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A Needs-based Framework for Approximating Decisions and Well-being

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Abstract

Behavioral economics has so far largely avoided discussing the psychological origins of preferences, as well as their relation to needs. This has not only restricted interdisciplinary exchange, but also significantly limits the predictive capabilities of models. For example, the revealed preference approach can only reliably predict repeating choices, while needing large amounts of observations for calibration.

In this paper, I show how unifying preferences with the psychological concept of needs strengthens economic models, by developing a decision-making framework for well-being assessment and choice prediction. To present the direct merit of this approach, I show how this framework yields a systematic approximation scheme, which is able to solve limitations of current approaches by describing new alternatives, non-repeating choices, or otherwise unobservable desires. Meanwhile, the approximation scheme requires less observations on an individual level than current approaches.

I achieve this by constructing a hierarchical dependency between human motivations and preferences through the language of needs. I show the basic feasibility of the approximation scheme through simulations on random populations.

In practice, the framework is applicable in situations where individuals exert choices only once and measuring preferences is expensive, like evaluating policy proposals or predicting decisions under technological change.

Keywords: Preferences, Basic Needs, Decision-Making, Behavioral Economics, Welfare Economics

1 Introduction

Psychologists and sociologists on one hand, and economists on the other hand speak different languages. Psychological and sociological theories are often phrased in terms of needs. Meanwhile, economists to a large extent reject the notion of needs, and describe behavior and well-being in terms of preferences and utility. Both theories are often displayed as mutually exclusive (Braybrooke 2014, pp. 8, 23; Soper 2006; Gough 2015). This gap effectively prevents communication and knowledge-transfer between these disciplines.

The goal of this paper is to bridge this gap by analyzing the connection between needs and preferences, which will eventually result in an overarching framework of decision-making, which in its limiting cases incorporates preference theory and (behavioral and normative) needs theories. The framework will combine different notions of needs within the literature, and reveals – among others – that needs can be simply viewed as a generalization of goods characteristics (Lancaster 1966).

The framework helps in resolving several limitations regarding preference orders and the measurement of utility functions through the revealed preference approach: It generalizes the scope of preference orders to account for unseen alternatives, unobservable desires and non-repeating choices. It provides a systematic approximation scheme for choice predictions and well-being assessments, which reduces the amount of required observations for constructing preference orders. It allows for normative evaluations independent of observed choices, and it offers new avenues to explore bounded rationality. To achieve this, human experiences and decision-making have to be modeled from a psychological point of view.

To illustrate the limitations of current approaches, and their remedies in the extant framework, I start with the generalizability of a measured preference order. In order to rationalize measured choices (i.e. construct a rational preference order), one has to assume consistent and stable preferences across observations (Dietrich and List 2013; Sen 1973). Due to this assumption, however, only preference orders over repeated choices can be measured (Pareto and Montesano 2014, pp. 72, 139). Thus, preference orders over non-repeating singular choices cannot be constructed.

Furthermore, Schotter (2008, pp. 83) argues that in sufficiently changing environments, the observed preference order loses its predictive power. Thus, it cannot make predictions about new alternatives (Camerer 2008, pp. 45; Lancaster 1966, p. 133), since there is no data collected about them (although there has been progress by applying the revealed preference approach to goods characteristics (Blow et al. 2008)).

Lastly, one can only make predictions based on *possible* choices under given constraints. Budget, time, institutional, and social constraints restrict which preferences can be obtained from choice data alone. Some examples explain these cases best: "I desire a living wage for my work, but it is not attainable with my educational background," or "I desire political participation, but my immigration status does not allow me to."

In short, the revealed preference approach is blind to preferences beyond *possible* and *repeated* choices over *known* alternatives. These issues become particularly relevant when we leave the laboratory context and try to predict choices in constantly changing environments, as is the case under technological progress, or preferences for policies. Here, choices may not be repeatable, so that a preference profile cannot be deduced. Furthermore, measuring choices can be very expensive in these contexts.

The second limitation is the reliance on choice data alone to construct utility functions, while making as few as possible assumptions about human behavior. Although this point has been stated as a strength of the revealed preference approach (Gul and Pesendorfer 2008), the sole reliance on choice data requires a large amount of observations to measure individual preference orders.[1] In order to minimize the reliance on observations, it has been suggested to supplement models by non-choice data (Schotter 2008, pp. 83; Rubinstein and Salant 2008, pp. 118), which has also been successfully implemented to improve predictions (Bernheim et al. 2013). Furthermore, it was argued to also include information about the individual's rationale, i.e. the reason *why* the individual made her choice (Schotter 2008, pp. 79).

The psychological evidence gives an intuitive appeal to this approach: Human behavior is on a general level driven by the same reasons (Brown 2007, ch. 1; Harsanyi

[1] Pollock (2006, pp. 22) goes even further, arguing that preference orders are even computationally infeasible to use for individuals themselves.

1997, pp. 139; Hull 1966; Scitovsky 1992); and discarding this information introduces a large amount of redundancy through repeatedly verifying established knowledge. Giving a trivial example, all people need to eat at least once a day (if they can). It would be rather absurd if this fact needs to be verified repeatedly through observations on an individual basis. A sensible approach would be the acknowledgment of this empirical "law of hunger" and introducing it in the decision-making framework.

Both limited generalizability and large amounts of observations can be mitigated by restricting oneself to approximate statements about behavior. The framework uses the strategy of hierarchically tracing back preference orders over alternatives to preference orders over needs. For psychological reasons, these preference orders are justified to be stable and shared across individuals, so that preferences for unseen alternatives, unobservable desires and singular choices can be approximately derived from them. The framework can be used for approximate prediction of behavior, as well as approximate positive and normative well-being assessments. In particular, it allows for approximative welfare evaluations with *zero* information about individuals.

I will develop the framework as follows. Assuming that the reader is less familiar with needs theories, I will present a basic overview over its different conceptions in sec. 2. The framework itself will be developed in sec. 3. In sec. 4, I will show how this framework can be used to formulate an approximation scheme for choice predictions, as well as positive and normative well-being evaluations. I will show the feasibility of the approximation scheme by applying it to simulated populations of individuals. Before concluding, I will highlight the similarities and differences between the approximation scheme and normative needs theories in sec. 4.2. A mathematical formalization of the framework is given in the online appendix A.

2 A Taxonomy of Needs Theories

The subsequently developed framework will built upon needs theories and embeds preference theory within them. Since economists are less familiar with needs theories, a more in-depth introduction will be given here.

The methodology of needs theories is less rigorous than preference theory. Dif-

ferent notions of the term "need" have to be clarified first. Gasper (2007) identified three usages (modes) of the term: Needs as explanations for drives, or the origin of behavior (mode A); needs as requirements (mode B); and needs as normative requirements (mode C). The goal of this section is an overview over these different concepts of needs in the literature.

2.1 Needs as Explanations for Behavior

In mode A usage, a need is interpreted as a motivator for actions, and thus can be seen as an origin of desires or preferences. In drive reduction theories, a need is (often) a biological or social motivator like food, water, air, shelter, sleep or reproduction (Gasper 2004, p. 142; Baxter 1988; Hull 1966): A currently deprived need will cause an urge or "motivational force" to satisfy that need (Doyal and Gough 1991, pp. 35; Thomson 1987), thus the deprivation causes a desire and influences the preference order in this moment. The motivational force will persist until a state of homeostasis is reached, i.e. the bodily equilibrium is restored. Adaptations of drive reduction theories in economics investigate e.g. impulsive behavior and addictions (Loewenstein 2011) or the formation of consumer preferences (Witt 2001).

2.2 Instrumental Needs

In the second usage of the term, needs are simply understood as requirements, or as *means* to an end (Gasper 2007, mode B). Needs as requirements are commonly defined through the relational formula "Individual I needs X in order to Y," for means X and end Y (Braybrooke 2014, pp. 29; Wiggins 2005),[2] as exemplified by "I need the car key in order to drive this car." Such statements are neutral and therefore neither carry normative weight (Griffin 1986, ch. III), nor do they have behavioral implications (like drive reduction theories); they just state the fact that X is needed as a requisite for attaining a specified end Y. For this reason, they will

[2]The use of language is often quite imprecise, so "need" may sometimes refer to the end instead of the means (Gasper 2007, p. 55). In this paper, the distinction between means and ends will be rigorously kept, see below.

be called *instrumental needs* in the following. When referring to needs (of any kind) in this paper, it is always implied that they are instrumental needs as defined by the relational formula (in particular, that they must serve at least one end).

An end can serve as an instrumental need (means) for other ends, thus instrumental needs form a hierarchy (Doyal and Gough 1991, p. 40). The alternatives an individual can choose, also called satisfiers, are part of the hierarchy (Doyal and Gough 1991, p. 69; Max-Neef 1992).

2.3 Needs as Normative Requirements

In the third usage of the term, needs are understood as normative requirements (Gasper 2007, mode C). Here, a need is not just instrumental for any end, but for an end with normative weight; i.e. there is a normative imperative to serve this end (first). The naming for normative requirements is not consistent in the literature, but I will use the most common term *basic need* (BN) for them.

Different normative needs theories identify different BNs, which are either derived through a particular procedure (as covered by ibid., p. 58), or must meet certain conditions (as listed by Baumeister and Leary 1995, p. 58). They all have in common that they derive their normative justification from a universalizable goal, e.g. avoidance of serious harm (Doyal and Gough 1991, p. 39; Wiggins 2005, p. 31), full human functioning (Hamilton 2003, p. 61), flourishing (Wiggins and Dermen 1987) or being "essential for ongoing psychological growth, integrity, and well-being" (Deci and Ryan 2000, p. 229). From this universalizable goal, normative needs theories derive a list of BNs, which have to be satisfied in order to achieve said goal. The lists derived from various theories have substantial overlap (Gough 2015, p. 1202; Alkire 2002) and can be roughly categorized into basic physical needs[3], as well as basic psychological and social needs.[4] Arguing from the normative goal, needs theories propose thresholds for BNs, below which e.g. serious harm is caused (Gough 2015, pp. 1202).

[3]Like health (Doyal and Gough 1991), or subsistence and protection (Max-Neef 1992).

[4]Like autonomy of agency (Doyal and Gough 1991), or autonomy, competence and relatedness (Deci and Ryan 2000), or affection, understanding, participation, leisure, creation, identity and freedom (Max-Neef 1992).

In the following, some common properties of most normative needs theories are discussed. By construction, BNs are universal, i.e. the effects of BN satisfaction or deprivation are independent of time, place and culture (Doyal and Gough 1991, p. 73; Deci and Ryan 2000, p. 246; Pölzler 2021, p. 4).[5] When being felt by all individuals, even across generations, BNs become interpersonally and intertemporally comparable (Gough 2015, pp. 1192, 1211).[6] Although BN satisfaction thresholds may vary across individuals or cultures, their universal effect on well-being has been shown by various empirical studies (Tay and Diener 2011; Chen et al. 2015; Deci et al. 2001).[7]

Furthermore, BNs are claimed to be objective in at least two ways. First, while preferences depend on one's subjective impressions, BNs exist independently of individual mental states (Doyal and Gough 1991, p. 42; Soper 2006, pp. 355; Pölzler 2021, p. 4): A BN is still a requirement to e.g. avoid serious harm to myself, even if I deny having this BN, or my preference *precisely is* to cause serious harm to myself. When defined in this sense, BNs bear the risk of paternalism (Pölzler 2021, pp. 8). This risk can however be mitigated, as explained in online appendix B. Second, BNs are also claimed to be objective in the sense of objective measurability (see e.g. Gasper 2007, pp. 59). For example, the required food intake could be objectively assessed through the amount of calories, vitamins, etc. This claim is however harder to justify for basic psychological needs.

Borne out of universality and objectivity (in its first sense), BNs are often delineated from "mere wants/desires/preferences" in the way that the latter don't carry any normative weight (Wiggins 2005, p. 33; Soper 2006, p. 356; Braybrooke 2014, p. 8). The argument goes along the following lines: While unsatisfied BNs will lead to physiological, psychological or behavioral pathologies, unfulfilled desires will only

[5]Therefore they are often also called *universal basic needs* (UBN). Economic discussions on universality and lists can be found in (Griffin 1986, ch. IV.3; Harsanyi 1997, p. 139, who also propose similar lists to the above mentioned), and on thresholds in e.g. (Griffin 1986, ch. III; Witt and Schubert 2010, pp. 19).

[6]By avoiding subjectivity of preferences and discounting issues, BNs are potentially more suitable in discussing sustainability considerations (Gough 2015, pp. 1203, 1211; Wiggins 2005, p. 44; Pölzler 2021, fn. 25).

[7]The authors often find only small differences between individuals. An overview over empirical studies on basic psychological needs can be found in (Ryan and Deci 2017, ch. 22; Ryan and Deci 2004, pp. 478; Ryan and Deci 2011, pp. 54; Vansteenkiste and Ryan 2013, p. 268).

give temporary distress (e.g. Baumeister and Leary 1995, p. 498). This gives precedence to satisfying BNs over fulfilling desires (Braybrooke 2014, pp. 33; Gough 2015, p. 1208).

This distinction and its conclusion would render needs and preferences incompatible. As will become apparent in sec. 3.3, this misconception rests upon a false dichotomy: Preferences can be *expressions* of BNs, i.e. I have a preference precisely because I am acting on a BN deprivation of mine. In this sense, needs (including BN) are the substrate *over which* preference orders are defined; or differently formulated, needs are just a generalization of consumer goods and goods characteristics (Lancaster 1966).

To summarize, there are two different – but overlapping – notions of needs: On one hand, needs are conceptualized as reasons or motives for action (mode A), which are often reduced to drives. Preferences bear the most similarity to this notion. Under the other notion, needs are means to a (normatively important) end (mode B and C). They are characterized by a hierarchical instrumental relationship towards a (universalizable) goal. In the remainder of the paper, a psychologically motivated decision-making framework will be developed, which describes the relationship between the different notions of needs and preferences.

3 The Framework: A Synthesis of Needs and Preferences

In the introduction, I concentrated on two drawbacks of the revealed preference approach; its limited generalizability and its dependence on many measurements. Addressing the issues entails exploring the psychological origins of desires[8] and motivation. A key aspect to establish this link is through understanding the interrelations between needs as requirements and needs as behavioral origins. This will be accomplished in the following by developing a behavioral framework for desire formation

[8]The term desire is preferred to preference, since a preference presupposes a preference order, which is not necessarily a given under arbitrary choice correspondences (Simon 1955, p. 110).

within the language of instrumental needs.

In short, it is proposed that individuals make decisions only for a small amount of (psychologically motivated) reasons, which will be called absolute ends. Through a hierarchy of instrumental needs, a desire for absolute ends will be translated into the desire for an alternative.

I will first argue that such a hierarchy connects all alternatives to a finite set of absolute ends (sec. 3.1), thus all human decision-making can in principle be described within this hierarchy. Second, I will argue that all decision-making originates from one or more absolute ends through sequences of choice correspondences (sec. 3.2).

3.1 Hierarchical Model of Needs

Where do preferences over alternatives come from? In economics, this question is rarely touched, and preferences over alternatives are taken as stable and given (Brey et al. 2012, p. 18; Dietrich and List 2013). But what (if anything) can be learned, if these assumptions are relaxed? In the first step to answer this question, the language of instrumental needs is employed in order to trace back preferences over alternatives towards preferences over finite and few ends. As already touched in sec. 2.2, alternatives and ends are connected through a hierarchy of instrumental needs. In this section, a procedure for constructing a hierarchy between all alternatives and ends will be developed.[9]

To construct a hierarchy between means and ends, I start with a Gedankenexperiment. I pick a single alternative A. In order to find out all ends which are served by this alternative, I can ask an individual with complete information the question "Why do you need (to do) A?" From the answer, I can identify all served ends of A. For these ends I can repeat the question to find out which ends they serve. By iterating this process (as argued similarly by Grisez et al. (1987, pp. 106)), I obtain a hierarchy of means and ends for the alternative A (Doyal and Gough 1991, p. 40).[10]

[9]Coincidentally, a very similar procedure was proposed by Grisez et al. (1987). Thankful for not having to reiterate all necessary arguments in detail, I will reference their work liberally. See also (Finnis 2011).

[10]Attempts towards a hierarchical pattern can also be seen in economics in goods characteris-

This process necessarily needs to terminate somewhere, i.e. there must be ends for which no further justification can be given (Grisez et al. 1987, p. 103; Braybrooke 2014, p. 32; Wiggins 2005, p. 30), which I will call an *absolute end* (AE) in analogy to the term absolute need used in (Wiggins 2005; Pölzler 2021). An *absolute need* (AN) is then an instrumental need, which is a means *only* to AEs. An AE is *attained* if all required ANs are *satisfied*. If at least one required AN is *deprived*, then one fails to attain the AE.

The above procedure for finding AEs could theoretically be repeated by asking every individual (with complete information) about all existing alternatives at any time. Through this, one can in principle end up with a (not necessarily unique) *complete hierarchy* connecting *all* alternatives to *all* possible AEs. When I perform the same exercise for a single (boundedly rational) individual, she will reveal only the means and ends known to her, which I will call her *individual hierarchy*. If she is uncertain how effective a means is to achieve an end, she will reveal her *expected individual hierarchy*.

Such a hierarchy of instrumental needs is sketched in fig. 1. Starting from AEs, the hierarchy has different levels, which are connected through means-ends relationships. Every means-ends relationship has an associated (expected) weight to express the (expected) effectiveness of a means to achieve an end. The weights vary across individuals due to objective and subjective factors, like personal taste. A negative weight indicates that this instrumental need impedes an end, while a weight of zero implies that the end is independent of this instrumental need.

To give an impression of a possible set of AEs, I provide (without judging or aiming for completeness; and in slightly modified form) the AEs identified by Grisez et al. (1987, pp. 106) and Finnis (2011, pp. 86): Living, meaning-giving (or self-determination, integrity, authenticity and inner peace), sociability, understanding, play, beauty, and spiritual harmony.[11] These AEs (and possibly others) thus con-

tics (Lancaster 1966), in the way "commodities" were described by Stigler and Becker (1977), or the conception of basic motivations (Bernheim et al. 2013). The most explicit development of a hierarchy of needs is found in Engel's work (Engel [1857] 2021; Chai and Moneta 2012).

[11] Although Finnis (2011, pp. 90) asserts that the list given is complete and even malign motives are derivative of the listed AEs, one could make an argument for adding pleasure and avoidance of

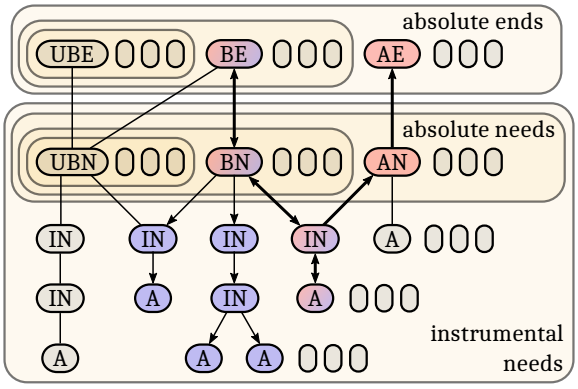

Figure 1: Example for a hierarchy of instrumental needs. The set of instrumental needs (IN) includes all alternatives (A) and absolute needs (AN). Absolute needs are only means to absolute ends (AE), while absolute ends serve no further end. Normatively relevant are (universal) basic needs ((U)BN) and (universal) basic ends ((U)BE). Lines indicate a nonzero weight between needs and ends. The decision-making process (blue) proceeds along the downwards arrows. A chosen alternative leads to the attainment of desired ends (color gradient) as well as ends not desired initially (red).

stitute ultimate *reasons for choosing* an alternative (cf. Grisez et al. 1987, pp. 105). Accordingly, examples for ANs can be derived by identifying direct means for these AEs. One can easily see that e.g. the needs nutrition, health, safety, fair treatment, autonomy, relatedness and knowledge serve as ANs for some of the AEs listed above.

Whether the given list of AEs proves to be complete – or even correct – is not of relevance in the following. It is sufficient to know that such a list must exist (by construction) and has a finite amount of elements .

The procedure to attain AEs from alternatives sketched out in the preceding paragraphs is a rather tedious (but in principle feasible) one. Was there anything to be learned from it? By employing this specific procedure, it was shown that one can construct a set of AEs, which is an *exhaustive* representation of reasons

boredom. Pleasure is rejected by Finnis (2011, pp. 95) by reference to Nozick's experience machine, though others argue that seeking for pleasure is intrinsic to us (see e.g. Schroeder 2020, ch. 3.2). The need for novelty and variety in order to avoid boredom are discussed in the psychological literature (Vansteenkiste and Ryan 2013, pp. 7). Also, the definition of meaning-giving varies throughout Finnis' writings and may or may not be ascribed to one AE.

for choosing *all possible* alternatives (mode B in terms of Gasper 2007). Thus, a choice can always be *rationalized* by reference to some AEs. In other words, when an individual is observed making a choice for an alternative, it is guaranteed that their reasoning for this choice can be traced back to one or more AEs. However, this does not (yet) mean, that the individual was also *motivated* by AEs, i.e. that she chose an alternative due to a desire for some AEs (mode A). This will be discussed in the following section.

3.2 How People Choose

In the last section, the hierarchy of instrumental needs was established by proposing a procedure for its construction. The hierarchy will serve as a backdrop for the coming analyses. Namely, individuals will form desires *over* instrumental needs and ends, much like economic agents have preferences over goods. In this section, I will explain *how* desires for alternatives form, i.e. the process through which for example a preference order over alternatives forms in a particular moment. The content of our desires, i.e. *why* a particular desire ranking over alternatives forms, is largely determined by the hierarchy weights and the psychological processes at play.

The reasoning in the following is in short: One or more (possibly competing) psychological processes cause a desire for a subset of AEs. The (possibly boundedly rational) individual will consciously or subconsciously prioritize over these AEs and then search for suitable alternatives. The conscious or subconscious search for alternatives will be performed over the expected individual hierarchy of instrumental needs. Eventually, a choice will be made among the desired alternatives.

In order to plausibly justify this reasoning, two main issues have to be addressed: Do psychological processes really cause desires for AEs? And, how does an individual prioritize over AEs or alternatives? The first question will be dealt with now, while the second one will be answered with help of choice correspondences later on.

3.2.1 Psychological Processes and Absolute Ends

Do psychological processes really cause desires for AEs? In addressing this question, it was argued before that AEs are the ultimate reasons for choices. In other words, one can plausibly explain choices in hindsight through their attained AEs.[12] However, this does not imply that these AEs also motivated the choice, i.e. that an individual first developed a desire for AEs, which then gave her the motivation to actively pursue an alternative in order to attain the AEs. Grisez et al. (1987, pp. 105, pp. 114) claim that for rationally desired alternatives the desire indeed originates from AEs: The individual first deliberates over the benefits of AEs, and based on this proceeds deliberating about the benefits of alternatives for these AEs. Can there be psychological evidence found for this claim? Unfortunately, due to the multifaceted origins of motivation, a conclusive proof cannot be given. Nonetheless, a great deal can still be said about the process of motivation and how it relates to AEs. I will briefly review three psychological theories.

Drive reduction theories (Hull 1966) were already mentioned in sec. 2.1. The deprivation of physical needs like food, water or rest will trigger a motivational force to satisfy them in order to return to an equilibrium state (homeostasis). In other words, the deprivation of physical needs will foremost cause a desire for sustained 'living', when speaking in terms of the classification of AEs by Finnis (2011, p. 86). The reasoning about *how* the AE is attained (i.e. which alternative) is secondary to the desire *that* the AE must be attained, thus the psychological process causes a desire for the AE first.

Optimal arousal theory (Berlyne 1960) extends drive reduction theories by arguing that the responsible process is a striving for an optimal arousal level. Pain, discomfort, or boredom cause states of high arousal, which induce strain, fatigue, or anxiety. High arousal in turn motivates the individual to return to an optimal arousal level (Scitovsky 1992, ch. 2). Furthermore, situations of high uncertainty also increase arousal, so that preparations for the future, like stockpiling food, can be explained as well (ibid., p. 29).

[12] Which is similar to arguing that a certain rational preference order must underlie given observed choices, as done by the revealed preference approach.

In terms of the extant framework, optimal arousal theory makes the psychological process explicit: The arousal level determines the 'amount of desire' for AEs. AEs are in this case the alleviation of pain, boredom or insecurity. The inclusion of boredom supports the claim that desires for AEs precede desires for particular alternatives: The individual develops a desire to avoid boredom and do *something* (Scitovsky 1992, pp. 32) as opposed to striving for a particular thing.

At last, Self-Determination Theory (Ryan and Deci 2000) describes behavior through a continuum of motivation. An individual is motivated in a 'controlled' way if the behavior is elicited through rewards or punishments. Avoiding punishments is clearly a desire to avoid future (physical or mental) pain. Another cause of controlled motivation is through ego-enhancement like pride or avoidance of guilt and anxiety. Here, the individual desires the AEs of 'sociability' and 'integrity'. On the other hand, an individual is 'autonomously' motivated if a matter is of personal importance for her and she consciously values it, or if an activity is done out of enjoyment for its own sake (ibid., pp. 72). Here, the motivation can stem from a desire for 'authenticity', 'integrity', 'pleasure', or 'understanding'. Intrinsic motivation can be traced back to the AE of 'play'.

Although these theories cannot prove that individuals develop desires for AEs before deliberating about alternatives, they provide solid support for this claim. Interestingly, the identified AEs have large overlap with the list given by Grisez and Finnis. Therefore, we can plausibly *assume* that psychological processes generally cause desires for AEs.

This result can now be combined with the one obtained in sec. 3.1, namely that AEs represent an exhaustive list of reasons for choosing alternatives. As a conclusion, *all desires for alternatives* are reducible to desires for AEs. In other words, desires for alternatives can be described by desires for AEs weighted by their means-ends relationships in the hierarchy.[13] Consequently, desires for AEs serve as the link between psychological theories and preference theory: A psychological process ulti-

[13]This result does however not mean that all desired AEs are acted upon mechanically (corresponding to a mode A interpretation of needs), but rather that there are *no other motives* to act upon. It is our unconscious impulses paired with the ability to consciously deliberate over the desires for AEs which give rise to the complexity of human behavior (Strack and Deutsch 2004).

mately ends in desires for AEs, and all desires for alternatives can be derived from desires for AEs.

3.2.2 Decision-Making through Sequences of Choice Correspondences

We have seen in the last section that an individual's decision-making is triggered by one or multiple psychological processes, which cause desires for AEs. Since time and resources are limited, the individual must decide which desire has highest priority, as well as how to satisfy the desire. The individual learned over time how particular AEs can be attained through particular alternatives, which is captured by the weights in her individual hierarchy of needs.

How do individuals prioritize over these AEs and instrumental needs in the hierarchy, so that the initial desires translates into a choice? In line with the psychological literature (Payne et al. 1993, pp. 9; Rieskamp and Otto 2006) and recent economic models (Apesteguia and Ballester 2013; Manzini and Mariotti 2007), individuals employ a sequence of choice correspondences to narrow down on an alternative. With preference maximization as the choice correspondence, individuals build a preference order over alternatives and choose the one with the highest preference. Contending choice correspondences for boundedly rational individuals in environments of high uncertainty are heuristics (Gigerenzer and Brighton 2009) as a generalization of satisficing (Simon 1955). Here, alternatives from a set are picked, and for example, the first recognized alternative is chosen (recognition heuristic), the alternative recognized fastest is chosen (fluency heuristic), or the first alternative fulfilling a number of criteria on a checklist is chosen (take-the-best heuristic).[14]

In the hierarchy, these choice correspondences are iteratively carried out over needs (incl. the alternatives themselves) and ends throughout the expected individual hierarchy to narrow down towards a final choice of alternatives. In this sense, needs and ends represent the elements *over which* desires are defined. Therefore, desire rankings (e.g. preference orders) are not only defined over alternatives, but there are desire rankings of increasing order of abstraction, up to the highest level of AEs. The

[14]The equivalence of choosing from checklists and rational preference maximization under certain conditions is proven by Mandler et al. (2012).

notion of abstract preferences is not new to economists (see fn. 10), but so far only limited effort had been made to make this distinction rigorous and explicit.

The decision-making process can then be described by the following four-step procedure:

1. (Possibly competing) psychological processes create desires for a set of AEs.
2. The individual searches her (possibly incomplete) expected individual hierarchy for relevant needs or alternatives, until a choice must be made. This may happen through conscious deliberation or through subconscious or habitual reasoning.
3. The individual employs a choice correspondence to choose a subset of needs of highest priority.
4. The individual *traverses* the hierarchy: Repeat steps 2 and 3 until an alternative is chosen.

The traversal (thin downwards arrows and blue shade in fig. 1) involves aggregating hierarchy weights until the individual sees reason to reduce the complexity of the choice problem: She will employ an intermediate choice correspondence to subsequently focus on a subset of the hierarchy, as evidenced by studies on noncompensatory choice strategies (Ford et al. 1989; Yee et al. 2007).

Steps 2 and 3 may be performed in parallel for heuristics: In these cases, building a preference order cannot be separated from the choice process, since the preference order is built dynamically in tandem with the search process for relevant needs and alternatives (Simon 1955, p. 110).

For a rational individual with complete knowledge, weights for all levels are known, and preference maximization is employed once over the whole individual hierarchy. Thus, preference theory is recovered.

In summary, the decision-making in a particular moment can be described by three ingredients: First, psychological processes create desires for AEs. These processes could be the search for homeostasis, optimal arousal, or intrinsic enjoyment,

among others. Second, an individual hierarchy of instrumental needs is traversed in search for suitable alternatives. Finally, during the traversal a sequence of choice correspondences is employed to iteratively choose among needs and ends. With these ingredients, in combination with the four-step procedure proposed above, the decision-making process can be fully described on a very general level. A possible mathematical formalization of this process is given in online appendix A.

3.3 Compatibility of Needs and Desires

We now arrived at the point to clear up the false dichotomy between (basic) needs and "mere desires" mentioned in sec. 2.3. It has been argued that BNs and preferences are incompatible concepts, since BNs signify normative relevance, while preferences are up to the individual's whims.

However, with the insight from the last section, preferences and needs should not be regarded as incompatible and competing concepts for defining normative importance. Rather, preferences are *explanations for behavioral consequences* of psychological processes (akin to mode A needs) while needs are requirements of mode B and C. Needs/ends are the elements over which preferences are *formed*, and thus can simply be regarded as a generalization of consumer goods and goods characteristics (Lancaster 1966). Economists like Stigler and Becker (1977) have been implicitly using this notion already through their definition of "commodities."

Insofar, the argument by needs theorists that one has to 'choose' between the concepts of BNs or preferences is not warranted. Without contradiction, one can simultaneously acknowledge the normative importance of BNs, and a felt desire for them or other needs. Thus, preferences can be *expressions* of BNs, i.e. I have a desire precisely because I am acting on a BN deprivation of mine. Conversely, one can equally agree that an unmet strong desire could cause serious harm as well, even if it does not originate from a BN (Hamilton 2003, p. 52).

On the other hand, economists dismissals of the relevance of BNs by pointing towards the subjectivity of preferences (over alternatives) becomes similarly invalid: Preferences over alternatives originate from preferences over ANs. Since BNs con-

stitute an important subset of these ANs, an individuals' preference order over BNs will in turn have a large influence on their preference order over alternatives. To borrow above sentence again: I have a preference precisely because I am acting on a BN deprivation of mine. Thus, disregarding BNs in models of decision-making is bound to decrease their predictive power considerably.

4 Application: Building an Approximative Theory of Decision-Making

As was highlighted in the introduction, solely choice-based models are impractical for choice predictions and well-being assessments for two reasons: On one hand, constructing preference orders over a set of alternatives requires a considerable amount of data-collection for one individual under the assumption of consistent and stable preferences over alternatives. On the other hand, the revealed preference approach suffers from limited generalizability: Individuals may execute choices only once, face novel alternatives, or they may have desires which they cannot express through a choice. In these cases, choices cannot be predicted with help of revealed preferences alone. Strictly speaking, the revealed preference approach is only valid for habitual behavior, where repeated consistent choices can be observed.

The above-stated limitations can be mitigated through an approximation scheme. However, within the revealed preference approach there is no natural way of approximating choices, because choice-based frameworks carry no information on how choices came about and which aspects of choices are relevant to individuals.[15]

In this section, I will develop an approximation scheme for predicting decisions, as well as positive and normative well-being assessments, based on the previously presented framework. Afterwards, I will apply the approximation to simulated populations of individuals to show its feasibility even with limited data about individuals.

[15]Choice-based theories lack the ability to distinguish between relevant, and irrelevant (or harmful) desires (see e.g. Hausman and McPherson 2006, pp. 125). Here, the relevance and irrelevance of different AEs for decisions and well-being is captured by explicitly considering the hierarchy of needs, as well as the psychological origins of desires for AEs.

In essence, the approximation consists of three parts. Since the complete set of AEs is unknown, an appropriate subset of AEs must be chosen first. Second, the (expected) individual hierarchy of needs will be approximated by truncating it at some level, and replacing the unknown weights of the lower levels by population averages. Third, for predicting decisions, one has to decide for a likely sequence of choice correspondences the individual employs.

Approximative Well-being Assessment To approximately assess well-being, first a subset of AEs is chosen which is most relevant to the individual. The only difference between positive and normative well-being assessment is the choice of AEs. For positive evaluations, one chooses a subset of AEs most relevant to the individual's *actual* well-being (e.g. from the list provided by Grisez et al. (1987)). For normative evaluations, the AEs are not chosen based on predictive quality, but on normatively desired outcomes (e.g. avoidance of serious harm, cf. sec. 2.3). I will therefore call this subset of AEs *basic ends* (BEs) and the corresponding set of ANs *basic needs* (BNs) to signify their normative relevance.[16]

Second, the expected individual hierarchy is approximated of order μ: Only *individual* weights for the highest hierarchy levels $m \leq \mu$ are measured, and weights for the remaining levels are approximated by population averages. Then, starting from the subset of AEs, one aggregates weights of the individual hierarchy up to level μ and the population-averaged weights on the remaining levels. For example, a zeroth-order approximation entails taking population averages for the whole hierarchy, and thus measuring *no individual* weights.

[16]The ANs governing behavior and the identified BNs can be, but must not be, different. The need for food is most likely a normative requirement *and* originates from a felt desire. On the other hand, the need for autonomy does not necessarily translate into a desire (Deci and Ryan 2000, p. 231).
The normative decision of including other ANs (e.g. privacy) in a set of BNs is of course not arbitrary, but should (and can) be a matter of public deliberation supported by empirical evidence. Further details about the procedure can be found in theories on Critical Rationalism (see e.g. Schubert 2006, pp. 7).

Approximative Decision-Making Approximately predicting decisions of single choices in particular situations requires additional knowledge about the individual's desires for AEs and choice correspondences.

The relevant AEs and the desire for them can be inferred from the most likely psychological process at play in that moment, for example by observing the current AN deprivation of the individual.

When choosing a likely sequence of choice correspondences the individual employs, research on heuristics (Rieskamp and Otto 2006; Gigerenzer et al. 2011) can inform us about good approximations. If no information about choice correspondences can be obtained, preference maximization over the whole hierarchy can be used. Thus it is guaranteed that the procedure is at least as good as preference maximization.

The weights of the expected individual hierarchy are approximated by replacing lower-level weights by their population averages, as was the case for approximative well-being assessments. The approximation is carried out by starting from the subset of AEs and traversing the expected individual hierarchy of order μ by aggregating the expected weights and employing the likely sequence of choice correspondences. The traversal of order μ yields the set of alternatives from which an individual would have chosen, had she stopped reasoning at this level. Traversing the approximative hierarchy towards the end yields the most probable choice of the individual.

Regarding measurements, predicting decision-making – and thus situation-specific choices – has the greatest information requirements by needing information about the likely sequence of choice correspondences and the initial desires for AEs. Assessing well-being on the other hand only requires knowledge of the individual hierarchy and its population averages, and thus can be carried out completely without individual-specific information in the most extreme case.

4.1 Generalizability under Limited Observations

Eventually, I show how the approximation scheme can be used for generalizing predictions towards novel alternatives and unobservable desires while having only a

limited amount of data available. As with any approximation, the goal is not maximum predictability, but rather the controlled trade-off between precision and data requirements; so that as much information as possible can be drawn from as little data as possible. I will first explain with help of a simulation how the approximation scheme scales with data availability for the task of well-being assessment. Then, I will explain how the approximation scheme allows for generalized predictions.

4.1.1 Approximating Well-being with Limited Data

In the following, I demonstrate the feasibility of the approximation scheme in utilizing few observations for well-being assessments. Given 2^N combinations of N alternatives, it allows us to reduce the amount of known individual weights to less than N while maintaining an approximate account of an individual's well-being.

I will assume for simplicity a hierarchy of $M = 3$ levels, where each level consists of $J_m = 2^m$ ends ($m \in \{1, \dots, M\}$), and two AEs ($J_1 = 2$). The hierarchy is thus able to describe all 2^N combinations of $N = 16$ alternatives through a maximum of $n_M = \sum_{m=1}^{M} J_m J_{m+1} = 168$ weights.[17] Meanwhile, a complete and transitive ordinal preference order requires between $2^N - 1$ and $\binom{2^N}{2}$ comparisons to be completely specified.

Approximating the hierarchy entails measuring weights of the individual hierarchy up to level $\mu < M$. Fig. 2a) shows the fraction of individual weights $\eta = n_\mu / n_M$ to be measured for an approximation of μ-th order in dependence of the total hierarchy levels M. For the given level $M = 3$, a first-order approximation requires $\eta \approx 5\%$ of all weights to be measured on an individual basis (i.e. 8 weights), while a second-order approximation requires $\eta \approx 24\%$ of all weights to be measured (i.e. 40 weights).[18] For a given approximation order μ (gray lines), the amount of individual weights to be measured compared to the total amount of weights in the hierarchy, η, drops exponentially with increasing hierarchy depth M, shown by the coloring (for the

[17] Here, I consider the worst case of a fully interconnected hierarchy. In reality, not all needs are connected to one another, so that the hierarchy is sparse, and many weights are zero.

[18] As highlighted before, an approximation of order $\mu = 0$ requires 0% of individual weights to be known.

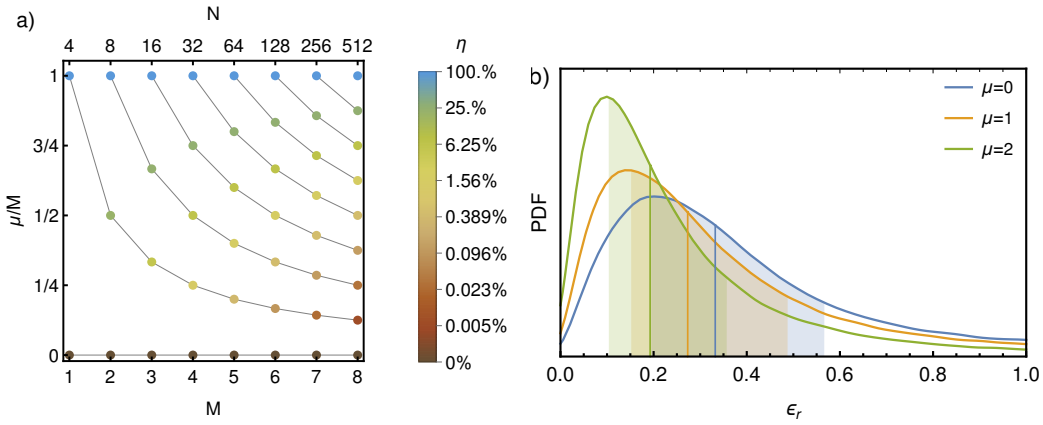

Figure 2: (color online) a) The fraction of individual weights η (colored) to be measured for the μ-th order approximation (connected by gray lines), assuming $J_m = 2^m$ ends at each hierarchy level. The deeper the hierarchy (increasing M), the more combinations of N alternatives can be described. Black dots represent the zeroth-order approximation, and blue dots ($\mu = M$) the exact hierarchy (i.e. no approximation). b) Kernel density estimation of the relative error distribution ϵ_r for each approximation order μ ($M = 3, r_i = 5, r_p = 0$). Vertical lines are the median and shaded areas the interquartile range of the distribution.

given J_m).

In the following, I demonstrate that one obtains a reasonable approximation to well-being from need satisfaction by applying the formalism from online appendix A to populations of individuals with random preferences (i.e. random hierarchy weights). The Mathematica script to replicate the results is available in the supplementary material.

For simplicity, I assume that needs (and alternatives) for each AE are perfect substitutes, so that calculating the need satisfaction reduces to matrix multiplications: $\boldsymbol{e}^1 = \prod_{m=1}^{M} W^m \cdot \boldsymbol{a}$. I am interested in the distribution of the relative error $\epsilon_r = |\boldsymbol{e}^1 - \hat{\boldsymbol{e}}^1_\mu|/|\boldsymbol{e}^1|$ between the actual need satisfaction $\boldsymbol{e}^1$, and the μ-th order approximation $\hat{\boldsymbol{e}}^1_\mu = \prod_{m=1}^{\mu} W^m \cdot \prod_{m=\mu+1}^{M} \overline{W}^m \cdot \boldsymbol{a}$, with the population averages of weights $\overline{W}^m$.

Unless stated otherwise, the parameters and assumptions will be chosen to reflect the worst-case scenario in order to obtain an upper bound to the approximation

procedure.

I will carry out simulations over 500 populations of 500 individuals each, which is sufficient to ensure a converged error distribution. Each population is characterized by a fixed population average $\bar{w}_{ij}^m$ of the hierarchy weights, around which the individual weights are normally distributed, $w_{ij}^m \sim \mathcal{N}(\bar{w}_{ij}^m, \sigma_{ij}^m)$. In real populations, alternative effects and tastes would be correlated between individuals. Meanwhile, the underlying *i.i.d.* assumption in the simulation allows for arbitrary variation of individual weights, and thus represents an upper bound to the error.

I consider the average error not only over different individuals, but also over different populations, since no population can be a-priori considered the "correct" one. A population is characterized by its mean weight $\bar{w}_{ij}^m \sim \mathcal{N}(\bar{\mu}_{ij}^m, \bar{\sigma}_{ij}^m)$. Without loss of generality, I consider $\bar{\sigma}_{ij}^m = 1 \forall i, j, m$.

As it turns out, the relative error distribution can be characterized by only two parameters: the relative deviation of individual weights around their population averages $r_i = \bar{w}_{ij}^m / \sigma_{ij}^m$, as well as the relative deviation of population averages $r_p = \bar{\mu}_{ij}^m / \bar{\sigma}_{ij}^m$. If not stated otherwise, $r_i = 5$ will be assumed in the following.[19]

I will choose $r_p = 0$, again representing the worst-case scenario where positive and negative weights of different needs/alternatives can cancel out upon simultaneous use.

Fig. 2b) shows the relative error distribution for different approximation orders μ, including its median and interquartile range (shaded). In the zeroth-order approximation, the median relative error in assessing well-being is $\epsilon_r \approx 32\%$, which is remarkably low considering that no individual characteristics are accounted for, while simulating under the above-stated worst-case conditions.

For increasing r_i, meaning a narrower distribution of individual weights around the population average, the relative error decreases, as shown in fig. 3a). For $r_i \to \infty$, the relative error distribution converges to $\epsilon_r = 0$, as expected. The higher r_i, the smaller the difference between the approximations, justifying the use of lower approx-

[19] For real-world applications, it could plausibly be hypothesized that weights exhibit less variation the higher the hierarchy level, reflecting our shared physiological and psychological human nature. In this case, r_i will increase for higher levels, reducing the relative error.

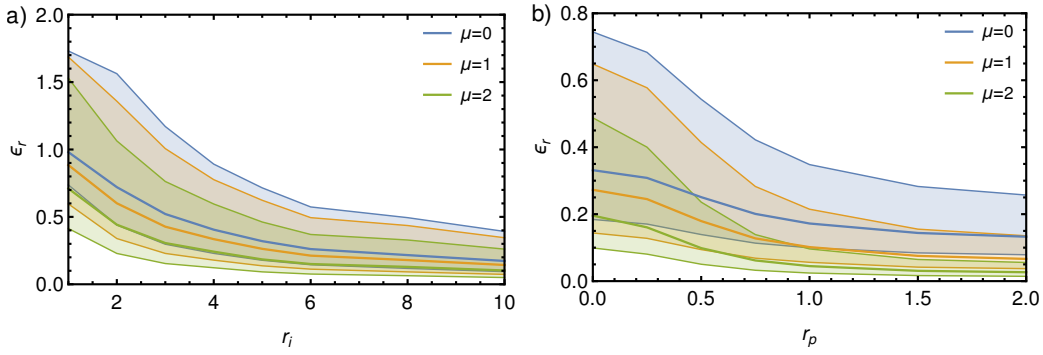

Figure 3: (color online) a) Dependence of the median and interquartile range (shaded) of the relative error ϵ_r on r_i for different approximation orders μ ($M = 3, r_p = 0$). b) Dependence on r_p ($M = 3, r_i = 5$).

imation orders. For $r_i \lesssim 2$ the approximation breaks down, since the probability that individuals are affected in opposite ways to the general population becomes higher.

When r_p increases, the distribution of positive and negative weights in the population is not symmetric anymore, meaning that the probability of opposing alternatives canceling each other is reduced. Therefore, approximation errors decrease, as can be seen in fig. 3b). For $r_p > 2$, virtually all needs/alternatives have positive effects on individuals, so that the relative error converges to a constant distribution. In this case, the zeroth-order approximation has a median error of $\epsilon_r \approx 13\%$.

Increasing the approximation order decreases the error monotonically for all parameter combinations. A first-order approximation yields for the chosen hierarchy depth ($M = 3$) a $10 - 50\%$ decrease in the the median relative error by requiring 5% of information about the individual hierarchy.

In conclusion, it can be said that the hierarchy of needs provides a remarkably efficient way of approximating well-being with a minimal amount of individual information requirements. Even a zeroth-order approximation yields reasonable errors, considering that the simulation represents an upper bound to real-world scenarios by allowing for arbitrary distributions of weights across individuals and populations, not taking into account possible correlations of weights within populations, allowing for the maximum detrimental effects of opposing alternatives ($r_p = 0$), and not

considering the convergence of weights for higher levels of the hierarchy.

4.1.2 Generalizing Predictions

Under limited generalizability, decision-making involving novel alternatives, unobservable desires, or singular choices cannot be predicted. In the following I sketch how the approximation scheme helps in these cases.

With unobservable desires and singular choices, all weights for an alternative are known to the individual, but a choice for them cannot be observed due to either prohibiting boundary conditions, or no previous choice situations occurred. To predict decisions in these cases, we are faced with the problem of not knowing the individual's hierarchy weights.

When a boundedly rational individual is faced with a novel alternative, she does not know of its effectiveness in satisfying her needs. Thus lower-level weights connecting the alternative in the hierarchy of needs are unknown to the individual. Neither we, *nor she*, know her hierarchy weights.

In this case, the revealed preference approach is bound to fail: if not even the individual knows the best course of action, one cannot derive general statements about her behavior from this potentially erroneous choice. The reason is that the assumptions of revealed-preference are not fulfilled: Neither does a novel alternative represent a repeated choice, nor can we assume consistency between choices in this case.

So how does an individual make a decision when confronted with novel alternatives? One can assume, that the individual already knows the higher-level weights of her hierarchy, by having obtained general knowledge about the world. Only lower-level weights, directly connecting to the novel alternative, are unknown. The individual will proceed to guess the unknown weights based on clues from the environment, by resorting to guessing the average effect on her surroundings, or other strategies. She will then carry out the decision-making with the imputed expected weights as described in sec. 3.2.2.

In other words, the individual performs a similar approximation of lower-level

weights to the one described in the last section: The unknown weights are replaced by e.g. one's subjective account of population averages. Thus, instead of having to compare a novel alternative to *all* other alternatives, as would have to be done for preference orders, the individual only has to guess a small set of weights to get an approximate account of the alternative's effects. In order to predict choices for novel alternatives, one can thus use the same approximation procedure used in the previous section.

The same holds for unobservable desires and singular choices as well: If the higher-level weights of the individual's hierarchy are known, one can obtain an approximate account of the likely counterfactual choice of the individual, as well as an approximate account of the well-being consequences of that choice.

In other words, the approximation scheme provides a suitable way of predicting choices and assessing well-being, irrespective of it being a habitual choice, a choice for a novel alternative, a counterfactual choice (involving unobservable desires), or a singular choice. I have already presented the effectiveness of the approximation procedure for assessing well-being in the last section, which carries over to predicting choices as well since it is only the reverse process. As stated before, successfully predicting choices further requires knowing the individual's momentary desires for AEs and an estimation of her sequence of choice correspondences.

In summary, I have shown the effectiveness of the approximative framework to assess well-being with limited data, and argued that the same procedure can be adopted to assess novel and counterfactual situations. In the following I will argue that normative needs theories are contained within the approximation scheme as well.

4.2 Reconstructing Normative Needs Theories

With the approximation scheme at hand, we can eventually take the full turn towards normative needs theories used in the literature (as presented in sec. 2.3). As it turns out, the theories described there represent the *zeroth-order* approximation for normative well-being assessments within the presented framework: First, they choose

a subset of normatively relevant BEs (e.g. avoidance of serious harm) and derive a set of BNs thereof.

To assess well-being through these BNs, they don't consider any individual characteristics (neither (expected) hierarchy weights, nor desires for BEs). They identify alternatives and their average contribution to BNs, as is e.g. done in development economics and the sustainability literature (Rao and Baer 2012; Vogel et al. 2021; Goldemberg et al. 1985).

In the last section, I have shown that well-being can be reasonably approximated through a zeroth-order approximation, even under worst-case conditions. The validity of the approximation crucially depends on the choice of AEs: As long as the choice of AEs incorporates the most important contributions to well-being, the corresponding alternatives will on average also contribute to well-being. The same caveat applies to the choice of BEs as well.

The framework, and by extension normative needs theories, are compatible with soft paternalism as long as autonomy is recognized as a BN. The argument is developed in online appendix B.

In summary, the social planner is able to perform approximate normative well-being assessments without the need to know individual preference orders, given that the average weights of alternatives contributing to the BEs are known. The extant framework also provides a straightforward way to improve on the normative needs theories discussed in the literature: Through measuring individual hierarchy weights on high levels of the hierarchy, the social planner is able to consider 'personalized' contribution to the normative goal.

5 Conclusion

The goal of this paper was to bridge the gap between psychological and sociological theories, which talk in the language of needs, and economic theories, which talk in the language of preferences. I accomplish this by developing a decision-making framework which conceptualizes a hierarchy of needs to establish the link between psychological desires and preferences (over alternatives). The framework thus opens

up the possibility for closer interdisciplinary communication between psychology, sociology and economics.

With the framework, I showed that contrary to the common belief that (basic) needs and preferences constitute antagonistic concepts, needs are rather the elements over which preferences are defined (and therefore, needs are simply a generalization of Lancaster's (1966) goods characteristics). I further explained how individual decision-making is performed.

Furthermore, I showed that the reliance on choice observations can be reduced by incorporating non-choice information in the framework. I chose the path of deriving non-choice information from psychological theories.

Finally, I showed that the hierarchy naturally leads to a consistent approximation scheme for choice predictions and well-being assessments, which respects the limited availability of observations. It is even applicable in situations where *no* previous choices have been observed, as is the case for novel alternatives, unobservable desires and non-repeated singular choices. I have shown the basic feasibility of the approximation scheme through simulations on random populations.

The approximation scheme has immediate applications in public policy: First, the social planner has only limited means of collecting data about individual choices; and when it is possible, it is often expensive. Furthermore, each policy proposal constitutes a novel alternative, over which individuals will express their preferences only once. Finally, individuals often cannot express their deeply held preferences due to institutional constraints; thus the revealed preference approach proves futile to elicit these preferences. With this framework, the social planner can perform approximate well-being assessments of counterfactual policies, predict acceptance of new policies, as well as proactively identify alternatives which individuals need and desire.

Other applications include predicting rare decisions by individuals, like choice of workplace, purchases of large household appliances or homes, and product choice under technological change. In these cases, individuals are faced with novel alternatives, where no previous choices have been made for the particular alternative.

The framework also provides a new opportunity for a sensible definition of norma-

tivity under bounded rationality: While it encompasses the definition of welfare as preference satisfaction, the framework can circumvent several issues appearing under bounded rationality[20] if defined in terms of the systematic approximative expansion. When performing the zeroth-order approximation, the approximation corresponds to normative needs theories.

The framework also provides ample possibilities to analyze failures of rationality. Just to name a few future strands of research, the hierarchy provides means for systematically analyzing deviations from complete knowledge; for analyzing discrepancies between expected and actual effects of alternatives; as well as for analyzing to which degree behavioral patterns conform to normative recommendations.

The presented framework represents only a first step towards a general decision-making framework, and undoubtedly many questions are still open. Among them, it needs to be clarified how to best measure hierarchy weights and desires for absolute ends through choice and non-choice observations.[21]

Furthermore, having direct experimental evidence for the decision-making from absolute ends towards alternatives, as well as applying the approximation scheme to real populations will further validate the framework in addition to the justifications already provided in this paper.

6 Acknowledgments

I would like to thank Desmond Gasper for fruitful discussions.

Declarations of interest: none

[20] In short, welfare economics loses the ability to distinguish between "good" and "bad" preferences like expensive tastes, sadistic preferences and addictions (Hausman and McPherson 2006, pp. 125; Brey et al. 2012, p. 18), while positional consumption gets legitimized (Bruni and Porta 2007, pp. xxiii; Witt 2016, pp. 225).

[21] As highlighted before, the literature on development economics and sustainability provides ways of incorporating non-choice information (Rao and Baer 2012; Vogel et al. 2021; Goldemberg et al. 1985). New developments within the revealed preference approach (Blow et al. 2008; Bernheim et al. 2013) might prove helpful here as well.

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7 Online Appendix

A A Possible Mathematical Description of the Framework

Needs and Ends: Ends $\boldsymbol{e}^m \in \mathcal{E}^m$ are attained when the corresponding needs are satisfied,

$$\boldsymbol{e}^m = \boldsymbol{\varepsilon}^m(\boldsymbol{n}^m; W^m), \tag{A.1}$$

where n_j^m expresses the need satisfaction of need j on level m. The effects of need satisfaction are mediated by the matrix of hierarchy weights $W^m = (w_{ij}^m)_{ij}$ between ends e_i^m and needs n_j^m. For $w_{ij}^m \gtrless 0$, need satisfaction (deprivation) is required to attain the corresponding end. For $w_{ij}^m = 0$, needs and ends are independent of each other. The function $\boldsymbol{\varepsilon}^m$, which can be read as "attaining the ends of the needs on level m", carries information about complementarities between needs in order to achieve the ends.

I also define the inverse relationship

$$\boldsymbol{n}^m = \boldsymbol{\nu}^m(\boldsymbol{e}^m; W^m, \boldsymbol{\tau}^m) = \boldsymbol{\varepsilon}^{m^{-1}}, \tag{A.2}$$

which expresses the "needs for attaining ends at level m". In general, there are more needs than ends (i.e. any end attainment can be caused by multiple combinations of need satisfactions), therefore $\boldsymbol{\varepsilon}^m$ is not uniquely invertible. For this reason, the inverse is characterized by a parametric solution through an arbitrary vector $\boldsymbol{\tau}^m$.[22]

[22]For example if all needs are perfect substitutes for ends, we have $\boldsymbol{e}^m = \varepsilon^m(\boldsymbol{n}^m; W^m) = W^m \cdot \boldsymbol{n}^m$. The inverse function is $\boldsymbol{\nu}^m(\boldsymbol{e}^m; W^m, \boldsymbol{\tau}^m) = W_R^{m^{-1}} \cdot \boldsymbol{e}^m + (I - W_R^{m^{-1}} \cdot W^m) \cdot \boldsymbol{\tau}^m$, with the generalized right-inverse $W_R^{m^{-1}}$ ($W^m \cdot W_R^{m^{-1}} \cdot \boldsymbol{e}^m = \boldsymbol{e}^m$) and parametric dependence on $\boldsymbol{\tau}^m$.

One can analogously formulate the expected quantities $\mathbb{E}\boldsymbol{e}^m = \mathbb{E}\boldsymbol{\varepsilon}^m(\boldsymbol{n}^m; \mathbb{E}W^m)$. If the individual has complete knowledge, we have $\mathbb{E}\boldsymbol{e}^m = \boldsymbol{e}^m$ and $\mathbb{E}W^m = W^m$.

Hierarchy: As explained in sec. 3.1, ends are means to other ends, thus we have

$$\boldsymbol{e}^{m+1} = \boldsymbol{n}^m \quad \forall m \geq 1. \tag{A.3}$$

Through this relation, the individual hierarchy can be constructed. In the following, I assume without loss of generality that all alternatives are on the same level $m = M$ of the hierarchy. I will also denote the alternatives as $\boldsymbol{a} \equiv \boldsymbol{n}^M$. The relations between different levels of the hierarchy are obtained through repeated function composition of eqs. (A.1) and (A.2) with help of eq. (A.3):

$$\begin{aligned}
\boldsymbol{\varepsilon}^{m_1 m_2}\left(\boldsymbol{n}^{m_2}; \{W^m\}_{m=m_1}^{m_2}\right) &\coloneqq \boldsymbol{\varepsilon}^{m_1}(\,\cdot\,; W^{m_1}) \circ \cdots \circ \boldsymbol{\varepsilon}^{m_2}(\boldsymbol{n}^{m_2}; W^{m_2}), \\
\boldsymbol{\nu}^{m_2 m_1}\left(\boldsymbol{e}^{m_1}; \{W^m\}_{m_1}^{m_2}, \{\boldsymbol{\tau}^m\}_{m_1}^{m_2}\right) &\coloneqq \boldsymbol{\nu}^{m_2}(\,\cdot\,; W^{m_2}, \boldsymbol{\tau}^{m_2}) \circ \cdots \circ \boldsymbol{\nu}^{m_1}(\boldsymbol{e}^{m_1}; W^{m_1}, \boldsymbol{\tau}^{m_1}).
\end{aligned}$$

It is easy to see that the inverse relationship also holds here,

$$\boldsymbol{\varepsilon}^{m_1 m_2\,-1}\left(\boldsymbol{n}^{m_2}; \{W^m\}_{m_1}^{m_2}\right) = \boldsymbol{\nu}^{m_2 m_1}\left(\boldsymbol{e}^{m_1}; \{W^m\}_{m_1}^{m_2}, \{\boldsymbol{\tau}^m\}_{m_1}^{m_2}\right).$$

By traversing the full individual hierarchy upwards, one can thus express AEs in terms of alternatives, $\boldsymbol{e}^1 = \boldsymbol{\varepsilon}^{1M}(\boldsymbol{a}; \{W^m\}_1^M)$, as well as expressing alternatives in terms of AEs by traversing the hierarchy downwards, $\boldsymbol{a} = \boldsymbol{\nu}^{M1}(\boldsymbol{e}^1; \{W^m\}_1^M, \{\boldsymbol{\tau}^m\}_1^M)$. One can also write down analogous relationships for the expected quantities.

Well-being: An individual's well-being is given by

$$U(\boldsymbol{e}^1) = U(\boldsymbol{\varepsilon}^{1M}(\boldsymbol{a}; \{W^m\}_1^M)).$$

Origins of Desires: The desires for AEs are situation-dependent and originate from psychological processes, as described in sec. 3.2.1. For drive theories, desires originate from current AN deprivation, thus $\mathbb{E}\boldsymbol{e}^{1^*} \sim -\boldsymbol{n}^1$. Self-determination theory

does not propose any needs dynamics, but one could reasonably interpret the origins of desires for basic psychological needs as $\mathbb{E}\boldsymbol{e}^{1^*} \sim \partial_t \boldsymbol{n}^1$.

Decision-Making: As explained in sec. 3.2.2, the decision-making process is carried out in several steps, iteratively narrowing down the set of alternatives by employing a sequence of choice correspondences C_t:

$$\underset{\left\{\mathbb{E}\boldsymbol{n}^{m_t}\left(\mathbb{E}\boldsymbol{n}^{m^*_{t-1}}\right)\right\}}{C_t}\left[\mathbb{E}U(\mathbb{E}\boldsymbol{n}^{m_t};\mathbb{E}\boldsymbol{e}^{1^*})\right] \text{ s.t. } \mathrm{BC}_t, \quad t \in \{1,2,\ldots,T\}, \tag{A.4}$$

with $m_0 = 0$ and $m_T = M$ and some boundary conditions BC_t. With each choice correspondence, the individual traverses the hierarchy from level m_{t-1} to level m_t, and determines the optimal set of needs/alternatives $\mathbb{E}\boldsymbol{n}^{m^*_t}$ at this level. Crucially, the individual only considers needs/alternatives which can be reached in the hierarchy from the choice in the previous iteration, $\mathbb{E}\boldsymbol{n}^{m^*_{t-1}}$. Thus she only considers the set $\{\mathbb{E}\boldsymbol{n}^{m_t}(\mathbb{E}\boldsymbol{n}^{m^*_{t-1}})\}$ in her decision at step t. The iteration over choice correspondences continues until a bundle of alternatives is found, i.e. $\mathbb{E}\boldsymbol{n}^{M^*} \equiv \mathbb{E}\boldsymbol{a}^*$ at $m_T = M$.

Some examples might be illustrative. The first one is a sequence of preference maximizations, $C_t = \max$. In all its explicitness, we get

$$\max_{\{\mathbb{E}\boldsymbol{n}^{m_t}\}}\left[\mathbb{E}U\left(\mathbb{E}\boldsymbol{\varepsilon}^{m_{t-1}+1,m_t}\left(\mathbb{E}\boldsymbol{n}^{m_t};\{\mathbb{E}W^m\}_{m_{t-1}+1}^{m_t}\right);\mathbb{E}\boldsymbol{e}^{1^*}\right)\right] \text{ s.t. } \mathrm{BC}_t. \tag{A.5}$$

The individual maximizes over the set of all $\{\mathbb{E}\boldsymbol{n}^{m_t} = \mathbb{E}\boldsymbol{\nu}^{m_t,m_{t-1}+1}\left(\mathbb{E}\boldsymbol{n}^{m^*_{t-1}};\{\mathbb{E}W^m\}_{m_{t-1}+1}^{m_t},\{\boldsymbol{\tau}^m\}_{m_{t-1}+1}^{m_t}\right)\}$ compatible with the previously chosen needs $\mathbb{E}\boldsymbol{n}^{m^*_{t-1}}$.

Neoclassical preference maximization considers all alternatives in one step, and thus iterates over the whole individual hierarchy only once:[23]

$$\underset{\left\{\mathbb{E}\boldsymbol{s}=\mathbb{E}\boldsymbol{\nu}^{M1}(\mathbb{E}\boldsymbol{e}^{1^*};\{\mathbb{E}W^m\}_1^M,\{\boldsymbol{\tau}^m\}_1^M)\right\}}{\max}\left[\mathbb{E}U\left(\mathbb{E}\boldsymbol{\varepsilon}^{1M}\left(\mathbb{E}\boldsymbol{a};\{\mathbb{E}W^m\}_1^M\right);\mathbb{E}\boldsymbol{e}^{1^*}\right)\right] \text{ s.t. } \mathrm{BC}_t.$$

[23] Utility maximization considers only repeated choices (Pareto and Montesano 2014), so that the momentary desires $\mathbb{E}\boldsymbol{e}^{1^*}$ are averaged out, and we obtain the usual expected utility maximization $\max_{\{\mathbb{E}\boldsymbol{a}\}} \mathbb{E}U(\mathbb{E}\boldsymbol{a})$.

The heuristic strategy of take-the-best (Gigerenzer and Brighton 2009) can be adopted in the following way:

$$\max\left[\mathbb{E}U(\,\cdot\,)\right] \text{ s.t. } \mathrm{BC}_t,$$
$$\left\{\mathbb{E}\boldsymbol{n}^{m_t}=\left(\mathbb{E}\nu_i^{m_t,m_{t-1}+1}(\,\cdot\,)\mathbb{1}_{ij}\right)_i\right\}_j$$

with the indicator function $\mathbb{1}_{ij}$. In other words, the individual maximizes over alternatives of the kind $\mathbb{E}\boldsymbol{n}^{m_t} = (0,\ldots,\mathbb{E}n_j^{m_t},\ldots,0)^T$. The arguments $(\,\cdot\,)$ are identical to preference maximization, eq. (A.5).

Approximative Decision-Making: The approximation concerns two parts, as described in sec. 4: On one hand, the set of AEs is restricted to some set considered relevant. So the first approximation is restricting the ends to a subset of AEs, $\hat{e}_i^1 \in \hat{\mathcal{E}}^1 \subseteq \mathcal{E}^1\ \forall i$. In other words, we assume $e_i^1 \approx 0\ \forall e_i^1 \notin \hat{\mathcal{E}}^1$ (analogously for $\mathbb{E}e_i^1$).

The second part of the approximation involves replacing lower-level weights by e.g. population averages: $W^m \approx \overline{W}^m \forall m > \mu$. Thus only the individual hierarchy weights up to μ, $\{W^m\}_1^\mu$ have to be known. In the zeroth-order approximation $W^m \approx \overline{W}^m \forall m$.

The approximate well-being is then given by

$$U(\hat{\boldsymbol{e}}^1) = U(\hat{\boldsymbol{\varepsilon}}^{1\mu}(\hat{\boldsymbol{\varepsilon}}^{\mu+1,M}(\boldsymbol{a};\{\overline{W}^m\}_{\mu+1}^M);\{W^m\}_1^\mu))$$

Similarly, the decision-making is carried out by a sequence of choice correspondences, with the difference that unknown weights are again replaced by population averages, and desires for AEs are limited to $\mathbb{E}\hat{\boldsymbol{e}}^{1^*}$. For $m_{t-1} \leq \mu$, the equations (A.4) and (A.5) hold, while for $m_{t-1} > \mu$ we have

$$C_t\left[\mathbb{E}U(\mathbb{E}\hat{\boldsymbol{n}}^{m_t};\mathbb{E}\hat{\boldsymbol{e}}^{1^*})\right] \text{ s.t. } \mathrm{BC}_t, \quad m_{t-1} > \mu \tag{A.6}$$
$$\left\{\mathbb{E}\hat{\boldsymbol{n}}^{m_t}\left(\mathbb{E}\hat{\boldsymbol{n}}^{m_{t-1}^*}\right)\right\}$$

with the appropriate replacement of $\overline{W}^m$.

B Paternalism and Normativity

Since normative formulations based on (objective and universal) basic needs are often criticized for being paternalistic, and thus incompatible with personal liberty (e.g. Reader 2006, ch. IV; Pölzler 2021, p. 8), I will spend some paragraphs explaining how these objections can be mitigated, and under which circumstances some degree of paternalism may be justifiable.

The argument against normative needs theories can be summarized succinctly as follows: For the sake of fulfilling their universalizable goal, normative needs theories have to resort to enforcing BN satisfaction. Enforcement is generally in conflict with upholding personal liberties, and therefore paternalistic. Paternalism is here understood as "the interference of a state or an individual with another person, against their will, and defended or motivated by a claim that the person interfered with will be better off or protected from harm" (Dworkin 2020).

Under bounded rationality, the necessity of some form of paternalism is recognized since it is known that individuals are subject to systematic biases, which led to the development of various 'soft' forms of paternalism (see e.g. Thaler and Sunstein 2003; Kirchgässner 2017; Camerer et al. 2003; Binder and Lades 2015).

As was also done elsewhere (Pölzler 2021; Crisp 2021, ch. 4.3), I argue that the inclusion of autonomy in the set of BNs rules out extreme forms of paternalism and makes this framework compatible with soft paternalism.[24]

The realization that autonomy in itself is conducive to well-being is recognized by economists (Sen 1993, p. 39; Kahneman and Sugden 2005, p. 176; Benz 2005) and psychologists alike (Chirkov et al. 2011; esp. Ryan and Deci 2011). By this, the trade-off between liberty and well-being can be reframed: A lack of autonomy is not only bad by appealing to a higher moral standard, but it can *also* negatively affect one's well-being. A social planner with the goal of maximizing well-being can therefore in principle determine the optimal amount of autonomy. Too much paternalism can decrease one's well-being (by depriving one's autonomy), but too little paternalism

[24]Other arguments for non-paternalistic normative needs theories can be found in (Hamilton 2003, pp. 165; Reader 2006, ch. IV; Gough 2015).

can do so as well by not providing a sufficient level of BN satisfaction required to enable positive freedoms (Pölzler 2021, pp. 8–9).

In practice, the interventions allowed by this framework are largely in line with soft paternalism, which have minimal impact on one's felt autonomy.[25] An enforcement of BN satisfaction is generally not permitted, but the social planner must *provide adequate opportunities* for BN satisfaction (ibid., pp. 8–9). Enforcement is only permitted to ensure a minimum amount of well-being (Camerer et al. 2003), while explicitly including autonomy in the set of BNs.[26]

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[25] The social planner has to provide opportunities for acquiring information (including providing education and (re-)framing of information (Camerer et al. 2003), as well as providing sensible default options (Thaler and Sunstein 2003)). Nudging is also permitted, since individuals not necessarily *perceive* limits to their choices as autonomy-depriving (Camerer et al. 2003, fn. 11).

[26] For example, force-feeding an individual engaging in a hunger strike deprives her need for autonomy, and is thus not justified. However, providing food and information about possible health risks are permissible (and normatively required), so that the individual can voluntarily end her hunger strike if she chooses to. If she is about to suffer irreparable damage, medical assistance should be provided.

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