Normality and the treatment-enhancement distinction

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Abstract

There is little debate regarding the acceptability of providing medical care to restore physical or mental health that has deteriorated below what is considered typical due to disease or disorder (i.e., providing "treatment"—for example, administering psychostimulant medication to sustain attention in the case of attention deficit disorder). When asked whether a healthy individual may undergo the same intervention for the purpose of enhancing their capacities (i.e., "enhancement"—for example, use of a psychostimulant as a "study drug"), people often express greater hesitation. Building on prior research in moral philosophy and cognitive science, in this work, we ask why people draw a moral distinction between treatment and enhancement. In two experiments, we provide evidence that the accessibility of health-related interventions determines their perceived descriptive or statistical normality (Experiment 1), and that gains in descriptive normality for such interventions weaken the moral distinction between treatment and enhancement (Experiment 2). In short, our findings suggest that the tendency to draw a moral distinction between treatment and enhancement is driven, in part, by assumptions about descriptive abnormality; and raise the possibility that normalizing novel biomedical interventions by promoting access could undermine people's selective opposition toward enhancement, rendering it morally comparable to treatment.

Keywords: human enhancement; moral judgment; experimental bioethics; unequal access; fairness.

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Introduction

In the seventeenth century, Sultan Murad IV vilified coffee-drinking in the Ottoman Empire and explicitly banned its public consumption in the capital. He believed that its stimulating effects could destabilize the social order and endanger his rule [1, 2]. Shortly after the Sultan's death, the Ottoman Empire began exporting coffee culture to Europe [3] and today brewed coffee is among the most popular consumption products in the world. More than 30% of the world's population drink coffee daily [4], and in most cultures, there is virtually no trace of the moral opprobrium that the Ottoman ruler expressed centuries ago. What changed?

These two facts—the widespread use of coffee and its near-universal demoralization—may be directly linked. For instance, a weakening of the belief that coffee is morally suspect could have encouraged its wider consumption. Might the reverse relation also hold? Could the progressive uptake, and thus statistical normalization of coffee-drinking have contributed to neutralizing people's moral apprehension? Psychological evidence supports an intimate connection between representations of statistical or *descriptive* normality (i.e., the prevalence or frequency of a behavior within a population) and *prescriptive* attitudes (e.g., that same behavior's perceived moral appropriateness; see [5, 6, 7]). Some studies have documented an impact of the former (what other people typically do) on both first-person behavior (what one would do [8, 9]) and third-party behavioral evaluation (one's moral judgments of what others do [6]). For instance, research using economic games has shown that both selfish and altruistic behavior is judged morally better when the behavior in question is common compared to when it is rare [6]. This illustrates how changes in a behavior's descriptive normality within a reference community can affect whether the behavior is deemed morally right.

Within bioethical scholarship, a convergent line of reasoning has emerged on the moral relevance of *equal access* [10-12]. Among bioethicists who do not object to human enhancement technologies wholesale, but rather view them as potential contributors to human flourishing, concerns about unfair access or availability are often raised. Simply put, novel biomedical enhancements (consider, for example, bionic eyes) are often costly and difficult to obtain. As a result, access to enhancement can be distributed unequally throughout the target group of potential beneficiaries: it is the economically advantaged who disproportionately reap the benefit of enhancement technologies. This raises ethical concerns about unfairness [13-18] and social inequality [19, 20] that undergird certain cautionary views in the enhancement debate. For instance, scholars have argued that access to enhancements should be limited to individuals from socioeconomically disadvantaged or underprivileged backgrounds to make up for an uneven "playing field" [21].

In the present work, we bring together these related lines of inquiry—on the relevance of perceived *normality* (in psychological science) and *access* to valued technologies (in philosophical bioethics) to judgments of moral acceptability. Across various domains, such as cognitive, mood, physical, and cosmetic enhancement, our studies ask whether changes in an intervention's accessibility (Experiment 1) and descriptive normality (Experiment 2) can influence its moral approval.

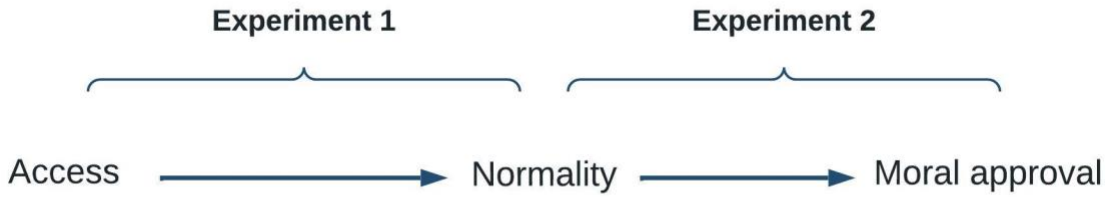

Fig. 1 Model of moral attitudes toward enhancement

We suggest that the answers to these questions may yield novel insight into a longstanding debate in bioethics, concerning the origins of the so-called treatment-enhancement distinction. Previous research has demonstrated that, across a wide range of enhancement domains, people support others' attempts to improve their capacities *up to* the norm more so than *above* the norm [15, 22]—even when both improvements are comparable in mechanism and magnitude. This empirical approach is predicated on a particular *conceptual* distinction between treatment and enhancement, often credited to Norman Daniels [23-25], that draws on a naturalistic conception of health and disease [26-28]. On this view, health is defined as adequate species-typical (biological or psychological) functioning, and disease as any substantial negative deviation from what is typical functioning within the species, vis-à-vis the individual's reference group (e.g., their sex and age group). Thus, a biomedical intervention to increase a person's height would be referred to as *treatment* if performed on an individual who suffers from a growth hormone-related functional deficit in order to raise their height up to the average in their reference group, but referred to as *enhancement* if it enabled a healthy individual (i.e., one whose growth hormone function was species- and reference class-typical) to grow taller than they otherwise would, especially so as to exceed average height.

Yet, enhancement has also been conceived more narrowly as improvement beyond the human *range*, and not merely above the *norm*—i.e., what is known as the beyond species-*maximal* approach [29, 30]. Some evidence indicates that improvements beyond the species-maximal level inspire greater moral disapproval than do improvements beyond the species-typical level [15].

Both species-typical and species-maximal approaches to distinguishing treatments from enhancements have been subject to various criticisms. These have concerned, for example, the apparent arbitrariness in determining the typical and maximal values of various traits and the requirement that there must be some underlying malady or medical condition. For example, short stature is considered "treatable" on the species-typical framework only if it is caused by a growth hormone deficit, malnutrition, or other aberrant factor, but not if it results from genetic inheritance—despite the fact that the socio-functional consequences for the individual would be the same, holding all else equal [30-31].

These concerns have motivated recent attempts to conceptually distinguish treatment from enhancement by applying functional-augmentative or welfarist criteria. The *functional-augmentative* approach defines any increase in a person's capacities as enhancement [32], regardless of how that capacity is distributed statistically in a population—thus circumventing the arbitrariness and medical condition critiques. On this view, a growth hormone treatment to increase a person's height counts unconditionally as enhancement—i.e., whether or not the person has a hormone deficit and regardless of their current height. The *welfarist* conception, by contrast, defines enhancement as any intervention into a person's biology or psychology that is expected to improve their overall well-being, again regardless of their current health-status or functioning [33-35]. This view moralizes the very notion of enhancement by tying it intrinsically to human welfare, and—although it allows for the possibility that a welfare-enhancing intervention may nevertheless

be all-things-considered morally wrong—it can also account for the intuition that certain capacity gains may reduce welfare (enhancing hearing ability in noisy environments) and, therefore, that biomedical *diminishment* of such capacities may be considered enhancement.

While these alternative theories can address the primary criticisms of the dominant species-typical view, they introduce an unusually broad and revisionist understanding of enhancement, in conflict with the lay distinction—according to which treatment and enhancement are mutually exclusive. Thus, for the purposes of the present work, we adopt the typical-functioning framework for categorically distinguishing treatments from enhancements. That is, we define "treatment" as any intervention through which an individual *attains* (or approaches) species-typical functioning along some dimension for their reference class, and "enhancement" as an otherwise similar or even identical intervention through which they *surpass* such functioning.

With that conceptual distinction in place, we then turn our attention to the *moral* distinction between treatment and enhancement. Previous research has shown that lay participants' moral intuitions largely align with the species-typical approach: that is, they tend to view interventions that help an individual attain typical functioning (especially through correction of a diagnosable malady or other aberrant process or condition) as morally better than interventions that allow a healthy individual to surpass typical functioning [22]. We ask a follow-up question: i.e., whether this moral distinction in lay attitudes depends on beliefs about the interventions' statistical or descriptive normality. In other words, as interventions become easier to obtain, is their use expected to proliferate? In turn, if their use proliferates, does the moral distinction between treatment and enhancement wane?

If the answer to these questions is "yes", this could explain a familiar observation in lay moral intuitions about enhancement: namely, that people often morally condemn the non-medical

use of "abnormal" drugs, that are neither widely available nor commonly used (e.g., methylphenidate, commonly prescribed as Ritalin) but approve of "normal" (i.e., widely available and commonly used) stimulants such as coffee [19], even for non-medical uses—even though the two substances may be comparable in terms of cognitive benefits and risk of adverse side-effects [36].

Finally, while we predicted that descriptive abnormality would reduce people's moral approval of enhancement, there is reason to doubt that such effects would emerge when participants morally evaluate those same interventions in treatment contexts. This asymmetry between treatment and enhancement might reflect people's general conviction that it is morally appropriate for patients (whose health has deteriorated below a species-typical level for their reference class) to receive any effective medical intervention within certain broad constraints (e.g., relating to governmental resources and distributive justice) that can restore their cognitive, affective, or physical health, irrespective of whether the intervention in question is widely accessible in the population (but see [37], for a discussion of self-inflicted deterioration). Thus, it may be expected that manipulating the descriptive normality of an intervention will not have a strong influence on judgments of moral acceptability when the intervention is characterized as an effective treatment for a medical condition. But such a manipulation may still influence moral judgments regarding the very same intervention when it is characterized as an enhancement. In this regard, our studies shed light on the circumstances in which people draw a moral distinction between treatment and enhancement. Specifically, the normative distinction between treatment and enhancement may arise from assumptions concerning the abnormality of the target intervention in question—and can be weakened, or even eliminated, by ensuring its accessibility and/or fostering its normalization.

Overview and General Methods

Recent work has identified distinct domains of human enhancement, including cognitive, affective (e.g., mood), moral, physical, cosmetic, and longevity enhancement [38]. To examine whether access and descriptive normality influence moral attitudes across domains, we drafted six pairs of treatment and enhancement interventions: two pairs involving improvements in cognition (drugs to improve memory and attention/reduce drowsiness), two relating to physical improvement (an intervention to achieve muscle growth and hormones for stature increase), one pair on mood improvement (a neuroactive drug for emotional stability), and one on cosmetic enhancement (an intervention to achieve greater facial symmetry; see the *Open Science Framework* page https://osf.io/8uwqk/ for details).

In each pair, we described a hypothetical intervention that could yield improvements both among patients (to *attain* species-typical functioning) and among healthy individuals (to *surpass* species-typical functioning). In the treatment condition, we narrated a case in which a patient sought treatment for a recognized disease or disorder that caused species-typical sub-functioning; and in the enhancement condition, we narrated a case in which a healthy individual who was already functioning at a species-typical level turned to the same intervention in order further improve their capacities in the relevant domain.

Participants were randomly assigned to consider a single case of either treatment or enhancement drawn from the battery of six matched pairs. In the introduction, participants read a brief description of the intervention and its potential applications to treatment and enhancement:

> In 2025, through a collaboration between different pharmaceutical and biotechnology companies, a new neurostimulant drug called Biaxonadil has been developed. This drug strengthens and improves attention and concentration. Studies have shown that in the academic and work environment, these abilities are boosted, making it easier to study and work. With this drug, tasks can be performed without feeling fatigue or irritability,

> increasing productivity and effectiveness. In addition, Biaxonadil is also useful for people with narcolepsy, excessive sleepiness, and sleep disorders. Clinical trials have shown that Biaxonadil is completely safe and has no side effects.

We also experimentally manipulated the degree of accessibility (Experiment 1) or descriptive normality (Experiment 2). *Access* to the intervention was manipulated by stipulating a percentage of the target population that *could* undergo the intervention; while the descriptive *normality* of the intervention was manipulated by stipulating the percentage of the target population that *did* undergo the intervention. In both experiments, the target population was a condition-specific primary group of beneficiaries: e.g., 'people with narcolepsy, excessive sleepiness, and sleep disorders' in the treatment condition versus 'working professionals and students' in the enhancement condition. Participants were randomly assigned to one of three levels of access/normality (i.e., low, intermediate, or high), by randomly drawing an integer value from the discontinuous uniform distribution from 10% to 20% (low), 45% to 55% (intermediate) and 80 to 90% (high). The wording of the manipulations was specifically as follows:

> Biaxonadil is *very accessible/fairly accessible/inaccessible*. Different public health surveys estimate that it can reach [*INTEGER*] % of people who are interested in using it. That is, a *majority/approximately half/a minority* of working professionals and students who wish to use Biaxonadil can access it.

Next, participants learned about an individual who decides to undergo the intervention for the purpose of either treatment or enhancement:

> Mary is a professional in the research industry. She is 44 years old and fully competent and has decided to pursue a higher position in the laboratory. She believes that to achieve this goal she will need to be more focused and concentrated. After consulting with her partner and family, she decides to use Biaxonadil.

Participants were then asked to report their personal moral attitudes toward the agent's behavior: they evaluated (1) the moral status of the agent's behavior (0: totally wrong – 10: totally

right), (2) whether it was fair or unfair (0: totally unfair – 10: totally fair), and (3) whether they agreed or disagreed with a statement proscribing the agent's behavior of the agent's action (0: strongly disagree – 10: strongly agree).

We were also interested in capturing participants' moral attitudes toward health policy. So, in the second part of the vignette, we described a public health advisor:

> Dr. Monroe is the ethics advisor to a government. Biaxonadil is not legal in her country and the authorities ask her for advice on the matter. Reports conducted in this country estimate that Biaxonadil can be distributed to [*INTEGER*] % of the working professionals and students who are interested in using it. That is, a *majority/approximately half/a minority* of the working professionals and students who wish to take it can access it.

Participants were then asked three questions about the advisor's behavior: They evaluated (1) the conditional *moral status* of the advisor's behavior if she recommends approval (0: totally wrong – 10: totally right), (2) whether it would be fair or unfair to approve Biaxonadil (0: totally unfair – 10: totally fair), and (3) whether the advisor should or should not approve Biaxonadil (0: should not – 10: should). Our dependent measure was the six-item average of moral approval (collapsed across individual and policy contexts), which revealed very good reliability in both Experiments 1 (Cronbach's $\alpha = .88$) and 2 (Cronbach's $\alpha = .84$).

Of course, moral judgments of an individual's behavior and a community policy need not be perfectly aligned. Some acts may be deemed personally wrong, yet collectively permissible—as when one protects others' right to engage in a behavior that one deems morally wrong. This predicts *greater* approval of policy shifts than of individuals' use of enhancement interventions. Alternatively, individual instances of a behavior may be deemed morally acceptable, but objectionable when generalized or universalized to the community. This predicts the opposite pattern: *reduced* approval of policy shifts than of individual's use of enhancement interventions. In Supplementary Analysis 1, we separately modeled individual and policy judgments in both

experiments: In short, the moral distinction between treatment and enhancement arises both in evaluations of an individual's behavior and in views about community policy; and evaluations of behavior and policy are both susceptible to effects of descriptive normality (see Supplementary Analysis 1). Thus, in the present manuscript we report only the combined six-item findings.

To capture perceptions of descriptive normality, participants were asked to estimate how many people out of ten potential beneficiaries in the target population (e.g., 'patients with narcolepsy, excessive sleepiness, and sleep disorders' in the treatment condition, versus 'working professionals and students' in the enhancement condition) *would* in fact undergo the described intervention (from 0: none to 10: all ten). In Experiment 1 only, participants were asked to classify the agent's (i.e., Mary's) use as either intended to "(A) improve the capacities of a healthy person" (i.e., as *enhancement*) or "(B) prevent illness or treat a pathology in a patient" (i.e., as *treatment*); and responses were recorded on an eleven-point scale from 0: "only A" to 10: "only B". At the end of the study, participants provided the following sociodemographic information: gender, age, educational attainment, religiosity, and political orientation.

Our primary, pre-registered prediction was that variation in *access* (and *normality*) would moderate the moral distinction between treatment and enhancement: see https://aspredicted.org/479ys.pdf. Any secondary and exploratory predictions are outlined in the Methods section of each study. The studies were approved by the ethics committee at the University of Granada (3058/CEIH/2022) and were performed in accordance with the ethical standards put forth in the 1964 Declaration of Helsinki and its later amendments. Data, materials, and analysis scripts are publicly available on the *Open Science Framework* at https://osf.io/8uwqk/.

Experiment 1

Experiment 1 explored participants' attitudes toward treatment and enhancement interventions, while manipulating the extent to which potential beneficiaries have *access* to the intervention in question. Our focus was on two separate questions: namely, whether increases in accessibility elevate the (i) perceived descriptive normality of the intervention, and (ii) moral approval of the intervention when used for enhancement.

Methods

To estimate the required sample size, we conducted a bootstrap power analysis by resampling with replacement from a pilot dataset. This analysis indicated that a sample of 500 participants would suffice to detect the target effect (i.e., the access×condition interaction on moral permissibility judgments) with 80% power and $\alpha = .05$ (see Appendix). We partnered with the market research firm Netquest (https://www.netquest.com) to recruit a nationally representative sample of 500 Spanish adults, with quotas by age bracket, gender, and geographical region. We collected responses from 507 participants, who were compensated for approximately 6 minutes at a rate of €13 per hour, and of whom 160 participants were excluded for failing the comprehension and/or attention questions. The final sample consisted of 347 participants (46% male, 54% female; median age = 48). Slightly over half the sample was non-religious (56%; one-sample proportion test: $\chi^2 = 4.61$, $p = .032$). According to a one-sample *t*-test, the sample leaned left-of-center overall, $t(346) = -5.83$, $p < .001$, Cohen's $d = -0.31$.

In a 2 (condition: treatment, enhancement) × 3 (access: low, intermediate, high) between-subjects design, participants were randomly assigned to one treatment or one enhancement case in which access was stipulated to be either low (accessible to 10%-20% of the target population), moderate (accessible to 45%-55% of the target population) or high (accessible to 80%-90% of the

target population). Participants reported whether (i) the intervention was morally permissible, (ii) descriptively normal, and (iii) constituted an instance of treatment or enhancement. The analyses reported below treat *access* as a continuous predictor by converting the percentage to a proportion (between .10 and .90).

Results

Table 1 reports the results of Experiment 1. In the subsections that follow, we discuss each of the analyses in sequence.

Table 1. *Model Summaries for Experiment 1.*

	Description		**Normality**		**Moral approval**					
	Model 1		**Model 2**		**Model 3a**		**Model 3b**		**Model 3c**	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Condition	171.0	<.001	10.16	.002	84.74	<.001	74.16	<.001	27.42	<.001
Access	0.01	.93	26.40	<.001	2.55	.11	0.40	.53	0.54	.46
Condition×Access	0.17	.68	2.31	.13	0.04	.84	0.61	.43	0.98	.32
Normality	-	-	-	-	-	-	20.49	<.001	20.21	<.001
Condition×Normality	-	-	-	-	-	-	9.66	.002	11.80	<.001
Description	-	-	-	-	-	-	-	-	13.13	<.001
Condition×Description	-	-	-	-	-	-	-	-	1.83	.18

Pre-Registered Analysis: Moral Approval

In a mixed-effects model of moral approval (Cronbach's $\alpha = .88$), we observed a main effect of condition—but no effects of access or of the access×condition interaction (see Model 3a in Table 1). As expected, moral approval was greater for treatment uses ($M = 7.80$, 95% CI [7.35, 8.24]) than enhancement uses ($M = 5.81$, 95% CI [5.36, 6.26]), $t = 9.20$, $p < .001$ (replicating [22]).

The magnitude of the moral distinction between treatment and enhancement ranged from Cohen's d = 0.52 (height gains) to Cohen's d = 1.39 (attention pills). Contrary to our pre-registered prediction, however, variation in the interventions' accessibility had no effect on moral approval of either treatment, t = 1.30, p = .19, or enhancement, t = 0.96, p = .34, uses.

Secondary Analyses: Descriptive and Normality Judgments

Participants were asked whether they conceived the intervention as an instance of treatment or enhancement. A mixed-effects regression model with condition, access, and the access×condition interaction as fixed effects (and scenario as a random effect) revealed a main effect of condition (see Model 1 in Table 1). Participants distinguished treatment cases (M = 2.82, 95% CI [2.24, 3.39]) from enhancement cases (M = 6.83, 95% CI [6.26, 7.41]), t = 13.08, p < .001. The effect of condition arose when analyzing each pair of interventions separately, 1.00 < Cohen's ds < 2.02. No effects of access or of the access×condition interaction were observed—suggesting that participants identified improvements *toward* species-typical functioning as cases of 'treatment', and similarly, improvements *beyond* species-typical functioning as 'enhancement'. This conceptual distinction was insensitive to the degree to which interventions were described as accessible or inaccessible to other potential beneficiaries.

As a measure of perceived descriptive normality, participants were asked to estimate how many potential beneficiaries out of ten *would* in fact undergo the intervention. This time, a mixed-effects model of normality judgments revealed both main effects of condition and access, but no access×condition interaction (see Model 2 in Table 1). The effect of access on perceived normality was positive in both treatment, B = 3.03, t = 4.81, p < .001, and enhancement, B = 1.63, t = 2.42, p = .016, conditions—with a mean correlation of r = .27. Additionally, treatment uses (M = 6.89,

95% CI [6.50, 7.28]) were seen as more descriptively normal overall than enhancement uses (M = 6.04, 95% CI [5.65, 6.44]), t = 3.18, p = .002.

Exploratory Analysis: Normality and Moral Approval

According to our hypothesized model, perceived normality influences moral approval (see Figure 1). Therefore, in our results, we should observe that, when participants perceive an intervention as more descriptively normal (/abnormal), they also consider it more morally permissible (/impermissible). So, we entered normality judgments as an additional predictor in our model of moral approval and allowed perceived normality to interact with condition. The interaction term enabled us to assess whether normality better predicts moral attitudes toward enhancement than toward treatment.

In this model (see Model 3b in Table 1), we observed main effects of condition and normality—as well as a normality×condition interaction. Specifically, perceived normality was associated with approval of enhancement, B = 0.33, t = 5.41, p < .001, mean-r = .39, but not treatment, B = 0.06, t = 0.96, p = .34, mean-r = .17 (see Figure 2a). This result provides correlational evidence of a link between the perceived normality and moral approval of enhancement interventions. Furthermore, the association between normality and moral approval was robust to the inclusion of descriptive judgments (regarding whether the intervention consists in treatment or enhancement; see Model 3c). In this same model, such judgments independently predicted moral approval: Specifically, participants who conceived of an intervention as treatment of a patient's disorder expressed greater moral approval of that intervention than participants who viewed it as an improvement of a healthy person's capacities. Together with evidence (in Model 2) that variation in access causally influences an intervention's perceived normality, this result raises the possibility that access may indirectly impact moral approval of enhancement through

effects on perceived normality—despite the absence of a total effect in this initial experiment (i.e., in Model 3a; see also mediation analyses in Supplementary Analysis 2).

Discussion

Participants conceptually distinguished treatment from enhancement (along the lines of [39]), and also viewed treatment interventions as morally preferable to enhancement interventions (as in [15, 22]). Contrary to our pre-registered prediction, however, variation in accessibility did not influence moral attitudes toward enhancement interventions. However, in a secondary analysis, we did obtain evidence of an indirect effect via descriptive normality: Specifically, variation in accessibility *did* influence perceived normality: In other words, as a certain intervention (whether treatment or enhancement) becomes increasingly accessible, it is also considered increasingly likely that potential beneficiaries will undergo the intervention in question.

In a final analysis, then, we found that gains in perceived normality were associated with increases in moral approval, though only in the enhancement condition—a pattern we had in fact anticipated. Meanwhile, approval of treatment was consistently high—and unaffected by perceptions of normality. Treatments intended to restore a patient's health were met with moral approval—regardless of how rare or frequent the treatment was. This may reflect a moral conviction that people *unconditionally* deserve to restore their health but may only enhance their health if doing so is statistically common.

Experiment 2

Experiment 1 provided evidence of an indirect effect of access on moral approval of enhancement via perceived normality. To ascertain whether perceived normality causally influences moral approval, we conducted a second experiment. In Experiment 2, we directly manipulated (rather

than simply measured, as in Experiment 1) the descriptive normality of the set of treatment and enhancement interventions and asked whether doing so influences participants' moral attitudes.

We predicted that greater descriptive normality would influence moral approval of enhancement, but not treatment interventions (in line with the correlational evidence we obtained in Experiment 1) [39, 40]. This prediction dovetails with recent, real-world examples (e.g., involving medical tourism in patients with long-term COVID, see [40]): Even when a certain treatment may be rare and expensive, this does not weaken people's conviction that patients have a moral right to obtain such treatment privately in hopes of restoring their health.

Methods

Informed by our initial power analysis for Experiment 1, we sought to recruit 500 native Spanish speakers. Due to funding constraints, in Experiment 2 we recruited a convenience sample on Prolific.co (https://www.prolific.co). 501 native Spanish speakers took part in the study (50% male, 47% female, 2% non-binary and 1% did not indicate their gender; median age = 25) and were compensated for approximately 5 minutes at a rate of £9/hour. As in Experiment 1, many participants were non-religious (54%) and politically left-of-center, one-sample $t(495) = -7.56$, $p < .001$, Cohen's $d = -0.34$.

The modifications to our experimental protocol were minimal: In Experiment 2, we replaced references to the degree of accessibility ("Biaxonadil is *easily accessible*", "...surveys estimate that it can reach 88%"), with matched statements about descriptive normality ("Biaxonadil is *widely used*", "...surveys estimate that it is used by 88%").

In a 2 (condition: treatment, enhancement) × 3 (normality: low, intermediate, high) between-subjects design, participants were randomly assigned to one of six experimental conditions. Participants considered a treatment or enhancement intervention whose use could be

abnormal (used by 10%-20% of the target population), relatively normal (used by 45%-55% of the target population) or very normal (used by 80%-90% of the target population). As in Experiment 1, participants were asked to morally evaluate the intervention (using the same six items; Cronbach's $\alpha = .87$), and to estimate its descriptive normality.

Results

Table 2 summarizes the results of Experiment 2. In the subsections that follow, we discuss and interpret Models 4 and 5 in sequence.

Table 2. *Model Summaries for Experiment 2.*

	Normality		**Moral approval**	
	Model 4		**Model 5**	
	F	*p*	*F*	*p*
Condition	4.03	.045	92.4	< .001
Normality	349	< .001	1.50	.22
Condition×Normality	1.39	.24	8.18	.004

Manipulation Check: Normality Judgments

In a model of normality judgments (see Model 4 in Table 2), we observed main effects of condition, and normality, but no normality×condition interaction. As expected, the effect of our descriptive normality (or prevalence) manipulation on *perceived* normality was positive in both the treatment, $B = 4.71$, $t = 12.42$, and enhancement, $B = 5.34$, $t = 14.06$, conditions, both *p*s < .001—with a mean correlation of $r = .65$. Additionally, treatment uses ($M = 6.41$, 95% CI [6.15, 6.67]) were seen as slightly more descriptively normal than enhancement uses ($M = 6.10$, 95% CI [5.83, 6.36]), $t = 2.01$, $p = .045$.

Primary Analysis: Moral Approval

To examine whether changes in descriptive normality moderated the treatment-enhancement distinction, we ran a mixed-effects model of moral approval with condition, normality, and the normality×condition interaction as predictors. This analysis revealed a main effect of condition, and a normality×condition interaction—but no main effect of descriptive normality (see Model 5 in Table 2). As in Experiment 1, participants morally distinguished treatment (M = 8.35, 95% CI [8.12, 8.59]) from enhancement (M = 6.91, 95% CI [6.67, 7.15]) interventions, t = 9.61, p < .001—with differences in moral approval ranging from Cohen's d = 0.44 to Cohen's d = 1.21.

Importantly, the manipulation of descriptive normality differentially affected moral approval of treatment and enhancement: Consistent with Experiment 1, the effect of normality arose in the enhancement condition, t = 2.89, p = .004, mean-r = .16, but not the treatment condition, t = -1.15, p = .25, mean r = -.08 (see Figure 2b).

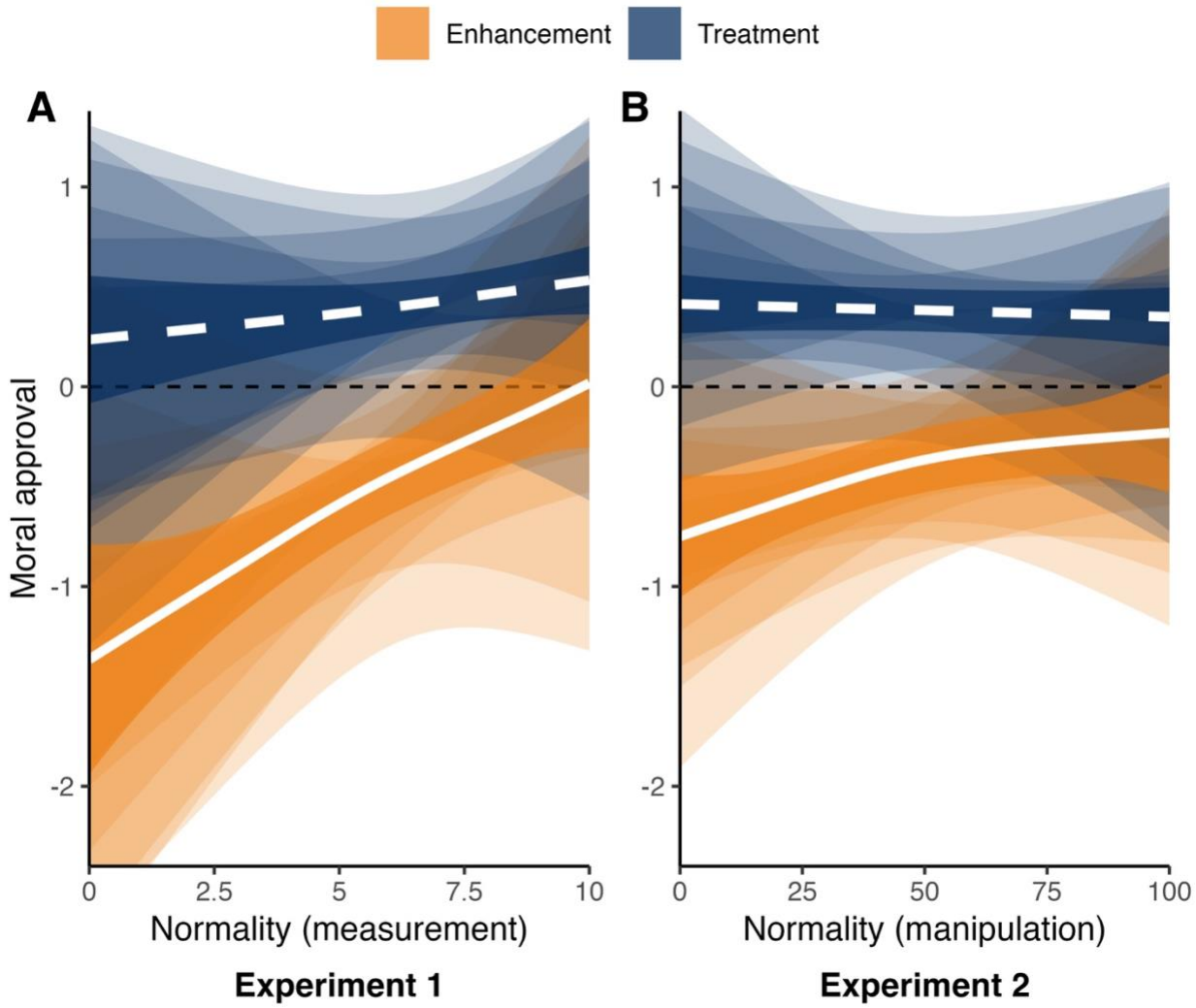

Fig. 2 Standardized (*z*-scored) moral approval by condition and normality in (A) Experiment 1 and (B) Experiment 2. Conditions are color-coded, and the dashed line represents the trend line for treatment, and the solid line represents the trend line for enhancement. The *y*-axes display standardized moral approval, after rescaling responses to have a mean of 0 and a standard deviation of 1. The *x*-axis in Figure 2A displays participants' reports of perceived normality, ranging from 0 to 10 beneficiaries (out of 10). The *x*-axis in Figure 2B displays experimentally assignments of normality, ranging from 0 to 100 beneficiaries (out of 100).

Discussion

Normality causally influenced moral attitudes toward enhancement, but not treatment. Experimentally 'normalizing' various biomedical enhancement interventions resulted in their greater moral approval, whereas no such effect arose for treatment interventions. Treatment procedures were evaluated favorably regardless of the degree to which the intervention in question was common among its potential beneficiaries [41]. This finding dovetails with the results of Experiment 1 and implies that the moral distinction between treatment and enhancement arises most strongly when the interventions in question are seen as descriptively abnormal—and significantly weakens when they are stipulated to be widespread among the target population.

General Discussion

In support of our model, we found that access promoted perceived descriptive normality (Experiment 1), and descriptive normality in turn elevated moral approval of enhancement (Experiment 2). These findings may help to explain patterns of longitudinal *liberalization* in people's moral attitudes toward enhancers from the moment they are first introduced to the moment they become widely used. Therefore, what are currently divisive enhancement biotechnologies may one day be seen as morally permissible if their use proliferates over time.

Bioconservative attitudes are often characterized as stemming from an embodied and intuitive aversion, in the form of disgust [42, 43] or vertigo [44], to the use of emerging biotechnologies; and empirical research attests to an association between disgust sensitivity and bioconservative views on enhancement [15]. These appeals to nature have been subject to intense philosophical scrutiny [45-47], effectively asking whether intuitive and affective processes ought to be discarded as unreliable guides in the moral domain [48]. Our results contribute to a growing theoretical [45] and empirical [15, 16] literature demonstrating that hesitancy surrounding human

enhancement technologies is not rooted solely in affective reactions, such as disgust. Specifically, the present evidence documented qualitatively distinct considerations that shape laypeople's attitudes toward enhancement: When asked to morally evaluate instances of enhancement, laypeople consult their descriptive beliefs about the intervention's prevalence and/or frequency; and the belief that enhancement practices are statistically abnormal can inspire attitudes of moral disapproval. In this regard, by helping to connect prior evidence on the impact of descriptive norms on moral reasoning [5-8] to bioethical scholarship on the relevance of equal access [10-12], our studies contribute to a richer portrayal of the processes that underlie reticent attitudes in the enhancement debate [49].

Limitations and Future Directions

Experiment 1 did not reveal an effect of access on moral approval. Relatedly, previous research on cognitive enhancement found that stipulating equal access to a neurostimulant did not suffice to neutralize laypeople's moral disapproval of enhancement in competitive contexts [16]. Rather, what neutralized concerns about unfairness was the additional stipulation of descriptive normality, i.e., that the stimulant is widely used throughout the target community of beneficiaries (e.g., players in a chess tournament or students in a class). Yet our studies demonstrated (in line with the model in Figure 1) that access promoted perceived descriptive normality, and that descriptive normality influenced moral attitudes toward enhancement (see also Supplementary Analysis 2). These seemingly conflicting findings may be reconciled by acknowledging that each effect in the causal chain was small to medium in size. Therefore, the indirect effect of access on moral approval via perceived normality (understood as the product of both effects) may be too small to reliably detect in an experimental setting.

Our studies were conducted in Spanish using both convenience and nationally representative sampling methods—providing some confidence that our results faithfully reflect attitudes toward human enhancement among Spanish speakers. Yet, whether these effects generalize to *other* world cultures is thus far unclear. In previous empirical research programs, national culture has been shown to play a clear role in shaping moral intuition—for example, by moderating the strength of utilitarian moral principles [50] or incompatibilist responses to the free will problem [51]. This raises the question of how culturally variable the present findings may be—with regard to both (a) the moral distinction between treatment and enhancement, and (b) the effect of normality on moral attitudes toward enhancement.

Future research ought to home in on the mechanism linking changes in descriptive normality to prescriptive moral reasoning. One possibility is that the normalization of enhancement alleviates concerns about unfairness and 'cheating' [52, 53]. Specifically, increases in an intervention's descriptive normality may distribute the benefits of enhancement more evenly throughout the target population. As a result, the relative improvements in functioning conferred to an individual who undergoes enhancement may taper off as the intervention is normalized—thereby neutralizing the concern that enhancement is unfair. Another, underexplored possibility is that the descriptive normality of an intervention serves as a cue of its safety [14, 54]. On this view, perceiving an intervention as abnormal raises the concern that it may be risky or unsafe; and that descriptive normality implies safety (rather than fairness), which in turn bolsters moral approval.

A closer look at the results of Experiment 2 suggest that the effect of normalization on enhancement attitudes may be non-linear (see Figure 2b and Supplementary Analysis 3). When enhancement interventions are seen as abnormal (i.e., below 50%) gains in descriptive normality exert a clear effect; but once they achieve moderate normalization, further increases in normality

(i.e., above 50%) have a negligible influence on moral approval. So perhaps it suffices for enhancement interventions to become *moderately* widespread in order to dissolve moral disapproval, though future work should pay more systematic attention to this threshold of normalization.

Finally, our studies were built upon Daniels' [24] "species-typical" conceptual distinction between treatment and enhancement. By eliciting descriptive judgments in Experiment 1, we also found that Daniels' distinction provides some purchase into laypeople's moral attitudes: Specifically, classifying an intervention as an improvement above the norm versus restoration up to the norm is not an inert step in bioethical reasoning. Rather, participants who conceived an intervention as treatment were more likely to morally approve of the intervention than participants who viewed that same intervention as enhancement. Still, scholars have offered independent grounds on which to replace Daniels' distinction with a distinction in terms of functionalist or welfarist criteria. We therefore acknowledge that, through the lens of these more recent accounts, our findings may not bear on the treatment/enhancement distinction *per se*, but instead shed light on discrepancies in the moral evaluation of different degrees of enhancement.

Conclusion

People hesitate when asked whether a healthy person may undergo biomedical interventions for the purpose of enhancement; even though the same medical intervention is met with virtually univocal support in therapeutic contexts—when intended to restore a patient's health. Drawing on past research in cognitive science and bioethics, the present work—an instance of so-called experimental philosophical bioethics [48, 55-57]—advanced an explanation of the *treatment-enhancement distinction* and the conditions in which it arises: In short, we found that providing access to health-related interventions shapes their perceived normality, and

normalization dampens people's selective disapproval of enhancement. As a result, people strongly differentiate between treatment and enhancement when the medical interventions in question are *inaccessible,* but this distinction weakens as interventions become more accessible—and, in turn, more widespread among their potential beneficiaries. These findings raise the possibility that normalizing novel biotechnological interventions can weaken people's opposition toward enhancement, rendering it morally equivalent to treatment.

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Appendix

Supplementary Analysis 1

To examine whether the effects of normality arose when looking separately at moral attitudes of individual behavior and community policy, we conducted further analyses with the three-item averages of moral attitudes toward individual behavior and policy: The normative distinction between treatment and enhancement arose both when evaluating an individual's behavior (Exp. 1: $B = 1.92$; Exp. 2: $B = 1.64$), and a shift in community policy (Exp. 1: $B = 1.67$; Exp. 2: $B = 1.25$), all ps < .001.

In Model 3b (Experiment 1), normality was associated with approval of enhancement but not treatment. A further analysis with judgment scope as a third factor (scope: behavior, policy) revealed that the two-way interaction between normality and condition, $F(1, 341) = 10.58$, $p = .001$, was qualified by a three-way interaction with scope, $F(1, 333) = 4.57$, $p = .033$. The three-way interaction indicated that the association between normality and approval of enhancement was stronger for policy judgments than behavior judgments, $B = 0.15$, $t = 1.99$, $p = .047$ (whereas no such difference arose regarding treatment interventions, $p = .30$). Still, both simple slopes were statistically significant: Perceived normality was associated with approval of an individual's use of enhancement interventions, $B = 0.26$, $t = 3.67$, as well as a policy advisor's endorsement of enhancement interventions, $B = 0.42$, $t = 6.04$, both ps < .001.

In Model 5 (Experiment 2), normality causally affected approval of enhancement but not treatment. Entering judgment scope as a third factor revealed a two-way interaction between normality and condition, $F(1, 490) = 8.17$, $p = .004$, but no three-way interaction with scope, $F(1, 492) = 0.22$, $p = .64$. The effect of normality on approval of enhancement arose equally for

judgments of an individual's use, $B = 1.11$, $t = 2.60$, $p = .009$, and a policy advisor's recommendation, $B = 1.00$, $t = 2.35$, $p = .019$.

Supplementary Analysis 2

We conducted mediation analyses (using the *mediation* R package; [58]) to assess whether perceived normality mediated the experimental effect of access on moral approval in each condition. In the enhancement condition, normality mediated the effect of access on moral approval (average causally mediated effect [*ACME*] = 0.58, $p = .006$)—whereas the direct effect was non-significant (average direct effect [*ADE*] = -0.08, $p = .89$). The corresponding analysis in the treatment condition uncovered no effects of access on moral approval of treatment—whether direct (*ADE* = 0.48, $p = .31$) or indirect via normality (*ACME* = 0.19, $p = .22$).

Supplementary Analysis 3

To assess whether the effect of normality on moral approval in Experiment 2 was non-linear, we replaced the discontinuous *proportion* of normality in Model 4 with the normality *factor* comprising three levels (low, intermediate, and high). We then conducted pairwise contrasts between levels of normality while applying Tukey correction for multiple comparisons: In the treatment condition, no significant differences arose between normality levels, ps > .40. Meanwhile, in the enhancement condition, moral approval differed between the low and intermediate levels of normality, $B = 0.80$, $t = 3.01$, $p = .008$, but not between the intermediate and high levels of normality, $B = -0.00$, $t = -0.01$, $p = 1$.