Choosing temporal freedom? How to investigate choice preference on an anisotropic dimension

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ABSTRACT

In Computer users usually prefer scenarios where they can choose between options by themselves over scenarios where options are selected otherwise. Such choice preference has been demonstrated for several dimensions, like position, color etc., but not for time. I speculate that this research gap is due to the traditional paradigms in choice preference research requiring choice options on the one hand to involve different waiting times but on the other hand to be of equal value to users. Yet, different points in time are inherently different in value – due to the anisotropy of time. I argue that this issue can be accounted for by countering the inherent value asymmetry of time by associating additional value to the option via a pre-experimental temporal learning procedure.

KEYWORDS

Choice preference, time-based expectancy, anisotropy of time

1 Introduction

Humans prefer scenarios where they can choose between option by themselves over scenarios where options are selected otherwise. This choice preference has first been demonstrated in non-human animals [1, 2] and has later been extended to questionnaire [3] and behavioral studies with humans [4, 5].

Choice preference has also been investigated in applied human-machine interaction scenarios. Rens et al. [6], for example, devised a computer game where players could navigate in a simulated 3D environment to areas where they were able to choose between several doors leading to further rooms, or navigate to areas where the door to a further room was already selected. It turned out that players navigated significantly more often to the areas where they had to choose themselves among future paths [see also 7]. Such studies are important for the design of artificial interaction environments, as they allow us to determine experimentally under which conditions individuals reliably prefer choice over non-choice interfaces.

However, the dimension of time has been largely neglected in this research tradition. While choice preference has been intensely investigated for the choice between locations, types of actions, colors, products, etc., it is – to my knowledge – yet unknown whether individuals prefer to choose themselves between potential temporal moments to act, compared to being given an otherwise selected temporal moment to act. In the following I will speculate on potential reasons for this apparent gap in the literature on choice preference, and will, then, sketch some research strategies to fill this gap.

2 Choice preference and the anisotropy of time

Choice preference has traditionally been investigated with simultaneous chain schedules of reinforcement. In such designs, each trial consists of two stages [8]. At the first stage, individuals chose (e.g., via a button press) the scenario they want to experience at the second stage. That is either a further choice scenario, where they can choose themselves between two options for gaining a reward (e.g., two further buttons), or a non-choice scenario where only one "option" (e.g., one button) is provided and leads to a reward. Both second stage scenarios yield only one reward per trial, thus the only difference is whether individuals chose or chose not between ways to gain that reward. Choice preference becomes evident in the first stage choices. When individuals, on the first stage, reliably chose to experience the choice scenario at the following stage, they prefer choice for its own sake, as the expected reward in the second stage is always constant. This means choice has a value and is, consequently, itself a kind of "reward".

For the inferential logic of such designs it's eminently important that the options to choose from are of about equal value to the individual. If one option is apparently better, individuals would always select the choice option anyway, just to make sure

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not to be stuck with the poorer option in the non-choice scenario, irrespective of whether they prefer choice as such or not. Preference for the good option would be indistinguishably confounded with preference for choice. Only when both options are about equally valuable, individuals could be sure to get a “good” option in the non-choice scenario as well; consequently, the only reason left to select the choice scenario would be preference for choice as such [9].

Devising options of about equal value is relatively unproblematic with non-temporal dimensions, like key locations or key colors. Left or right response locations, or blue or green colors, have usually no – or only a neglectable – difference in value for individuals. Thus, preferences for choice between them can unambiguously be attributed to the value of choice itself – as long as any possible, yet unlikely, preference for a certain color or location are ruled out by baseline tests.

The dimension of time, on the contrary, does not lend itself particularly well to devising different options of equal value. Due to the anisotropy of time, that is the inherent directedness of time, acting at a later moment in time implies necessarily an additional amount of waiting time compared to acting at an earlier moment in time [10]. Thus, the later moment inherently includes additional temporal “costs”.

In basic psychology [11] as well as in human-machine interaction research [12-14], such temporal costs are typically conceptualized as waiting times, and their potential aversiveness is explored. In most contexts, users prefer interaction uninterrupted by delays, and would – if possible – chose not to wait at all [15, 16]. A rich literature in basic research has attempted to quantify the aversive nature of waiting by probing how much value (e.g. money or food) we are willing to trade for it [e.g., 17]. Above that, waiting research in human-computer interaction has explored how to ameliorate negative emotional reactions to technically unavoidable waiting by different distraction strategies [e.g., 18]. According to this logic it would make no sense to ask whether individuals prefer to choose whether to wait short or long, because one would select the choice option anyway: not for the sake of choice, but just to avoid potentially being stuck with a long wait option in the non-choice scenario.

In other contexts, delays are desired, positively experienced and typically self-initiated, like when making a pause from an effortful physical or mental activity [19, 20]. In such contexts, longer pauses are often preferred to shorter ones (depending on exhaustion). Yet, again it is – due to the anisotropy of time – difficult to construct temporal options of equal value to choose from. An exhausted individual will always prefer the choice scenario to a non-choice scenario, just because the former one definitely includes the desired longer pause option, while the latter involves the risk being stuck with only the shorter pause option.

Thus, in some context, a longer time interval before action is aversive (as, e.g., in waiting), while in other contexts it is desirable (as in pauses), but due to the inherent directedness of time two different options (short or long), necessarily have different values. And this in turn makes it difficult to disentangle preference for choice between points in time from the – highly likely – preference for apparently better one of the two temporal options.

3 Investigating temporal choice preference

Despite the difficulty to investigate temporal choice preference by traditional choice preference designs, the question of whether we prefer temporal choice is of increasing practical importance. Many contemporary interface designs explicitly encourage temporal choices of the users, when, for example, choosing to allow an newly available update installation now or at a later point in time. When such scheduling decisions are delegated to the users, they have to weigh the anticipated aversive waiting against the disadvantages of operating on an outdated system. Likewise, social media platforms increasingly offer temporal self-control functions to let users time, and schedule their pauses or online-activities [21, 22]. Given the increasing prevalence of temporal choice in human-computer interaction, it is important to know how much users value and prefer such design decision. So far, research has only investigated and quantified preferences for different waiting times when we already have the choice between waiting times [e.g., 23]. Yet, a systematic research program on how much users prefer such a temporal choice scenario over a scenario where the time to act is externally determined, is still wanting. In the preceding subsection I speculated that this research gap is due to the anisotropy of time posing a particular challenge to the traditional paradigms in choice preference research.

In the following I argue that this difficulty can be overcome by employing a design strategy inspired by recent findings in associative learning research. This strategy would allow to devise feasible research paradigms apt to gaining potential evidence for temporal choice preference.

The design strategy I like to suggest comes from basic and applied research in the area of time-based expectancy. Time-based expectancy means that different durations of an interval preceding an event are predictive with regard to the nature of the event, for example when one event is typically preceded by short waiting time, and another one by long waiting time [24-26].

In many contexts the valence of time, that is whether more time is negative (like with an unwanted wait) or positive (like when making a pause), originates from relatively basic functional principles of the (biological or artificial) system: In natural language, for example, longer conversation pauses predict negative [27], or more complex utterances [28]; an longer system response times in machines often predict errors [29]. Yet, recent research has shown that such associations between waiting time and value can be rapidly learned with high flexibility. Thomaschke, Bogon, and Dreisbach [30] trained participants to either associate expectancy for a positive event to a short interval and expectancy for a negative event to a long interval, or the other way around. The training yielded fast and reliable associations in either direction without participants becoming aware of the association.

I suggest employing such training procedure in order to create different temporal option of equal overall value, in order to use these options for tests of temporal choice preference. Assume two different time intervals preceding rewards that should be involved in choice options with equal value. In a first step one must estimate the amount of waiting cost difference between the two intervals in terms of reward. That is: How much additional reward is necessary for the individual to choose the longer instead of the (inherently better) shorter interval. In a second step, one can train participants to implicitly expect that extra reward after the longer, but not after the shorter interval. When participants will have learned that associations via time-based expectancy learning, both options should be of equal value to them, although they involve different intervals. After such preparatory learning stages, it should be possible to incorporate these both options into a traditional choice-preference design:

In a simultaneous chain-schedule (see above) participants could, at a first stage, select whether they like to choose between the different interval option at the second stage, or select a scenario where only one of the two temporal options is available at the second stage. Here, the first stage selections would be unambiguously due to temporal choice preference, as both options are of about equal value to participants. As the options are equally favorable it should not matter to participants whether they chose among them or the choice is made by the experimenter, unless they prefer the choice for its own sake.

4 Conclusions

Which choices computer users prefer to have, and which choices are even aversive to them, is contentiously debated [31, 32] and has been intensely investigated during the past couple of decades [33, 34]. However, the temporal dimension has largely been neglected in this research, because it has been difficult to equate different temporal options to choose from which do not differ in value. I argued that this problem can be accounted for by using associative learning procedures from time-based expectancy research. By such training procedures one could create equally valuable but still temporally different option to choose from, and thereby testing in an unconfounded manner whether individuals prefer to choose among waiting intervals or not.

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