A damage/benefit evaluation of addictive product use

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ABSTRACT

Aims To obtain damage/benefit assessments of eight commonly used addictive products and one addictive behaviour from French addiction experts and link these to overall evaluations. **Design and setting** Criteria-based evaluation by experts in addiction. Specific statistical modelling to estimate the relative contribution of various criteria to formulating expert general opinion on products. **Participants** Forty-eight French experts in addiction. **Measurements** Twelve criteria covering the whole spectrum of damages and benefits to users and to society evaluated using visual analogue scales (VAS). Direct measure of expert overall subjective opinions on products from user and from social perspectives. **Findings** Damage scoring identified alcohol (damage score = 48.1), heroin (damage score = 44.9) and cocaine (damage score = 38.5) as the most harmful products to users and to society; gambling was considered the least harmful (score = 22.5), replicating previous results. Damage scoring correlated poorly with legal status or with overall subjective expert opinions of products. Benefit perception scores indicated alcohol as a clear outlier (benefit score = 45.5) followed by tobacco (benefit score = 34.3) and cannabis (benefit score = 31.1). Statistical modelling suggested that experts attributed 10 times more importance to benefit perception than to damages when making their subjective opinion from a user perspective and two times more importance to benefit perception than to damages in formulating their opinion from a social perspective. **Conclusions** The perceived benefits of addictive products appear to have a major impact on the opinion of those products expressed by a number of French addiction experts.

Keywords Criteria-based evaluation, damage evaluation, perceived benefit evaluation, subjective opinion.

INTRODUCTION

A number of studies have been conducted recently to assess harm comparatively for different addictive products [1–4]. All these studies show that the measure of product harm to users and to society is rarely predictive of its legal status. Otherwise, alcohol and tobacco would be illegal.

One explanation for this discrepancy is that public policies are not based on up-to-date scientific facts on drugs. Efforts should thus be made to collect scientific data on drug harms and better inform politicians. However, a complementary explanation could be that perceived benefits to society and to users deeply influence political decisions. If this hypothesis is valid, then restrict-ing the evaluation of addictive product use to damages severely limits its relevance for policy makers.

Evaluating benefits is not an easy task. For most economic and social benefits facts do exist [5–8], but cultural benefits and user benefits are subjective items. Ideology [9], history, culture and personal experiences [1], as well as pressures from organized lobbies, all have an influence on an individual's perception of benefits. The issue is whether reliable and reproducible measures of benefit perception are possible.

Discussing 'benefits associated with product consumption' when considering drugs with very deleterious effects could sound counterintuitive or even shocking to therapists. Damage/benefit analyses have been carried out for some addictive products, in the form of both

individual analysis [10–13] and comparative analysis, but these only considered user-perceived benefits [1]. To our knowledge, the current study presents the first simultaneous damage/benefit assessment of commonly used drugs and addictive behaviours. Following work by Nutt *et al.* [2,3], we based our study on the medical and scientific knowledge of experts on addictive products, asking them to evaluate all products simultaneously without considering their legal status. To clarify further the general perception of experts on addictive products, these criteria-based measures were complemented with an assessment of their global subjective opinions on addictive products. Crossing these two classes of measures shed an interesting light on the making of expert general opinion.

METHOD

Study design

We focused on eight commonly used addictive products: alcohol, tobacco, cannabis, cocaine, heroin, amphetamine, ecstasy and other synthetic drugs (with the exception of amphetamine and ecstasy). Products rarely used in France, such as methamphetamine, were not included. Instead, we added gambling, a common addictive behaviour, proposed recently for inclusion among addictions in the future DSM-5. To simplify this text, we will refer to gambling as a 'product' in what follows.

Our study design is based on previous work by Nutt *et al.* [2,3], with appropriate adaptations implemented to deal with the joint evaluation of damages and benefits. First, to facilitate the simultaneous evaluation of damages and benefits, the procedure for damage assessment was simplified. Secondly, the inevitable heterogeneity of benefit perception among experts was buffered by querying a substantial number of experts. Thirdly, the protocol did not include consensus stages, as we believed that such stages would be much more complicated to build for benefits than for damages.

Our *ad hoc* methodology is based on several precise criteria for both damage and benefit evaluation. Whereas Nutt *et al.* considered, respectively, nine [2] and 16 [3] criteria for damage assessment, we defined six criteria for damage assessment covering the entire spectrum of potential product effects. Three criteria described damages to product users ('user damages') and three others described damages at the societal level ('social damages'). Six criteria covering the entire spectrum of potential beneficial product effects were constructed and subdivided into three criteria for benefits associated with product consumption ('user benefits') and three criteria for benefits to society ('social benefits'). Table 1 shows the descriptions of these 12 criteria as presented to evaluators.

The authors defined these criteria with the help of physicians from the Department of Psychiatry and Addictology of Paul Brousse Hospital (Villejuif, France) to ensure expertise on all nine products. All criteria were then validated by the executive committee of the French Federation on Addiction (FFA), a society that includes most professional French associations involved in addictions care (including hospitals, medico-social centres, universities, harm reduction, general practitioners and patient self-help groups).

Criteria were designed such that each criterion constituted a category deemed to have an equivalent contribution to global damages (or benefits). In this way, fixing an equal number of criteria for damages to users and damages to society meant that if a simple sum of criteria were performed to obtain a global damage measurement, that measurement would correspond to a 50–50% weighting of user and social dimensions, respectively. This choice is similar to that made by the expert consensus group of Nutt *et al.* [3], which chose a 54.2% weight for social damage criteria and a 45.8% weight for user damage criteria.

We sampled a significantly larger group of experts than the 15 experts gathered by Nutt *et al.* [2,3]. Recruitment took place at an FFA board meeting in May 2010. Forty-eight experts (mean age = 48 years, 60% men, 49% psychiatrists, 77% physicians and 21% other medico-social professions) participated in the study. This group is representative of the FFA board members and therefore constitutes a relevant expert panel on addictions.

Two weeks in advance of the FFA board meeting all meeting participants received a list of publications in high-impact journals and important reports for each product, validated by the criteria expert group and available on our website, along with a presentation of our study. The evaluation questionnaire was presented orally during the meeting. For each of the 12 criteria for the nine products, the questionnaire included a visual analogue scale (VAS) graduated from 0 ('no damage' or 'no benefit') to 10 ('extreme and frequent damage' or 'extreme benefit'). The comparative perspective between products in the scoring was fostered through a concomitant evaluation of each criterion for the nine products, using similar VAS.

Each expert was instructed to complete the questionnaire individually—there was no consensus stage. The larger size of the expert sample recruited by this simple procedure opened the way for interesting statistical analyses of the evaluations and meaningful interpretations of summary statistics. However, not including a consensus stage has an important drawback. It impedes a decision-making analysis or the development of alternative methods able to elucidate how different criteria

Table 1 Evaluation criteria and their definition.

	User damages or benefits	*Social damages or benefits*
Damages	**Acute health damages.** These include all immediate effects, for example: respiratory failure, cardiovascular disease, overdose, coma, traffic accidents, acute behaviour disorders, violence, acute psychotic disorders, etc.	**Health and social costs.** These include, for example, direct health expenditures related to care and hospitalization, indirect welfare expenditures related to invalidity and sick leave and expenditures linked to welfare benefits and permanent disability. Public health and social expenditures are associated with the frequency of consumption and the hazards of these products
	Chronic health damage. For example: cancer, chronic cardiovascular disease, lung disease, cirrhosis, chronic psychosis, chronic cognitive disorders, dementias, hepatitis, human immunology virus (HIV)	**Legal costs.** These may be linked with violence and antisocial behaviours caused by the use of these products related to the fight against trafficking and the parallel economy from illicit substances, etc. These costs may also include importation duties, cost of police and legal fees as well as the cost of incarceration
	Dependence. This dimension takes into account elements of both physical dependence and psychical dependence, especially loss of control, cravings, and the compulsive needs it causes	**Social consequences of dysfunctional behaviour.** Social dysfunction, related to accidental or intentional damages caused to others, material damages (family or social violence); consequences to family functioning, caused by the effects of the product, or to the modified motivations of its consumers which distances them from their family in favour of the activities linked to the products are evaluated
Benefits	**Hedonistic benefits.** Here, the intensity of the pleasure obtained and the intensity or the uniqueness of the sensations procured is evaluated	**Economic benefits.** The economic importance (in the legal economy) of production, sales, distribution, commercialization, promotion and consumption of the product is evaluated. NB: The benefits to the society are evaluated taking into account the percentage of consumers
	Identity benefits. Using the product enables the consumer to integrate certain environments and social codes that reinforce his identity. The potential for socialization, related to the collective and cultural value of its use, is to be evaluated	**Social benefits.** The importance of the product's consumption in maintaining social balance, especially among social groups who compete for its production and distribution is evaluated. NB: The benefits to society are evaluated taking into account the percentage of consumers
	Auto-therapeutic benefits. Product use enables the consumer to soothe internal suffering and tension, especially those generated by relations with others. Eventual health benefits from these substances (cardiovascular benefits from wine (French paradox), nicotine and neurones, etc.) are to be integrated	**Cultural benefits.** The product's place among the various cultures and microcultures, its festive or convivial value, its integration into social rituals is evaluated. NB: These benefits are evaluated taking into account the percentage of its consumers

should be weighted for global evaluation. We mentioned above that our criteria for damages and benefits were constructed by our experts with a particular concern for the relative importance of the various categories. For further reflection, two complementary questions were included in the questionnaire for each product. One pointed to the user dimension—'Do you think that it is preferable to live and consume the product?'—with answers 'yes, I prefer to live and consume the product' or 'no, I prefer to live and not consume the product'. The other pointed to the social dimension—'Do you think that it is preferable to live in a society where the product is consumed?'—with answers 'yes, I prefer to live in a society where the product is consumed' or 'no, I prefer to live in a society where the product is not consumed'. These questions had two objectives. First, they correspond to the 'expert overall subjective opinion from a user perspective' and 'expert overall subjective opinion from a social perspective'. Thus, they allow quantitative descriptions of these items. Secondly, crossing these global opinions with the criteria-based scoring via statistical modelling (see below) revealed the weights that our experts associated implicitly with the different damage and benefit criteria when formulating their opinions.

Analyses of VAS scores and expert general opinion

For each criterion and each product, we used the mean values of VAS scores for the entire expert sample as summary statistics. This choice was validated by the homogeneity of the mean VAS scores across subgroups of experts (male experts, female experts, physicians, etc.).

We calculated an overall damage score for each product by summing the mean VAS scores for all six damage criteria. As discussed previously, this measurement gives equal importance to all six criteria. A similar overall benefit score was computed for each product, with an equal relative weight for all six criteria.

To produce an initial approximation, we calculated a damage/benefit balance for each product by subtracting the overall benefit score from the overall damage score, a positive balance reflecting an excess of damages over benefits. In this raw computation, damages and benefits are supposed to have the same importance: one unit of harm is deemed equivalent to one unit of benefit.

To test the validity of this hypothesis and to refine the damage/benefit balance computation, we analysed the expert overall opinions on products. Subjective opinions on product consumption from both a user and a social perspective were first described as proportions of 'yes' answers from experts.

Secondly, we designed a specific statistical analysis to cross the information on the overall opinions of experts with their criteria-based evaluation of damages and benefits. The main goal of this analysis was to estimate the weights assigned implicitly to the different damage and benefit criteria by the experts when making their overall opinions on products.

We built a model in which the opinion is the variable to be explained and the criteria-based evaluations of damages and benefits are the possible explanatory variables. We hypothesized that the opinions could be modelled correctly by a linear combination of damage and benefit criteria. Because the opinion is a binary outcome (yes/no), logistic modelling was the natural regression framework to be applied. With this model, the estimation of a regression coefficient for an explanatory variable directly represents its relative importance in the making of expert opinions. Damages and benefits are rescaled. Estimations of regression coefficients are the weights implicitly assigned by experts to the damage and benefit criteria.

As the overall opinions of experts from a user and from a social perspective were collected separately, two separate sets of regressions were performed. In the first set, the opinion from a user perspective was regressed on the three user criteria for damages and the three user criteria for benefits. In the second set, the opinion from a social perspective was regressed on the three social criteria for damages and the three social criteria for benefits.

The validity of all the regressions performed was checked by controlling that, for all regression coefficients β_i, the ratio $\sigma(\beta_i)/\beta_i$ was below 30.

To ensure a robust estimation of the regression parameters, the making of expert opinions was analysed jointly for all products.

Three models were applied successively and separately to the two regression sets. Under the most general model (model 1), all six criteria used to regress the opinion had an independent regression coefficient. Thus, the weight assigned to each criterion could differ. Under the intermediate model (model 2), a single regression coefficient was estimated for all damage criteria and another for all benefit criteria. Benefits and damages criteria could thus contribute unequally to the making of expert subjective opinion, but all benefit criteria were forced to have the same weight and all damage criteria were forced to have the same weight. Under the simplest model (model 3), a single regression coefficient was applied to all criteria. In this final case, all benefit and damage criteria were forced to have the same weight, which corresponded strictly to the raw damage/benefit balance proposed above.

All three models provided relative weights for each criterion but model 1 had more parameters than model 2 and model 2 had more parameters than model 3. To identify the most parsimonious model, i.e. the model with the smallest number of parameters and the best capacity to explain the overall subjective opinions, we used the Akaike information criterion (AIC) [14]. This criterion, derived from the maximum likelihood computation, was computed for each model. The most parsimonious model was then identified as the one with the minimum AIC value. We chose this criterion because, statistically speaking, it is a valid way to identify the most parsimonious model even when outcomes of the regression are non-independent. This is the case in our study, as opinions on all products were analysed jointly and the opinions of a given expert on different products may be correlated.

Finally, the relative weights estimated from the most parsimonious model were used to refine the damage/benefit balance for each product. Instead of simply subtracting the overall benefit score from the overall damage score, the 'overall weighted damage–benefit balance' was computed by summing the damage criteria scores, each one multiplied by the corresponding estimated weight, and subtracting the benefit criteria scores, each one multiplied by the corresponding estimated weight.

All analyses were performed using R software for statistical analyses [15].

RESULTS

Figure 1 shows the nine products ranked by their overall damage scores with the relative contribution of all six
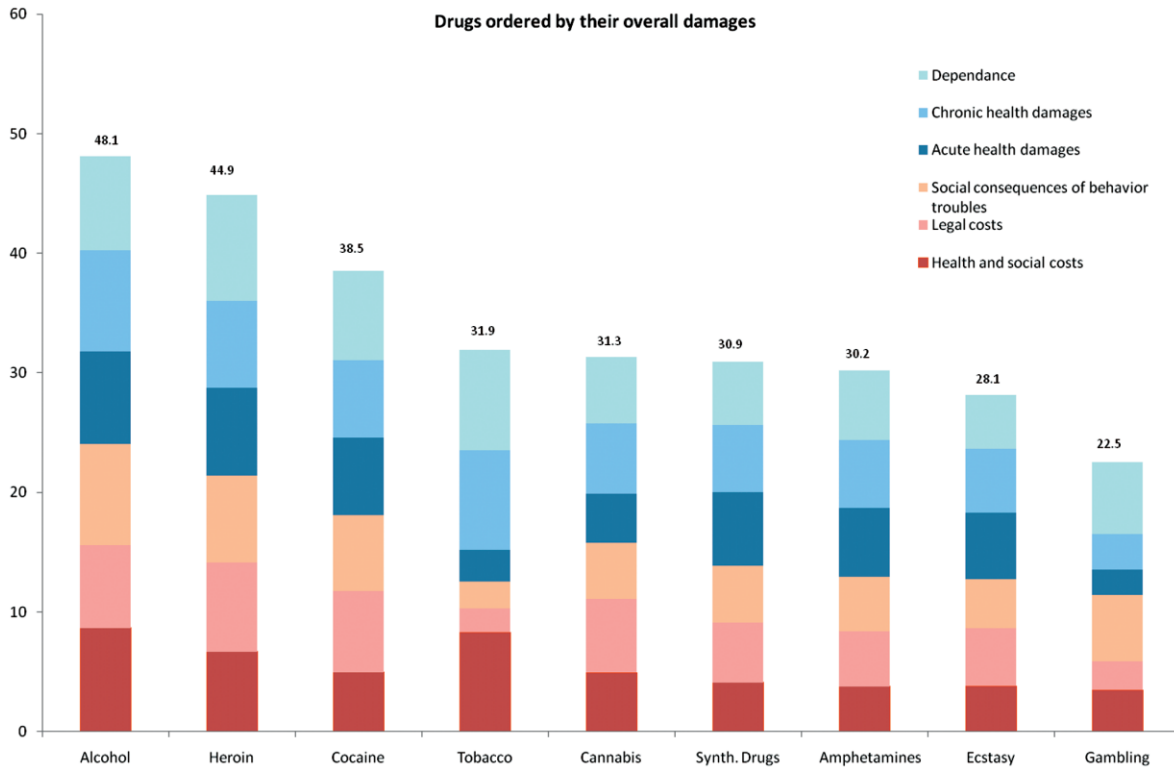
Figure I Products ordered by decreasing overall damages. Contributions to the overall score of each six damage criteria. The three user criteria are clustered at the top shown in blue; the three social criteria at the bottom shown in red

Table 2 Expert general subjective opinion on the products. Proportions of experts preferring to live and consume the product and proportions of experts preferring to live in a society where the product is consumed.

	Alcohol	Gambling	Cannabis	Tobacco	Amphetamines	Ecstasy	Synthetic drugs	Cocaine	Heroin
Prefer to live and consume the product	75%	29%	23%	13%	10%	8%	11%	8%	15%
Prefer to live in society where the product is consumed	82%	58%	42%	38%	27%	24%	24%	22%	20%

criteria. According to both individual and social criteria, alcohol is the most harmful product, followed by heroin and cocaine. If tobacco, cannabis, amphetamine, ecstasy and other synthetic drugs show similar overall damage scores, tobacco is characterized by relatively greater damage to users over damage to society. Gambling is a clear outlier, with less damage to users and to society. The correlation between this overall damage score and the total harm score proposed by Nutt *et al.* [3] for the seven products in common (alcohol, tobacco, heroin, cocaine, cannabis, amphetamine, ecstasy) is remarkably high ($r^2 = 0.95$). This is all the more interesting because the Nutt *et al.* harm score computation involved an explicit differential weighting of criteria, whereas our score embeds the relative importance of criteria in those criteria's definitions. We consider this result as a first valida-

tion of our damage grid. Furthermore, similarly to Nutt *et al.* [2,3], the correlation between our overall damage score and the legal status of products is very poor.

Interestingly, the correlations between the overall damage scores and the overall subjective opinions expressed by experts on the products from both a user and a social perspective are also poor (see Table 2). With 75% of experts preferring the possibility of a product's consumption and 92% of experts preferring to live in a society where its consumption is possible, alcohol ranked first in terms of overall positive opinions although it was considered to be the most harmful product. Conversely, gambling was the 'product' with the smallest damage score but only 29% of the experts chose the possibility to gamble and 52% preferred to live in a society where gambling is possible. We note that for all products, experts
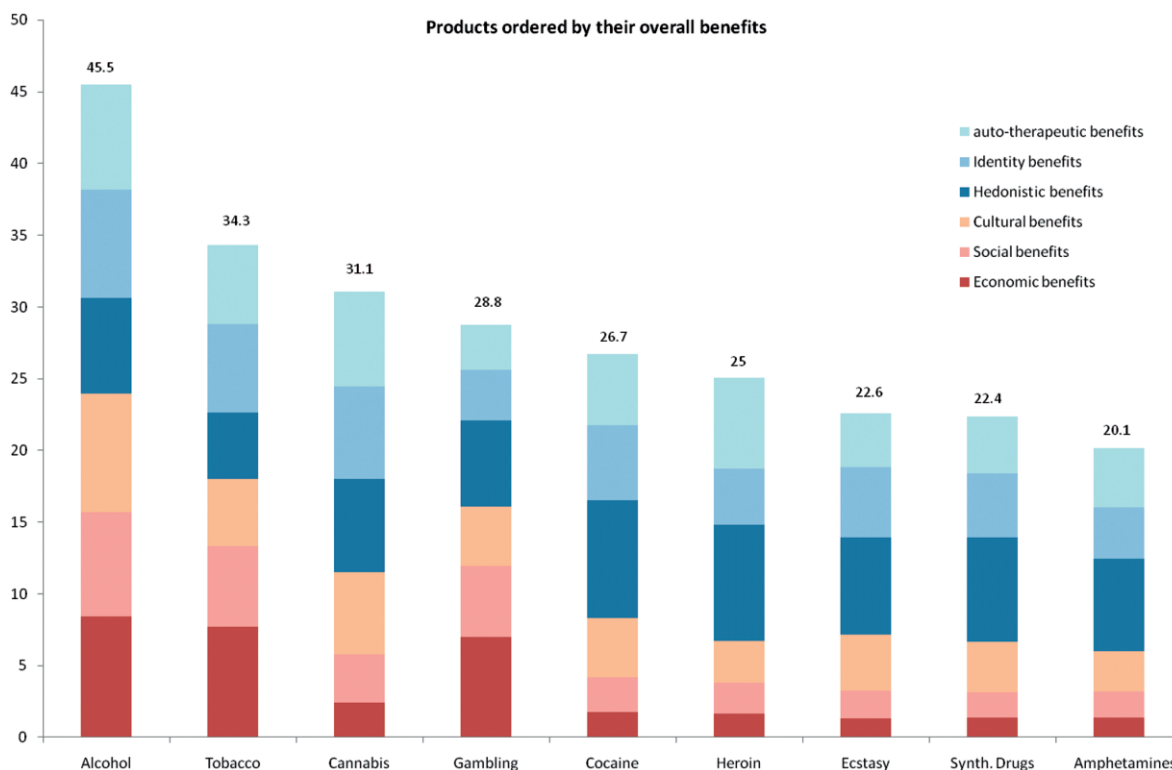
Figure 2 Products ordered by decreasing overall benefits. Contributions to the overall score of each six benefit criteria. The three user criteria are clustered at the top shown in blue; the three social criteria at the bottom shown in red

were more tolerant to product use when considering the social perspective than when considering the user perspective.

These results confirm that, even for experts, the overall damage score is not a sufficient explanatory variable for their subjective opinion on products. This reinforces the idea of benefit perception measurements.

Figure 2 shows the nine products ranked by their overall benefit scores with the relative contribution of all six criteria. Alcohol stands as a clear outlier with the highest individual and social benefits, followed by tobacco. Cannabis ranked third, with an overall benefit score greater than that of gambling.

In an initial approximation, damages and benefits were pooled in the raw balance in which all criteria contribute equally to the global balance (damage criteria are counted positively and benefit criteria are counted negatively). Using this approach, gambling and tobacco are the only two products with a negative balance, meaning that benefits are estimated to be higher than damages. The balance for cannabis is more favourable than for alcohol, although both are positive. The balance is clearly positive for all other products (see Fig. 3).

To test the robustness of this raw approach to damage/benefit balance assessment, we applied *ad hoc* statistical modelling in which expert overall subjective

opinions were regressed on damage and benefit VAS score evaluations. The results, presented in Table 3, show that the model that best explains expert preference formulations is model 2 for both user preference (smaller AIC of all three models) and social preference (equal AIC for models 2 and 1 but model 2 is preferable as it is more parsimonious). This means that using the raw damage/benefit balance to summarize the criteria-based evaluation of experts (i.e. model 3) is not the best way to predict the general subjective opinions expressed by experts. Interestingly, however, assigning equal weights to all damage criteria, on one hand, and equal weights to all benefit criteria, on the other hand, is a more parsimonious model of subjective opinion than considering each criterion separately. This result reinforces the robustness of the relative weighting embedded in our damage criteria definition, already indicated by the comparison with Nutt *et al.* [3]. Figure 4 presents the weights for damage and benefit criteria, estimated using models 2 and 1. From this analysis we estimate that, globally, experts give 10 times more importance to benefits than to damages when making their subjective opinion from a user perspective. Although it is less parsimonious, model 1 proposes interesting estimations of the relative impacts of the different criteria evaluated. The two criteria identified as having the greatest impact on subjective
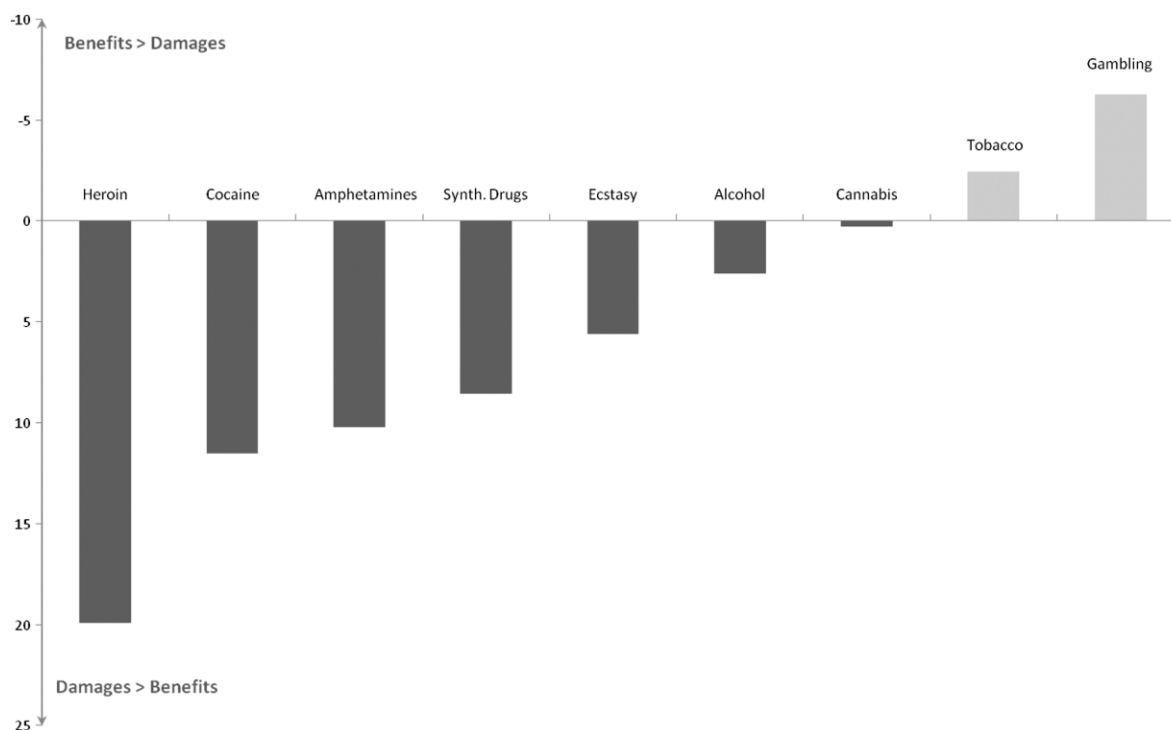
Figure 3 Overall unweighted damage–benefit balance

Table 3 Comparison of models linking expert general subjective opinion and criteria-based evaluation of damages and benefits.

Weighting scheme applied to the damage/benefit criteria	Subjective opinion from a user perspective		Subjective opinion from a social perspective	
	n	*AIC*	*n*	*AIC*
Equal weight for all criteria; univariate model 3	1	440	1	476
Equal weight for damage criteria/equal weight for benefit criteria; bivariate model 2	2	427	2	472
Independent weight for all criteria; multivariate model 1	6	422	6	472

Akaike's information criterion (AIC) and number of parameters (*n*) are presented for the three models studied, processing the subjective opinions separately both from a user perspective and a social perspective.

opinion-making are 'identity benefits' and 'auto-therapeutic benefits'.

The evaluations of benefit criteria also have a more decisive impact on the general subjective opinion from a social perspective than the evaluations of damage criteria, but the differential is more balanced (weights for benefits are 1.67 those for damages). Three criteria appear to be underweighted under model 3: social consequences, legal costs and economic benefits.
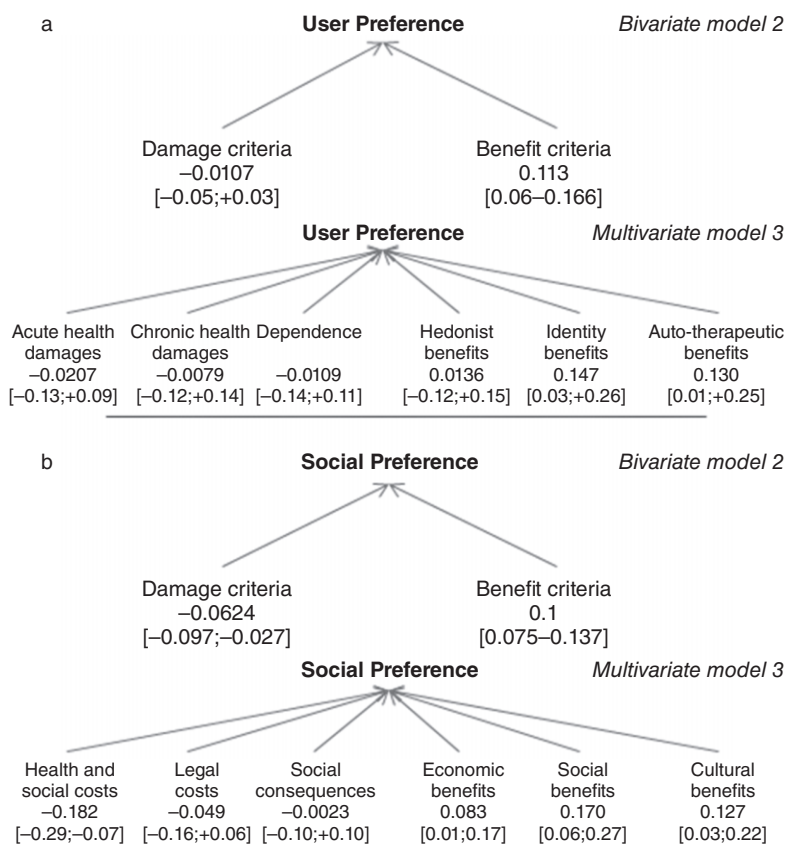
Finally, Fig. 5 presents the overall weighted damage–benefit balance, calculated using the weights estimated under model 2. In this representation, the correlation with legal status is notable. All legal products are on the right side of the scale; all illegal products are on the left. Note that gambling and cannabis have very similar

profiles. Both have a balance less favourable than that of tobacco, although the expert subjective opinions on these two products were positive more frequently than for tobacco. This can be explained by experts' opinions associating low economic benefits with cannabis and relatively small benefits to users with gambling.

DISCUSSION

The results from this damage/benefit analysis are interesting from several perspectives.

First, we identified alcohol, heroin, cocaine and tobacco as the most harmful addictive products. This result correlates strongly with the expert consensus-based measures of harm proposed by Nutt *et al.* [3]. The

a

User Preference   *Bivariate model 2*

Damage criteria   Benefit criteria
−0.0107   0.113
[−0.05;+0.03]   [0.06–0.166]

User Preference   *Multivariate model 3*

Acute health   Chronic health Dependence   Hedonist   Identity   Auto-therapeutic
damages   damages   benefits   benefits   benefits
−0.0207   −0.0079   −0.0109   0.0136   0.147   0.130
[−0.13;+0.09] [−0.12;+0.14] [−0.14;+0.11] [−0.12;+0.15] [0.03;+0.26] [0.01;+0.25]

b

Social Preference   *Bivariate model 2*

Damage criteria   Benefit criteria
−0.0624   0.1
[−0.097;−0.027]   [0.075–0.137]

Social Preference   *Multivariate model 3*

Health and   Legal   Social   Economic   Social   Cultural
social costs   costs   consequences   benefits   benefits   benefits
−0.182   −0.049   −0.0023   0.083   0.170   0.127
[−0.29;−0.07]   [−0.16;+0.06] [−0.10;+0.10] [0.01;0.17] [0.06;0.27] [0.03;0.22]

Figure 4 Estimation of weights associated with damage and benefit criteria in expert subjective opinion-making and corresponding confidence intervals. (a) Analysis of expert opinion from a user perspective and (b) from a social perspective. Estimation obtained with the bivariate model 2—upper part of (a) and (b) and the multivariate model 1—lower part of (a) and (b)
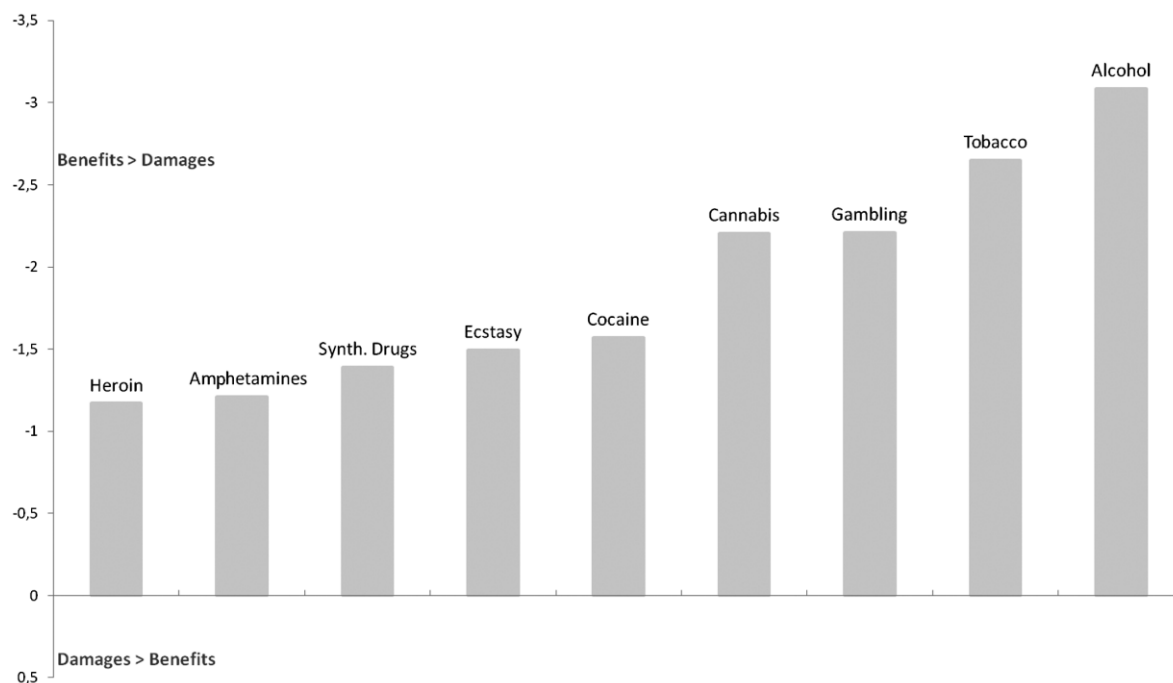
Figure 5 Overall weighted damage–benefit balance

similarity in harm assessment obtained using two relatively different study designs in two different countries certainly strengthens the value of these evaluations. It also validates our criteria definitions and our direct and larger expert-sample based evaluation procedure, at least for the seven commonly used products included in the two studies.

Secondly, our analysis of subjective opinion-making suggests that the perceived benefits from a user perspective are particularly important. This result is all the more interesting because most experts queried in our study were therapists. In other words, having an outstanding knowledge of harm to users did not prevent these experts from considering benefits first. From an evolutionist perspective, this result is not surprising. If the use of psychoactive products is present in every culture and every era, this is because of the pleasure obtained, the positive emotional states created, the stimulating and therapeutic effects against stress, pain, suffering or negative symptoms associated with psychiatric disorders [16]. Recent neurobiological data also support this perspective [17–20]. Psychoactive products modify and modulate the fundamental mesocorticolimbic network involved in pleasure, motivation or regulation of emotions.

Thirdly, as noted by others [1–3], our data show that the correlation between level of harms and drug legislation is poor, yet our systematic damage/benefit approach shed an interesting light on this discrepancy. The estimated damage/benefit weighted balance clusters the products into three categories: alcohol and tobacco appear at the most favourable end of the scale, gambling and cannabis cluster in the middle and all other illegal products are grouped at the least favourable end of the scale. This clustering reflects the particular status of alcohol and tobacco. The harmfulness of alcohol is outweighed completely by the high perceived benefits associated with this product. A similar mechanism is observed for tobacco. At the other end of the scale, perceived benefits for heroin, cocaine, ecstasy, amphetamines and other synthetic drugs are notably weaker. Their buffering effect on damages is less marked. Cannabis is the product for which the legal status appears the most questionable from our study. With high perceived benefits and moderate damages, cannabis has a weighted balance equivalent to gambling.

This correlation between legal status and the damage/benefit weighted balance should, however, be considered with caution. By construction, benefits to society (in particular economic and social benefits) are highly dependent on the legal status of the products. Taxes cannot be applied to illegal products. Note that legality also influences the evaluations of damages to society. The fight against trafficking and the parallel economy from illicit substances represents substantial legal costs. Our measurements and results should thus be taken for what they are: evaluations and analyses within in a specific legal context.

The present results are based on evaluations by experts in addiction. If their expertise on damages is expected to be strong enough to provide objective analysis, the situation is necessarily different for benefits. Frequent exchanges with product users, empathy and personal experiences of direct consumption of some products influence experts' knowledge but do not provide objective analysis. At best, their evaluation reflects accurately the perception of benefits among French experts in addiction. However, when designing the present study, we hypothesized that the subjectivity inherent in measuring benefits should not prevent their analysis. As our study illustrates, benefits have significant importance in opinion making, even among damage experts, thus strengthening our hypothesis. The goal here is not to collect objective facts on benefits. We know that such perceptions are complex and influenced by personal history, culture, experiences and efficacy of certain powerful lobbies. Rather, we think that, as for damages, a precise understanding of benefit perception could help to improve public policies in addiction. Consequently, similar studies should be conducted in the general population or in specific groups targeted for public health campaigns. The methodology developed in this paper could be fruitful for evaluating damage/benefit balances in the general public and among policy makers.

Declarations of interest

None.

Acknowledgements

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