how the boosting framework applies to existing cases and could be used to further inform future design of health informatics interventions aimed at fostering SDM.

In the eHealth era, information technology provides ample opportunities to unlock and share valuable information resources, such as information exchange and supporting patients and their healthcare providers in making well-informed medical decisions that align with what matters most for the person whose values are at stake: the patient. In other words, health informatics has the potential to boost decision making capacity. However, in order to be effective, health informatics interventions need to be well attuned to the way the human mind is wired and to the way the care process takes place. The boosting framework can support the design of health informatics interventions such as tailored text messages, online health information tools and PtDAs. Experimental research showed for instance that messages that were personalized (tailored) to the individual (“boosts”) led to a higher decrease in snacking consumption than non-tailored messages [17]. Research has also revealed that online health information tools are facilitating immediate, intermediate and long-term (including clinical) patient outcomes, even in older patients. In particular those tools that not only provide information, but also have self-management and/or information exchange functions, exactly the functions that can serve as boosts, seemed to be effective [18]. Although the majority of existing PtDAs are paper-based, not yet digital [16], the development of online PtDAs is rapidly increasing. Using online PtDAs has several benefits, including the possibility to provide personalized information, tailored to individual patient information needs and to be more interactive. Finally, the use of “big data” in patient and provider decision support allows to access and use vast amounts of data that have been collected for other purposes (such as cancer registry data) but may be valuable in the SDM context as well [19]. Recent research uses for instance prediction models based on “big data” to estimate personalized risks and outcomes, such as drug interactions, or treatment (side) effects.

For the design and evaluation of PtDAs, it is important to build on insights from relevant theories such as the boosting framework, to ensure that decision support interventions help their users to harness their decision pitfalls and to foster their decision competences [20]. This is especially important if a PtDA is intended to be used by a patient without the input of a clinician (e.g., to support cancer screening decisions) In section 1.5, we elaborate on the design of health informatics interventions which aim to inform patients about eligible healthcare options. In section 1.6, we elaborate on the design of values clarification methods in health informatics interventions.

1.5. Medical information provision through patient decision aids

In order to make well-informed medical decisions, the patient and the healthcare provider need access to medical information about the options to which a patient is eligible, including risk information. The vision behind the boosting framework aligns with this need: to equip individuals with competences, such as risk literacy competences, and hence, to empower them to make well-informed choices when facing a difficult personal choice.

A classic example of how the boosting framework may help to make better decisions and can inform the design of more effective ways to communicate risk information involves boosts that help to better understand medical risk information. Generally, patients as well as healthcare providers have difficulty understanding conditional probabilities [e.g., 21]. For instance, consider the conditional probabilities for breast cancer. Let's assume the base-rate (prevalence) to get breast cancer is one out of 100 women. The accuracy of a mammogram, an X-ray test to indicate whether a person has breast cancer, is about 80-90%. More specifically, the probability of the mammogram resulting in a positive test result when breast cancer is present (sensitivity) is 80%. The probability of the test result of the mammogram being negative when the disease is absent (specificity) is 90%. Now, a woman is tested positively on the X-ray test, what is the chance this woman has breast cancer? In other words, what is the positive predictive value of the mammogram, what is the probability that a patient has the disease when the test result is positive? Both healthcare providers and patients typically overestimate this chance and judge it to be around 75%, whereas the actual chance is much lower: It is only 7-8%. This is because people tend to neglect the base-rate. Gigerenzer and colleagues indicated that we could make these risks much more understandable for healthcare providers and patients by using natural frequencies rather than conditional probabilities. Risk information about breast cancer would then be explained in the following way: Out of 1000 women, 10 women will have breast cancer and 990 will not. Out of those 10 women who *do* have breast cancer, 9 will receive a positive result on the X-ray test and 1 will not (false negative). Out of the 990 women who *do not* have breast cancer, 99 will receive a positive result (false positive) and 891 women will receive a negative result. This way, it is more transparent to see the role of base-rates: many women *without* cancer are in fact *tested* positively. This approach to presenting risk information can be considered a boost, because by presenting risk information in terms of frequency information, the understanding of the information increases and therefore potentially the quality of decisions based on this information increases as well. In a similar way, illustrations, animations and videos can serve as boosts. Illustrations, in particular those supporting a text, are widely used to facilitate learning of information by improving comprehension and recall [22]. Adding videos to online texts, particularly personalized videos using a conversational narration style, also improves memory for medical information [22], and animations can even bridge the information processing gap between audiences with low and high health literacy [23].

1.6. Values clarification though patient decision aids

For the alignment of medical decisions to an individual patient's (often implicit) values and personal circumstances, patients need to clarify their personal values and preferences. This can be challenging. Moreover, potential outcomes and risks associated with the medical options to which a patient is eligible, can be hard to imagine or hard to verbalize, and the available options often involve important, high-stakes and highly personal trade-offs, such as those between quality and quantity of life, which cannot be solved in a straightforward manner. How much future quantity of life would you be willing to "trade" for a better quality of life right now, for example? Taking people's values into account is even more important for specific groups at risk, such as people with multimorbidities or older people, for whom no or limited clinical evidence is available. Guidelines for treatments are usually based on studies in which those groups were excluded [23], resulting in a lack of detailed information about the optimal treatment.

Some PtDAs do not only provide information, but also include additional content aimed at supporting patients to clarify their personal values and preferences: Values Clarification Methods (VCMs). Every tool that provides patients better insights about their values can be considered a boost, as these tools make participants more competent in processing and weighing their values. From a boosting perspective [3] it is important to systematically analyze which competences patients (and/or healthcare providers) are naturally possessing or lacking in this regard and to create tools (boosts) to augment or overcome these.

2. Explanation of success or failure in health informatics interventions for SDM

2.1. Success factors and failures of patient decision aid design and evaluation

The design and evaluation of most PtDAs is heavily informed by the International Patient Decision Aid Standards [IPDAS; 24]. The IPDAS collaboration is a group of international researchers, practitioners and stakeholders who have outlined a systematic process for PtDA development and evaluation, as well as specific recommendations, e.g., information presentation and values clarification methods (VCMs). It comes with a set of quality criteria and reporting standards to help ensure that PtDAs are of high quality, accurate and unbiased. This is essential because PtDAs can have an important influence on decisions made [16]. The IPDAS quality criteria are related to the following dimensions: 1) information provision, 2) presentation of outcome probabilities (risk communication), 3) clarifying and expressing values (VCMs), 4) decision guidance, 5) using a systematic development process, 6) using evidence, 7) disclosure and transparency (COI), 8) use of plain language, 9) and evaluation of PtDA effectiveness. The development process to a large extent builds on the Ottawa Decision Support Framework (ODSF) which is guided by expectancy value, decisional conflict, and social support theories, but is mostly consensus based [24]. It describes PtDA development as an iterative process which includes extensive involvement of and testing with patients and healthcare providers. The IPDAS recommendations and quality criteria draw on systematic reviews of available evidence, including those for information provision and risk communication and values clarification. These recommendations are currently being updated.

The state-of-the-art knowledge about the effectiveness of PtDAs to support people in making medical treatment or screening decisions is promising: an accumulating amount of research, including over 100 PtDAs studies across a variety of medical treatment and screening decisions, has showed that patient decision aids have been effective in improving people's knowledge, feelings of being well-informed and clarity about their personal values. The evidence is less clear with regard to other outcomes, but it appears likely that people who have been exposed to PtDAs also have more accurate knowledge of the benefits and harms associated with medical options and have been more actively involved in the decision making process. Also, there is some evidence suggesting that PtDAs may help people to make choices that are congruent with their personal values and preferences, but more research is needed in this area. PtDAs do not have adverse effects on health outcomes or patient satisfaction. More research is needed to determine if PtDAs help people receive and adhere to their chosen option [16] and if this results in, for example, better well-being and quality of life.

Even though the available evidence shows that the use of PtDAs has the potential to help people make better health decisions (in terms of better matching their values and preferences), more fine-grained understanding of the underlying processes is limited. Most studies so far have compared PtDAs to usual care rather than using a study design suitable to identify "active ingredients". This limits the extent to which evidence-based guidance for designing effective PtDAs can be formulated. A theory-based approach can help to further the field. In the past, VCMs for example have often been designed without clearly being rooted in theory [25]. This may have hampered VCM effectiveness and complicated transparent and coherent, systematic design and evaluation. Where theory has been used, debate followed about the appropriateness of theory for the design of VCMs [e.g., 20,26]. Similarly, there is a gap in the evidence base for risk communication in the context of PtDAs. For example, it is still unclear how we can tailor risk communication in the context of eHealth and interactive tools to individual needs and abilities. What are optimal risk communication formats for vulnerable groups, including those with lower health literacy, numeracy and/or graph literacy? Rooting the design of PtDAs (including VCMs and risk communication) in theory and providing a clear rationale on how the theory has informed PtDAs design, enables targeted tests of the underlying mechanisms and may ultimately help to uncover the "active ingredients" of PtDAs. Addressing this gap will require systematic testing of different information formats within the same PtDA.

2.2. Challenges and opportunities of the boosting framework in the context of health decision support design and evaluation.

Application of the boosting framework to personal health choices and the SDM process unveils new and promising horizons for future research and could inform the design and evaluation of health informatics interventions aimed at facilitating SDM, including PtDAs. In this section, we elaborate on the challenges and opportunities of the boosting framework in the context of health decision support design and evaluation.

The main opportunities of using the boosting framework in this context are the guidance it can provide to design and test health informatics interventions that fit the way the human mind is wired, so that the interventions are likely to be more user-friendly, useful and effective–and therefore also more likely to be implemented and used sustainably. Implementation of PtDAs, and more broadly speaking of SDM, in everyday healthcare has so far been a major challenge [e.g., 2]. In a recent study [27] investigating usage of a patient decision aid, observing a sample of more than 1000 patients diagnosed with prostate cancer, only about one in three eligible patients received a link to an online patient decision aid. Those who did receive a link to the decision aid, typically also accessed the decision aid online, utilized most of its content and functions, and discussed the decision aid summary in a follow-up consultation with their health care provider. Even though the overall implementation rate was low in this study, a wide variation in implementation rate (16-84%) was observed between hospitals. Even though the boosting framework may not be sufficient in overcoming the implementation challenge, it may provide some useful opportunities.

The main challenges of using the boosting framework in the context of fostering personal health choices and SDM with health informatics interventions, may very well exist in implicit or explicit resistance to adopting new roles in the patient/clinician encounter, on the part of patients as well as healthcare providers. For example, many patients do not dare to voice their preferences, needs or concerns, out of fear of being labelled a “difficult” patient [e.g., 28]. Healthcare providers may mistakenly assume that their patients do not want to or are not able to take a more active role, but research shows the contrary [18]. Healthcare providers may also have false beliefs about the amount of extra time needed for SDM: Even though the effect of using PtDAs on consultation length is typically about 2 to 3 minutes [16], the belief that SDM is too time consuming is one of the main clinician-reported barriers to implementing SDM in everyday clinical practice[29].

The boosting framework can help shed light on promising avenues for future research. Ultimately, the aim of SDM is to help patients and caregivers make well-informed decisions in collaboration with the health care provider and aligning with what matters most from the patient’s perspective. Whereas it is by now well established that PtDAs can help (“boost”) people’s competences to understand the medical information relevant to the medical choice they are facing and to clarify their personal values, far less is known about how to help people implement their preferences in everyday healthcare. We believe the vision behind the boosting framework unveils new and promising horizons for future research. Boosting is focused on competences people need to make better decisions when they face a challenging decision. Competences that have so far been “boosted” in the field of SDM-focused health informatics, are mainly related to understanding (risk) information and values clarification. In the clinical encounter, where patients and healthcare providers implement the final health decisions, other crucial competences are at play as well, which may very well lie on the social, interpersonal dimension. For example, certain decisions may mean deviating from clinical guidelines and this requires courage, trust and tolerance of uncertainty [e.g., 30]. If the ultimate aim is to empower people so that they can make choices which result in tailored care that truly aligns with what matters most to them, we may therefore need to shift gears, broaden the scope and focus on boosting those other competences that may very well be crucial in driving the ultimate SDM behaviour in the clinical encounter.

3. Discussion

In this section, we reflect on the value of the boosting framework in the context of personal health choices and SDM and on the maturity of the boosting framework in this context.

Generally speaking, the use of theory and frameworks in the design and evaluation of health informatics interventions aimed at supporting health choices and SDM comes with certain advantages compared to building health informatics interventions based on common sense. First, theories and frameworks are more consistent with the state-of-the art scientific knowledge and facts, in this case mainly from the field of decision-making psychology, than common sense. This makes theory-based design more likely to result in effective interventions. Moreover, a theoretical framework, such as the boosting framework, can be developed into a more explicit process theory tailored to the field of personal health choices and SDM, from which testable assumptions can be derived. By empirically testing these assumptions, the theory matures, with adaptions based on empirical findings where necessary, which can in turn yield new testable assumptions.

Currently, the boosting framework does not yet provide a full-blown process model with detailed "how-to" information describing how research evidence can be translated into practical health informatics solutions. Rather, we believe the boosting framework helps to explicate some guiding principles for future research, from which testable assumptions can be derived. To find the most promising avenues for future research, we should start with the end in mind and stay focused on the ultimate aim: Helping patients and caregivers to make well-informed medical decisions that align with what matters most from the patient's personal perspective [31]. Table 1 provides some examples to illustrate the potential of the boosting framework in the SDM context.

Table 1. Health Informatics in SDM: Guiding principles and testable assumptions derived from the boosting framework.

Guiding Principle	Testable Assumptions	Empirical Evidence
Competences can help people make better decisions; boosts can exist of making information easier to understand; or training (more difficult) skills	(1) Presenting risk information in natural frequencies improves understanding (2) Adding illustrations, animations and videos to text-based information improves understanding (3) Training social skills will smoothen interaction between patient and health care provider	Partly available
Decisions based on acquired competences increase people's autonomy	(1) Decisions based on boosts increase autonomy (2) More adherence to patient preferences, (3) More well-being (specifically in the long run)	More research needed
Competences can be used across different patient populations, situations and time	(1) People can acquire decision-making competences relevant to SDM through formal education (2) Healthcare providers can acquire generic SDM competences in professional education	More research needed

By systematically testing these assumptions a process model for boosting SDM can be developed, which can inform the design and evaluation of future health informatics interventions, aimed at boosting all the crucial competences people need in order to be able to make personal health choices that truly line up with their key values and serve their health and well-being in the long run.

The boosting framework is ideally suited to inform the development of health informatics interventions where patients have a choice. By building on existing competences and supporting learning, it has the potential to support autonomy and empower patients to take a more active role in making a decision that is informed and in line with their personal preferences and values. Boosting also highlights the importance of tailoring interventions and the intervention context based on what we know about psychological processes. This is an area in need of systematic research, comparing the effect of different methods of information provision and values elicitation on a broad range of outcomes. The ultimate goal of any decision support intervention is to support patients and their healthcare providers in making evidence-based, informed decisions that are in line with a patient's personal values and preferences. The boosting framework might help achieve this in a way that maximizes patient autonomy while at the same time reducing decisional burden.

Teaching questions for reflection

1. What do designers of health informatics interventions aimed at fostering SDM need to know about the theoretical approach of boosting?
2. What do designers of health informatics interventions aimed at fostering SDM need to know about the similarities and differences between the boosting and the nudging framework for supporting human decision makers?
3. How likely is it that basing the design of a health informatics intervention aimed at fostering SDM (e.g., a PtDA) will lead to improved SDM? Why?
4. What is needed to help the field of health informatics move forward and understand how the vision behind the boosting framework can be applied to have the strongest impact on fostering SDM?

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