**On Trading Off Labor and Leisure:
A Process Model of Perceived Autonomy and Opportunity Costs**

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In press, *Motivation Science*

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This work was supported by a grant from the German Science Foundation (DFG; HO 4175/5-1 and HO 4175/5-2) awarded to the corresponding author. We would like to thank Matthew Baldwin and two anonymous reviewers for helpful comments on an earlier draft of this manuscript.

Abstract

Why do certain tasks and activities feel effortful, and, ultimately, result in task disengagement? To answer this question, we connected and extended prior work on labor/leisure tradeoffs, autonomy, opportunity costs, effort, and task utility into an integrative model of the antecedents and consequences of perceived opportunity costs, defined as the perceived costs of missing out on a tempting alternative action. Using both an experimental causal chain approach (Experiments 1-3) as well as a large experience sampling study ($N_{obs} = 9,994$), we found that activities that were low in autonomy predicted opportunity costs, and that opportunity costs, in turn, positively predicted feelings of effort and negatively predicted task utility. Mediation analyses supported the process model. Finally, using a novel dropout-paradigm, Experiment 5 provided evidence that opportunity costs are causally related to task disengagement. Our findings suggest that opportunity costs may play a non-negligible role in creating the subjective sensation of effort and in guiding task choice. Moreover, they provide a conceptual bridge to autonomous motivation which may shield the individual from the perception that he/she may have better things to do.

Keywords: Opportunity costs, autonomy, effort, labor, leisure, self-regulation

In order to successfully self-regulate, people must work hard on actions that they *have* to do (e.g., labor), often times at the expense of fun and effortless actions that they *want* to do (e.g., leisure; Baumeister & Heatherton, 1996; Inzlicht, Schmeichel, & Macrae, 2014). For example, successful self-control requires that people prioritize working over taking a break, running an extra mile on the treadmill over pushing the stop-button, studying for an exam over having fun with friends, and so on. Yet, despite their many positive long-term outcomes—enacting such have-to tasks is usually not accompanied by positive feelings. Rather, have-to tasks *feel* effortful, and effort is aversive and costly (Kool, McGuire, Rosen, & Botvinick, 2010; Kool, McGuire, Wang, & Botvinick, 2013; Kurzban, 2016; Shenhav et al., 2017). So why does enacting the means to reach desired end states often feel ‘effortful,’ despite the obvious benefits of doing so?

To answer this question, one needs to first understand what motivates people to invest effort in the first place, a question that had been thoroughly addressed by decades of research on motivation intensity theory (MIT; Brehm & Self, 1989; for a review, see Richter, Gendolla, & Wright, 2016). The core focus of MIT is on the *mobilization of effort* (i.e., the investment of effort to carry out a behavior when executing a given task at hand). According to MIT, mobilized effort essentially represents the difficulty or demand of the task at hand. Under most circumstances (i.e., when success is possible), mobilized effort is proportional to task difficulty/demand, i.e., a task-inherent feature (Gendolla & Richter, 2013; Richter et al., 2016). The reason for this proportionality with task demands is that individuals are motivated to conserve effort resources, i.e., do not want to allocate more effort than necessary. Furthermore, the amount of effort that is necessary to succeed needs to be justified such that the benefits of investing effort outweigh the costs. Therefore, MIT assumes a maximum amount of effort (potential motivation) people are willing to invest in task execution, as determined by success

importance: If people perceive that success is unlikely and/or that the task is not “worth the effort” anymore they are expected to disengage (Richter et al., 2016). Although the *subjective experience* of effort is not a central focus of the model, according to MIT, this feeling of effort may be assumed to arise from actual effort mobilization during task execution (Gendolla & Richter, 2013; see also Bijleveld, 2018; Shenhav et al., 2017).

In the present article, we scrutinize an additional answer to the question of why have-to tasks feel effortful by including the larger context: the availability of *attractive alternative activities*. According to Kurzban and colleagues (Kurzban, Duckworth, Kable, & Myers, 2013), one reason behind the cost of cognitive labor is given by *opportunity costs* (OC henceforth), the cost of missing out on an attractive alternative action. According to the model, OC give rise to the subjective experience of effort, and in turn to task disengagement. Specifically, the feeling of effort is assumed to be the output of a mental system that considers the costs of continuing to engage in the current activity, relative to the next best (or even better) alternative action that an organism could engage in at a given point in time. Thus, in order to decide whether it is worthwhile to maintain the current course of action or to seek out new opportunities (which was theorized to be adaptive, e.g., Inzlicht et al., 2014), people must monitor and evaluate the costs and benefits of the current activity in relation to attractive alternative/tempting options. The opportunity cost model, in contrast to MIT, appears to neglect the role of task demand but rather seems primarily geared towards accounting for the *experience* of effort rather than the *mobilization* thereof, and for how the experience of effort and the associated reduction in task utility may affect *task choice* rather than *task execution* (see Gendolla & Richter, 2013, for this criticism of the opportunity cost model).

Despite these shortcomings, the opportunity cost model may direct attention to some understudied issues regarding task-exogenous antecedents of the experience of effort, as well as its consequences for task selection. The model allows for the interesting prediction that two individuals dealing with identical task demands may experience diverging levels of effort due to differing OC, with consequences for task persistence. In this work we empirically test an extended process model of OC, described next, which not only introduces a novel important mediating variable – autonomy, but also emphasizes the subjective nature of OC. In a nutshell, our model adds to Kurzban et al.'s (2013) model that when people engage in laborious activities, they experience reduced autonomy, which in turn contributes to perceived OC. Thus, as a consequence of perceived OC, people may experience the aversive sensation of effort and a reduction in experienced task utility, which may affect whether they choose to persevere on the task or disengage from it.

A process model of opportunity costs

Building on and extending the theoretical model by Kurzban and colleagues (2013), we empirically investigated a process model of opportunity costs that integrates the components labor, autonomy, OC, effort, and task utility (Figure 1). The first part of the model focuses on the antecedents, the second part on the consequences of OC, including task disengagement as an ultimate consequence.

Antecedents of Opportunity Costs

The left portion of the model spells out the potential links between engaging in labor vs. leisure activities (a surface-level variable) and autonomy (a deep-level, psychological mechanism) to elicit OC. We define labor as the expenditure of physical or mental effort in the service of external rewards. Labor has been shown to be costly: According to the ‘law of less

work' (Hull, 1943) and the 'principle of least action' (Gibson, 1900), people are 'lazy organisms' (McGuire, 1969) who prefer to select tasks so as to minimize physical as well as cognitive labor while maximizing utility (Kool et al., 2010; Shenhav et al., 2017; see also Brehm & Self, 1989). Based on this literature, we expected that perceptions of OC might occur more frequently when people engage in labor activities.

Which (deep-level) psychological aspect about labor, however, may be responsible for the experience of OC? Our key assumption in our extended model is that the effect of labor on OC is mediated via feelings of autonomy (Deci, 1980). Specifically, we expected that labor reduces feelings of autonomy, and that reduced autonomy would predict OC. According to self-determination theory, people pursue autonomous actions because they reflect genuine interests, are personally important and meaningful, are chosen by oneself, and entail a feeling of personal freedom (Deci, 1980; Deci & Ryan, 1985; Ryan & Deci, 2008). On the other hand, people pursue controlled activities for external reasons, because they are characterized by a sense of external control, greater pressure, and obligation. We therefore reasoned that, on average, labor activities should be associated with decreased feelings of autonomy, as compared to leisure.

Why might autonomy reduce the perception of OC? A number of studies have found that autonomy contributes to behavioral persistence in a wide variety of contexts that require continuous self-regulation over extended periods of time (e.g., studying, dieting, exercising, quitting smoking, etc.; Muraven, Gagné, & Rosman, 2008). In a related vein, Milyavskaya, Inzlicht, Hope, and Koestner (2015) found that autonomy reduced people's valuation of temptations. Building on these earlier findings, we suggest that feelings of autonomy motivate people to engage (and remain engaged) in a given activity, thus shielding them from distractions

and temptations that would otherwise occupy their thoughts and trigger OC. From this reasoning we hypothesized the following:

H1: Labor activities decrease feelings of autonomy.

H2: Reduced feelings of autonomy increase perceived OC.

Consequences of Opportunity Costs

In line with the opportunity cost model (Kurzban et al., 2013), we hypothesized that OC increase feelings of effort and decrease task utility. The model assumes that mental effort is the output of an OC analysis in which the costs and benefits of the current activity are being compared to those of salient action alternatives. When a person is devoting her time to one task but realizes she would rather be devoting her time to an alternative activity (i.e., perceives OC), she is assumed to experience a sensation of effort and to ascribe less utility to the current task. At this point, either more rewards are needed to counteract these costs, or performance starts to decline until the task is given up eventually, because it is no longer worth the effort.

Note that the model treats an increase in perceived effort and reduced task utility as two correlated consequences of the opportunity cost comparison mechanism. Little is known about their exact interplay, which may be complex: It is possible, for instance, that the experience of effort (at least partially) drives task utility judgments, serving as one important cue. It is also possible that reduced task utility (at least partially) renders the current task more effortful, at least subjectively. Therefore, treating the two constructs as associated consequences of perceived OC at this early stage of theory building seemed sensible. We therefore hypothesized that:

H3: OC increase feelings of effort.

H4: OC decrease task utility.

So far, we have sketched the main part of the model, but clearly it is possible to connect

the model with more ultimate outcomes. As a secondary hypothesis, and in line with the model by Kurzban et al. (2013), we assumed that OC would ultimately encourage task disengagement and designed our last study in particular to assess task disengagement. That is, the more people see an activity as effortful and low in utility, the less they should be willing to keep persisting on it, leading to task disengagement, a prediction that is also in line with MIT (Brehm, Wright, Solomon, Silka, & Greenberg, 1983; Brehm & Self, 1989). Our secondary hypothesis thus reads:

H5: OC increase task disengagement.

Overview of Present Studies

The present research sought to investigate the antecedents and consequences of OC. In a series of five studies (total $N = 1,426$), we tested the hypotheses derived from the outlined process model of OC. Our approach combined controlled, internally valid experimental testing with ecologically valid sources of data from everyday life to provide a comprehensive test of the proposed model. In the first three experiments, we adopted a rigorous causal chain approach (Spencer, Zanna, & Fong, 2005) to test each link of the model (H1-H4) by manipulating one conceptual variable in the model at a time and assessing its effect on the subsequent variable. To complement this series of experiments in an ecologically valid way, we also conducted an experience-sampling study (Study 4) in order to test and cross-validate our path model. Finally, in Experiment 5, we created a drop-out paradigm designed to explore whether increasing OC experimentally may result in earlier task disengagement (H5). The data and syntax for all projects can be accessed at our OSF project page (<https://osf.io/gtafh/>).

Experiment 1: Framing a Task as Labor Decreases Perceptions of Autonomy

In Experiment 1, we tested the hypothesis that labor decreases perceptions of autonomy (H1). We reasoned that the most rigid experimental test of this link would consist of a setting

where participants perform the very same objective activity, but categorize it as falling more into the category of labor or leisure. Building on earlier work (Werle, Wansink, & Payne, 2015), we framed the same task either as a labor or as a leisure activity and examined the effect of task framing on perceptions of autonomy while working on the task. Based on a pilot, we assumed a medium effect size of around $d = 0.50$ and expected a sample of 210 participants or more to be sufficient to detect such an effect with 95% power (Faul, Erdfelder, Lang, & Buchner, 2007).

Method

Participants and design. 300 Amazon.com Mechanical Turk volunteers in the United States participated in the study (52.3% males, $M_{age} = 36.29$, $SD = 10.58$) and received \$1. Participants were randomly assigned to either the labor or the leisure framing condition. Due to a technical problem, condition assignment information was not available for four participants.

Procedure. First, participants learned that they were participating in a study that involved solving anagrams. Participants assigned to the labor framing condition read:

Welcome to our “Mental work” study! This is a study that involves solving anagrams. Anagrams have been found to be very challenging and demanding. We would like you to engage in this task by working hard! This is work and not free time.

Participants assigned to the leisure framing condition read:

Welcome to our “Play with words” study! This study involves solving anagrams. Anagrams have been found to be recreational and relaxing. We would like you to engage in this task with leisure and joy. This is playtime and not work.

All participants were assured that their MTurk reward would not depend on how many anagrams they solve correctly. Next, all participants completed a practice trial. Afterwards participants were briefly reminded of the respective task framing and then engaged in the anagram task. The task consisted of 15 anagrams which had four to six letters each. All

participants needed to spend at least three minutes on the task before the next button appeared and they were able to proceed. Following the anagram task, participants filled out the nine-item self-report measure of autonomy. Finally, participants saw the anagram solutions.

Measures. To assess autonomy, we used the self-determination scale by Reeve, Nix, and Hamm (2003) and adjusted it to the anagram task. The scale consists of 9 items assessing perceived locus of causality (e.g., *I felt I was allowed to do what I wanted to be doing*), volition, (e.g., *During the anagram-solving, I felt pressured*) and perceived choice (e.g., *I believe I had a choice over how to approach the anagram task*), all on scales from 1 (*not at all*) to 7 (*very much*). All nine items combined well into a total autonomy score ($\alpha = .76$).

Results and Discussion

An independent samples *t*-test predicting autonomy from the experimental manipulation revealed that participants felt less autonomous when a task was framed as labor, $M = 3.76$, $SD = 1.21$, versus framed as leisure, $M = 4.30$, $SD = 1.20$, $t(294) = 3.81$, $p = .001$, $d = 0.44$. Thus, results from Experiment 1 provide some support for the hypothesis that labor decreases perceptions of autonomy. Regarding anagram performance, there was no difference in the average number of anagrams solved in the labor, $M = 11.24$, $SD = 3.62$, versus leisure condition, $M = 11.53$, $SD = 3.17$, $t(294) = 0.75$, $p = .456$, $d = 0.09$.

Experiment 2: Constraining Autonomy Increases Opportunity Costs

Experiment 2 tested the hypothesis that autonomy reduces OC (H2). In order to manipulate autonomy we adapted a controlled choice paradigm (Moller, Ryan, & Deci, 2006; Zuckerman, Porac, Lathin, & Deci, 1978; Baumeister, Bratslavsky, Muraven, & Tice, 1998). In this paradigm autonomy is manipulated by having participants select which side of a debate they would like to endorse. Participants in the autonomous choice condition have full choice over

which side of the debate they want to take. In contrast, participants in the controlled choice condition are initially told that they could choose which side they want to endorse. However, they are then subtly pressured to choose the other side of the debate. Our experimental manipulation was based on the notion that the administration of choice and interest increases autonomous motivation, whereas the administration of pressure and demand decreases it (Deci & Ryan, 2008; Moller et al., 2006). Thus, we hypothesized that the autonomous choice condition would lead to lower OC relative to the controlled choice condition. Assuming a medium effect size of around $d = 0.50$, an overall sample of 210 participants or more allowed us to be able to detect such an effect with high statistical power of 95% or higher.

Method

Participants and design. We recruited 302 US participants (49.7 % male, $M_{\text{age}} = 35.14$, $SD = 10.69$) via mTurk (www.amazon.com, 2014) in exchange for monetary compensation. Participants were randomly assigned to either the autonomous or the controlled choice condition.

Procedure. First, participants read:

To investigate how people respond to persuasion, we'd like you to help us make arguments, which will be shown to other MTurkers to try to alter their attitudes. In particular, we'd like you to write a short persuasive speech regarding whether cannabis should be legalized.

Participants in both conditions were initially told that the decision of which speech to make was entirely up to them and indicated their choice of side of debate. However, participants in the controlled choice condition were subsequently told that it would help the study a great deal if they wrote from the perspective of the other side than the one they had selected. Participants could then choose whether they agreed to write for the other side or not, and then typed their speech in a textbox. 51 participants did not comply with our request and stayed with their initial decision (we suspect that the somewhat higher rejection rates compared to previous studies may

be due to the online nature of the study). We excluded those participants from analyses, but note that a sensitivity analysis showed that statistical conclusions do not change when including them. Finally, participants completed a measure of perceived OC.

Measures. We measured perceived OC on a continuous scale consisting of two items ($\alpha = .87$): *While writing the speech, I felt that I would rather want to do something else (e.g., instead of writing a speech)* and *While writing the speech, I felt I was missing out on the opportunity to engage in an alternative activity (e.g., something other than writing a speech)*. Ratings were made on a seven-point scale from 1 (*not at all true*) to 7 (*very true*). To assess autonomy for our manipulation check, the same self-determination scale was used as in Experiment 1 ($\alpha = .90$).

Results and Discussion

Participants in the autonomous choice condition reported higher average levels of autonomy, $M = 5.10$, $SD = 1.06$, than participants in the controlled choice condition, $M = 2.94$, $SD = 1.17$, $t(249) = 15.17$, $p < .001$, $d = 1.97$. Thus, the experimental manipulation of autonomy was highly successful. To test whether the manipulation of autonomy influenced perceptions of OC we conducted an independent-samples t -test. Confirming H2, participants in the autonomous choice condition reported lower perceptions of OC, $M = 3.09$, $SD = 1.87$, than participants in the controlled choice condition, $M = 3.81$, $SD = 1.82$, $t(249) = 3.03$, $p = .003$, $d = 0.39$, suggesting that OC increase with decreasing levels of autonomy.

Experiment 3: Manipulating Opportunity Costs Affects Feelings of Effort and Task Utility

Experiment 3 tested the proximal consequences of OC, i.e., whether OC impact feelings of effort (H3) and task utility (H4) in a controlled laboratory environment.¹ To this aim, we developed a novel paradigm intended to create group differences regarding the perception of OC.

Specifically, halfway through an effortful task, participants were presented with the opportunity to roll a die to determine whether, for the rest of the experiment, they will continue to work on the effortful task, or they will get to work on a different, fun task. We used a loaded die to assure that participants will keep working on the initial effortful task, while manipulating whether participants perceived that they had foregone an *attractive* alternative opportunity (OC condition), or not (control condition).

We assessed perceived effort, interest, and importance both before and after the OC manipulation, and predicted the following a priori contrast: Participants in the OC condition should report higher levels of effort and lower levels of task utility at the second measurement (after the manipulation of OC), whereas participants in the control condition should experience the same levels of effort and task utility at both measurements. Based on a preliminary finding regarding task utility¹, we assumed a medium effect size of $d = .50$ or higher (analogous to an effect size f of .25) and expected a sample of approx. 70 participants or more to be sufficient to detect an interaction effect in a mixed design with at least 95% power (Faul et al., 2007).

Method

Participants. One-hundred and ten participants from a large university in Western Germany (25.5 % males, $M_{\text{age}} = 22.00$, $SD = 4.19$) participated in this study. Participants were assigned to either the OC ($n = 54$) or control condition ($n = 56$). Eight participants in the OC condition had to be excluded from analyses because in a small fraction of rolls (14.5%) the loaded die produced an unintended outcome.

Procedure. Participants were told they were taking part in a bogus validation task of a dyscalculia screener, adjusted for our purposes. This ostensible validation study involved a version of the add-3 task (Kahneman, Tursky, Shapiro, & Crider, 1969; Francis, 2014), a task

that combines cognitive processing and working memory. Participants are shown four random numbers for one second each, must memorize the numbers, and add three to each of the memorized numbers (1 becomes 4, 3 becomes 6, etc.). The task is effortful because participants only have one second to memorize and four seconds to type in the numbers. To avoid possible ceiling effects of effort, we slightly lowered the amount of effort necessary by granting participants twice as much time to memorize and type in their numbers. That is, participants had two seconds to memorize and eight seconds to type in their numbers.

Participants first completed five practice trials before performing 30 trials of the add-3 task with a duration of 5 minutes. Afterwards, they completed measures of perceived effort (“How effortful do you perceive the task to be?”), importance (“How important do you perceive the task to be?”), and interest (“How interesting do you perceive the task to be?”), each on a scale from 1 (*not at all*) to 10 (*very much*). Participants then learned that they would roll a die that would decide which of two tasks they would be doing next. In the OC condition, participants learned that when rolling an even number, their next task was to do the add-3 task again, whereas when rolling an uneven number their next task was to watch funny and popular video clips. Our reasoning was that rolling an even number would induce OC, because participants would have to forego the attractive alternative to watch videos rather than continuing on the effortful task. In the control condition, however, participants learned that when rolling an even number their next task was to do the even-numbers version of the add-3 task again, whereas when rolling an uneven number, their next task was to do the uneven-numbers add-3 task. Hence both options in the control condition were essentially equal. Unbeknownst to participants, the die handed to them by the experimenter was *loaded*, so that it would land on the number six (i.e., on an even number) with almost every toss. Thus, after rolling the die, (almost) all participants in the OC

condition learned that they would move on with the second, identical part of the add-3 task, rather than engaging in the fun task. Following the add-3 task, which had 30 trials but involved new sets of numbers, they again completed measures of effort, importance, and interest. As a manipulation check, participants indicated perceived OC on two items (“To what extent would you have preferred the other outcome, i.e., to work on the alternative task?”; “Do you believe that the outcome made you miss out on a better task?”; $\alpha = .73$).

Results

An independent samples *t*-test predicting OC from the experimental manipulation showed that participants in the OC condition, $M = 5.46$, $SD = 2.32$, perceived higher levels of OC than participants in the control condition, $M = 2.06$, $SD = 1.85$, $t(100) = 8.22$, $p < .001$, $d = 1.65$.

Mean effort and task utility ratings for our main analyses are presented in Figure 2 as a function of time and condition. As can be seen from the Figure, there was a marked increase in effort in the OC condition at posttest. In order to statistically compare effort levels in the OC condition at posttest with all other conditions in our mixed design, we computed an a priori contrast from a mixed model in SPSS (which uses the Satterthwaite approximation to calculate *dfs*). To estimate the semi-standardized effect size coefficient for the contrast, we repeated the analysis with standardized effort scores, using the pre-test mean and standard deviation for standardization. The contrast for effort was significant, $F(1, 126.4) = 21.97$, $p < .001$, $\beta = .59$, confirming H3.

As task interest and task importance were not highly correlated, $r = .31$, $p = .002$, we not only report the results for the combined task utility score but also separately for the two items. An a priori contrast comparing the task utility composite in the OC condition at posttest with all other conditions was significant, $F(1, 125.4) = 16.37$, $p < .001$, $\beta = -.35$, confirming H4.

Regarding task interest, an a priori contrast comparing task interest in the OC condition at posttest with all other conditions was significant, $F(1, 129.0) = 5.61, p = .019, \beta = -.25$.

Regarding task importance, the a priori contrast comparing importance in the OC condition at posttest with all other conditions was not reliable, $F(1, 106.7) = 2.16, p = .144, \beta = -.15$. Hence, the above task utility effect appeared to be driven by changes in task interest rather than importance.

Finally, we checked for task performance/execution differences between conditions in a supplementary analysis. A 2 (condition: OC vs. control) $\times$ 2 (time: before vs. after) ANOVA showed a large main effect of time, $F(1, 100) = 56.70, p < .001, \eta_p^2 = .36$, indicating that participants improved from pretest, $M = 71.7\%, SD = .25$, to posttest, $M = 83.5\%, SD = .19$, probably due to practice with the add3 task. However, there was no main effect of condition, $F(1, 100) = 0.37, p = .545, \eta_p^2 = .004$, and neither was there an interaction of time and condition, $F(1, 100) = 0.97, p = .327, \eta_p^2 = .01$. Thus, despite experiencing higher levels of effort and reduced task utility, participants in the high OC condition were still able to mobilize enough effort to perform equally well as those in the low OC condition.

Discussion

Experiment 3 validated a novel paradigm to experimentally induce perceived OC while holding many aspects constant (such as the actual task at hand). The key finding was that our manipulation of OC led people to experience higher effort (H3) as well as lower task utility (H4) when both interest and importance were combined. In our view, these results are noteworthy insofar as they provide the first experimental evidence in support of the central causal claim behind Kurzban et al.'s opportunity cost model: That, all else being equal, perceived OC result in heightened feelings of effort (and reduced task utility). Moreover, and in line with our initial

distinction between task execution and task choice, there was no discernible effect of increased OC on performance (at least within the relatively short period of the task and without any option to choose engaging in a different task in this experimental setting). Thus, another important insight from this experiment is that OC may not have any discernible immediate effect on task performance, as people engaging in have-to tasks may nonetheless mobilize sufficient resources to meet task demands, as predicted by MIT (e.g., Gendolla & Richter, 2013; Richter et al., 2016).

Study 4: Opportunity Costs in Everyday Life

Experiments 1 to 3 so far employed an experimental causal-chain approach to establish the separate links proposed by our process model. In Study 4, we sought to complement the internally valid approach with an approach that maximizes ecological validity. To this end, we conducted a one-week experience-sampling study on perceived OC in everyday life. This allowed us to test H1 through H4 simultaneously, as well as to test the mediation pathways implied by our process model. To achieve good statistical power in light of the multilevel nature of the data, we attempted to optimize both the number of participants (targeting at least 300) and the number of measurement occasions (> 20) in light of our financial resources.

Method

Participants. We recruited 362 participants (76% female, $M_{\text{age}} = 27.97$, $SD = 7.70$) from a large city in Western Germany via various Facebook groups, university mailing lists, and participant pool mailing lists.² Participants were only eligible if they were 18 years or older, and possessed a smartphone including data plan. Of these participants, 27% were full-time employees, 15.5% were part-time employees, 17.4% were students who indicated to have a part-time job, 37.3% were students without a part-time job, and 2.5% were unclassified. Students were mostly enrolled in three different fields of study (psychology, education, and media

psychology). Employees occupied very different professions; most of them had regular office jobs. Participants received €15 if they completed at least 80% of the survey.

Procedure. We used the web-based experience-sampling application *SurveySignal* to administer the primary independent and dependent variables (Hofmann & Patel, 2015). After reading and agreeing to the informed consent, participants filled out an intake survey assessing demographic and personality information. From then on, each day for a week, they received a total of six daily signals between 8 a.m. and 8 p.m. or 9 a.m. and 9 p.m., depending on the participant's preference. This time window was divided into six blocks of 120 minutes each. Within each of these time blocks one daily signal time was randomly selected with the restriction that two successive signals were at least 45 minutes apart. The study also contained an end-of-day survey tapping into well-being-related aspects which were not in the focus of the present research question and hence will not be elaborated on further. Overall, a total of 9,994 daily mobile surveys were returned with a median response rate of 76% out of the 42 daily signals.

Experience Sampling Protocol

When signaled, participants indicated which activity they were currently engaged in. For convenience, participants were provided with a multiple-choice list of 16 common activities (academia/work, finance, housework/groceries, commuting, communication, social media, relationship, food consumption, active leisure (fitness/sports), social leisure, passive leisure, enjoying life, religion, charity, relaxation, daydreaming), but could also choose and specify the category *other* if their current activity did not fit the list. Next, participants indicated whether they classified their current activity as labor or leisure. Then they reported on their perceived autonomy (*How much autonomy do you have with the current activity?*), effort (*How effortful is the current activity?*), interest (*How interesting is the current activity?*), importance (*How*

important is the current activity?), all on scales from 0 (*not at all*) to 4 (*very much*). In order to assess OC, we asked participants whether there was an alternative activity they would rather engage in (yes vs. no) and, if so, whether this alternative behavior belonged to labor or to leisure. Finally, they indicated what they were planning on doing next using the same list, which was used to assess their current activity. A number of additional items (e.g., sleep quality, happiness) were assessed, which are outside the scope of the present research.

Analytical Approach

This study allowed us to investigate both antecedents (labor/leisure; autonomy) and proximal consequences of OC (effort, task utility) using multilevel path analysis. We expected that spending time on labor would positively predict OC and that this effect would be mediated by feelings of low autonomy. OC, in turn, would be predictive of higher feelings of effort, and lower perceived task utility. Because measurement occasions (Level 1) were nested within persons (Level 2), we tested the main hypotheses of our process model using multilevel path analyses using Mplus (Muthen & Muthen, 2004). As our focus was on within-person processes we investigated the proposed process model at Level 1, i.e., at the level of naturally occurring fluctuations in activities and associated constructs within persons. To this end, all Level 1 predictors of the model were person-mean centered (Enders & Tofighi, 2007). Level-2 between-person differences were not estimated due to our process focus. To test the various constituent predictions and mediation hypotheses implied by our theoretical framework, we employed a series of analysis steps, up to a final joint estimation of all model pathways in a single path analysis. Because OC was a categorical variable, we applied probit regression for all analyses involving OC (MacKinnon & Dwyer, 1993). Next to unstandardized coefficients, we report fully standardized regression coefficients for continuous predictors in the model and semi-

standardized coefficients for binary predictors. Regarding data aggregation, we checked correlations between related constructs to see whether these could be combined. As expected, interest and importance were correlated highly enough, $r = .47, p < .001$, to justify combining them into an aggregate measure of task utility.

Results

Descriptively, participants engaged 44.0% of the time in labor and 56.0% of the time in leisure. The single most frequent activity was academia/labor (32.3%), followed by passive leisure (14.2%), food consumption (10.1%), commuting (10.1%), social leisure (9.6%), social media (7.7%), housework (6.6%), active leisure (5.8%), relationship activity (4.5%), pleasure/enjoyment (3.3%), private communication (2.8%), daydreaming (2.5%), relaxation (1.1%), finance (0.6%), charity (0.3%), and religion (0.2%) (category “other”: 4.3%). Participants indicated OC on 26.7% of all the signals responded to. Hence, the experience of OC in everyday life seemed far from trivial.

We first investigated whether engaging in labor versus leisure activities predicted OC. A multilevel probit regression with labor as dummy predictor (0 = leisure; 1 = labor) on OC as dichotomous outcome showed that labor was positively associated with OC, $B = 1.21, p < .001$ (semi-standardized $\beta = 1.03$). Translating this coefficient into a probability showed that, during labor, participants indicated having OC 48.0% of the time, whereas during leisure it was only 11.4% of the time (see Figure 3). This corroborates the idea that OC are a frequent part of labor.

Next, we conducted a multilevel path analysis to test whether autonomy mediates the labor→OC relationship (see also left part of Figure 4). As predicted, labor was negatively associated with autonomy, $B = -.69, p < .001$ (semi-standardized $\beta = -.72$). Low autonomy, in turn, predicted a higher likelihood of OC $B = -.26, p < .001$ ($\beta = -.21$). The estimation of the

indirect pathway confirmed that autonomy mediated parts of the positive relationship between labor and OC, $B = .18, p < .001$ (see Figure 4).

Finally, we estimated the entire path model including also effort and task utility as proximal consequences. As Figure 4 illustrates, OC positively predicted feelings of effort, $B = .06, p < .001$ (semi-standardized $\beta = .06$), and negatively predicted perceived task utility, $B = -.19, p < .001$ (semi-standardized $\beta = -.28$). The indirect effects connecting autonomy to effort and task utility were both reliable, as were the two serial mediation pathways originating from labor vs. leisure activities via autonomy and OC (see Figure 4).

Discussion

Study 4 employed a measurement-intensive experience-sampling design to closely capture the occurrences of OC as people go about labor and leisure activities in their natural environments. Consistent with our process model and H1 and H2, we found that OC were more frequent during labor, that engaging in labor was related to reduced autonomy, and that reduced autonomy was associated with higher levels of perceived OC. Moreover, autonomy mediated parts of the relationship between labor and OC.

We also confirmed our findings from Experiment 3 that OC positively predicted feelings of effort and negatively predicted task utility (Hypotheses 3 and 4). Mediation analyses established that the entire serial pathway from labor to effort and task utility can be considered reliable. However, these indirect effects cannot be considered particularly large which can be explained by the generally lower degree of control over additional sources of variance that we traded off here in return for enhanced ecological validity and heightened generalizability across settings. Of course, other factors outside of the nomological net of constructs tested here may also determine why labor feels effortful and less valuable.

In sum, these additional data from everyday life show that engaging in labor can be linked to the notion of ‘have-to’ goal pursuit, whereas engaging in leisure is typically more strongly in line with want-to or self-determined goal pursuit (Hockey, 2011; Inzlicht et al., 2014). These findings are consistent with the idea that decreasing levels of autonomy may evoke the desire to do something else: something that feels more autonomous and internally rewarding. As spelled out in our secondary Hypothesis 5, the associated increase in the subjective experience of effort and the associated reduction in the perceived utility of the task may eventually trigger such task disengagement decisions. Our last experiment was specifically designed to test this possible ultimate consequence of OC on task choice.

Experiment 5: Opportunity Costs and Task Disengagement

Finally, we sought to examine whether OC influence people's actual behavior by influencing their decisions to opt out from a tedious task (see also Gendolla & Richter, 2013). To this aim, we developed a novel drop-out paradigm that introduces a focal tedious task which can be abandoned at different exit points in favor of another task, that is either extremely attractive (high OC) or not so much attractive (low OC). Similar to Experiment 3, we manipulated OC while keeping the task everybody worked on constant. However, unlike Experiment 3, participants could decide to opt out from the task and move on to another task.

We assessed the decision to quit the task after each of 5 blocks of the task (after the final possible, sixth task, the task ended). We predicted that OC would influence task disengagement, such that high OC would lead to earlier drop out from the task compared to low OC. We also measured perceived task effort and perceived task utility right before every exit point. We predicted that effort would impact task disengagement positively and task utility would impact disengagement negatively. We also inspected the link between OC and effort/task utility over the

course of the task. However, note that this analysis was severely limited by the fact that participants kept dropping out continuously as they lost interest (our key DV of interest); Hence, each concurrent assessment of effort and task utility in the high vs. low OC condition can only be computed across the decreasing subsets of people who have not yet “voted with their feet” by opting out. For this reason, Experiment 3, in which opting out was not possible, may have constituted a more stringent test of changes in effort and task utility (but not task disengagement). In the absence of any prior reference point, assuming a small to medium effect size regarding our focal survival analysis of task disengagement (equivalent to a hazard ratio of approx. 1.5; Azuero, 2016) and 90% statistical power requires approximately 250 events for analysis which translates into approximately 315 participants when assuming a median survival time of participants that is halfway through the experiment, i.e., after 60 trials (calculated from <http://www.sample-size.net/sample-size-survival-analysis/>).

Method

Participants and design. 352 Mechanical Turk volunteers in the United States participated in the study (58.0% male, $M_{age} = 34.89$, $SD = 10.86$) and received \$2. Participants were randomly assigned to either the low ($n = 177$) or the high ($n = 175$) OC condition. We excluded five participants who indicated to “probably” or “definitely” discard their answers in response to an explicit quality-of-response assessment, leaving 347 participants for analyses.

Procedure. First, participants learned that they were participating in a pilot study for a perceptual experiment about colors, in which they would be asked to rate the color of a series of shapes that would be used in future studies. We further told participants that their input from the task was very important to us and that we needed as many ratings as possible, and that, as rating many similar colors could be challenging, they would have the opportunity to quit every 20

trials. Furthermore, as the experiment was set to approximately 20 minutes in total, they would be redirected to a memory experiment in case they chose to quit, in which they would watch short video clips and answer a few questions about them for the remaining time. Participants in the low OC condition were informed that these videos were about mundane activities (e.g., washing dishes). Participants in the high OC condition were informed that these videos were rated as extremely amusing and funny in another study.

Participants then engaged in the alleged pilot task consisting of 120 trials in total (i.e., 6 blocks of 20 trials). On each trial of the task, a shape (circle, triangle, or square), colored in hard to distinguish shades of blue and green appeared above a slider scale with the labels “blue” and “green” on each side. Participants had to slide the bar in order to answer the question “Which color is more dominant, blue or green?” After every block of 20 trials, participants answered three questions assessing effort, interest, and importance of the pilot task, identical to those from Experiment 3. They were then asked “How would you like to continue?” and could choose between “I want to continue with the pilot (shapes task)” and “I want to switch to the memory task”. The latter option reminded participants of the content of the memory task, depending on OC condition (i.e., watching videos of mundane activities vs. watching funny videos). When participants completed the pilot task (either because they opted out or because they completed all trials) they answered a manipulation check [“In your opinion, how enjoyable do you expect the video(s) in the memory experiment to be?”, 1 (*not at all enjoyable*) to 10 (*very enjoyable*)].

Results and Discussion

An independent samples *t*-test for groups with unequal variances (Levine test $F[1,345] = 29.11, p < .001$) predicting perceptions of video enjoyability from the experimental manipulation revealed that participants expected the videos to be more enjoyable in the high, $M = 7.24, SD =$

2.25, as compared to low OC condition, $M = 5.02$, $SD = 2.98$, $t(319.77) = 7.84$, $p < .001$, $d = 0.26$.

We used the R package Survival (Therneau & Lumley, 2015) to run a Cox proportional hazards regression. To examine whether OC influences task disengagement, we used OC (low vs. high) to predict the point at which participants opted out from the experiment (either after the 1st, 2nd, 3rd, 4th, or 5th section). In line with our prediction, the survival analysis showed a tendency to opt out from the pilot task with the progress of the experiment, with participants in the High OC condition showing a larger tendency to opt out compared to participants in the Low OC condition across the blocks of the laborious task, Hazard Ratio $HR = 1.32$, $z = 2.36$, $p = .018$. The survival curves for both conditions are plotted in Figure 5.

After having established the effect of OC on disengagement we examined the influence of perceived effort and task utility on disengagement. To do so, we added the two time-dependent covariates—effort and utility (i.e., the average of interest and importance) at each time point—to the model (see Therneau, Crowson, and Atkinson, 2013). As expected, the analysis showed that participants tended to opt out from the pilot task the more they perceived it to be effortful, $HR = 1.07$, $z = 2.92$, $p = .004$, and that participants tended to opt out from the pilot task the less they perceived it to be important and interesting, $HR = 0.92$, $z = -3.00$, $p = .003$.

To explore whether there was a traceable influence of OC on effort and utility over time (despite the drop-out nature of the task), we ran two supplementary multilevel analyses using the lme4 package in R (Bates, Mächler, Bolker, & Walker, 2014). The block variable was centered on block six in order to also test for group differences at this last point in time. Task utility decreased over time $B = -0.16$, $SE = 0.02$, $t(590.02) = -7.14$, $p < .001$, and was lower in the high OC compared to the low OC condition at the last measurement occasion, $B = -0.69$, $SE = 0.33$,

$t(632.49) = -2.08$, $p = .038$. Moreover, the interaction between OC and block was significant, $B = -0.14$, $SE = 0.04$, $t(590.02) = -3.10$, $p = .002$, indicating that the utility of participants in the high OC condition, $B = -0.23$, $SE = 0.03$, $t(591.91) = -6.66$, $p < .001$, dropped faster than the utility in the low OC condition, $B = -0.14$, $SE = 0.04$, $t(590.02) = -3.10$, $p = .002$ (see Supplementary Figure 3). Although perceived effort increased over time, $B = 0.12$, $SE = 0.03$, $t(614.68) = 3.80$, $p < .001$, OC did not influence the amount of effort participants felt at the last measurement occasion, $B = -0.15$, $SE = 0.39$, $t(764.80) = -0.39$, $p = .696$, nor did it interact with block, $B = -0.04$, $SE = 0.06$, $t(614.68) = -0.57$, $p = .566$ (Supplementary Figure 3). It is possible that OC had a weaker influence on effort in the present experiment as compared to Experiment 3. However, note that participants could not opt out from the task in Experiment 3. In the present experiment, they may have chosen to do so before effort in the high OC had developed and accrued relative to effort in the low OC group. Even though speculative, the differential pattern for effort and task utility suggests that changes in effort vs. task utility may accrue and become behaviorally relevant at different rates.

General Discussion

Understanding why people invest effort into what they are doing and persist in those activities is of pivotal importance for many areas in psychology. Drawing on the recent interest in the concept of OC and experienced effort (Kurzban et al., 2013; Kool & Botvinick, 2014; Shenhav et al., 2017), we empirically validated an integrative model linking labor, autonomy, OC, effort, task utility, and task disengagement. Specifically, the model extends earlier theoretical work by Kurzban et al. (2013) by connecting both surface-level (i.e., engaging in labor) and psychological (i.e., a low sense of autonomy) antecedents of *perceived* OC with its proximal (i.e., experienced effort; low task utility) and distal (task disengagement) consequences.

We tested the model via a causal chain approach (Spencer et al., 2005) in four experiments as well as in its entirety using experience-sampling, with mutually reassuring results. Our attempt to satisfy both concerns regarding internal as well as external validity implies the advantage relying on a variety of different methods rather than on a single method to examine the phenomenon of interest. Finally, we devised a new dropout-paradigm (Experiment 5) in which participants could decide when to quit while performing multiple blocks of an effortful have-to task. Using survival analysis, we found that high as compared to low OC were associated with a lower likelihood of persevering the laborious task until the end.

In terms of theoretical implications, Experiment 3 showed that, all aspects of the focal task being equal, high OC appeared to increase the subjective experience of effort (as well as to decrease perceived task utility). OC may thus provide an additional answer to the question of why have-to tasks are effortful posed in our introduction. The notion of OC seems particularly suited in directing attention to the relationship between the current task *in relation to* available alternatives in a person's motivational field, and thus connects well to broader questions of task choice—in particular to how people go about balancing or trading off activities and their associated needs over time (e.g., Inzlicht et al., 2014; Kool & Botvinick, 2014). The fact that task performance was not affected by OC, at least over the relatively short periods of time participants engaged in the demanding task at hand, illustrates how important it is to conceptually separate task choice from task execution (Gendolla & Richter, 2013). Put simply, most adults are well capable of investing the resources it takes to match task demands and perform reasonably well even in the presence of tempting alternative activities. However, our results from Experiment 5 (and a related finding from our supplementary study) suggest that—as time moves on *and* (nonsanctioned) opportunities for disengagement present

themselves—chances are that people may persist less reliably on the task originally assigned to them, resulting in lower aggregated productivity on the task over time.

Experiment 2 and Study 4 suggest that autonomous motivation decreases *perceived* OC, emphasizing the important role autonomy plays in determining the attractiveness of alternative activities. This finding converges with research showing that when a person experiences a greater sense of autonomy during goal pursuit, disruptive behavior, such as giving in to short-term temptations and distractions along the way, becomes less likely (Muraven et al., 2008). It is still not fully clear, however, whether autonomy primarily affects people's ability to regulate temptations—a late-stage effect—or whether it affects the experienced strength of these temptations in the first place. One way to interpret our findings from a self-regulatory perspective is that a sense of autonomy may instill the current activity with an immediate intrinsic incentive, thus shielding people from intruding thoughts and feelings about alternative activities/temptations that may otherwise emerge. Future research should attempt to test these possibilities more closely by linking work on OC with the literature on goal shielding and executive functioning (Hofmann, Schmeichel, & Baddeley, 2012; Shah, Friedman, & Kruglanski, 2002). Hence, whereas previous work has primarily investigated how extrinsic rewards undermine autonomy, future research should also scrutinize the process by which autonomy may undermine extrinsic reward-seeking.

Next to the link from autonomy to OC, the precise mechanism(s) through which OC increase experienced effort also deserve further attention. At face value, there appear to be three major possibilities: First, the sensation of mental effort may represent the direct “output of mechanisms designed to measure the OC of engaging in the current mental task,” as originally proposed by Kurzban et al. (2013; p. 665); in this view, there is no more further process to

explain—effort simply *is* the phenomenological “readout” of this computational mechanism (much like the sensation of hunger indexes the body’s current caloric needs). Second, OC may be used as one informational cue (among others) along the tenets of self-perception theory (e.g., Bem, 1972), a cue that can be utilized to infer/ascribe effortfulness and utility with regard to an ongoing activity. Third, it is possible that OC impose actual costs in terms of cognitive control. That is, the mental representation of alternative opportunities may act as a sort of mental distraction, the suppression of which requires cognitive resources. As a consequence, fewer cognitive control resources remain to deal with the task at hand, increasing task difficulty and thus rendering the task more effortful—an explanation that would be consistent with the general tenets of MIT. The present work only established the general effect; carefully crafted future research will be needed to distinguish among these different underlying mechanisms.

Finally, our findings raise intriguing questions regarding the relationship between mobilized and experienced effort. Whereas the present research primarily focused on the experience of effort, MIT is more strongly concerned with mobilized effort as manifested, for instance, in physiological indicators (Gendolla & Richter, 2010; Richter et al., 2016). Even though the assumption that perceived and allocated effort should typically cohere is intuitively appealing and empirically supported (e.g., Bijleveld, 2018), it is possible that they may diverge to the extent to which subjective effort on a given task may be shaped by (or attributed to) task-exogenous factors such as OC as compared to task-inherent factors such as task demands. Future research should attempt to better clarify this possibly highly dynamic relationship.

To conclude, the present work is the first to empirically test the central role of OC in labor/leisure tradeoffs, as well as their antecedents and consequences. We gathered new evidence showing that the notion of OC may, in fact, be connected to feelings of autonomy, and may have

a role to play with regard to the subjective sensation of effort as well as task choice. As such, this concept may enrich and complement existing accounts of the origins of effort and broaden our understanding of when and why people disengage from have-to tasks when given the chance.

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Footnotes

¹ Before conducting Experiment 3 we had run one more additional experiment which is reported in the supplementary materials only. In that experiment, we had participants imagine self-generated opportunity costs through a recall task (see Supplementary Materials). We obtained a significant difference concerning task utility (and task persistence), however, no difference in effort. This task may have been less ideal for two reasons: First, the manipulation check indicated a considerably weaker difference between conditions, $d = 0.52$, when compared with Experiment 3, $d = 1.63$. Second, we assessed effort only retrospectively after the experiment was done. In our subsequent experiment (Experiment 3) we turned to a paradigm that actually manipulated the experience of opportunity costs, instead of merely relying on participants' imagination, and we assessed effort in the moment.

² To meet our inclusion criteria participants needed to respond to at least to 5 out of the 42 signals we sent. 469 participants initially signed up for the Study, however, a number of interested participants dropped out quickly because the study was too time intensive and incompatible with their jobs.

Figure 1. A process model of opportunity costs building on Kurzban and colleagues (2013).

Spending time on (cognitive) labor decreases feelings of autonomy (the proximal antecedent).

Low autonomy increases opportunity costs, which in turn increases feelings of effort and decreases task utility. Both increased effort and reduced task utility are assumed to ultimately trigger task disengagement.

Figure 2. Ratings of the opportunity costs (OC) versus control condition on effort (Panel A) and task utility (Panel B) in Experiment 3. Error bars represent standard errors, *** $p < .001$ (see Supplementary Materials for additional post-hoc analyses on which cell contrasts are based).

Figure 3. Percentage of opportunity costs participants experienced during labor and during leisure, Study 4. As can be seen, opportunity costs occurred more frequently during labor than during leisure.

Indirect (Mediation) Effects:

Labor→Autonomy→Opportunity Costs: $B = .179$ [$.165; .193$], $p < .001$

Autonomy→Opportunity Costs→Effort: $B = -.015$ [$-.020; -.009$], $p < .001$

Autonomy→Opportunity Costs→Task Utility: $B = .050$ [$.044; .056$], $p < .001$

Labor→Autonomy→Opportunity Costs→Effort: $B = .010$ [$.006; .014$], $p < .001$

Labor→Autonomy→Opportunity Costs→Task Utility: $B = -.035$ [$-.039; -.030$], $p < .001$

Figure 4. Multilevel, path-analytic test of the proposed process model of opportunity costs in Study 4. Autonomy mediates the effect of engaging in labor (vs. leisure) on perceived opportunity costs (0 = no; 1 = yes). Opportunity costs predict feelings of effort and task devaluation. Due to the binary variables involved, the path model was estimated using the robust weighted least squares estimator (WLSMV) in Mplus, modelling a probit link for binary outcomes. All coefficients are unstandardized regression coefficients. Standardized coefficients for continuous predictors or semi-standardized coefficients for binary predictors are provided in brackets. Residual pathways of labor on effort/task utility are not shown for simplicity. $***p < .001$.

Figure 5. Survival curves for the high and low opportunity costs (OC) condition in Experiment 5, as estimated from the Cox regression model. Survival rates are plotted across the six blocks of the laborious have-to task. Lower survival values indicates a lower proportion of participants who choose to continue at a given block in time.

SUPPLEMENTARY MATERIALS

for

Rom, S. C., Katzir, M., Diel, K., & Hofmann, W. (in press). On trading off labor and leisure: A process model of perceived autonomy and opportunity costs. *Motivation Science*.

Content

- **(1) Supplementary Study:** Manipulating opportunity costs via an imagination task.
- **(2) Supplementary (post-hoc) Analyses for Experiment 3**
- **(3) Supplementary Figure 1 for Experiment 5:** Effort and task utility assessed at each block of the pilot task in Experiment 5, separately for the high and low opportunity cost condition.

(1) Supplementary Study: Manipulating opportunity costs via an imagination task

This study tested the third link of our model: that opportunity costs predict feelings of effort and decrease task utility (H3 and H4). We asked participants to imagine opportunity costs to the current activity at hand. This manipulation was intended to create group differences regarding the perception of opportunity costs, before participants engaged in an anagram task. Afterwards, participants completed a series of self-report questionnaires assessing task utility, measured as interest and importance, and perceived effort. We predicted that participants in the opportunity costs condition would report higher levels of effort and lower levels of task utility.

Method

Participants and design. One hundred Amazon.com Mechanical Turk volunteers in the United States participated in the study (57.40 % males, $M_{age} = 38.23$, $SD = 13.52$). We excluded one participant who did not answer a single anagram and questionnaire item. Participants were randomly assigned to the imagined opportunity costs or control condition.

Procedure. First, participants learned that they were participating in a study that involved solving anagrams. Then, participants were given a practice trial. Afterwards, participants in the imagined opportunity costs condition read that: *Instead of doing online studies such as this one, you could be doing something else valuable right now. Please think of what instead of solving some anagrams right now, you could do with your time instead.* Participants in the control condition were given another practice trial. Next, all participants proceeded to the anagrams task consisting of ten anagrams, including one unsolvable anagram. They were instructed that they needed to spend at least 4 minutes on the task and were free to choose when to continue after that time had elapsed. Following the anagram task, the survey asked participants to report on task utility (*The anagram task was interesting*, *The anagram task was important to me*, ($\alpha = .83$)) and perceived effort (*The anagram task was effortful*), all on scales from 1 (*not at all*) to 7 (*very much*). As a manipulation check, participants indicated levels of opportunity costs on the same items as in Experiment 2.

Results

Manipulation check. An independent samples *t*-test predicting opportunity costs from the experimental manipulation revealed that participants in the imagined opportunity costs condition ($M = 5.10$, $SD = 1.33$) perceived higher levels of opportunity costs than participants in

the control condition ($M = 4.29$, $SD = 1.18$), $t(97) = 2.60$, $d = .65$, $p = .011$, $\eta^2 = .07$. Thus, the experimental manipulation of opportunity costs was successful.

Hypothesis testing. We conducted a series of independent-samples t -tests to examine how the manipulation of opportunity costs influenced effort and task utility. Contrary to our expectations, participants in the imagined opportunity costs condition ($M = 5.28$, $SD = 1.53$) perceived the task to be as effortful as participants in the control condition ($M = 5.73$, $SD = 1.24$), $t(97) = -1.63$, $p = .106$. However, as predicted, participants in the opportunity costs condition ($M = 4.35$, $SD = 1.40$) ascribed lower task utility relative to participants in the control condition ($M = 5.24$, $SD = 1.18$), $t(97) = -3.43$, $p = .001$. Finally, regarding task performance, participants in the opportunity cost condition ($M = 6.68$, $SD = 1.82$) solved as many anagrams as participants in the control condition, ($M = 6.96$, $SD = 2.03$), $t(97) = -.72$, $p = .472$. However, participants in the imagined opportunity cost condition ($M = 281.73s$, $SD = 93.12$) spent significantly less time on the (not fully solvable) anagram task than those in the control condition ($M = 347.58$, $SD = 187.33$), $t(97) = -2.18$, $p = .032$, indicating earlier task disengagement.

Discussion

Results did in part replicate and extend the findings obtained in Study 1: Participants in the opportunity costs condition ascribed lower task utility. These results replicate Study 1's finding with the exception of finding no significant effect for self-reported effort. The results even trended in the opposite direction. Importantly, we did not measure effort in the moment but effort after the task was completed, which might be less accurate for predictions about effort. Also, opportunity costs were only imagined and implemented in a setting that was hard to control, so the effects might not have been strong enough to influence perceptions of effort.

Experiment 3 tried to overcome this limitation by implementing more tangible opportunity costs, and in a tightly controlled laboratory setting.

(2) Supplementary Post-Hoc Analyses for Experiment 3

The below analyses present post-hoc cell comparisons for the pre-post cell means of the experimental 2 (condition: OC vs. control) $\times$ 2 (time: before vs. after) mixed design.

Effort. Additional cell contrasts from a traditional 2×2 GLM analysis indicated that participants in the OC condition gave lower effort ratings before, $M = 4.46$, $SD = 2.35$, than after they tossed the die, $M = 5.59$, $SD = 1.80$, $F(1, 100) = 14.04$, $p < .001$, $\eta_p^2 = .12$. Conversely, participants in the control condition gave equally high effort ratings before, $M = 4.29$, $SD = 1.73$, and after they tossed the die, $M = 4.38$, $SD = 1.47$, $F(1, 100) = .18$, $p = .674$, $\eta_p^2 = .001$.

Task Utility Composite. Additional cell contrasts from a traditional 2×2 GLM analysis showed that participants in the OC condition gave higher task utility ratings before, $M = 5.35$, $SD = 2.10$, than after they tossed the die, $M = 4.48$, $SD = 1.59$, $F(1, 100) = 15.96$, $p < .001$, $\eta_p^2 = .14$. Conversely, participants in the control condition gave equally high importance ratings before, $M = 4.90$, $SD = 2.07$, and after they tossed the die, $M = 4.91$, $SD = 1.48$, $F(1, 100) = 0.01$, $p = .96$, $\eta_p^2 < .001$.

Task Interest. Additional cell contrasts from a traditional 2×2 GLM analysis showed that participants in the OC condition gave higher interest ratings before, $M = 5.60$, $SD = 2.49$, than after they tossed the die, $M = 4.13$, $SD = 1.60$, $F(1, 99) = 12.91$, $p = .001$, $\eta_p^2 = .12$. Conversely, participants in the control condition gave equally high interest ratings before, $M = 4.68$, $SD = 2.88$, and after they tossed the die, $M = 4.32$, $SD = 1.80$, $F(1, 99) = .95$, $p = .331$, $\eta_p^2 = .01$.

Task Importance. As the a priori contrast was not reliable, we do not report post-hoc tests for this variable.

(3) Supplementary Figure 1 for Experiment 5

Supplementary Figure 1. Effort (Panel A) and task utility (Panel B) assessed at each block of the pilot task in Experiment 5, separately for the high and low opportunity cost condition.