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The value of control

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Abstract

Voluntary actions are accompanied by a sense of control over this action and its effects. Forming an appropriate sense of control (or sense of agency) has widespread consequences of individual and societal relevance. Moreover, perceived control might serve as a powerful action motivator, although this critical function has been addressed scarcely so far. Thus, in two experiments ($N = 101$ adults for each study), we directly examined the value of control for human agents by allowing participants to choose between financial gain and situational control. Crucially, a significant share of participants chose to be in control even when this option was less financially rewarding. That is, participants had to be offered 66% (Study 1) and 34% (Study 2) of expected asset earnings as an additional reward to make them predictably waive control. In addition to the value of objective decision rights, we also measured subjectively perceived control. This is a further extension of prior research as similar levels of objective control can lead to substantially different subjective feelings of control. Hereby, we found a share of the participants to create an illusionary sense of agency in situations of little objective control. These results portray perceived control as a powerful motivator for human behavior that comes with a unique and quantifiable value for individual agents.

KEYWORDS
choice, perceived control, reward, sense of agency

1 | INTRODUCTION

1.1 | The sense of agency

All voluntary actions are accompanied by the belief (implicit or explicit) that we are at least to some degree in control of our actions and that we can effect changes through them in our environment (Eitam et al., 2013; Frith, 2014; Gozli, 2019; Haggard, 2017; Moore, 2016). This belief, that is the sense of agency, may be an explicit thought or it may be the implicit, unconscious notion that we can control our actions and, through our actions, the environment (Hughes et al., 2013; Schwarz, Pfister, et al., 2018; Schwarz, Weller, Klaffehn, & Pfister, 2019; Synofzik et al., 2008, 2013; Wegner, 2003; Wegner & Wheatley, 1999). Sense of agency is a crucial part of acting and serves as a precursor for many related concepts, such as a sense of responsibility for action outcomes or the distinction between self and other (Bigenwald & Chambon, 2019; Frith, 2014; Gallagher, 2000; Haggard, 2017; Haggard & Tsakiris, 2009). In the present studies, we investigate how much human agents value a sense of agency and whether such a need for control can lead to financially suboptimal decision-making.

1.2 | Perceived control as a motivator for future behavior

Recent years have seen a surge of studies on sense of agency in its explicit expression as well as related, though controversially discussed,

perceptual phenomena (Antusch et al., 2021; Haggard, 2017; Ma et al., 2021; Schwarz, Burger, et al., 2018; Schwarz & Weller, 2023; Schwarz, Weller, Klaffehn, & Pfister, 2019; Schwarz, Weller, Pfister, & Kunde, 2019; Tanaka & Kawabata, 2021; Tonn et al., 2021; Wen & Imamizu, 2022; Zapparoli et al., 2022). While most earlier investigations focus on experienced sense of agency for past events, recent studies also started to encompass sense of agency as a crucial motivator for future actions (Eitam et al., 2013; Karsh & Eitam, 2015; Karsh et al., 2016; Schwarz et al., 2022). In line with this perspective, studies indicate that perceived control (i.e., sense of agency) over the external world is associated with good mental health (Benassi et al., 1988; Taylor et al., 1991), success in the workplace (Liu et al., 2011), and high life satisfaction (Diener, 1984; Hong & Giannakopoulos, 1994). In general, human agents favor situations over which at least some control can be exercised (Bown et al., 2003) or which are characterized by high perceived competence (Goodie, 2003; Heath & Tversky, 1991; Taylor, 1995). As this preference can also be found when control cannot improve the final outcome, it has been suggested that exercising and perceiving control has a positive affective component itself (Leotti & Delgado, 2011, 2014; Leotti et al., 2010). Such a prospective view on the sense of agency extends the scope of current research and its application (Zapparoli et al., 2020).

1.3 | Preference for having control

Research from behavioral economics has also targeted the influence of control on human behavior. However, in contrast to most previously mentioned studies, this research focused on the objective presence of control, for example, the right to make a decision, instead of the subjective perception of control. Hereby, it was shown that human agents favor the right to make an own decision instead of delegating it to someone else (Bartling et al., 2014; Fehr et al., 2013) and are more willing to take financial risks when a decision leads to higher levels of control (Young et al., 2011). The detailed underpinnings of such decisions, however, are still an open question. Some research suggests that having control might lead to (irrational) feelings of having better chances to receive the desired outcome (Sloof & Von Siemens, 2017). In contrast, other findings indicate a preference for control even when people are well aware that being in charge has no influence on the eventual result (Bobadilla-Suarez et al., 2017). Regardless of the exact reason for this behavioral pattern, these findings raise the question to which extent human agents value control and whether they are willing to sacrifice other rewards to increase their sense of agency. A first attempt to quantify the value of control within an experimental context indicated that humans are willing to forgo 8% to 15% of expected asset earnings in return for control (Owens et al., 2014).

1.4 | Present objective

In the present studies, we aim to integrate these two research traditions from cognitive sciences and behavioral economics in a novel, experimental paradigm. We critically extend prior research (e.g., Fehr et al., 2013; Owens et al., 2014) which focused on a preference for objective control by specifically addressing the value of the subjective perception of control (i.e., the sense of agency). This is a crucial step as the exact same situation can evoke varying perceptions of control in different individuals, depending on situational aspects (e.g., Schwarz et al., 2022).

In our setup, participants could choose between having control over a monetary reward or, instead, receiving an additional monetary bonus for giving control to a (fictitious) co-actor. By manipulating the size of this additional reward, our approach allowed the direct evaluation of how much control is worth to a given individual and quantifies its role as a motivator in this experimental context. As previous findings indicate that experiencing sense of agency is rewarding in itself, we expected a considerable share of participants to choose own control, even when this option is less financially rewarding than waiving control. We further assumed that this effect would be mediated by the amount of possible monetary rewards. Moreover, we tested whether subjective judgments of agency are related to an individual's absolute value of control.

Study 1 was preregistered (https://osf.io/s2y9z/?view_only=35bc955b7d92466caaae518c0f4e1602). Raw data, the analysis syntax, and programming files are available on the Open Science Framework (https://osf.io/74xgy/). All procedures performed in this study were in accordance with the ethical standards of the institutional and national research committee and adhered to all legal requirements of the study country.

2 | STUDY 1

The main aim of this study was to investigate to which extent human agents value situational control and how interindividual differences in perceived control might affect such preferences.

2.1 | Method

2.1.1 | Participants

We tested 101 adult participants in an online study. A priori power calculations focused on the correlational rather than experimental parts of the study, because correlational analyses require substantially larger sample sizes. Due to the novelty of the task and therefore a lack of comparable prior studies to indicate possible effect sizes, we assumed a medium effect size of $r = .3$, yielding an optimal sample size of 84 participants ($\alpha = .05$, $1 - \beta \geq .80$, two-tailed testing; calculated with the pwr.r.test function in the pwr package, version 1.3; Champely et al., 2020). To ensure sufficient power also in the face of dropouts, we increased the sample size by 20%.

During debriefing, we asked participants to indicate how well they understood the instructions on a scale from 0 (*not at all*) to 100 (*absolutely*). Six participants reported a rating <50 and were not included in the analyses for this reason. Our final sample thus consisted of 95 participants who received £4.00 for their participation as

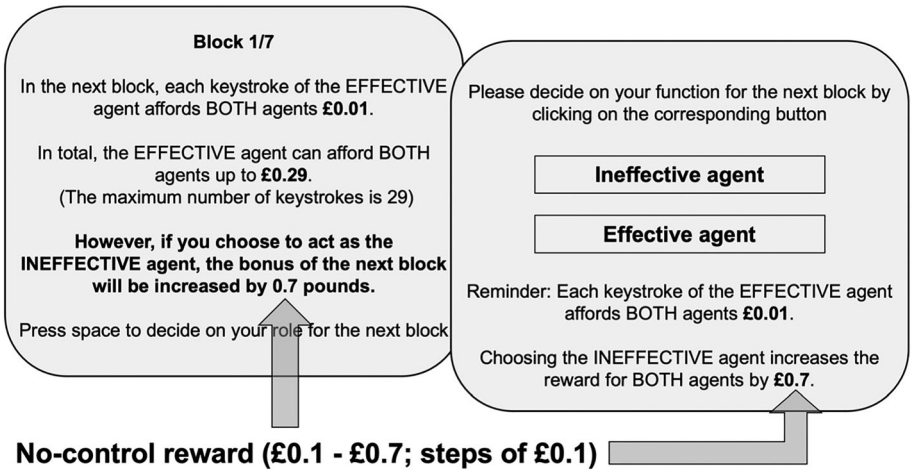

FIGURE 1 Participants were informed about potential rewards for both functions and could then make their decision for the next block. Whereas the maximum bonus participants could afford when acting as the *effective agent* (main reward) was constant for all blocks (£0.29), we manipulated the size of the additional reward to waive control (no-control reward, £0.1–0.7; steps of £0.1).

well as the bonus pay they earned during the study (38 females, 55 males, 1 non-binary, 1 N/A; age: $M = 28.9$ years, $SD = 8.1$ years). In total, participants reported 24 different nationalities, of which Poland ($n = 19$), Portugal ($n = 18$), and South Africa ($n = 11$) were the most common.

2.1.2 | Procedure

The experiment was conducted online. We implemented the experiment with the programming environment lab.js (Henninger et al., 2021) and recruited participants via Prolific. Before working on the task, all participants received detailed instructions on the study and agreed explicitly to the experimental terms.

We informed participants that they would encounter the responses of another participant who finished the experiment earlier and who could thus not react to any of the participants' actions. However, this was not true, and each participant took part independently. They were fully debriefed about this at the end of the session.

The experiment consisted of seven blocks and two preceding practice blocks, lasting 2 min each. Participants could decide between two different functions for each experimental block: *effective agent* and *ineffective agent* (see Figure 1).

Participants were told that their function would be assigned automatically if they were in the role of the follower (which none of them were). The task for both functions (*effective* and *ineffective agents*) was similar: Participants could press the key "J" as often as they wished (see Figure 2 for the detailed block procedure). However, the consequences of each keystroke differed between both functions. Whereas pressing "J" as the *ineffective agent* had absolutely no consequence, pressing "J" as the *effective agent* granted a bonus of £0.01 to both players.[1] We limited the number of compensated keystrokes to 29, resulting in a maximum bonus of £0.29 for each block. This bonus will be called "main reward" in the following. Participants were told that if they chose the function *ineffective agent*, their co-actor would serve as *effective agent*, and his/her previous responses would decide on the participant's reward. In truth, participants received as the main reward a random bonus between £0.16 and £0.29 for blocks in which they chose the *ineffective agent*. We decided on this reward range to keep our cover story realistic and prevent feelings of frustration or anger but still limit the participants' sense of control due to the unpredictability of the outcome.

Crucially, choosing the *ineffective agent* provided both agents an additional bonus (hereinafter referred to as "no-control reward"). The size of this no-control reward differed between each block (£0.1–0.7; steps of £0.1) and was announced before participants decided on their function. The order of no-control rewards was randomized for each participant. As the main reward of each block could amount to a maximum of £0.29, choosing the *ineffective agent* maximized the final bonus when the no-control reward was at least £0.3. Moreover, because participants were informed that both agents will receive the main reward, participants could expect that the co-actor would have done his or her best to maximize this bonus. Accordingly, an agent focusing on profit maximization might choose the *ineffective agent* even in blocks with a no-control reward lower than £0.3.[2]

The procedure of each block was identical for both functions except for two small differences. As *ineffective agents*, participants had to press space after half of the block, that is after 1 min, in order to proceed, to increase focus and attention in ineffective blocks. As *effective agents*, participants were informed when the maximum number of keypresses was reached. However, they still had to wait until the end of the block and were free to continue pressing "J" if they chose to do so. After each block, participants were asked to rate on a visual analog scale how much control they felt over the outcome (affording themselves and the co-actor money or receiving a bonus from the co-actor) and as how pleasant they evaluated their function

[1]We chose to compensate both players per keystroke so that maximizing profit would supersede social strategies (e.g., "an eye for an eye"). To this end, we also informed our participants that their co-agent had played earlier and could thus not react to their actions. Please note that the second player was, unknowingly to the participants, fictitious and in fact participants played alone.

[2]Indeed, several participants ($n = 14$) followed this profit maximization strategy, opting for the *ineffective agent* function in every block, no matter which no-control reward was offered.

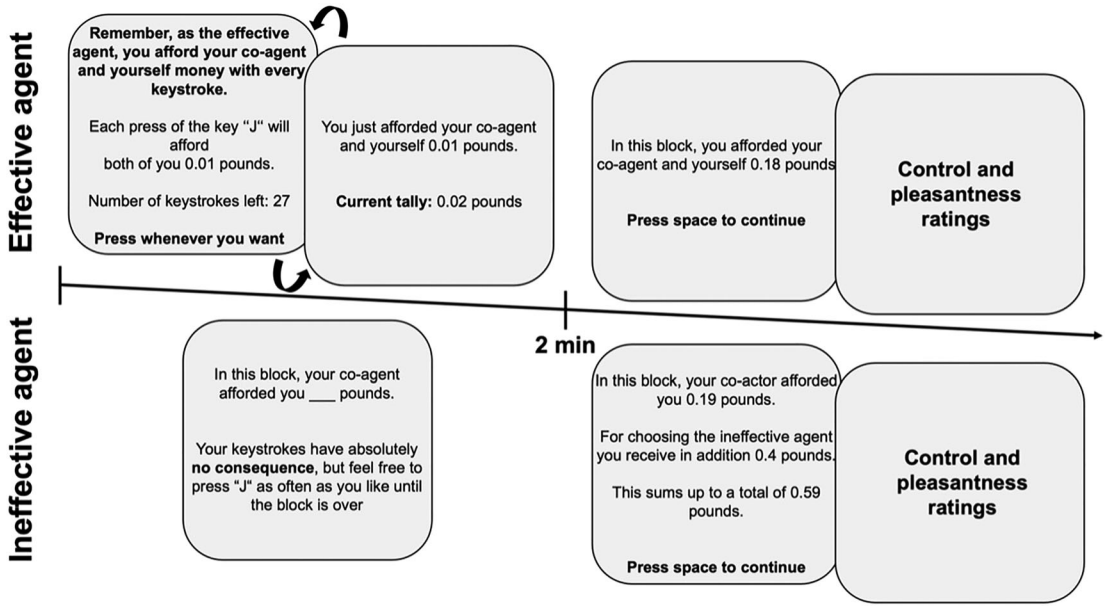

FIGURE 2 The procedure of a typical block for both functions within the experiment. When participants acted as the *effective agent*, pressing their response key granted a monetary bonus. They received visual feedback on how much money they had already afforded themselves and the co-actor as well as a counter displaying how many effective keystrokes they could potentially still make (maximum of 29). When the function *ineffective agent* was chosen, pressing "J" had no consequence at all. At the end of each block, participants were informed about the tally of this block and had to rate perceived control and pleasantness using a visual analog scale.

in this block. To indicate their response, participants moved a slider going from "no control at all" to "absolute control" (control ratings) or, respectively, from "very unpleasant" to "very pleasant" (pleasantness ratings). Both ratings were scaled on a range from 0 to 100. Participants also received feedback on the bonus they earned in the previous block.

We included two practice blocks at the beginning of the experiment to familiarize participants with the precise wording of the instructions. These initial practice blocks were similar to the experimental blocks with the only difference that no actual rewards could be earned, while reward information was presented as in the experimental blocks. Also, participants could not decide on their function for practice blocks, but they were assigned the *effective agent* and the *ineffective agent* in random order, so they had experienced both functions before the main study started.

In our post-questionnaire at the end of the experiment, we asked participants whether they got distracted during the study and whether they applied any kind of strategy. Participants also rated how much they based their decision for one of both functions on having control over the main reward and whether they were affected by considerations regarding their co-actor. Finally, we asked how well participants understood our instructions.

2.1.3 | Data analysis

As a manipulation check, we calculated a two-tailed *t*-test comparing control ratings between both functions (*effective agent* vs. *ineffective agent*). To evaluate whether participants chose the *effective agent* function dependent on the no-control reward, we first calculated a two-tailed *t*-test for each block, testing the average share of *effective agent* choices against zero. To examine whether this share declined with increasing bonus to waive control (=no-control reward), we computed a rmANOVA of the average number of *effective agent* choices per block using the no-control reward as a within-subjects factor. If Mauchly's test indicated a violation of the sphericity assumption, Greenhouse–Geisser corrections were applied. To measure the precise value at which participants tend to choose the *effective agent* function more often than the *ineffective agent* function, we further calculated a psychometric function based on a model-free, local linear fitting approach (package "modelfree" for MatLab; Zchaluk & Foster, 2009). We conducted this analysis for the whole sample as well as separately for all participants who showed variance in their choice behavior during the study (i.e., participants who selected the effective as well as the ineffective agent at least once). To test whether the share of *effective agent* choices changed over time, we calculated another rmANOVA of *effective agent* choices, using block number as a within-subjects factor.

As an exploratory analysis, we compared bonus payouts and pleasantness ratings between both functions via a two-tailed *t*-test. Moreover, we calculated an individual reward threshold for each participant (i.e., the lowest amount of no-control reward for which this participant chose to act as the *ineffective agent*) and correlated this value with corresponding mean ratings of control and pleasantness for both functions. We also correlated the number of keypresses in *ineffective agent* blocks with corresponding mean ratings of control

TABLE 1 Mean percentages, confidence intervals, and comparisons of the participants' *effective agent* choices against zero for each no-control reward in Study 1.

No-control reward (£)	*M* (%)	95% CI	*t*(94)	*p*	*d*
0.1	72.63	[63.50; 81.76]	15.79	<.001	1.62
0.2	44.21	[34.04; 54.38]	8.63	<.001	0.89
0.3	26.32	[17.30; 35.33]	5.79	<.001	0.59
0.4	15.79	[8.32; 23.26]	4.20	<.001	0.43
0.5	17.89	[10.04; 25.74]	4.53	<.001	0.46
0.6	10.53	[4.24; 16.81]	3.33	=.001	0.34
0.7	13.68	[6.65; 20.72]	3.86	<.001	0.40

and pleasantness for this function, as well as average ratings of control and pleasantness, both over all blocks and separately for each function.

2.2 | Results and discussion

Control ratings were significantly higher for blocks in which participants decided to act as the *effective agent* compared with blocks in which the function *ineffective agent* was chosen; *effective agent*: $M = 80.74$, $SD = 19.07$; *ineffective agent*: $M = 44.41$, $SD = 29.61$), $t(79) = 9.64$, $p < .001$, $d_z = 1.08$. Please note that 14 participants chose the function *ineffective agent* for the entire experiment (thus choosing the profit maximization strategy, see Section 2.1). Likewise, one participant always chose the function *effective agent*, independent of the no-control reward. As these participants did not produce rating scores for both functions, they were not included in analyses comparing both functions.

Across all conditions, participants chose the function *effective agent* in 28.72% ($SD = 21.30\%$) of all blocks. For each possible no-control reward, the share of participants choosing the *effective agent* was significantly above zero (see Table 1). The share of *effective agent* choices declined when the no-control reward increased, $F(6, 564) = 34.68$, $p < .001$, $\eta_p^2 = .27$, $\varepsilon = .87$ (GG-corrected). This effect holds true when using a generalized linear mixed model approach: Adding the predictor no-control reward to the model led to a significantly better model fit, $X^2(1) = 128.46$, $p < .001$. More specifically, the odds for choosing the *effective agent* significantly decreased when the no-control reward increased $OR \leq 0.01$, $z = -9.53$, $p < .001$. Modelling a psychometric function on our data further pinpoints the decision threshold for *effective agent* choices around £0.19 (95% CI [0.17; 0.23], slope −2.38 [−2.70; −1.59]), indicating that within this experimental framework, participants needed an additional bonus of at least £0.19 to give up control predictably. This equals 66% of expected asset earnings (£0.19 out of £0.29). When we only included participants who showed choice variation throughout the experiment, that is, who did neither choose the profit maximization strategy (only *ineffective agent* choices) nor the control maximization strategy (only *effective agent* choices), the decision threshold for *effective agent* choices increased to £0.22 (95% CI [0.21; 0.26], slope −2.67 [−3.03; −1.78]). Moreover, the share of *effective agent* choices did not change significantly during the experiment, $F(6, 564) = 1.51$, $p = .173$, $\eta_p^2 = .01$.

When choosing the *effective agent*, participants usually ($M = 90.80\%$, $SD = 23.70\%$) used the maximum number of possible keypresses. Overall, participants received an average bonus payment of £0.50 ($SD = £0.20$) per block. When acting as the *effective agent*, the average reward was significantly lower compared with *ineffective agent* blocks (*effective agent*: $M = £0.28$, $SD = £0.02$; *ineffective agent*: $M = £0.69$, $SD = £0.06$), $t(79) = 57.71$, $p < .001$, $d_z = 6.45$. The correlative analyses reported in the following are summarized in Table 2. The number of keypresses participants[3] chose to perform as *ineffective agents* ($M = 104.05$, $SD = 163.41$) correlated with control ratings for *ineffective agent* blocks, $r(92) = .26$, $t(92) = 2.63$, $p = .010$, but not with pleasantness ratings, $r(92) = .08$, $t(92) = 0.73$, $p = .468$ (see Figure S1). The individual reward threshold (i.e., the lowest amount of no-control reward for which this participant chose to act as the *ineffective agent*) of each participant was not related to the average control or pleasantness ratings for either function, $|rs| \leq .14$, $|ts| \leq 1.29$, $ps \geq .201$.

Interestingly, the function *effective agent* was evaluated as significantly less pleasant than the function *ineffective agent* (*effective agent*: $M = 62.75$, $SD = 22.91$; *ineffective agent*: $M = 71.40$, $SD = 20.41$), $|t|(79) = 2.95$, $p = .004$, $|d_z| = 0.33$. However, averaged across all blocks, ratings of control and pleasantness were positively correlated, $r = .55$, $t(93) = 6.31$, $p < .001$. This effect also holds true when correlations were calculated separately for both functions; *effective agent*: $r = .53$, $t(79) = 5.54$, $p < .001$; *ineffective agent*: $r = .45$, $t(92) = 4.82$, $p < .001$ (degrees of freedom depend on the number of participants who either always chose the *ineffective agent* or the *effective agent* and could thus not be included in the respective analyses).

Our results imply that many, but not all, human agents are at least to some extent willing to accept financial losses in order to be in control over a situation.

3 | STUDY 2

To validate our findings, we replicated Study 1 and tracked for additional analyses also the full number of keypresses in *effective agent* blocks. Moreover, we added further follow-up questions to specifically address the behavior of participants in situations of little

[3]One participant could not be included in this analysis for always choosing the *effective agent* function (see above).

Condition	Variables	r	t	df	p
Ineffective agent	Number of keypresses * control	.26	2.63	92	.010
Ineffective agent	Number of keypresses * pleasantness	.08	0.73	92	.468
Effective agent	Reward threshold * control	.14	1.29	78	.201
Effective agent	Reward threshold * pleasantness	.04	0.34	78	.738
Ineffective agent	Reward threshold * control	−.11	1.03	92	.307
Ineffective agent	Reward threshold * pleasantness	−.03	0.27	92	.787
Overall	Control * pleasantness	.55	6.31	93	<.001
Effective agent	Control * pleasantness	.53	5.54	79	<.001
Ineffective agent	Control * pleasantness	.45	4.82	92	<.001

TABLE 2 Correlative analyses in Study 1.

objective control. Finally, we slightly adopted the experimental procedure to account for a potential limitation of our first study. That is, for the lowest reward levels, participants might have decided on control to avoid an unpredictable punishment (receiving less money than they could have earned when being in control) which could have led to an overestimation of the individual value of control within Study 1.

3.1 | Method

3.1.1 | Participants

Following the same power calculation as for Study 1, we collected a new sample of 101 participants via Prolific. Again, we did not analyze data of participants who reported a rating <50 for the question how well they understood the instructions. This applied to five individuals, leading to a final sample size of 96 participants (37 females, 56 males, 3 diverse; age: $M = 29.9$, $SD = 8.4$). Participants reported a total of 23 nationalities, the most common were South Africa ($n = 15$), the United Kingdom ($n = 13$), and Portugal ($n = 13$).

3.1.2 | Procedure

The experimental procedure was similar to Study 1 except for two minor changes. First, instead of a random bonus between £0.16 and £0.29, participants received the maximum amount of £0.29 in each trial for which they acted as the *ineffective agent*. This was done to investigate whether participants decided on control for the lowest reward levels because of a fear of unpredictable punishments (receiving a lower reward than they could have earned when opting for control). Moreover, this should make our cover story regarding the fictious co-actor more realistic as participants almost always used the maximum number of keypresses when acting as the *effective agent* in Study 1. Second, we added two questions to our post-questionnaire at the end of the experiment. We asked participants whether and if so, why they pressed the key even when this had no effect on the reward. Moreover, participants rated how much they had the feeling that pressing the key, even when keypresses had no effect on reward size, increased their perceived control over reward size.

3.1.3 | Data analysis

We performed the same analyses as for Study 1. In addition, we compared the number of keypresses between both functions with a two-sided *t*-test and also correlated the number of keypresses for *effective agent* blocks with ratings of control and pleasantness for this function.

3.2 | Results and discussion

Control ratings for *effective agent* blocks were significantly higher compared with *ineffective agent* blocks (*effective agent*: $M = 80.20$, $SD = 20.52$; *ineffective agent*: $M = 40.39$, $SD = 29.40$), $t(65) = 8.70$, $p < .001$, $d_z = 1.07$. Thirty participants were not included in analyses comparing both functions as they chose a profit maximization strategy and acted as the *ineffective agent* for the entire experiment (see Section 2.1).

Overall, participants decided on the function *effective agent* in 21.13% ($SD = 20.20\%$) of all blocks. The share of participants choosing the *effective agent* was significantly above zero for each level of no-control reward (see Table 3) and declined when the no-control reward increased, $F(6, 570) = 12.86$, $p < .001$, $\eta_p^2 = .12$, $\varepsilon = .79$ (GG-corrected). Similar results can be found when using a generalized linear mixed model approach: Adding the predictor no-control reward to the model led to a significantly better model fit, $X^2(1) = 45.96$, $p < .001$. That is, the probability for choosing the *effective agent* significantly decreased when the no-control reward increased $OR = 0.03$, $z = -6.31$, $p < .001$. Modelling a psychometric function on our data further pinpoints the decision threshold for *effective agent* choices around £0.10 (95% CI [0.10; 0.12], slope −1.87 [−2.34; −0.75]), indicating that within this experimental framework, participants needed an additional bonus of at least £0.10 to give up control predictably, which corresponds to 34% of expected asset earnings (£0.10 out of £0.29). When we only included participants who showed choice variation throughout the experiment, that is, who did neither choose the profit maximization strategy (only "ineffective agent" choices) nor the control maximization strategy (only "effective agent" choices), the decision threshold for "effective agent" choices increased to £0.18 (95% CI [0.15; 0.23], slope −2.19 [−2.47; −1.21]). Moreover, the

TABLE 3 Mean percentages, confidence intervals, and comparisons of the participants' *effective agent* choices against zero for each no-control reward in Study 2.

No-control reward (£)	*M* (%)	95% CI	*t*(95)	*p*	*d*
0.1	47.92	[37.74; 58.09]	9.35	<.001	0.95
0.2	29.17	[19.91; 38.42]	6.25	<.001	0.64
0.3	16.67	[9.08; 24.26]	4.36	<.001	0.44
0.4	14.58	[7.39; 21.77]	4.03	<.001	0.41
0.5	10.42	[4.19; 16.64]	3.32	=.001	0.34
0.6	16.67	[9.08; 24.26]	4.36	<.001	0.44
0.7	12.50	[5.76; 19.24]	3.68	<.001	0.38

TABLE 4 Correlative analyses in Study 2.

Condition	Variables	*r*	*t*	*df*	*p*
Effective agent	Number of keypresses * control	.22	1.83	64	.072
Effective agent	Number of keypresses * pleasantness	.11	0.85	64	.399
Ineffective agent	Number of keypresses * control	−.02	0.15	94	.883
Ineffective agent	Number of keypresses * pleasantness	−.08	0.80	94	.425
Effective agent	Reward threshold * control	.07	0.59	64	.560
Effective agent	Reward threshold * pleasantness	.13	1.06	64	.292
Ineffective agent	Reward threshold * control	.15	1.48	94	.143
Ineffective agent	Reward threshold * pleasantness	−.01	0.06	94	.949
Overall	Control * pleasantness	.25	2.45	94	.016
Effective agent	Control * pleasantness	.59	5.81	64	<.001
Ineffective agent	Control * pleasantness	.26	2.62	94	.010

decision to choose the *effective agent* did not depend on the point in time within the study, $F < 1$.

The number of keypresses participants chose to perform did differ slightly between both functions (*effective agent*: $M = 42.25$, $SD = 25.91$; *ineffective agent*: $M = 59.61$, $SD = 88.68$), but this difference was not significant, $t(65) = 1.72$, $p = .090$, $d_z = 0.21$, and was not related to ratings of control or pleasantness for either function (see Table 4), $|rs| \leq .22$, $|ts| \leq 1.83$, $ps \geq .072$. The average bonus payment estimated £0.53 (SD = £0.24) per block. Participants earned significantly less money when acting as *effective agents* compared with *ineffective agent* blocks (*effective agent*: M = £0.26, SD = £0.07; *ineffective agent*: M = £0.73, SD = £0.07), $t(65) = 42.79$, $p < .001$, $d_z = 5.27$. The individual reward threshold (i.e., the lowest amount of no-control reward for which this participant chose to act as the ineffective agent) of each participant did not correlate with control or pleasantness ratings for either function (see Table 4), $|rs| \leq .15$, $|ts| \leq 1.48$, $ps \geq .143$.

Pleasantness ratings did not differ significantly between both functions (*effective agent*: $M = 64.64$, $SD = 24.15$; *ineffective agent*: $M = 70.02$, $SD = 22.98$), $|t|(65) = 1.36$, $p = .179$, $|d_z| = 0.17$. Across all blocks, ratings of control and pleasantness were positively correlated, $r = .25$, $t(94) = 2.45$, $p = .016$. A similar effect was found when correlations were calculated separately for both functions; *effective agent*: $r = .59$, $t(64) = 5.81$, $p < .001$; *ineffective agent*: $r = .26$, $t(94) = 2.62$, $p = .010$ (reduced degrees of freedom for the *effective agent* analyses reflect that 30 participants never chose this function and thus could not be included in the respective analyses).

Study 2 replicates the main finding of our first experiment: Some, but not all, human agents decide at least in some circumstances on being in control also when this behavior is financially suboptimal.

4 | GENERAL DISCUSSION

4.1 | Objective decision rights

What is the intrinsic value of being in a position of increased control, even when this position comes at direct monetary costs? We studied this question in two experiments by asking our participants to choose between having control over a monetary reward or instead, receiving an additional bonus for relegating control to a fictitious co-actor. When participants opted for control, reward size was determined by the number of times they pressed a specific key. Overall, while the majority of participants preferred to waive control when this decision improved the final monetary gain, a substantial subset of participants still chose control over monetary gain at least in some circumstances. Moreover, only a clear minority of participants (Study 1: 16%; Study 2: 31%) chose a pure profit maximation strategy throughout the entire experiment. This financially suboptimal preference for control seems to be stable over time and, thus, cannot be explained by an early exploration of the experimental setup. This finding emphasizes the relevance of control for human agents (e.g., Diener, 1984) that can even gain clinically relevant dimensions: For example, the usage of irrational or even dysfunctional behavior to gain control over a

situation is also a common finding within clinical populations like individuals suffering from anorexia nervosa (Engel et al., 2022) or obsessive–compulsive disorder (Szalai, 2019).

Our findings point toward an even higher value of control than found in earlier empirical studies (e.g., Owens et al., 2014). While in Owens et al. (2014), participants were willing to forego 8–15% of expected asset earnings, in our setup, an additional bonus of 66% (Study 1) and 34% (Study 2) of expected compensation was necessary to make participants predictably waive control. Both studies differ in several aspects which makes it somewhat difficult to isolate the main reason for the discrepancy between our results and these earlier findings (e.g., online study vs. lab study; mixed, international sample vs. mainly American business students; 8 vs. 10 decisions for or against control; graduated bonus payment vs. either $0 or $20). One crucial difference, however, might lie in the maximum amount of bonus compensation participants could receive in return for waiving control. In Owens et al. (2014), participants could earn $20, in contrast to only £0.29 per block in the present experiments. Following findings of reduced (or even reversed) loss aversion for small amounts of money (Harinck et al., 2007), humans might appreciate situational control proportionally more for lower monetary stakes, that is, they might be willing to lose relatively more money in favor of gaining control when the stakes are low. Furthermore, different kinds of demand characteristics might play a role here (Orne, 1962). For instance, participants in our study could have had the feeling that it is expected from them to choose the effective agent at least once within the study. Choosing the ineffective agent and, thus, overcoming this potential demand characteristic may have required additional effort. Assuming that this effort equals a premium of a few pennies, it would constitute a much higher percentage of potential earnings in our setup compared with earlier work (Owens et al., 2014).

4.2 | Subjectively perceived control

In addition to earlier research (e.g., Owens et al., 2014), we not only investigated objective control (e.g., the right to make a decision) but also addressed subjective feelings of control, that is, the sense of agency. By asking participants after each block how much control they felt over the respective outcome, we were able to analyze the detailed relation of perceived control and the willingness to forgo monetary rewards to be in charge of a situation. However, control ratings for blocks as effective agents did not correlate with the individual reward threshold. This implies that the decision for or against waiving control to increase monetary gain was not driven by a generally higher or lower level of subjective agency across participants. Nevertheless, one should not jump to the conclusion that objective and perceived control are necessarily identical. While actual control is an important predictor of perceived control, previous evidence indicates that both deviate in specific circumstances, for example, in situations of outcome uncertainty or of particular personal relevance (see, e.g., Reis et al., 2022, and Schwarz et al., 2022, for the importance of personal and situational factors on subjective agency). Instead, the present finding could suggest a complex decision process based on more aspects than mere perceived control. Further, it could indicate that perceived control can have complex effects on participants' behavior that are, at this point in time, difficult to predict and complicated to integrate analytically: For example, low sense of agency could lead to an increased need for control, even if such behavior is not beneficial for monetary gain. Likewise, high sense of agency may also lead to a similar outcome, as these participants may already be primed for having control and therefore this choice might be the easier option. Of course, the reverse could also be argued for either option.

The high relevance of perceived control for human behavior is additionally supported by our analysis of the participants' behavior in situations of little objective control. Even when acting as *ineffective agents*, participants decided on pressing the key for a considerable number of times (Study 1: $M = 104.05$; Study 2: $M = 59.61$) and often continued pressing the key as *effective agents*, although the maximum number of keypresses was reached. Interestingly, in Study 1, the average number of keypresses performed as *ineffective agent* was positively correlated with ratings of control. Thus, we speculate that this behavior might acted as a helpful coping mechanism by creating an *illusion of control* (Langer, 1975). However, such a relationship was neither present in Study 2 nor regarding keypresses exceeding the maximum number in *effective agent* blocks.

Our results also indicate that this need for control is strongly mediated by individual factors: Whereas some participants chose to perform over 600 keypresses in no-control blocks, other participants did not perform any keypresses at all. A more fine-grained analysis of keypresses in *ineffective agent* blocks in Study 2 revealed a bimodal distribution (see Figure S2), $b = .762$, which is not the case for keypresses in *effective agent* blocks, $b = .505$ (see Freeman & Dale, 2013, and Pfister et al., 2013, for details on the bimodality coefficient). As reported in our follow-up questionnaire, the dominant motivation for such ineffective keypresses was the feeling that doing so might be beneficial eventually. These reports, in turn, would be a sign of an increased perception of agency due to this actually ineffective behavior, supporting our speculation of such actions to cope with situations of objectively little control. Further support for this assumption comes from another follow-up question, in which we asked participants how much they had the feeling that pressing the key, even when keypresses had no effect on reward size, increased their perceived control over the reward. The average response rating for this question was 37.16 on a scale from 0 to 100 ($SD = 36.00$), with 40% of participants indicating a rating of at least 50 and 17% of participants even indicating a rating of 80 and higher.[4] Interestingly, these ratings were positively correlated with the number of such ineffective keypresses, $r = .26$, $t(94) = 2.61$, $p = .010$. Thus, it seems reasonable to assume that at least for some participants, this objectively ineffective behavior indeed acted as a coping mechanism to bolster their sense of agency.

[4]See Tables S1 and S2 for descriptive results of each quantifiable follow-up question in both studies. Responses to free-text questions can be found on the Open Science Framework (https://osf.io/74xgy/?view_only=11d5935828ce43a69b13c06f712a1c9e).

4.3 | Perceived control and pleasantness

In both experiments, we found a strong, positive correlation of control and pleasantness ratings, both across the entire study as well as calculated separately for each function. At the same time, having no control over reward size was evaluated as significantly more pleasant than having control in Study 1, and we found a similar descriptive trend in Study 2. At first glance, this exploratory finding contradicts our key assumption and earlier research, which showed that control is desirable (Bown et al., 2003) and rewarding (Leotti & Delgado, 2011, 2014). However, several characteristics of our setup might be responsible for this result. Even when participants had no control over reward size, they had nevertheless deliberately chosen to serve as *ineffective agents*. Accordingly, they might still feel some indirect control over the outcome which is reflected in comparatively high control ratings for this function (Study 1: 45.30 out of 100, Study 2: 40.39 out of 100). This effect might have been further increased by their ability to choose ineffective actions (i.e., keypresses without effects) to bolster their perceived control. Moreover, earlier research indicates that there are indeed situations in which control is not desirable. As mental effort increases with a rising number of possible options (Hick, 1952) and action-selection fluency in turn is closely linked to the sense of agency (Chambon & Haggard, 2012), choosing from a quite large selection can be perceived as less pleasant than when the choice is rather limited (Iyengar & Lepper, 2000). Moreover, it was shown that having choices (i.e., control) is much more important for individuals than making choices because each choice includes the possibility of a wrong decision and an increased responsibility for the outcome (Ogden et al., 2008). This might be especially true when, as in our setup, behavior does not only affect oneself but also others (Pahlke et al., 2015). Finally, even though the observed positive correlation of control and pleasantness ratings suggests that perceived control has a positive affective component (see also Bown et al., 2003), this is not a mandatory requirement of a behaviorally relevant reward. There are several kinds of rewards that, while promoting specific behaviors, also come along with negative consequences like reduced intrinsic motivation (Hidi, 2016).

4.4 | Limitations

One limitation of our findings is that for the two lowest levels of no-control reward (£0.1 and £0.2), there was the possibility that the bonus awarded by the (fictitious) co-actor was below the maximal possible main reward (£0.29). This possibility was particularly relevant in Study 1, as here, the reward afforded by the co-actor was chosen randomly between £0.16 and £0.29 while this amount was fixed to £0.29 in Study 2. Indeed, the share of *effective agent* choices for the lowest levels of no-control reward was substantially lower in Study 2 (e.g., no-control reward = 0.1: Study 1 = 72.63%, Study 2 = 47.92%; $t(189) = 3.59$, $p < .001$, $d = 0.52$). Accordingly, deciding on control in these conditions might to some extent also reflect avoidance of an unpredictable, aversive outcome. The fear of such random punishments, however, also represents the desire for control which, in turn, can prevent such negative experiences. An alternative explanation is that the (almost) completely predictable behavior by the co-actor likely increased the participants' perceived control when choosing the *ineffective agent*. In other words, participants in Study 2 also may have chosen the ineffective agent more often because the additional control afforded by this function is already increased compared with Study 1.

Another possible influential factor in our study are social aspects, as our setup, at least allegedly, included another person who was associated with the experimental process. However, our instructions attempted to minimize such effects. Participants were informed that the co-actor had already finished the experiment prior to the participant, the participants had no information on their fictitious co-actor, and they could be insured that there would be no future interaction with the co-actor. Furthermore, both actors benefited equally from the choice of the participant. If social factors such as altruistic motives play a role, this might have actually reduced the share of participants choosing to be in control, rendering the present results to be rather conservative.

Finally, our measure of subjective control consisted of a single-item self-report question. Even though this constitutes a widespread and established way to capture explicit judgements of control (Moore, 2016), it nevertheless bears some limitations like social desirability and varying interpretation of scale values (Synofzik et al., 2008).

4.5 | Practical implications

Next to these theoretical contributions, our findings bear practical implications for all domains in life that include making decisions between having own control or delegating decision power to other agents. This includes financial investment strategies and healthcare delivery. For example, policy makers in healthcare should focus on establishing environments which provide individuals sufficient control about their own well-being. As our results indicate, it might not only be important that individuals indeed are in charge of a situation but also that they perceive sufficient control.

4.6 | Future research opportunities

Our findings aspire several avenues for future research. In particular, the subjective perception of control should be integrated more comprehensively within future work on the relevance of control in decision-making. For example, future studies might look into the question of how different levels of perceived control may result in different decision-making strategies, potentially mediated by individual factors. Moreover, the variability in the present results indicates that also the relation of perceived control and the value of control might be strongly influenced by individual aspects. In general, recent studies indicate a small but consistent effect of personality constructs on the

sense of agency, especially in situations of uncertainty (Schwarz et al., 2022). That is, higher levels of openness and extraversion were positively correlated to perceived control, while the opposite relation was found for neuroticism. Future research should, thus, address the specific relation of individual factors and the value of control. As indicated by the large discrepancy between our results and earlier findings on this research question (e.g., Owens et al., 2014), also the impact of situational characteristics (e.g., reward size; control over yourself or other agents) needs to be investigated more closely. Finally, the external validity of our results should be tested by transferring our paradigm to specific real-world scenarios, like the value of control in stock market investments.

4.7 | Conclusions

The present study investigates the value of control for human agents. In a novel paradigm, we provide empirical evidence that many, but not all, human agents to some extent choose perceived control over monetary gain and that this choice is mediated by the amount of monetary loss mandated by choosing control. The present studies give precise monetary numbers to the value of objective control, that is, the right to make a decision, within this context. In addition to prior research, we also addressed the role of subjectively perceived control, that is, the sense of agency. Interestingly, for some participants, the need for control was further emphasized by their tendency to perform actions, even if these actions have no overt consequences. Thereby, this behavior potentially served for creating an illusionary sense of agency, possibly as a coping mechanism in no-control situations.

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CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

Raw data, the analysis syntax, and programming files are available on the Open Science Framework (https://osf.io/74xgy/).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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