How Pills Undermine Skills: Moralization of Cognitive Enhancement and Causal Selection

Emilian Mihailov¹, Blanca Rodríguez López², Florian Cova³ & Ivar R. Hannikainen^{4*}

¹ University of Bucharest (Romania)

² Complutense University of Madrid (Spain)

³ University of Geneva (Switzerland)

⁴ University of Granada (Spain)

* Correspondence concerning this article should be addressed to: Ivar R. Hannikainen, Department of Philosophy I, Faculty of Psychology, Cartuja Campus, Universidad de Granada (Spain), 18011.
Contact: ivar@ugr.es

Word count (excluding References and Supplementary Information): 7623

Abstract

Despite the promise to boost human potential and wellbeing, enhancement drugs face recurring ethical scrutiny. The present studies examined attitudes toward cognitive enhancement in order to learn more about these ethical concerns, who has them, and the circumstances in which they arise. Fairness-based concerns underlay opposition to competitive use—even though enhancement drugs were described as legal, accessible and affordable. Moral values also influenced how subsequent rewards were causally explained: Opposition to competitive use reduced the causal contribution of the enhanced winner's skill, particularly among fairness-minded individuals. In a follow-up study, we asked: Would the normalization of cognitive enhancement alleviate concerns about its unfairness? Indeed, proliferation of competitive cognitive enhancement eradicated fairness-based concerns, and boosted the causal role of the winner's skill. In contrast, purity-based concerns emerged in both recreational and competitive contexts, and were not assuaged by normalization.

Keywords: cognitive enhancement; moral foundations; causation; bioethics.

Highlights

- Views on cognitive enhancement reflect both purity and fairness concerns.
- Fairness, but not purity, concerns are surmounted by normalizing use.
- Moral opposition to pills undermines user's perceived skills.

PILLS UNDERMINE SKILLS

How Pills Undermine Skills: Moralization of Cognitive Enhancement and Causal Selection

Nootropics, such as modafinil and methylphenidate, bring mild cognitive benefits outside therapeutic contexts. They can improve memory, problem-solving abilities, spatial working memory, and the ability to divide and reallocate attention (Randall, Shneerson, & File, 2005; Turner et al., 2003; Linssen et al., 2012; Mehta et al., 2000). Informally dubbed “smart pills”, these pharmacological means of cognitive enhancement have become increasingly common in tertiary education, and even in the workplace (Sahakian et al., 2015; Nicholson, Mayho, & Sharp, 2015; Mihailov & Savulescu, 2018; Brühl, d’Angelo, & Sahakian, 2019).

The proliferation of smart pills, however, has been met with notable backlash. Concerns have been raised about their safety (Scheske & Schnall, 2012; Sattler et al. 2013), their psychological implications (e.g., for identity; see Riis et al. 2008), and their societal repercussions, for instance, downstream effects on structural inequality and injustice (Fitz et al., 2013; Schelle et al. 2014; Forlini et al. 2015).

Perhaps the most recurring objection is that cognitive enhancement is in one way or another *unfair* (Schermer, 2008; Rose, 2006; Pulfrey & Butera, 2013). First, ethicists have denounced that, if smart pill use is most common among the socioeconomically advantaged, its liberalization will only exacerbate current levels of inequality. In line with this, Fitz and colleagues (2014) found that lay respondents viewed cognitive enhancement as relatively unfair when the pills were acquired through family wealth, by comparison to personal earnings. Second, people also oppose cognitive enhancement on procedural grounds: For instance, students who take smart pills in preparation for an exam are perceived as acting unfairly (Faber et al., 2016). Further research by Conrad and colleagues (2019) points toward a plausible explanation: namely, that enhancement is seen as more

objectionable in athletic or academic contexts, which imply direct competition with others, than in the workplace (see also Dinh et al. 2020; Dodge et al., 2012).¹

Interestingly, moral condemnation does not stem from prohibition or social sanction, and can persist even when enhancement is expressly permitted (Schermer, 2008; Savulescu, 2006), suggesting that fairness might not be the sole concern (Landy et al., 2017). Indeed, a rich discussion in the philosophical literature emphasizes concerns about *inauthenticity*: i.e., that recurring use of smart pills spares people the effort ordinarily required to cultivate one's unique talents or hone one's skill (Cole-Turner, 2000; Kass, 2003), thereby trivializing achievement (Fukuyama, 2002; Elliott, 2003; Sandel, 2007). These concerns are echoed in the general public's beliefs that people "should be content with their talents and abilities", and that their "achievements should come from their own effort and not from pills and devices", as documented in a large-scale European survey (Bard et al., 2018; see also Forlini et al., 2015).

1.1. Individual Differences in Attitudes toward Enhancement

To further understand moral attitudes toward cognitive enhancement, we drew on *moral foundations theory* (Graham, Haidt, & Nosek, 2009). Across cultures, people's moral values can be classified based on a superstructure of five foundations—harm, fairness, loyalty, authority and purity—which undergird attitudes toward various contemporary issues, such as environmentalism (Feinberg & Willer, 2012), whistle-blowing (Waytz, Dungan, & Young, 2013) and terrorism (Van de Vyver et al., 2015).

In the context of cognitive enhancement, moral foundations could be expected to play a prominent role. For instance, individual differences in fairness values may undergird opposition to cognitive enhancement, conceptually replicating previous research (Faber et al., 2016). Additionally,

¹ In a pilot study (N = 104), we observed that the strongest opposition emerges when evaluating activities like sports (in line with Dodge et al., 2012), that imply competition with others. Participants viewed four scenarios describing different types of activities: chess, studying, playing music, and working. Participants were relatively neutral towards most uses (work, music, studying: Ms = 0.29, 0.38, 0.17; SDs = 1.84, 1.90, 1.84), but viewed enhancement in the context of mental sports as impermissible (chess: M = -0.78, SD = 1.81), one-sample $t(103) = -4.39$, $p < .001$.

purity values might independently predict the rejection of cognitive enhancement (Scheske & Schnall, 2012)—given the tight empirical and conceptual links between moral purity, the pursuit of naturalness, and the avoidance of bodily contamination.

In addition to the framework of moral foundations, we investigate the plurality of participants' ethical concerns through two further means: First, we record participants' judgments of authenticity, deservingness and fairness—asking whether these beliefs underlie attitudes of approval. Second, we draw on qualitative coding methods to examine the content of participants' open-ended justifications for their attitudes toward enhancement.

1.2. Inauthenticity as Causal Selection

Concerns about authenticity postulate that cognitive enhancement can to some degree replace effort and dedication. In actuality, though, a cursory glance at the primary literature demonstrates that performance enhancements are generally modest (Mihailov & Dragomir, 2018). How, then, is the illusion of dramatic performance boosts sustained? Potentially, the media—with its emphasis on metaphors such as “miracle drug” and “brain steroid”—help to conjure images of radical cognitive improvement (Racine & Forlini, 2000). Research in *causal cognition*, however, provides another plausible and complementary framework.

Several studies have now shown that causal explanations for events are shaped in part by perceptions of the morality of their putative causes: Other things being equal, more immoral contributors to an outcome tend to be more causally salient than morally neutral contributors (Alicke, 1992; Rodriguez-Arias et al., 2020). This phenomenon can be decomposed into two complementary effects. In conjunctive cases, in which A and B *together* result in outcome C, as A becomes more immoral, previous studies have revealed that (i) A acquires *greater* causal relevance (known as abnormal inflation) and that (ii) B independently becomes less causally relevant (known as causal supersession; Icard, Kominsky & Knobe 2017; Kominsky et al. 2015).

Cognitive enhancement can be seen through the lens of conjunctive causation: The agent's prior knowledge and relevant abilities, together with the effects of the cognitive enhancer and a myriad of other causal contributors, give rise to the outcome in question (e.g., passing or failing an exam, or winning or losing a race). As such, moral attitudes toward enhancement could magnify the pill's perceived causal efficacy (demonstrating abnormal inflation), and also undermine the agent's perceived knowledge and skill (demonstrating supersession). As such, the theory of causal selection might provide a plausible mechanism for the origin of authenticity concerns: specifically, that moral opposition creates the impression that pills are highly efficacious, and/or their users unskilled.

In these studies, we stipulate that rewards were conjunctively caused, i.e., the result of agents' abilities, talent and dedication, together with the effects of smart pills and other elements including luck. We then examine effects of causal selection by asking participants to analyze the causes of protagonists' success in both recreational and competitive contexts.

1.3.Overview

Experiment 1 was an exploratory study with no associated pre-registration, while Experiment 2 was a replication and extension study with pre-registered hypotheses. Both experiments examine the effect of competitive versus recreational contexts on the permissibility of cognitive enhancement, and on patterns of causal selection. Additionally, in Experiment 2, we evaluate the effects of normalization of enhancement in each context.

Our analytic approach is the following: First, we report experimental effects of condition on permissibility, and causal selection. Second, we investigate whether individual differences in moral foundations moderate the effects of condition on permissibility and causal selection. Third, through mediation analysis, we assess whether contextual and individual differences in causal selection are mediated by variation in permissibility.

Both studies involve repeated-measures designs, so the analyses rely on mixed-effects regression models with crossed random effects of participant and scenario. Degrees of freedom are

calculated using the Kenward-Roger approximation (notated as df_{K-R} , see Kenward & Roger, 1997).

Data, analysis scripts and materials are available on the *Open Science Framework* at

<https://osf.io/qg85f/>.

2. Experiment 1

In Experiment 1, we described a series of agents who took smart pills while working, studying, playing an intellectual sport or a musical instrument. Through both their effort and the effects of cognitive enhancement, these agents succeed in their respective activities. We investigated laypeople's intuitive assessments of the moral permissibility of cognitive enhancement, and their evaluations of material and immaterial rewards obtained in competitive and recreational contexts. Participants also completed a validated measure of moral foundations in order to understand how concrete assessments of enhanced performance are systematically linked to prior moral values.

2.1. Methods

2.1.1. Power Analysis

We sought to ensure 90% statistical power to detect an average effect (i.e., $r = .21$, or Cohen's $d = 0.43$, as per Richard, Bond Jr, & Stokes-Zoota, 2003), with a significance level of $\alpha = .05$. The corresponding power analysis recommended a sample size of 115 participants in each condition (i.e., target $N = 230$).

2.1.2. Participants

We recruited 332 native English speakers (65% women, Mdn age = 30) from Prolific (<https://prolific.ac/>), a crowdsourcing company linking researchers and prospective participants. Participants were compensated with £1.20 for approximately 8 minutes of their time (completion [mm:ss]: $Q_1 = 6:01$, $Mdn = 7:48$, $Q_3 = 10:22$). Most participants were non-religious (78%) and college-educated (70%) nationals of the United Kingdom (73%).

PILLS UNDERMINE SKILLS

89 participants failed the attention check built into the MFQ-30, and/or the comprehension check at the end of the experiment, resulting in a sample of 243 participants. We therefore met, and slightly exceeded, our target sample size for this study.

2.1.3. Procedure

After providing informed consent, participants read the following introduction to our study:

Many policy makers are considering whether to enact regulations about cognitive enhancers, i.e., substances that improve cognitive function, such as memory, attention, or motivation.

These substances have only mild side effects and have successfully passed clinical trials.

You will now read about four scenarios. In each scenario, someone uses a cognitive enhancer (also called a smart pill). We will then ask you different questions about the person's behavior.

For each of the following scenarios, please imagine that there is no rule against the use of smart pills. Everyone can use them if they choose to. Also imagine that everyone has equal access to smart pills. They are not expensive or difficult to obtain.

In a between-subjects design, participants were randomly assigned to either the Competitive or Recreational condition. In each condition, participants viewed four scenarios involving cognitive enhancement in a random order (Chess, Music, Study, Work; see Appendix).

In the Competitive condition, it was implied that protagonists were competing against others while in the Recreational condition it was not. For instance, one scenario pair involved a chess player who either entered a prestigious tournament (Competitive) or played a chess video game at home (Recreational). Immediately after the scenario, participants made judgments of permissibility (see Measures section).

Next, participants were informed that the agent succeeded in attaining either material rewards, e.g., a job offer or a cash prize (in the Competitive condition), or social rewards, primarily others' gratitude and praise (in the Recreational condition). We asked participants whether the actor

deserved the outcome, whether the outcome was fair, and whether the outcome was truly the actor's own accomplishment.

A subset of participants ($n = 195$) was additionally asked to causally describe the protagonists' success.² Since cognitive enhancement can only marginally improve performance, we stipulated that rewards were the result of smart pills in conjunction with agents' abilities, talent and dedication (e.g.: "Thanks to both his effort and the effects of the smart pill, John scores highly on the test and is admitted to a top-tier college") and asked participants to assess the causal contribution of the agent's (i) skill, (ii) the pill, and (iii) other causes.

At the end of the survey, we administered the 30-item Moral Foundations Questionnaire (Graham, Haidt, & Nosek, 2009), and requested basic demographic information. This protocol was reviewed and approved by the Ethics Committee at the University of Bucharest.

2.1.4. Measures

1. *Permissibility*: Our primary dependent measure was the moral permissibility of the agent's conduct (i.e., "Do you find [agent]'s behavior morally permissible?") on a seven-point scale, from -3: "Completely impermissible" to 3: "Completely permissible"..
2. *Fairness assessments*: Participants reported whether the outcome was fair, on a scale from -3: "Definitely not/Not at all" to 3: "Definitely/Completely".
3. *Deservingness assessments*: participants reported whether the agent deserved the outcome, on a scale from -3: "Definitely not/Not at all" to 3: "Definitely/Completely".
4. *Authenticity assessments*: participants reported whether the outcome was truly the agent's own accomplishment (*authenticity*), on a scale from -3: "Definitely not/Not at all" to 3: "Definitely/Completely".

² We detected a programming issue partway through data collection, and corrected in time for a subset of the sample to view the causal selection questions.

PILLS UNDERMINE SKILLS

5. *Causal rating - Pill*: the percentage of causal influence ascribed to the cognitive enhancement brought on by the pill (ranging from 1% to 98%).
6. *Causal rating - Skill*: the percentage of causal influence ascribed to the agent's ability, talent, dedication, and effort (ranging from 1% to 98%).
7. *Fairness values*: the six-item average (Cronbach's $\alpha = .62$) of participants' reliance on the moral foundation of fairness.
8. *Purity values*: the six-item average (Cronbach's $\alpha = .76$) of participants' reliance on the moral foundation of purity or sanctity.

2.2.Results

Our manipulation check indicated that agents were seen as competing in the Competitive condition (89%, 95% CI [82%, 94%]) but not in the Recreational condition (7%, 95% CI [4%, 14%]), $\chi^2(1, N = 243) = 159.9, p < .001$, *Cramer's V* = .81. Descriptive statistics are reported in Table 1.

Table 1.

Condition Means and 95% Confidence Intervals: Experiment 1.

	Competitive	Recreational
<i>Permissibility</i>	1.05 [0.52, 1.58]	1.52 [1.00, 2.05]
<i>Deservedness</i>	1.07 [0.33, 1.80]	1.30 [0.57, 2.03]
<i>Fairness</i>	0.93 [0.21, 1.65]	1.22 [0.51, 1.94]
<i>Authenticity</i>	0.94 [0.38, 1.50]	1.52 [1.00, 2.05]
<i>Skill</i>	53.2 [44.2, 62.2]	58.8 [49.8, 67.8]
<i>Pill</i>	32.0 [30.1, 34.0]	27.5 [25.6, 29.4]
<i>Other</i>	14.8 [12.8, 16.7]	13.7 [11.9, 15.6]

2.2.1. *Experimental Effects*

Moral Permissibility. We observed a significant effect of context on judgments of permissibility, $F(1, df_{K-R} = 241) = 5.76, p = .017, \eta^2_p = .023$. Recreational use ($M = 1.52, 95\% \text{ CI } [1.00, 2.05]$) was seen as more permissible than competitive use ($M = 1.05, 95\% \text{ CI } [0.52, 1.58]$), $B = 0.48, 95\% \text{ CI } [0.09, 0.86], t(df_{K-R} = 241) = 2.40, p = .017$.

Deservedness, Fairness, and Authenticity. No effects of context were observed on judgments of deservedness, $F(1, df_{K-R} = 241) = 1.38, p = .24$, fairness, $F(1, df_{K-R} = 241) = 1.92, p = .17$, or authenticity, $F(1, df_{K-R} = 241) = 1.45, p = .23$ (see also Table 1).

Causal Selection. A two-way ANOVA revealed a main effect of element, $F(2, df_{K-R} = 1830) = 968.8, p < .001, \eta^2_p = .514$, and a two-way interaction between context and element, $F(2, df_{K-R} = 1830) = 14.13, p < .001, \eta^2_p = .015$. The main effect of context was constrained to zero, $F(1, df_{K-R} = 165) = 0.00, p = 1$, since the three causal contributors were forced to sum 100. Probing the simple effects of context revealed greater causal relevance of (i) the agent's skill in the Recreation condition, $B = -5.56, t(df_{K-R} = 1091) = -4.08, p < .001$, and of (ii) the pill's in the Competition condition, $B = 4.52, t(df_{K-R} = 1091) = 3.32, p < .001$. Meanwhile, 'other' causes had a comparable effect across conditions, $B = 1.03, t(df_{K-R} = 1091) = 0.76, p = .45$.

2.2.2. *Regression and Moderation Analyses*

Determinants of Moral Permissibility. An ANCOVA revealed main effects of deservedness, $F(1, df_{K-R} = 761.8) = 49.52, \eta^2_p = .061$, fairness, $F(1, df_{K-R} = 845.7) = 32.61, \eta^2_p = .037$, and authenticity, $F(1, df_{K-R} = 952.5) = 12.55, \eta^2_p = .013$, all $ps < .001$. Each of these predictors explained independent variance in permissibility after controlling for the effect of context, $F(1, df_{K-R} = 239.8) = 6.29, p = .013$. Additionally, a two-way interaction emerged between fairness and context, $F(1, df_{K-R} = 843.4) = 12.27, \eta^2_p = .014, p < .001$. No such interactions arose for deservedness or authenticity, $F_s < 1, ps > .60$.

As shown in Table 2, the simple slopes of deservedness and authenticity were positive in both conditions, and the magnitude of these effects did not differ between contexts: deservedness $t(df_{K-R} = 835) = -0.43, p = .67$, authenticity $t(df_{K-R} = 938) = 0.33, p = .74$. In contrast, assessments of fairness predicted permissibility only in competitive contexts, and the slope of fairness differed across contexts, $B = 0.35, 95\% \text{ CI } [0.15, 0.54], t(df_{K-R} = 843) = 3.50, p < .001$.

Table 2.

Partial Regression Coefficients and 95% Confidence Intervals: Experiment 1.

	Competitive	Recreational
<i>Deservedness</i>	0.34 [0.21, 0.48]	0.39 [0.24, 0.54]
<i>Fairness</i>	0.43 [0.30, 0.56]	0.09 [-0.06, 0.23]
<i>Authenticity</i>	0.15 [0.05, 0.25]	0.12 [0.01, 0.23]

Moral Foundations of Cognitive Enhancement. Next, we examine the moral foundations that underlie attitudes toward cognitive enhancement. Model comparisons revealed that entering MFQ-Fairness ($AIC = 3224, \chi^2[df = 2] = 7.64, p = .022$) and MFQ-Purity ($AIC = 3220, \chi^2[df = 2] = 11.01, p = .004$) into the model improved fit to the data, whereas entering harm, loyalty or authority did not yield significant improvement, $ps > .10$. Further, a model including *both* MFQ-Fairness and MFQ-Purity foundations ($AIC = 3214$) increased model fit above and beyond either the fairness ($\chi^2[df = 2] = 13.80, p = .001$) or purity ($\chi^2[df = 2] = 10.44, p = .005$) models. Thus, both fairness and purity values helped to predict people's attitudes toward cognitive enhancement.

Simple slopes analyses revealed that MFQ-Purity selectively predicted opposition to recreational use ($B = -0.50, 95\% \text{ CI } [-0.77, -0.23]$ vs. Competition: $B = 0.10, 95\% \text{ CI } [-0.16, 0.35]$), $t(df_{K-R} = 237) = 3.18, p = .002$. Meanwhile, MFQ-Fairness selectively predicted opposition to competitive use ($B = -0.49, 95\% \text{ CI } [-0.84, -0.14]$ vs. Recreation: $B = 0.32, 95\% \text{ CI } [-0.05, 0.69]$) $t(df_{K-R} = 237) = -3.12, p = .002$ (see Figure 1A).

Figure 1. (A) Permissibility and (B) causal judgments in competitive and recreational contexts by MFQ Fairness. (C) Mediation model of causal judgments by permissibility judgments at low, average, and high levels of fairness values.

Moral Foundations and Causal Selection. We reasoned that participants' judgments of causal selection could depend on the moral foundations they espouse: Indeed, the model including both MFQ-Fairness and MFQ-Purity foundations ($AIC = 17179$) increased model fit above and beyond a model without moral foundations ($AIC = 17191$; $\chi^2[df = 12] = 35.83$, $p < .001$).

Simple slopes analyses revealed that MFQ-Fairness underlay causal emphasis on the pill in competitive contexts ($B = 3.91$, 95% CI [1.84, 6.29]), but not recreational contexts ($B = -0.58$, 95% CI [-3.06, 1.89]), $t(df_{K-R} = 1071) = 2.56$, $p = .011$. MFQ-Fairness also underlay *de*-emphasis of the

agent's skill in competitive contexts ($B = -2.88$, 95% CI $[-5.27, -0.50]$), but not recreational contexts ($B = 1.73$, 95% CI $[-0.75, 4.21]$), $t(df_{K-R} = 1071) = -2.63$, $p = .009$ (see Figure 1B).

In turn, MFQ-Purity revealed the opposite pattern: causal emphasis on the agent's skill ($B = 2.64$, 95% CI $[0.86, 4.43]$ vs. Recreation: $B = -0.73$, 95% CI $[-2.47, 1.02]$), $t(df_{K-R} = 1071) = 2.65$, $p = .008$, and de-emphasis of the pill ($B = -2.48$, 95% CI $[-4.26, -0.69]$ vs. Recreation: $B = 1.56$, 95% CI $[-0.18, 3.31]$) selectively in the Competitive condition, $t(df_{K-R} = 1071) = -3.18$, $p = .002$.

2.2.3. Mediation Analyses

Research on causal selection (Icard et al., 2017; see also Alicke, 1992) indicates that moral appraisals shape judgments of causation. Thus, this theory predicts that permissibility judgments will mediate both *contextual* (competition vs. recreation) and *individual* (high vs. low fairness values) differences in causal selection.

We first examine differences in causal selection across contexts employing a mediation analysis. To maximize power for our exploratory analysis, we treated the *skill-pill difference score* (Cronbach's alpha = .91) as our dependent measure. Indeed, permissibility judgments mediated the effect of competitive contexts on causal selection (ACME = -4.91 , 95% CI $[-9.42, -0.40]$, $p = .033$), rendering the direct effect non-significant (ADE = -5.54 , 95% CI $[-14.01, 2.71]$, $p = .19$).

Next, we turn to individual differences. The indirect effects should be strongest among fairness-minded individuals (who revealed the greatest opposition to competitive use). In other words, MFQ-Fairness ought to moderate the indirect effect (the *ab*-path), and not the direct effect (the *c*-path), of context on causal selection. We examined moderation of both the direct and indirect effects through 5000 simulations, and obtained support for the predictions of causal selection: The indirect effect differed across levels of MFQ-Fairness, ACME = 11.68 , 95% CI $[-22.56, -1.82]$, $p = .023$, whereas the direct effect did not, ADE = -0.45 , 95% CI $[-17.92, 16.71]$, $p = .96$ (see also Figure 1C).

2.3.Discussion

What if we assumed that athletes could enhance lawfully? Or that someone could repeatedly benefit from smart pills without slightly widening the divide between the privileged and the underprivileged? Would it *then* be unequivocally permissible for people to use smart pills to do better? Replicating previous studies (Landy et al., 2017; Sattler et al, 2013), we observed generally favorable attitudes toward cognitive enhancement, particularly in recreational (i.e., non-competitive) contexts.

Recreational and competitive users also elicited distinct causal intuitions: Specifically, competitive victory was causally attributed to the enhancement drug in greater measure than was success in recreational contexts--which participants attributed largely to the agent's talent and skill. Was this effect *due* to moralization of competitive use? Given the correlational link between judgments of permissibility and causal selection in our study, we cannot determine this decisively. However, some considerations speak in favor of this interpretation.

Fairness-minded individuals were more likely to draw a moral distinction between competitive and recreational uses, but also to distinguish the causes of success in each context. From the perspective of causal selection, it is easy to explain why this is so: The effect of context on causal selection is largely *indirect* via differences in permissibility judgments. In other words, competitive uses are viewed as less permissible, which in turn shifts causal explanations toward the pill (and/or away from the user's skill); and this indirect effect is strongest among participants with a fairness-oriented worldview. A moderated mediation analysis provided support for this model of the underlying mechanism. Meanwhile, under various alternative causal models (e.g., in which permissibility judgments instead arise from patterns of causal selection), we cannot as readily explain why fairness-minded participants would differ in their causal judgment as well.

Our methods in Experiment 1 did not enable us to separate the effects of abnormal inflation (i.e., a greater effect of the pill) from supersession (i.e., a reduced role of skill) in competitive

contexts. So, in Experiment 2, participants were asked to make independent judgments of the causal role of skills and pills—without imposing a sum score constraint.

3. Experiment 2

In Experiment 2, we conducted a pre-registered replication of the key findings in Experiment 1. We also pursued two further goals by adding a condition in which cognitive enhancement had been normalized. First, do purity and fairness concerns persist when cognitive enhancement becomes the norm? Second, do we see patterns of causal selection arising in the comparison between normalized and rare use of cognitive enhancement?

Manipulating the descriptive normality of cognitive enhancement can help us understand whether purity and fairness-based concerns are intrinsic (i.e., inalienable from the act of cognitive enhancement) or extrinsic (i.e., capable of being surmounted). If as cognitive enhancement proliferates, ethical concerns diminish, this could indicate that the concerns in question are not intrinsically linked to cognitive enhancement. If instead, its normalization does *not* mitigate people's moral concerns, we could conclude that their concerns are intrinsic.

3.1. Methods

3.1.1. Power Analysis and Pre-Registration

To estimate the required sample size for our replication attempt, we conducted a bootstrap power analysis resampling from the data in Experiment 1 with replacement. Based on 5000 resamples, we obtained evidence that 125 participants per cell would suffice to reliably detect: (i) the main effect of Context on permissibility, and (ii) the two-way interactions with MFQ-Fairness and MFQ-Purity ($1 - \beta > .99$), as well as (iii) the causal selection effect (i.e., two-way interaction between Context and Element; $(1 - \beta = .91)$). R code for this bootstrap power analysis is available at: <https://osf.io/45h6v/>.

We registered our predictions prior to data collection at: aspredicted.org/blind.php?x=jj4q26.

In the Results section, we report these analyses in their own subsection titled ‘Pre-Registered Analyses’.

3.1.2. *Participants*

Based on data from Experiment 1, we estimated a 20% exclusion rate due to inattentiveness. In order to reach our target sample size of 500 participants, we invited 625 participants from Prolific.co to take part in Experiment 2.

Participants were eligible to take part if (i) they were native English speakers, (ii) had not participated in Experiment 1, and (iii) passed a simple comprehension check at the beginning of the study³. 624 participants (64% women; Age: *Mdn* = 35) completed the study, and were compensated with £1.00 for approximately 10 minutes of their time (completion [mm:ss]: $Q_1 = 8:14$, *Mdn* = 10:23, $Q_3 = 13:42$). As in Study 1, most participants were non-religious (77%) and college-educated (71%). 81 participants failed the attentiveness check in the MFQ-30, resulting in a final sample of 543 participants.

3.1.3. *Procedure*

In a 2 (Normality: Rare, Frequent) by 2 (Context: Competitive, Recreational) between-subjects design, participants viewed four scenarios in a randomized order. As in Study 1, agents employed cognitive enhancement either in competitive or recreational contexts. This time, however, we also manipulated whether the use of smart pills was widespread or rare. For instance, in the Chess scenario, participants would learn that contestants either “rarely” or “very often” (depending on the condition assignment) “take smart pills to improve their concentration during tournaments, and [the agent] knows that”.

For each scenario, participants judged whether cognitive enhancement was permissible, briefly justified their judgment using an open-ended text, and rated the causal contribution of the

³ 216 participants failed this comprehension check, and were not invited to take part in the study.

PILLS UNDERMINE SKILLS

agent's skill, the smart pill, and other elements. Finally, following the experimental portion of the study, participants completed the 30-item Moral Foundations Questionnaire, and optionally provided demographic information.

3.1.4. Measures

The analyses in Study 2 draw on the following five measures:

1. *Permissibility*: Our primary dependent measure was the moral permissibility of the agent's conduct (i.e., "Do you find [agent's name]'s behavior morally permissible?") on a sliding scale, from -3: "Completely impermissible" to 3: "Completely permissible".
2. *Causal rating - Pill*: the degree of causal influence ascribed to the cognitive enhancement brought on by the pill, from 1: "Not at all" to 7: "Completely".
3. *Causal rating - Skill*: the degree of causal influence ascribed to the agent's ability, talent, dedication, and effort, from 1: "Not at all" to 7: "Completely".
4. *Fairness values*: the six-item average (Cronbach's $\alpha = .63$) of participants' reliance on the moral foundation of fairness.
5. *Purity values*: the six-item average (Cronbach's $\alpha = .75$) of participants' reliance on the moral foundation of purity or sanctity.

3.1.5. Qualitative Coding

After inspection of participants' open-ended justifications, we agreed upon 25 categories, and attained a Cohen's $\kappa = .68$ in an initial attempt to code a subset of the justifications using the proposed criteria. Discussion of the coding exercise led to a revision of the coding criteria (see Table 6), based upon a final set of 25 categories.

Two coders (who were blind to experimental condition) coded each of the first-trial justifications ($n = 543$) using the revised criteria and obtained good intercoder reliability, Cohen's $\kappa = .80$. A third coder resolved the remaining disagreements between the first two coders by applying the tie-breaker method.

3.2.Results

Manipulation checks confirmed that: (1) Agents were more often seen as competing in the Competitive condition (87%, 95% CI [82%, 90%]) than in the Recreational condition (14%, 95% CI [10%, 19%]) , $\chi^2(1, N = 541) = 284.42, p < .001$, *Cramer's V* = .72. (2) Cognitive enhancement was seen as more common in the Frequent condition ($M = 6.57, SD = 0.91$) than in the Rare condition ($M = 4.17, SD = 2.41$), $t(df_{\text{Welch}} = 353) = 15.40, p < .001$, *Cohen's d* = 1.32. Descriptive statistics are reported in Table 3.

Table 3.

Condition Means and 95% Confidence Intervals: Experiment 2.

	Competitive		Recreational	
	Rare	Frequent	Rare	Frequent
<i>Permissibility</i>	0.49 [0.16, 0.83]	1.34 [0.98, 1.69]	1.32 [0.98, 1.67]	1.29 [0.95, 1.62]
<i>Skill</i>	5.46 [5.29, 5.62]	5.71 [5.54, 5.89]	5.37 [5.19, 5.54]	5.40 [5.24, 5.57]
<i>Pill</i>	4.20 [4.04, 4.37]	4.12 [3.94, 4.30]	4.13 [4.13, 4.37]	3.90 [3.74, 4.07]
<i>Other</i>	3.31 [3.14, 3.47]	3.11 [2.93, 3.29]	2.91 [2.74, 3.08]	3.0 [2.83, 3.17]

3.2.1. Replication: Pre-Registered Analyses

Experimental Effects. Replicating our primary result in Study 1, we observed a significant effect of context on judgments of permissibility, $F(1, df_{K-R} = 273) = 20.31, p < .001$. i.e., in the Rare condition, recreational use ($M = 1.32, 95\% \text{ CI } [0.90, 1.74]$) was seen as more permissible than competitive use ($M = 0.49, 95\% \text{ CI } [0.08, 0.91]$), $B = 0.83, 95\% \text{ CI } [0.47, 1.19]$, $t(df_{K-R} = 273) = 4.51, p < .001$.

Turning to judgments of causal relevance, a two-way ANOVA revealed a main effect of context, $F(1, df_{K-R} = 273) = 5.72, p = .017$, element, $F(1, df_{K-R} = 3018) = 963.9, p < .001$, and a two-way interaction between context and element, $F(1, df_{K-R} = 3018) = 6.04, p = .002$. However, the two-

way interaction did not reflect a significant difference in judgments of the agent's causal relevance, $B = 0.09$, 95% CI [-0.11, 0.28], $t(df_{K-R} = 273) = 0.88$, $p = .38$, nor of the pill's causal relevance, $B = 0.08$, 95% CI [-0.12, 0.27], $t(df_{K-R} = 273) = 0.77$, $p = .44$. Rather, unexpectedly, a significant difference for judgments of 'other' causes was found. This indicates that other causal contributors played a greater role in competitive contexts than in recreational contexts, $B = 0.40$, 95% CI [0.20, 0.59], $t(df_{K-R} = 273) = 4.02$, $p < .001$.

Table 4.

Moderation of Permissibility Judgments by Moral Foundations: Experiments 1 and 2.

	Exp.	Model F	Model P	Model F & P
<i>Context</i>	1	$F(1, 239) = 6.37, p = .012$	$F(1, 239) = 6.44, p = .012$	$F(1, 237) = 7.01, p = .009$
	2	$F(1, 271) = 21.6, p < .001$	$F(1, 271) = 20.3, p < .001$	$F(1, 269) = 21.3, p < .001$
<i>Fairness_{MFQ}</i>	1	$F(1, 239) = 1.57, p = .21$	-	$F(1, 237) = 0.69, p = .41$
	2	$F(1, 271) = 1.90, p = .21$	-	$F(1, 269) = 0.96, p = .33$
<i>Purity_{MFQ}</i>	1		$F(1, 239) = 3.96, p = .048$	$F(1, 237) = 3.79, p = .053$
	2	-	$F(1, 271) = 5.04, p = .026$	$F(1, 269) = 3.56, p = .060$
<i>Context×Fairness_{MFQ}</i>	1	$F(1, 239) = 6.10, p = .014$	-	$F(1, 237) = 9.75, p = .002$
	2	$F(1, 271) = 7.90, p = .005$	-	$F(1, 269) = 7.00, p = .009$
<i>Context×Purity_{MFQ}</i>	1	-	$F(1, 239) = 7.15, p = .008$	$F(1, 237) = 10.11, p = .002$
	2	-	$F(1, 271) = 0.30, p = .58$	$F(1, 269) = 0.00, p = .95$

Moderation Analyses. A model comparison indicated that adding MFQ-Fairness (see Model F in Table 4) improved the fit of the simple model (i.e., Condition only: AIC = 3659.7), $\chi^2(df = 2) = 9.74$, $p = .008$. Model F revealed a two-way interaction between condition and MFQ-Fairness (as in Study 1): Specifically, fairness values underlay opposition to competitive use ($B = -0.48$, 95% CI [-

PILLS UNDERMINE SKILLS

0.80, -0.15]), but not recreational use ($B = 0.22$, 95% CI [-0.15, 0.59]), $B = -0.70$, 95% CI [-1.19, -0.21], $t(df_{K-R} = 271) = -2.81$, $p = .005$ (see Figure 2A).

Entering MFQ-Purity also improved model fit, though only at the marginal significance level, $\chi^2(df = 2) = 5.35$, $p = .069$. In contrast to Study 1, however, MFQ-Purity values did not *interact* with condition, $F(1, df_{K-R} = 271) = 0.30$, $p = .58$, but rather exerted a main effect, $F(1, df_{K-R} = 271) = 5.04$, $p = .026$. Higher scores on the Purity subscale were linked to reduced permissibility of cognitive enhancement across contexts, $B = -0.20$, 95% CI [-0.38, -0.03], $t(df_{K-R} = 272) = -2.25$, $p = .025$.

Next, we turn to moderation analyses of the causal ascriptions. As with permissibility judgments, entering MFQ-Fairness, $\chi^2(df = 6) = 12.57$, $p = .050$, or MFQ-Purity, $\chi^2(df = 6) = 18.62$, $p = .005$, improved model fit. As shown in Table 5, no main effects of MFQ-Fairness or MFQ-Purity emerged, or interactions with context. Two-way interactions with causal element emerged, which were qualified by three-way interactions with context--i.e., for both MFQ-Fairness and MFQ-Purity.

Simple slopes analyses revealed that purity-minded individuals tended to ascribe (i) a stronger causal role to the Pill, $B = 0.14$, 95% CI [0.00, 0.29], $t(df_{K-R} = 661) = 1.98$, $p = .048$, and (ii) a weaker causal role to Skills, $B = -0.16$, 95% CI [-0.30, -0.01], $t(df_{K-R} = 661) = -2.17$, $p = .031$, *selectively* in the Recreation condition.

In turn, fairness-minded individuals tended to ascribe (i) a stronger role to Skills, $B = 0.26$, 95% CI [0.06, 0.46], $t(df_{K-R} = 661) = 2.51$, $p = .012$, but (ii) not the Pill, $B = 0.03$, 95% CI [-0.17, 0.23], $t(df_{K-R} = 661) = 0.33$, $p = .74$, in the Recreation condition (see Figure 2B). No significant simple slopes emerged for Other causes ($ps > .15$), or in the Competition condition (all $ps > .25$).

Table 5.

Moderation of Causal Selection by Moral Foundations.

Model F	Model P	Model F & P
---------	---------	-------------

PILLS UNDERMINE SKILLS

<i>Context</i>	$F(1, 271) = 5.85, p = .016$	$F(1, 271) = 5.65, p = .018$	$F(1, 269) = 5.75, p = .017$
<i>Element</i>	$F(2, 3014) = 966.5, p < .001$	$F(1, 3014) = 968.4, p < .001$	$F(2, 3010) = 971.6, p < .001$
<i>Fairness_{MFQ}</i>	$F(1, 271) = 0.39, p = .53$	-	$F(1, 269) = 0.25, p = .62$
<i>Purity_{MFQ}</i>	-	$F(1, 271) = 0.61, p = .43$	$F(1, 269) = 0.50, p = .48$
<i>Context×Element</i>	$F(2, 3014) = 5.58, p = .004$	$F(2, 3014) = 6.08, p = .002$	$F(2, 3010) = 5.62, p = .004$
<i>Context×Fairness_{MFQ}</i>	$F(1, 271) = 0.09, p = .77$	-	$F(1, 269) = 0.12, p = .73$
<i>Context×Purity_{MFQ}</i>	-	$F(1, 271) = 0.00, p = .96$	$F(1, 269) = 0.00, p = .95$
<i>Element×Fairness_{MFQ}</i>	$F(2, 3014) = 3.41, p = .033$	-	$F(2, 3010) = 3.52, p = .030$
<i>Element×Purity_{MFQ}</i>	-	$F(2, 3014) = 4.09, p = .017$	$F(2, 3010) = 4.58, p = .010$
<i>Context×Element ×Fairness_{MFQ}</i>	$F(2, 3014) = 2.63, p = .072$	-	$F(2, 3010) = 3.52, p = .030$
<i>Context×Element ×Purity_{MFQ}</i>	-	$F(2, 3010) = 4.92, p = .007$	$F(2, 3010) = 5.42, p = .004$

3.2.2. Replication: Exploratory Analyses.

Mediation Analyses. We found robust contextual differences in permissibility, but few corresponding differences in causal selection. We reasoned that this could perhaps be due to *suppression* (Tzelgov & Henik, 1991) by a direct effect of context: i.e., competitors (and particularly victorious competitors in the Competition condition) could reasonably be imputed more talent and ability than hobbyists (in the Recreation condition).

So, we sought to (i) replicate contextual differences in causal selection employing a mediation analysis, while (ii) ascertaining whether the absence of a total effect was the result of suppression. Indeed, a mediation analysis with 5000 quasi-Bayesian simulations revealed a positive direct effect of competitive contexts on the causal role of Skill, $B = 0.26$, 95% CI [0.03, 0.48], $p = .023$, and replicated the negative indirect effect via permissibility (previously observed in Experiment 1), $B = -0.16$, 95% CI [-0.23, -0.09], $p < .001$. An indirect effect on the causal role of Pill

PILLS UNDERMINE SKILLS

was also observed, $B = 0.10$, 95% CI [0.05, 0.17], $p < .001$, but no direct effect, $B = -0.02$, 95% CI [-0.34, 0.29], $p = .90$.

In Experiment 1, the indirect effect was strongest among fairness-minded individuals who revealed the strongest opposition to competitive use: MFQ-Fairness moderated the indirect effect (specifically, the a -path), and not the direct effect (the c -path), of context on causal selection. Experiment 2 afforded the possibility to replicate that effect, while also disambiguating whether it was driven primarily by supersession (i.e., the perceived absence of skill) or inflation (i.e., the perceived efficacy of pills)?

We examined moderation of both the direct and indirect effects through 5000 simulations. As in Experiment 1, the direct effects were not moderated by MFQ-Fairness (skill: $B = -0.10$, 95% CI [-0.56, 0.35], $p = .66$; pill: $B = -0.16$, 95% CI [-0.81, 0.50], $p = .64$). The indirect effect on Skill judgments was moderated by MFQ-Fairness, $B = -0.26$, 95% CI [-0.45, -0.10], $p = .003$, whereas the effect on Pill judgments was not, $B = 0.16$, 95% CI [-0.03, 0.37], $p = .10$ (see Figure 2C).

Figure 2. (A) Permissibility and (B) causal judgments in competitive and recreational contexts by MFQ Fairness: Experiment 2. (C) Moderated mediation model of causal judgments via permissibility, revealing amplification of the indirect effect on skill ratings by MFQ Fairness.

3.2.3. Extension: Exploratory Analyses

Experimental Effects. A two-way ANOVA revealed main effects of context, $F(1, df_{K-R} = 539) = 9.11, p = .003$, normality, $F(1, df_{K-R} = 539) = 8.83, p = .003$, as well as a context $\times$ normality interaction, $F(1, df_{K-R} = 539) = 11.19, p < .001$ (see Figure 3). Probing the two-way interaction revealed that normalization had no effect on the permissibility of recreational use, $B = -0.04$, 95% CI [-0.39, 0.32], $t(df_{K-R} = 539) = -0.20, p = .84$, but promoted approval of competitive use, $B = 0.84$, 95% CI [0.47, 1.21], $t(df_{K-R} = 539) = 4.47, p < .001$.

Figure 3. Permissibility of cognitive enhancement in competitive (top) and recreational (bottom) contexts by normality (common; uncommon). Justifications are overlaid at their mean permissibility value, and jittered vertically to aid visualization. Descriptions for each category label can be found in Table 6.

Next, we examined the effect of normalization on causal ascriptions in a three-way ANOVA. We observed no main effect of normality, $F(1, df_{K-R} = 539) = 0.15, p = .70$, or normality $\times$ context interaction, $F(1, df_{K-R} = 539) = 0.05, p = .82$. We did, however, find a normality $\times$ element interaction,

$F(2, df_{K-R} = 5962) = 8.34, p < .001$, which was qualified by a three-way interaction with context, $F(2, df_{K-R} = 5962) = 6.89, p = .001$.

So, we explored the simple effects of prevalence on causal attributions in each context separately: Normalization reduced the causal role of the Pill, particularly in the Recreation condition, $B = -0.22$, 95% CI $[-0.42, -0.03]$, $t(df_{K-R} = 1347) = -2.31, p = .021$ (vs. Competition: $B = -0.08$, 95% CI $[-0.28, 0.11]$, $t(df_{K-R} = 1347) = -0.83, p = .41$); and also increased the causal role of Skill, particularly in the Competition condition, $B = 0.26$, 95% CI $[0.06, 0.46]$, $t(df_{K-R} = 1347) = 2.58, p = .010$ (vs. Recreation: $B = 0.03$, 95% CI $[-0.16, 0.23]$, $t(df_{K-R} = 1347) = 0.35, p = .73$).

Moderation Analyses. Replication analyses previously showed that MFQ-Fairness predicts opposition in the Competition condition, and MFQ-Purity predicts opposition across conditions--when smart pills were described as uncommon. Did normalization moderate these effects or not? Indeed, the association between MFQ-Fairness and opposition toward competitive use was moderated by normalization, $B = 0.50$, 95% CI $[-0.01, 1.00]$, $t(df_{K-R} = 535) = 1.94, p = .054$. Namely, the simple effect of MFQ-Fairness observed in the Uncommon condition ($B = -0.48$, 95% CI $[-0.81, -0.15]$) was absent in the Common condition ($B = 0.02$, 95% CI $[-0.37, 0.40]$).

Meanwhile, the marginal effect of MFQ-Purity (i.e., collapsing across contexts) was unaffected by normalization, $B = -0.15$, 95% CI $[0.47, 1.21]$, $t(df_{K-R} = 535) = -1.18, p = .24$: i.e., purity-based opposition arose whether enhancement was rare ($B = -0.20$, 95% CI $[-0.38, -0.02]$) or common ($B = -0.35$, 95% CI $[-0.53, -0.17]$). If anything, the association with MFQ-Purity appeared to *strengthen*—and not weaken—via normalization.

3.2.4. Open-Ended Justifications

The most frequent justifications for participants' judgments are displayed in Table 6 (see also Figure 3). Many justifications cited reasons for exculpation: e.g., that cognitive enhancement is allowed (*rule_f*: e.g., "If they are not illegal, I don't see a problem with using them"; 26.7%), useful (*productive*: e.g., "If it helps him to concentrate, then it's OK"; 19.9%), widely used (*common*:

PILLS UNDERMINE SKILLS

“Everyone else does it, so should Steve”; 14.2%), harmless (*noharm*: e.g., “There is no harm to him or anyone else”; 13.4%), not for personal gain (*nocomp*: e.g., “Alex is playing for fun against a computer”; 11.8%), and widely accessible (*easy*: e.g., “They are equally available to everyone”; 8.7%). Only the sixth most frequent category supported disapproval: namely, that cognitive enhancement provides the user with an unfair advantage (*unfair*: e.g., “John will have an unfair advantage when taking the exam compared to other students”; 8.3%).

Table 6.

Justification Categories: Reliability and Frequency.

Label	Criterion	κ	Competitive		Recreational		Agg. %
			Unc. (n = 150)	Com. (n = 119)	Unc. (n = 133)	Com. (n = 146)	
Reasons For							
rule_f	There is no rule that prohibits CE; CE is allowed by law and/or community norms.	.91	51	35	29	30	26.70%
productive	CE is useful; it helps the agent achieve their goals, surmount difficulties, or improve their capacity.	.73	30	9	28	41	19.90%
common	Most people use CE; CE is (statistically) expected from someone in the agent’s position.	.76	2	47	3	25	14.20%
noharm	It is harmless (e.g., no side effects) to the agent; does not negatively affect others.	.95	6	6	28	33	13.40%
nocomp	CE is not used in a competitive setting, i.e., in which the agent’s success would deprive others of a reward	.77	7	0	31	26	11.80%
easy	Most people have access to CE and can use CE if they want to.	.79	23	11	4	9	8.70%
level	Since others use CE, the agent is forced to use CE to ‘level the playing field’.	.84	0	31	0	5	6.60%
freedom	The agent is free to do as they please with their own body; it’s a personal choice.	.79	9	3	12	8	5.90%
other	The agent acted for altruistic reasons and/or benefitted others.	.88	2	0	15	13	5.50%
Reasons Against							
unfair	CE gives the agent an unfair advantage.	.90	39	3	2	1	8.30%
uncommon	Most people do not use CE; CE is (statistically) infrequent among people in the agent’s position.	.67	19	0	10	0	5.30%

PILLS UNDERMINE SKILLS

dumb	Moral dumbfounding; judgment is restated without justification; reports inability to justify answer.	.70	9	3	6	6	4.40%
unreal	Success does not really count; the outcome did not stem from the agent's natural ability; in this context, people ought to succeed without CE.	.57	10	4	3	4	3.90%
badprac	Compares CE to prototypical misconduct: e.g., cheating, lying, doping, stealing.	.91	4	8	4	4	3.70%

Note. CE: cognitive enhancement; Unc.: Uncommon; Com.: Common; Agg.: aggregate. Categories with fewer than 20 entries are omitted.

As such, many justifications alluded to stipulations in the introduction, for instance, to the conditions of legality and accessibility (i.e., [*rule_f*] and [*easy*]), and were associated with permissive judgments (*rule_f*: $z = 3.24$, $p = .001$; *easy*: $z = 4.74$, $p < .001$). Other justifications demonstrated participants' awareness of our experimental manipulations (e.g., [*nocomp*] or [*common*]), and were also tied to judgments of permissibility (*nocomp*: $z = 2.06$, $p = .039$; *common*: $z = 3.50$, $p < .001$). Finally, other justifications attested to participants' consequentialist reasoning—e.g., when citing the absence of detrimental outcomes (i.e., *noharm*: $z = 3.29$, $p = .001$); or the presence of beneficial outcomes (i.e., *productive*: $z = 4.17$, $p < .001$).

Reasons for disapproval were less frequent and more diverse, ranging from perceptions of inauthenticity (3.9%), irrationality (2.0%), and potential harm (2.2%), to concerns about abnormality (5.3%) or the nature of competition (1.7%), and analogies or similes involving prototypically moralized conduct (3.7%). As previously noted, the concern about gaining an 'unfair advantage' over others did emerge relatively frequently, (i) when considering abnormal and competitive use, and (ii) accompanied attitudes of disapproval, $z = -5.90$, $p < .001$.

3.3. Discussion

Contextual differences in the permissibility of cognitive enhancement were successfully replicated in Experiment 2. In line with our pre-registered prediction, competitive uses of cognitive enhancement were deemed worse than recreational uses. Furthermore, we once again found that this moral distinction was tied to people's individual concern with the moral foundation of fairness.

PILLS UNDERMINE SKILLS

Experiment 2 also examined the effect of normalization on cognitive enhancement. When enhancement was described as common in each context, competitive uses were considered as permissible as recreational uses. Further analyses, drawing on participants' moral foundations as well as their open-ended justifications, revealed that normalization eliminated fairness-based concerns. In contrast, normalization had no effect on purity-based disapproval.

Patterns of causal selection were somewhat more unclear—and only partially confirmed the findings of Experiment 1. However, subsequent mediation analyses helped to interpret our initial results: When treating causal ratings as independent, we obtained evidence of mutual suppression between the direct and indirect effects of competition on causal selection. Specifically, we replicated the negative indirect effect on skill via permissibility (i.e., pointing toward causal supersession), but this time uncovered a direct effect as well (such that participants ascribed a *greater* causal role to skills in competitive victory than in recreational success, owing perhaps to competitors' heightened skill level). Meanwhile, the indirect effect indicated that participants ascribed a *reduced* causal role to skills, via their moral disapproval of competitive uses. Importantly, the indirect effect was magnified by individual emphases on the moral foundation of fairness—helping to disambiguate the direction of causation between causal and moral judgments.

The examination of open-ended justifications provided convergent insight into people's reasoning about cognitive enhancement. Many participants spontaneously cited the extrinsic criteria that prefaced the experiment (e.g., accessibility or legality) as the bases for their permissive views. Others appeared to engage in consequentialist thinking, emphasizing the benefits of enhancement and/or the absence of harm to others (see also Viciano et al., 2021). Lastly, fairness-related grounds for opposition were also articulated in participants' justifications, though overwhelmingly for abnormal and competitive uses—mimicking the results we obtained in our quantitative analyses. Simply normalizing enhancement, or referring to their use in non-competitive contexts, sufficed to virtually eliminate this moral objection.

4. General Discussion

Previous survey research unveiled evidence that concerns about unfairness underlie disapproval in the general public (Faber et al., 2016; Landy et al., 2017; Sattler et al., 2013; Scheske & Schnall, 2012; Schelle et al., 2014). In two experiments, we asked participants to imagine hypothetical circumstances in which extrinsic concerns relating to economic inequality and illegality were screened off, and investigated whether people would continue to oppose cognitive enhancement, suggesting further grounds for condemnation, or not.

Participants generally supported cognitive enhancement in both recreational and competitive contexts, and across a range of activities such as mental sports, academic study, work or art. Furthermore, when justifying their permissive attitudes, they alluded to extrinsic factors, such as the pill's legality, its accessibility to others and its prevalent use, and even its basic utility.

Our studies, however, documented a clear exception to this general pattern: Describing cognitive enhancement as uncommon reduced approval of competitive (but not recreational) uses. Analyses of supplementary measures, moral foundations, and participants' open-ended justifications demonstrated that this reduced approval was linked to the semblance of an unfair advantage.

In line with a growing literature on causal selection (Alicke, 1992; Icard et al., 2017; Kominsky et al. 2015), judgments of the enhanced user's skill aligned with participants' moral attitudes. Participants who held permissive attitudes were more likely to causally attribute success to agents' skill and effort, while participants who held restrictive attitudes were more likely to view the pill as causally responsible. This association resulted in stronger denial of competitive users' talent and ability, particularly among fairness-minded individuals.

The moral foundation of purity, comprising norms related to spiritual sanctity and bodily propriety, and which appeals predominantly to political conservatives (Graham et al., 2009), also predicted attitudes toward enhancement. Purity-minded individuals were more likely to condemn enhancement users, regardless of whether cognitive enhancement was normal or rare. This

categorical opposition may elucidate the origin of conservative bioethicists' (e.g., Kass, 2003) attitudes toward human enhancement: i.e., in self-directed norms regulating the proper care of one's own body (see also Koverola et al., 2021). Finally, whereas explicit reasoning about interpersonal concerns and the unjust treatment of others accompanied fairness-based opposition, our qualitative analyses data did not reveal a cogent, purity-based rationale—which could be interpreted as evidence that purity-based opposition is not guided by moral reasoning to the same degree (Mihailov, 2016).

4.1.Limitations and Future Directions

Prior work strongly suggests that moral norms shape causal judgments (Alicke, 1992; Icard et al., 2017; Kominsky et al. 2015; Rodriguez-Arias et al., 2020). Nonetheless, because causal judgments and moral judgments were measured cross-sectionally in our studies, we cannot ascertain the direction of causation between them. Causation could even be bidirectional: such that moral condemnation arises partly from the belief that pills are causally efficacious, while also independently promoting that causal judgment. Relatedly, the pattern of causal selection effects wavered across exploratory and confirmatory studies—and therefore should be interpreted with caution.

Our studies treated competition and recreation as discrete categories defined by the material versus social nature of rewards. Yet, it may be more illuminating to conceive of competition and recreation as describing continua along which properties of the reward, such as their *magnitude* and/or *distribution*, can vary. In competitive success, agents gain sizable resources, and derivatively acquire social status and wellbeing (Elster, 1991; Nozick, 1974). As such, fairness-based opposition may respond to variation in the magnitude of rewards, or in their distribution (e.g., zero-sum vs. non zero-sum; see Dodge et al., 2012). Future work could therefore expand upon the present findings by conceptualizing competitiveness as a continuous plane along which both the magnitude of rewards and their distribution vary.

4.2. Implications for Ethical Analysis

Evidence of folk morality can play a central role in ethical theory (DePaul, 2005; Kagan, 2001), and also guide practice and policy (Earp et al., 2020; Rawls, 1951, 2009). On the first, deontological theories emphasize the import of *universalizability*: if it is wrong (/right) for everyone to x , then it is wrong (/right) for an individual to x . However, in our studies, moral judgments of cognitive enhancement defied this moral principle. Whether it was permissible for everyone to enhance (i.e., a property unaffected by the prevalence of enhancement) did not determine whether it would be permissible for an individual to enhance. Rather, at least when considering competitive activities, participants employed a different principle—a principle of “normalization”: if almost no one (/everyone) x s, then it is wrong (/right) for an individual to x . This principle is not as visibly articulated in existing moral theory, and could deserve closer attention going forward.

Turning to normative aspects, consultative approaches to bioethics often leverage broad public opposition as grounds for legal prohibition, and widespread approval as grounds for deregulation. With regard to cognitive enhancement, cumulative evidence suggests that opposition is largely driven by downstream concerns about injustice or illegality, and is sporadic once these concerns are set aside. A *parsimonious* approach to normative inference (Earp, Lewis, Dranseika & Hannikainen, 2021) would first hypothesize that this pattern of moral intuitions may afford normative insight, and then proceed by examining further evidence to falsify this hypothesis.

Finally, according to authorship/authenticity objections, enhancement taints the agent’s authorship over, and causal merit for, their success (Lenk, 2007). Our evidence of causal supersession on the agent’s skill may help to elucidate the psychological basis of these objections: Namely, perceptions of inauthenticity may stem from prior fairness-based disapproval of cognitive enhancement—and not in fact constitute independent grounds for disapproval. This empirical portrait of authenticity objections may appear unflattering and somewhat threaten their normative significance (Kumar & May, 2019).

4.3. Conclusion

People's attitudes toward enhancement are largely tied to extrinsic factors, such as its legality, accessibility and utility. Enhancement in competition nevertheless appears unfair to many, particularly when smart pills use is uncommon. Furthermore, in a practical demonstration of causal supersession, fairness-based disapproval also undermines competitors' perceived merit and ability—an effect which may shed light on the psychological basis of authenticity concerns. The proliferation of cognitive enhancement will perhaps alleviate these concerns about its unfairness, but have little to no effect on purity-based disapproval—which emerges even toward recreational use, and when enhancement is the norm.

Acknowledgments

We wish to thank Brian Earp, Joshua Knobe, and Julian Savulescu for helpful comments on previous drafts of this manuscript. We are also grateful to the attendees at the 2nd *Meeting of the Spanish Experimental Philosophy Association* and the 2019 *Yale-Oxford BioXphi Summit* for feedback on presentations of these findings.

References

- Alicke, M.D. (1992). Culpable causation. *Journal of Personality and Social Psychology*, 63(3), 368.
- Bard, I., G. Gaskell, A. Allansdottir, R.V. da Cunha, P. Eduard, J. Hampel, E. Hildt, C., Hofmaier, N. Kronberger, S. Laursen, & A. Meijknecht. (2018). Bottom up ethics-neuroenhancement in education and employment. *Neuroethics*, 11(3), 309-322.
- Brühl A.B., C. d'Angelo, & B.J. Sahakian. (2019). Neuroethical issues in cognitive enhancement: Modafinil as the example of a workplace drug? *Brain and Neuroscience Advances*, 3.
- Cole-Turner, R. (2000). Do means matter?. In *Enhancing Human Traits: Ethical and Social Implications*, ed. E. Parens, 151–161. Washington, DC: Georgetown University Press.
- Conrad, E.C., S. Humphries, & A. Chatterjee. (2019). Attitudes toward cognitive enhancement: the role of metaphor and context. *AJOB neuroscience*, 10:1, 35-47.
- Dinh, C. T., Humphries, S., & Chatterjee, A. (2020). Public opinion on cognitive enhancement varies across different situations. *AJOB neuroscience* 11(4):224-237.
- Dodge, T., Williams, K. J., Marzell, M., & Turrisi, R. (2012). Judging cheaters: is substance misuse viewed similarly in the athletic and academic domains?. *Psychology of Addictive Behaviors*, 26(3), 678.
- Douglas, T. (2007). Enhancement in sport, and enhancement outside sport. *Studies in Ethics, Law, and Technology*, 1, 1–11.
- DePaul, R. M. (2005). Intuitions in Moral Inquiry. In *Oxford Handbook of Ethical Theory*, ed. D. Copp, Oxford: Oxford University Press.
- Earp, B. D., Demaree-Cotton, J., Dunn, M., Dranseika, V., Everett, J. A., Feltz, A., ... & Tobia, K. (2020). Experimental philosophical bioethics. *AJOB Empirical Bioethics*, 11(1), 30-33.
- Earp, B., Lewis, J., Dranseika, V., & Hannikainen, I. R. (2021). Experimental philosophical bioethics and normative inference. *Theoretical Medicine and Bioethics*, forthcoming.

- Elliott C. (2003). *Better than Well: American Medicine Meets the American Dream*. New York, NY: Norton 2003.
- Elster, J. (1991). Envy in social life. In *Strategy and Choice*, 49-82, ed. R. Zeckhauser. Cambridge, MA: The MIT Press.
- Faber, N.S., J. Savulescu, & T. Douglas. (2016). Why is cognitive enhancement deemed unacceptable? The role of fairness, deservingness, and hollow achievements. *Frontiers in Psychology*, 7, 232.
- Farah, M.J. (2015). The unknowns of cognitive enhancement. *Science* 350(6259), 379-380.
- Feinberg M., & R. Willer. (2013). The moral roots of environmental attitudes. *Psychological science* 24(1): 56-62.
- Fitz, N. S., R. Nadler, P. Manogaran, E.W.J. Chong, & P.B. Reiner. (2014). Public attitudes toward cognitive enhancement. *Neuroethics*, 7(2), 173-188.
- Forlini, C., Schildmann, J., Roser, P., Beranek, R., & Vollmann, J. (2015). Knowledge, experiences and views of German university students toward neuroenhancement: an empirical-ethical analysis. *Neuroethics*, 8(2), 83-92.
- Fukuyama, F. (2002). *Our Posthuman Future: Consequences of the Biotechnology Revolution*. New York: Profile Books.
- Graham, J., J. Haidt, & B.A. Nosek. (2009). Liberals and conservatives rely on different sets of moral foundations. *Journal of Personality and Social Psychology*, 96(5), 1029.
- Icard, T.F., J.F. Kominsky, & J. Knobe. (2017). Normality and actual causal strength. *Cognition* 161, 80-93.
- Kagan, S. (2001). Thinking about cases. *Social Philosophy and Policy*, 18(2), 44-63.
- Kass, L.R. (2003). Ageless bodies, happy souls. *New Atlantis* 1, 9-28.
- Kenward, M. G., & Roger, J. H. (1997). Small sample inference for fixed effects from restricted maximum likelihood. *Biometrics*, 983-997.

- Kluckhohn, C. (1944). Navaho witchcraft. Papers. Peabody Museum, Harvard University.
- Kominsky, J.F., J. Phillips, T. Gerstenberg, D. Lagnado, & Knobe, J. (2015). Causal superseding. *Cognition* 137, 196-209.
- Koverola, M., Kunnari, A., Drosinou, M., Palomäki, J., Hannikainen, I.R., Jirout Košová, M., Kopecký, R., Sundvall, J., & Laakasuo, M. (2021) Non-human superhumans: Understanding moral disapproval of neurotechnological enhancement, in prep.
- Landy, J. F., Walco, D. K., & Bartels, D. M. (2017). What's wrong with using steroids? Exploring whether and why people oppose the use of performance enhancing drugs. *Journal of personality and social psychology*, 113(3), 377.
- Lenk, C. (2007). Is enhancement in sport really unfair? Arguments on the concept of competition and equality of opportunities. *Sports, Ethics and Philosophy*, 1(2), 218-228.
- Linssen A.M.W., E.F.P.M. Vuurman, A. Sambeth, and W.J. Riedel. (2012). Methylphenidate produces selective enhancement of declarative memory consolidation in healthy volunteers. *Psychopharmacology*, 221(4), 611–619.
- Mehta M.A., A.M. Owen, B.J. Sahakian, N. Mavaddat, J.D. Pickard, and T.W. Robbins. (2000). Methylphenidate enhances working memory by modulating discrete frontal and parietal lobe regions in the human brain. *The Journal of Neuroscience* 20(6), 1–6.
- Mihailov, E. (2016). Is deontology a moral confabulation?. *Neuroethics* 9(1), 1-13.
- Mihailov, E., & A. Dragomir. (2018). Will cognitive enhancement create post-persons? The use (lessness) of induction in determining the likelihood of moral status enhancement. *Bioethics*, 32(5), 308-313.
- Mihailov, E., & J. Savulescu. (2018). Social policy and cognitive enhancement: Lessons from chess. *Neuroethics*, 11(2), 115-127.
- Nicholson P.J., G. Mayho, & C. Sharp. (2015). *Cognitive enhancing drugs and the workplace*. London: BMA.

- Nozick, R. (1974). *Anarchy, State, and Utopia*. New York: Basic Books.
- Pulfrey, C., & F. Butera. (2013). Why neoliberal values of self-enhancement lead to cheating in higher education: A motivational account. *Psychological Science* 24(11), 2153-2162.
- Racine, E., & C. Forlini. (2010). Cognitive enhancement, lifestyle choice or misuse of prescription drugs?. *Neuroethics* 3(1), 1–4.
- Randall, D.C., J.M. Shneerson, & S.E. File. (2005). Cognitive effects of modafinil in student volunteers may depend on IQ. *Pharmacology Biochemistry and Behavior*, 82(1), 133–139.
- Rawls J. (1951). Outline of a decision procedure for ethics. *The Philosophical Review* 60(2), 177-197.
- Rawls, J. (2009). *A Theory of Justice*. Harvard: Harvard University Press.
- Rose, S. (2006). *The Future of the Brain: The Promise and Perils of Tomorrow's Neuroscience*. Oxford: Oxford University Press.
- Richard, F. D., Bond Jr, C. F., & Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Review of General Psychology*, 7(4), 331-363.
- Riis, J., Simmons, J. P., & Goodwin, G. P. (2008). Preferences for enhancement pharmaceuticals: The reluctance to enhance fundamental traits. *Journal of Consumer Research* 35(3): 495-508.
- Rodríguez-Arias, D., Rodríguez López, B., Monasterio-Astobiza, A., & Hannikainen, I. R. (2020). How do people use ‘killing’, ‘letting die’ and related bioethical concepts? Contrasting descriptive and normative hypotheses. *Bioethics*, 34(5), 509-518.
- Sahakian B.J., A.B. Bruhl, J. Cook, C. Killikelly, G. Savulich, T. Piercy, & P.B. Jones. (2015). The impact of neuroscience on society: cognitive enhancement in neuropsychiatric disorders and in healthy people. *Philosophical Transactions of the Royal Society* B370(1677):20140214.
- Sandel, M. (2007). *The Case Against Perfection: Ethics in the Age of Genetic Engineering*. Cambridge, MA: Harvard University Press.

- Sattler, S., Forlini, C., Racine, É., & Sauer, C. (2013). Impact of contextual factors and substance characteristics on perspectives toward cognitive enhancement. *PLoS One* 8(8): e71452.
- Savulescu J. (2006). Justice, fairness, and enhancement. *Annals of the New York Academy of Sciences* 1093(1):321-338.
- Schelle, K.J., N. Faulmüller, L. Caviola, & M. Hewstone. (2014). Attitudes towards pharmacological cognitive enhancement – a review. *Frontiers in Systems Neuroscience* 8:53.
- Scheske, C., & Schnall, S. (2012). The ethics of “smart drugs”: Moral judgments about healthy people's use of cognitive-enhancing drugs. *Basic and applied social psychology* 34(6): 508-515.
- Schermer, M. (2008). On the argument that enhancement is “cheating”. *Journal of Medical Ethics* 34: 85–88.
- Turner, D.C., T.W. Robbins, L. Clark, A.R. Aron, J. Dowson, & B.J. Sahakian. (2003). Cognitive enhancing effects of modafinil in healthy volunteers. *Psychopharmacology* 165(3):260–269.
- Van de Vyver, J., D.M. Houston, D. Abrams, and M. Vasiljevic. (2016). Boosting belligerence: How the July 7, 2005, London bombings affected liberals’ moral foundations and prejudice. *Psychological science* 27(2): 169-177.
- Viciano, H., Hannikainen, I. R., & Rodríguez-Arias, D. (2021). Absolutely right and relatively good: Consequentialist see bioethical disagreement in a relativist light. *AJOB Empirical Bioethics*, forthcoming.
- Waytz, A., J. Dungan, and L. Young. (2013). The whistleblower's dilemma and the fairness–loyalty tradeoff. *Journal of Experimental Social Psychology*. 49(6):1027-33.

Funding

This research was made possible through the support of a Ministerio de Economía y Competitividad award (FFI2015-67569-C2-2-P) and a Ministerio de Ciencia e Innovación award (RTI2018-098882-B-I00). The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the funding bodies. The funding bodies played no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

Author Contributions

EM and BRL developed the study concept. All authors were responsible for study design and data collection. IRH performed the data analysis and interpretation. IRH and EM drafted the manuscript, and BRL and FC provided critical revisions. All authors approved the final version of the manuscript for submission and agree to be accountable for the accuracy and integrity of this work.