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Using Online Crowdsourced Data to Measure the Availability of Cannabis Home Delivery: A Pilot Study

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ABSTRACT. Objective: The growing availability of cannabis products through home delivery services may affect cannabis-related health outcomes. However, research is impeded by a lack of data measuring the scale of home delivery. Prior research demonstrated that crowdsourced websites can be used to validly enumerate brick-and-mortar cannabis outlets. We piloted an extension of this method to explore the feasibility of measuring availability of cannabis home delivery. **Method:** We tested implementation of an automated algorithm designed to webscrape data from Weedmaps, the largest crowdsourced website for cannabis retail, to count the number of legal cannabis retailers offering home delivery to the geographic centroid of each Census block group in California. We compared these estimates to the number of brick-and-mortar outlets within each block group. To assess data quality, we conducted follow-up telephone interviews with a subsample of cannabis delivery retailers. **Results:** We successfully implemented the webscraping. Of the 23,212 block groups assessed, 22,542 (97%) were served by at least one cannabis delivery business. Only 461 block groups (2%) contained one or more brick-and-mortar outlets. In interviews, availability varied dynamically as a function of staffing levels, order sizes, time of day, competition, and demand. **Conclusions:** Webscraping crowdsourced websites could be a viable method for quantifying rapidly evolving availability of cannabis home delivery. However, key practical and conceptual challenges must be overcome to conduct a full-scale validation and develop methodological standards. Acknowledging data limitations, cannabis home delivery appears to be nearly universal in California, whereas availability of brick-and-mortar outlets is limited, underscoring the need for research on home delivery. (*J. Stud. Alcohol Drugs, 84,* 330–334, 2023)

BRICK-AND-MORTAR cannabis outlets are now commonplace in the 37 U.S. states that have legalized medical or recreational cannabis (National Conference of State Legislatures, 2022). One indicator relevant to cannabis-related health outcomes is the physical availability of cannabis, commonly measured by the number of cannabis outlets within a given geographic area (e.g., Census tract). Greater physical availability is hypothesized to make it easier to find, purchase, and use legal cannabis (Kilmer, 2019). Cannabis outlet density has also been linked to cannabis use and cannabis use disorder (Freisthler & Gruenewald, 2014; Mair et al., 2015). Cannabis use is associated with not only harms (including motor vehicle crashes, psychotic disorders, respiratory disease, and low birth weight) but also potential benefits (including reductions in opioid use) (Hasin, 2018; Smart & Pacula, 2019).

This research relies on complete, accurate listings of outlet locations. Although direct observation of outlets is the gold standard for generating listings, Cao et al. (2020) demonstrated that crowdsourced websites can be used to validly enumerate brick-and-mortar outlets in California. This approach has been widely used in empirical research (Freisthler & Gruenewald, 2014; Lipperman-Kreda et al., 2014; Mair et al., 2015; Shi et al., 2016). However, to our knowledge, no studies have tested whether such platforms can measure physical availability of cannabis through home delivery services.

Home delivery represents a growing proportion of legal retail cannabis sales (Business Wire, 2021). Consumers can often choose between large online deliverers (e.g., Eaze) and local brick-and-mortar outlets offering home delivery. Compared with brick-and-mortar outlets, delivery services may have larger sales volume, serve more tech-savvy consumers, and promote more at-home rather than in-community use; these factors have potentially important implications regarding the populations most affected by cannabis legalization (Matthay & Schmidt, 2021). Underage cannabis purchases, for example, may increase alongside home delivery because age verification is done at the doorstep rather than in-store.

Cannabis availability research that incorporates home delivery is absent. A primary barrier is lack of data. Traditional availability research characterizes people as "exposed" to the density of outlets in their residential neighborhoods (Gruenewald, 2011; Mair et al., 2019). To conduct analogous research for home delivery, researchers need listings of all retailers offering home delivery and information on the geographic zones to which each retailer delivers. Yet this infor-

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mation is not recorded in official license listings, and direct observation of all home delivery transactions is impossible.

In this methodological pilot study, we adapted Cao et al.'s (2020) method for enumerating brick-and-mortar cannabis outlets to explore the feasibility of using crowdsourced websites to measure availability of legal cannabis home delivery. We webscraped data from Weedmaps—the largest crowdsourced website for cannabis retail—to quantify the number of cannabis retailers delivering to specific locations, and conducted telephone calls with a subsample of delivery businesses to shed further light on data quality. We focused on California, the state with the longest history of cannabis legalization (medical cannabis in 1996 and recreational cannabis in 2016) and home to the world's largest legal cannabis market. Our study reveals practical and conceptual challenges that must be overcome before proceeding with a full-scale validation and developing methodological standards (Cao et al., 2020; Pedersen et al., 2018, 2020).

Method

Data sources, webscraping approach, and analysis

Weedmaps is a popular promotional website that allows cannabis retailers to list their business address, website, contact information, license type (medical, recreational, or hybrid), and modes of sale (delivery, storefront, or both). Among available crowdsourced websites (e.g., Leafly), only Weedmaps allows users to input an address or geographic coordinates (latitude, longitude) and return listings of all cannabis retailers delivering to that location. We exploited this feature to quantify availability of cannabis home delivery.

We measured how many home delivery retailers served the geographic centroid of each Census block group in California (N = 23,212). Between July 23, 2020, and August 5, 2020, we applied a Python-based program to query the application programming interface (API) underlying Weedmaps by inputting the coordinates for each centroid and extracting the number of cannabis retailers reporting to deliver to that location.

For comparison, in July 2020, we also webscraped listings of all brick-and-mortar outlets. After geocoding the listing addresses, we tabulated counts of brick-and-mortar outlets in each block group. See the Appendix for detail on measurement considerations. (A supplemental appendix appears as an online-only addendum to this article on the journal's website.)

Verification pilot

To inform interpretations and identify potential measurement challenges and limitations, we conducted two types of verification. First, we purposively selected four block groups representing a range of commercial landscapes and policy contexts, and conducted an exhaustive verification of all delivery businesses reporting to serve them (Appendix Table 1). For each of the 47 delivery businesses reporting to serve these four block groups, one coauthor conducted brief, unstructured telephone interviews to verify that the business delivered to the address corresponding to the block group centroid. They also asked how the delivery region was defined, if at all, and whether it varied by time of day, order characteristics, or other factors.

Second, we randomly selected 15 delivery-only retailers. For each, one coauthor reviewed the business's website to determine whether it was possible to identify a clearly defined delivery region. If no such region could be determined, or no website was available, the coauthor called the business to verify its delivery region and any variation by time of day, order characteristics, or other factors.

Results

Availability of cannabis home delivery

Of the 23,212 block group centroids assessed, 22,542 (97%) were reportedly served by at least one cannabis delivery business (Figure 1; see also the Appendix section "Number of delivery retailers per block group"). We identified 1,706 unique businesses offering home delivery. California block groups were served by a median of 9 home delivery businesses (range: 0–40) (Appendix Figure 1).

Verification pilot

Of the 47 cannabis delivery retailers that reported delivery to 4 selected block groups, 11 (23%) could not be reached by phone, 36 (77%) were successfully contacted, 35 (74%) were operational, and 24 (51%) confirmed delivering to the designated address. For the 15 randomly selected delivery-only cannabis retailers, we were able to verify clearly defined delivery regions for only 7 (see Appendix section "Selective website evaluation and call verification"; Appendix Figure 2).

Calls revealed several considerations for using Weedmaps to accurately measure availability of cannabis home delivery. Several retailers reported no fixed delivery zone. Instead, access to delivery depended on the number of existing orders, time of day, staffing levels, whether competing businesses were also open, and order size. Some businesses offered rapid, on-demand delivery whereas others delivered after hours or days because of the above factors or pre-scheduled delivery routes. Some businesses had no telephone listings, suggesting that they operated exclusively through online orders. We also found considerable duplication in the delivery retailers listings. A single business serving three different towns might have a separate listing for each town.

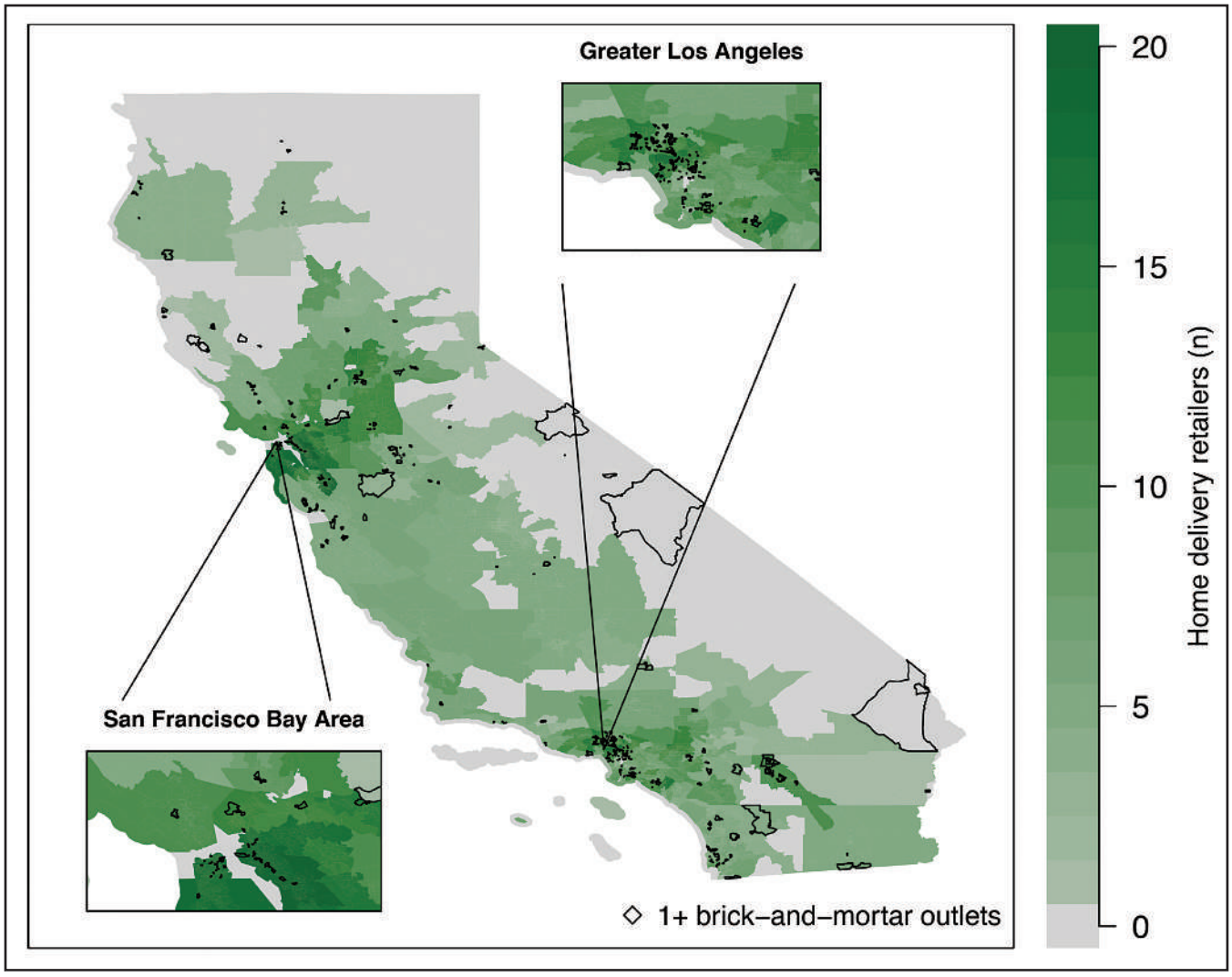

FIGURE 1. Number of cannabis home delivery and brick-and-mortar retailers serving each Census block group in California. Coloring indicates the number of cannabis home delivery retailers reported to service each Census block group. The black outlines indicate those block groups that contain one or more brick-and-mortar cannabis retailers.

Comparison to brick-and-mortar outlet counts

We identified 591 unique brick-and-mortar cannabis outlets. In comparison with the 97% of block groups with reported access to cannabis home delivery, only 461 block groups (2%) contained at least one brick-and-mortar cannabis outlet (see Figure 1 and Appendix Figure 3).

Discussion

Widespread availability of cannabis home delivery could have substantial public health implications, but little data on delivery exists. This methodological pilot study demonstrates the feasibility of using Weedmaps to measure availability of cannabis home delivery. We successfully implemented an automated webscraping algorithm to identify cannabis home delivery retailers serving every block group centroid in California. This approach is a potential scalable solution to the challenges of monitoring fast-growing business in cannabis home delivery. However, there are several unique methodological issues that will require verification research and development of methodological standards.

Our measure of availability of cannabis home delivery must be validated before the results can be acted on. Acknowledging important data limitations detailed below, a cautious interpretation of the results suggests that cannabis home delivery is widespread in California. Although the vast majority of block groups had no brick-and-mortar cannabis outlets, virtually all had reported access to at least one home delivery retailer. Weedmaps listings included some apparent duplication, and retailers could have overpromised on where they deliver. In addition, illegal brick-and-mortar cannabis

outlets are prevalent in California (Cao et al., 2020; Unger et al., 2020), and Weedmaps primarily captures legal retailers (Branfalt, 2020). Even so, the findings suggest that physical availability of legal retail cannabis may be far greater than previously understood based on brick-and-mortar outlets alone (Freisthler & Gruenewald, 2014; Lipperman-Kreda et al., 2014; Mair et al., 2015; Shi et al., 2016). Widespread availability of legal cannabis delivery also undercuts current efforts by 74% of California cities and counties to ban cannabis retailers by disallowing them from siting within their borders (Matthay et al., 2022; Silver et al., 2020). Further, the methods proposed here can be applied to states where illegal retailers are rare. The estimated density of home delivery retailers varied considerably across California block groups. Thus, prior research assuming that delivery is unlikely to contribute to block group–level variation in cannabis availability may need to be reconsidered (Cao et al., 2020).

Several practical challenges must be addressed before a full-scale validation of our approach is warranted. Our verification efforts, confined to 47 delivery businesses serving 4 diverse block groups, found that only half actually delivered to designated locations. Cao et al. (2020) show value in combining listings from multiple crowdsourced platforms plus official license listings to increase sensitivity and specificity, but the address search function appears unique to Weedmaps: official license listings and other websites do not indicate the region to which each retailer delivers. Duplicative listings were also more common for delivery retailers than for brick-and-mortar outlets. Listings of delivery services may therefore require special de-duplication procedures. Retailers reporting to deliver statewide—and those operating exclusively through websites, apps, or text messaging—may require additional verification. Further, missingness must be assessed: although Weedmaps' name recognition means that businesses are strongly incentivized to list themselves, some delivery businesses may not register on Weedmaps, and reported availability of home delivery should be compared to that from individual companies offering home delivery (e.g., Eaze).

The challenges for measuring cannabis delivery are also conceptual. Standard methods assume that availability is fixed in space and time, based only on physical proximity between residential addresses and brick-and-mortar outlets. Yet we found that home delivery varies dynamically as a function of staffing levels, order sizes, time of day, competition, and demand. Researchers will therefore need to adopt standard definitions sensitive to this variation in availability, along with differences in price between the two sources. In the absence of fixed geographic delivery zones, researchers must think carefully about how to operationalize cannabis availability in light of home delivery by revising existing conceptual models (Mair et al., 2019). Different conceptualizations of cannabis availability for brick-and-mortar versus delivery may also have differing implications for cannabis use and related harms. Whether such differences exist and why should be evaluated.

In future research, consumer surveys of cannabis purchasing patterns should be used to quantify variation in home delivery utilization and to validate Weedmaps data. Such surveys, although costly, should also examine the implications of home delivery for enforcement of public health regulations. As a proprietary business, Weedmaps could change its data on delivery services at any time. Researchers should therefore encourage state regulatory agencies to monitor the geographic footprint of cannabis delivery businesses by incorporating defined delivery zones as a component of licensing. Other states permitting home delivery (Colorado, Massachusetts, Michigan, Nevada, and Oregon) do so only with restrictions such as these.

Monitoring the scale of the cannabis home delivery is warranted because more states are legalizing cannabis. Growing availability of cannabis through home delivery could translate into increases in cannabis-related benefits and harms. Methodological work to measure home delivery also has implications for other commercial substances, including alcohol and tobacco, for which home delivery is also increasingly common, understudied, and challenged by measurement. Generalizabilty of this study may be limited because the scale of home delivery in California is unique. Thus, varying contexts must also be evaluated, as the accuracy of our method may vary by social context and cannabis market characteristics.

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Editor's note: In the January 2023 issue, the *Journal of Studies on Alcohol and Drugs* published an article by Mitchell and McCambridge (2023) titled "Interactions Between the U.S. National Institute on Alcohol Abuse and Alcoholism and the Alcohol Industry: Evidence From Email Correspondence 2013–2020." To place this article in a broader context of policy-related research on alcohol, the journal solicited responses from some of the leading investigators working in the emerging area of research on commercial determinants of health and disease. The resulting commentaries and correspondence are published in the current issue, along with responses from the original authors, Gemma Mitchell and Jim McCambridge. — Thomas F. Babor, Ph.D., M.P.H.

COMMENTARY

Tall Tales and Hidden Shallows: The Single-Minded Influence of the Alcohol Industry Over Public Discourse, Science, and Government Bodies— A Comment on Mitchell and McCambridge (2023)

JUST AS ALCOHOL is no ordinary commodity (Babor et al., 2023), the alcohol industry is no ordinary industry. A large proportion of sales (one study estimated some 60% of total sales revenue in England) (Bhattacharya et al., 2018) come from a minority of consumers who drink at more harmful levels (Viet Cuong et al., 2018). This represents a substantial conflict of interest in relation to public health. The highly concentrated alcohol industry is economically and thus politically powerful, with similar market structures and political strategies to the tobacco industry (Hawkins et al., 2018). It also shares historic links with the tobacco industry, including through co-ownership (Lesch & McCambridge, 2022; McCambridge & Morris, 2019).

There is a growing understanding that such commercial actors operate in predictable ways, that they can be viewed as commercial determinants of health (Kickbusch et al., 2016), impacting health directly but also indirectly through shaping policy, public opinion, science, and social norms. At times, these efforts can seem logically inconsistent, for example, decrying or obstructing large bodies of peer-reviewed public health research as "junk science," while at the same time placing substantial value and certainty on unevidenced corporate social responsibility initiatives, such as responsible drinking campaigns (Jones et al., 2017). They are, however, strategically consistent. In tandem with strategic influence on science and the use of science in policymaking (Legg et al., 2021), such efforts seek to maximize profit, minimize legal liability, and avoid reputational damage. The value of using a commercial determinants approach is that it brings together a range of theoretical perspectives, disciplinary lenses, evidence types, and methodological approaches to consider companies and sectors as units of analysis. It allows us to explore the strategic consistency that underpins, for example, alcohol industry corporate social responsibility, scientific practices, lobbying activities, legal action, and marketing efforts (see Maani et al., 2022).

Increasingly, such research shows that where conflicts of interest exist, both the commercial activities that result and their impacts can be measured and predicted (Lee et al., 2022; Maani et al., 2022) in a similar way to how shapes that a protein may take in a solution can be predicted based on its composition, its exposure to molecular crowding, and pH. Just as with protein biochemistry, science on the nature and activity of corporate actors is helping society bear witness to these phenomena, in ways that can benefit humanity.

Yet, as this latest article by Mitchell and McCambridge (2023) so strikingly reveals, staff within the National Institute on Alcohol Abuse and Alcoholism (NIAAA) not only were seemingly oblivious to the evidence regarding the nature, role, and conflicts of interest of the alcohol industry but also actively and deliberately enabled its efforts to influence research, policy, and practice. This included revolving-door practices, inviting comment on policy and guidelines, even helping the industry criticize independent public health research that might inform alcohol regulation. Strikingly, this went as far as coordinating press releases with the industry (Mitchell & McCambridge, 2023). There are strong echoes to previous research using freedom of information requests that showed Coca-Cola working with key staff in the U.S. Centers for Disease Control and Prevention, who then sought to help Coca-Cola lobby against sugar taxes (Maani Hessari et al., 2019). Considering the NIAAA's role in setting global norms and shaping wider agendas around alcohol research and policy, this level of cooperation provides a powerful lever for a globally consolidated industry to influence science and public health and manage its reputation in both mature and emerging markets.

Perhaps part of the reason such alcohol industry actors have remained partners of governments and are treated differently than the tobacco industry is that they have found ways to surround themselves with an apparent moral agency, using language of responsible marketing (Savell et al., 2016) and self-regulation (Durand et al., 2015) of corporate social responsibility, and a shared desire for responsible drinking (Maani Hessari & Petticrew, 2018). In the best public relations tradition, they adorn themselves in the finest of words, telling tall tales of their moral purpose, and leaving wider society oblivious to the hidden shallows of their business model, their reliance on harmful consumption

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(Bhattacharya et al., 2018). Often logically inconsistent, always strategically consistent.

We conclude with three reflections on the implications of this article. First, these findings underscore how important, and useful, research of this kind is. By providing detailed insights into otherwise black-boxed processes and institutions, freedom of information requests can advance both public understanding and the evidence base for how commercial actors influence public organizations. This is a powerful tool that researchers seeking to understand the science–policy nexus and the forces that shape it should consider in triangulation with other sources of evidence. Second, this research underscores the value of a commercial determinants of health lens, not just in assessing the impact of products on health, but also that of wider political and scientific practices on discourse, evidence, and public understanding. Last, it underscores that, contrary to the views expressed by certain individuals within NIAAA as revealed in this latest research, a key part of the science of alcohol is the science of understanding the alcohol industry. Few scientists would question that publicly funded research seeking to address the burden of tobacco-related harm should include research on the tobacco industry. As this article adds an important piece to a growing evidential and conceptual picture, surely it is time to extend this understanding to the commercial determinants of health more generally. Organizations such as NIAAA should be supporting the science, not undermining it.

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Commentary

More Public Health Scrutiny Is Needed on Government Actions: A Comment on Mitchell and McCambridge (2023)

THE ARTICLE BY Mitchell and McCambridge (2023) is a commendable attempt to shed light on a key dimension of the complex political economy of alcohol. The authors have faced a very difficult task making sense of a mass of piecemeal correspondence, with conversations often drifting offline and with limited or no contextual information. Yet, the analysis gives a clear sense of the issues at stake, however incomplete the picture may be.

I will provide some brief reflections, focusing on the 2015 Organisation for Economic Co-operation and Development (OECD)[1] alcohol report (Sassi, 2015), which I had the privilege to lead. I will do this in a personal capacity, as I am no longer an OECD official, and the contents of this commentary must not be read as reflecting the views of the Organisation. The correspondence analyzed in the article eloquently shows some of the challenges that were involved in producing and publishing the OECD alcohol report. International organizations are used to dealing with difficult and sensitive subjects, but at the time there was a clear feeling in the team that we had hit an especially difficult one. The whole OECD hierarchy, from the Secretary General down, and the Chair of the OECD Health Committee, all named in the acknowledgment pages of the report, deserve credit for their determination to prevent external influences from derailing the report and its underlying science. The Secretariat painstakingly responded to every point raised by external stakeholders, whether constructive or aggressive. We took what we thought was sensible into account, and we rejected what was not. At no point did I feel that we had to make substantive concessions to anyone, precisely because the entire organization was firmly behind that work. We did, however, accept to change the title of the report close to its publication, as a tactical move to relieve some of the mounting pressures. The original title ("Drinking lives away") wasn't the reflection of some radical anti-alcohol ideology. It had been borrowed from a road safety campaign run in Italy, based on messages written by schoolchildren, one of which was "don't drink your life away." We replaced it with one mentioning harmful alcohol use, in line with World Health Organization (WHO) policy. The move worked, and the report was published. This is what matters above all. We would not have changed that title if complaints had only come from industry. Country pressures were more difficult to resist, and this is the critical point that needs to be understood when reading Mitchell's and McCambridge's article, as I will discuss further below.

The OECD has formal processes in place for receiving inputs from different relevant stakeholders. Business stakeholders provide inputs through the Business and Industry Advisory Committee (BIAC, now Business at OECD). The OECD Health Committee decided to exclude BIAC from the sessions in which the alcohol report was being discussed. Of course, the Secretariat did receive, and listened to, comments from BIAC on many occasions, but when decisions about the report were being made by the Committee, BIAC was excluded.

BIAC had even expressed support for a focus on alcohol policies in the Secretariat's public health work, on the grounds that alcohol is a hindrance to workforce productivity. However, as soon as the Secretariat started working in this area the perspective of alcohol manufacturers became dominant. How did this happen? What does this tell us about the power and influence of alcohol manufacturers in business circles, let alone the wider world?

There is little doubt that an increasing industry concentration, at least in the spirits and beer sectors, has led to a stronger lobbying capacity by alcohol manufacturers. It was one of the goals of concentration in the first place. But lobbying is a legitimate activity in modern democracies, as long as it does not degenerate into unlawful practices and tactics. The alcohol industry can be expected to protect and promote their interests. It is the actions of the lobbied, more than those of the lobbying, that we should focus on. Because the lobbied (i.e. governments, in their various forms, including public research funding agencies) are those accountable to the public for the policies that regulate the economy and our

[1]Editor's note: The OECD is an international forum where the governments of 37 democracies with market-based economies develop evidence-based policy standards to promote sustainable economic growth.

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own lives, and for the science on which policies are based. To those policies we should be able to entrust the protection of our health. Today, governments all too often prioritize business interests over their citizens' health. We see this in so many instances, from alcohol to climate change, from food policy to gambling.

The greatest challenges to the OECD report came from some governments (beyond the health ministries represented in the Health Committee, of course), which prompts questions on why governments are often keen to support the alcohol industry agenda, despite the very clear damage alcohol causes in multiple ways. For too long, the public health community has focused much attention on fighting industry interference in policy, while looking complacently upon governments, deemed capable and willing to engage in a "health in all policies" agenda. The reality is that health ministries, which are supposed to lead a public health policy agenda bringing the rest of government on board, are politically weak and far too preoccupied with running increasingly unsustainable health care systems. Other government departments are driven by different incentives and pursue different goals, sometimes in conflict with public health. We have not been doing enough to understand those incentives and goals, let alone trying to change them, and ultimately we have not been able to hold governments to account. This is the lens through which I would encourage everyone to read Mitchell's and McCambridge's article.

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Commentary

The Alcohol Industry Is No Ordinary Stakeholder: A Response to the Commentaries on Mitchell and McCambridge (2023)

I THANK SASSI (2023) for taking the time to reflect on the production of the Organisation for Economic Co-operation and Development (OECD) report on alcohol (Sassi, 2015). The commitment from Sassi and colleagues to publishing an evidence-based report is clear, as are the political challenges faced in producing it. Sassi describes a range of stakeholders resisting the report's original title, *Drinking Lives Away,* and notes that it would not have been changed if the complaints came only from the alcohol industry. This makes a distinction between industry and other stakeholders that our findings do not support. As we report in the article, a National Institute on Alcohol Abuse and Alcoholism (NIAAA) senior leader advised a Diageo (one of the world's largest alcohol producers) representative on how to frame their concerns about the report to the OECD, including the title. Once it became clear that the title was going to be changed, the NIAAA official asked the Diageo representative for their "thoughts" on an alternative. Strikingly, in this case the NIAAA appeared to be supporting the alcohol industry's lobbying efforts.

Maani and Lauber (2023) discuss the legitimization achieved by industry when alcohol and the harms it causes are framed as problems of individual responsibility, leading governments to treat the alcohol industry differently than tobacco. This echoes work on the corporate political activity of the food and gambling industries, where there are examples of corporate actors not only influencing the discourse on how to act to reduce harm (van Schalkwyk et al., 2021) but also creating the very principles of scientific integrity (Mialon et al., 2021). Viewed in this context, although this was clearly not the intention of the authors of the OECD report, the title change to *Tackling Harmful Alcohol Use: Economics and Public Health Policy* could be seen as a framing "win" for industry, apparently aided by the NIAAA.

Although I agree with Sassi (2023) that attention must be paid to the role of governments, this cannot be done without also acknowledging the role industry plays in shaping that government activity. As Maani and Lauber (2023) argue, a "commercial determinants of health" lens is required to study the topic. The value of this analytical approach is that it treats industry as an object of study, permitting researchers to explore connections between seemingly separate actors (governments, industry), activities (science, policy, marketing), and harmful consumption industries.

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COMMENTARY

Links Between Industry and U.S. NIAAA Underline the Need to Rebalance Science in the Public Interest: A Comment on Mitchell and McCambridge (2023)

MITCHELL AND MCCAMBRIDGE (2023) meticulously detail the extensive interactions between the alcohol industry and leaders of the U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA), the largest public sector funder of alcohol research globally. The authors' source material—email exchanges between NIAAA leaders and the alcohol industry obtained via Freedom of Information Act requests—limits their ability to definitively examine why the alcohol industry was engaging so assiduously with National Institutes of Health (NIH) staff and the extent of its influence, including over the NIAAA research agenda. This comment therefore seeks to put their important findings in the broader context of the now overwhelming body of evidence of corporate influence over science, including publicly funded science. It outlines the urgent need to rebalance science in the public interest and begins to explore how this can be done.

Beyond the infamous examples of tobacco and fossil fuel companies, it is now firmly established that corporations from diverse industries systematically influence all aspects of science: what is researched, how the research is conducted, whether it is published, how it is interpreted, who it reaches, and whether it is used in policy (Legg et al., 2021). They do so in remarkably consistent ways, and a new model details how such actions work to systematically bias whole evidence bases and serve corporate interests—delaying regulatory action, preventing litigation, and maximizing product sales (Legg et al., 2021).

Focusing specifically on what is researched, comprehensive evidence shows that corporations use their own funding to skew science away from public health toward two particular lines of inquiry: research that supports their policy and legal positions by hiding product harms, and research focused on products that can be commercialized (Fabbri et al., 2018). In line with this, corporate-funded research is significantly more likely to favor the sponsor (Fabbri & Gilmore, 2023; Legg et al., 2021). With Organisation for Economic Co-operation and Development (OECD) data indicating that private research and development spending outstrips and is growing faster than government spending (OECD, n.d.), this biasing effect on the evidence base will only increase. To compound this, growing evidence indicates that corporations have also sought to and successfully shaped external research agendas—including those of various U.S. NIH divisions—in exactly the same way (Kearns et al., 2015; Legg et al., 2021; Parascandola, 2005).

For example, the sugar industry re-focused the then National Institute of Dental Research (NIDR) priorities away from researching public health interventions to reduce sugar consumption with a sugar industry report ultimately becoming the foundation of the NIDR's first request for proposals under its National Caries Program (Kearns et al., 2015). Its tactics—cultivation of relationships with the NIDR and the emerging alignment between industry and NIH positions—are markedly similar to the findings now being reported for the alcohol industry (Mitchell & McCambridge, 2023), including suggestions that one NIAAA leader promised to "quash" specific areas of research the alcohol industry felt was damaging (Begley, 2018).

That corporations can exert such influence over publicly funded research is alarming and indicates that the need to protect science from vested interests is more compelling and complex than ever. What can be done? Public research funders must first be aware of this evidence base. To redress the biased focus of corporate funding, they can shift their own toward public health research (Bero, 2023). To prevent influence on their agenda, they must rethink the way they understand and deal with conflicts of interest (COI), moving to address conflicts at structural, not just individual, levels (Marks, 2019). Although the NIH has detailed ethics and COI policies, these operate primarily at the individual level, focusing on transparency and disclosure by staff and grantees. Consequently, the NIAAA leaders involved sought and were given ethical approval for some of their interactions with alcohol industry representatives (Babor, 2023), despite the fundamental COI between a federal institute charged with addressing harms from alcohol use and those of an industry whose primary remit is to maximize sales of and profits from alcohol. A structural approach would instead seek to recognize and address these core conflicts

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(Fabbri & Gilmore, 2023). The Integrity Matrix developed by Marks provides one means by which research and other public agencies can begin to identify the "systemic ethical perils" of working with industries whose interests conflict with public health (Marks, 2019).

Beyond this, attempts to address the biasing impact of direct corporate funding have hitherto largely focused on improving research integrity (for example, by improving research contracts and ensuring freedom to publish), and enhancing transparency through disclosure. However, some of these strategies have shown to be inadequate and easily circumvented (Fabbri & Gilmore, 2023; Legg et al., 2021). Given the scale of the problem, it is incumbent upon us to now consider more comprehensive solutions. The most promising is dedicated manufacturer taxes. These are particularly relevant for corporations whose products are potentially harmful and should therefore fund research on those products yet have long records of research misconduct. Some countries have already successfully established such models, ensuring they are implemented independent of and free from industry influence (Fabbri & Gilmore, 2023; Legg et al., 2021).

How much more evidence do we need before we realize that it is imperative (and possible) to protect science from vested interests by doing things differently? At a minimum, taxpayers have the right to know that research they fund works in the public interest.

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COMMENTARY

Alcohol Producers' Success in Blocking Alcohol Marketing Research: A Comment on Mitchell and McCambridge (2023)

MITCHELL AND MCCAMBRIDGE (2023) have added useful detail to the large body of literature detailing how the alcohol industry influences science (McCambridge et al., 2023). What they were able to glean from the email traffic between the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the alcohol industry provides clear evidence of bias against research and researchers seeking to pursue and better understand what most scientific authorities—including the World Health Organization (2017), the Task Force on Community Preventive Services (Guide to Community Preventive Services, 2019), and the National Academies of Science, Engineering, and Medicine (2018)—have concluded are the most effective ways to reduce and prevent alcohol-related harm.

Their findings reveal a worrisome philosophical alignment between the views of alcohol producers (that alcohol problems arise and are best handled at the individual level) and the views of NIAAA's leadership. This alignment of views feeds directly into the industry's economic interests in blocking evidence-based measures to restrain unlimited alcohol availability, keep alcohol prices relatively high, and protect young people from exposure to alcohol marketing. It also increases the stigma experienced by individuals who do develop alcohol use disorders and, as such, functions as a barrier to those individuals' ability to seek out and receive treatment.

There is one area of research that has been particularly impaired by the inappropriate relationship between the alcohol industry and NIAAA documented in this article. This journal published a synthesis of research on alcohol marketing and youth that used the Bradford Hill criteria to conclude that the relationship between youth exposure to that marketing and subsequent youth drinking is causal (Sargent & Babor, 2020).[1] At the Center on Alcohol Marketing and Youth, we produced path-breaking studies over 15 years that both demonstrated where and how youth were being exposed to alcohol marketing and made concrete suggestions for reducing that exposure (Jernigan, 2011; Ross et al., 2021).

Our work was primarily funded by the U.S. Centers for Disease Control and Prevention (CDC), but we deepened it with NIAAA's support for the first-ever survey of young people's alcohol consumption by brand. This study (Roberts et al., 2016) grew out of a suggestion made to us by Dr. T.K. Li, the previous director of NIAAA. When we showed him our studies of the relationship between youth exposure to alcohol marketing and youth alcohol consumption, he pointed out that alcohol marketing was branded and that we needed to be more granular in our analysis, making the link between exposure to the marketing of specific alcohol brands and youth consumption of those brands.

Our work on alcohol marketing and youth was explicitly criticized in email correspondence between NIAAA and the alcohol industry (Mitchell & McCambridge, 2023, supplemental file d, p. 63), and our subsequent efforts to continue that work were denied funding despite being highly recommended by the National Institute of Health's (NIH) own peer reviewers (Begley, 2018). NIAAA's bias has seriously impaired that work and the lives it has tried to protect. Most of our research on alcohol marketing and youth preceded the explosion of algorithm-driven marketing via digital and social media. Our efforts to pursue this line of research were precisely what NIAAA refused to fund. As a result, there is a huge gap in knowledge regarding contemporary alcohol marketing and its impact on young people. A recent systematic review of studies of youth exposure to digital alcohol marketing and alcohol use found only cross-sectional studies, and nothing published in the United States past 2017 (Noel et al., 2020). As a research community, we have in essence abandoned the current generation of young people to the industry's increasingly sophisticated digital marketing efforts, and NIAAA has been a key player in that abandonment.

Although CDC supported the study of youth exposure to alcohol marketing in traditional media such as cable television until 2020, we were for years unable to convince the agency to take any initiative regarding marketing in digital and social media. Thankfully, CDC recently issued a call for

[1]Ironically, this synthesis appeared in a supplement funded by an NIAAA grant that had been awarded before the agency's apparent embargo on funding research on the effects of alcohol marketing on health.

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white papers as a prelude to possibly funding further work to measure and reduce youth exposure to alcohol marketing in social media. Yet CDC's ability to make a difference here will be limited by the sheer size of its budget. In FY 2023 (the current fiscal year), NIAAA's budget is $595 million, whereas CDC's entire budget for work on alcohol is a mere $5 million.

Mitchell and McCambridge (2023) present enough evidence to raise serious questions about the sufficiency and effectiveness of NIAAA's—and by extension the NIH's—institutional guardrails against private sector influence over science. CDC has done a far better job of keeping the industry at arm's length than NIAAA, and their products have been of far greater practical use to individuals, coalitions, and policy makers around the country looking to translate alcohol prevention science into population-level interventions on the ground. CDC has also somehow managed to avoid the steady drumbeat of industry contacts documented by Mitchell and McCambridge. Its success in doing so suggests that more of the resources for alcohol research should be given to CDC, unless NIAAA can learn from its southern cousin, develop stronger protections against conflicts of interest, and cease its industry-encouraged neglect of such crucial research areas as the influence of digital and social marketing of alcohol on young people's drinking and related harms.

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Commentary

The End of the Beginning or the Beginning of the End? A Response to Two Commentaries on Mitchell and McCambridge (2023)

THE COMMENTARIES BY Gilmore and Fabbri (2023) and Jernigan (2023) capture, I believe, key strengths of my article with Gemma Mitchell from the January issue of the *Journal of Studies on Alcohol and Drugs* (Mitchell & McCambridge, 2023) and explore context and implications, themselves making interesting contributions to the literature.

Gilmore and Fabbri (2023) suggest that "it is now firmly established that corporations from diverse industries systematically influence all aspects of science: what is researched, how the research is conducted, whether it is published, how it is interpreted, who it reaches, and whether it is used in policy" (p. 340). I agree with the key implication they draw that what is already known should compel structural as well as individual-level interventions to oppose these forces to defend the public interest, particularly in respect of research funders. The National Institute on Alcohol Abuse and Alcoholism (NIAAA) and, indeed, the National Institutes of Health (NIH) have failed to grasp the structural nature of the problem following the debacle of the MACH trial (National Institutes of Health, 2018). There is a danger, however, that the argument could be taken to imply that there is not much more we need to know. Also in light of Jernigan's (2023) characterization of a "large body of literature detailing how the alcohol industry influences science" (p. 342), it is appropriate to mark how far we have come and to reflect on how far we have to go.

Although Gilmore and Fabbri's (2023) portrait works as a big-picture account of what can occur, and indeed why, the circumstances in which corporate actors do behave in this way may require more nuanced analyses. Also, arguably we know little about the effectiveness of superficially similar approaches by corporations across sectors in producing bias in scientific evidence and interfering in policy making. We certainly know little for alcohol (McCambridge et al., 2018, 2023). For tobacco, notwithstanding the large empirical literature based on the internal company documents, we are also early in the development of explicit theory building and hypothesis testing (Ulucanlar et al., 2016).

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Comparative analyses are thus needed that identify not only similarities across corporate sectors but also what is distinct between them. For different sectors, their supply chains, products, services, or activities may be more or less intrinsically harmful to health, environment, and society. There will also be variability within the sector, particularly contrasting larger companies with smaller ones, with implications for how corporations think about, and what they do in, science and policy in relation to harms they cause (Iivonen, 2018). Corporations are organizations with internal lives that may be more or less antisocial in their character within a given sector, potentially making for variability in openness to change (Fyke & Buzzanell, 2013).

Perhaps we have gained key insights in first-generation case studies, which direct our attention to where we need to look for deeper understanding. We need to follow up on that with more compelling research that does not stop at the identification of bad actors and is explicit about where the evidence needs to be stronger for different stakeholders. We should expect that the effectiveness of corporate interventions will be contingent on the architectures of scientific and policy making institutions, the ideas that permeate their sense of purpose, and the interplay of competing interests within and around them (Lesch & McCambridge, 2021). Systematic reviews that address the kinds of questions suggested here will use rigorous methods to obtain the needed depth. Deviant cases—findings that counter prevailing narratives—deserve particular examination. Reviews of reviews are needed to examine methods used and interrogate both findings in common and those that are conflicting to build trust in the science within and beyond the research community.

Jernigan's (2023) commentary makes for a nice contrast with Gilmore and Fabbri (2023), underlining complementarity. Jernigan sketches out the fine detail on marketing research funding that needs to be studied rigorously in a case study. He appears to have a strong case that his work on alcohol marketing has been suppressed by NIAAA and is clear eyed about the long-term public health consequences of such funding bias. There is smoking-gun evidence in the email correspondence. Jernigan articulates strongly the short-term

consequences for young people, and in the longer run this means ruined lives and premature deaths.

I agree with Gilmore and Fabbri (2023) that the communication of the big picture is an urgent task to safeguard the integrity of public funding and to start to undo damage already done. I also agree with Jernigan on implications for decision making at the intersections of public health policy and science policy. As progress is made on funding, it reinforces progress possible in the complementary approach of more fine-grained empirical studies of particular corporations and sectors and the associated theory building and hypothesis testing. Public health policy needs more population-level research, and NIAAA should solicit it. Also note that the institute is far from alone among health-research funders in this respect. In addition to being social epidemiology, this is essentially applied social-sciences research, and social-sciences research funding is everywhere scarcer than health research funding of all types.

The power of corporations is increasingly obvious, making clearer the need to manage better the most antisocial corporations and sectors in particular. It may be that whoever wins the battle for public support on this issue will determine whether this is the end of the beginning or the beginning of the end. Science policy itself has been an important target for corporate influence (McCambridge et al., 2019), in addition to particular scientific institutions such as NIAAA (Mitchell & McCambridge, 2023). Neoliberal governments increasingly demand that publicly funded research should serve impact agendas defined increasingly in narrow economic terms (Smith et al., 2016). There is, of course, a public interest that high-quality research can help articulate in more compelling ways to the public and to policy makers. Making plain the costs to public health and society, explaining how and why they are avoidable, and showing how the situation can be improved will perhaps be the end of the beginning of this era in research and the beginning of the end of the corruption of NIAAA by the major alcohol companies.

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Correspondence

NIAAA-Supported Research and the Public Discourse Around Alcohol: A Clarification Regarding Mitchell and McCambridge (2023)

Dear Editor,

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) would like to clarify the assessment by Mitchell and McCambridge (2023), "Interactions Between the U.S. National Institute on Alcohol Abuse and Alcoholism and the Alcohol Industry: Evidence From Email Correspondence 2013–2020." The article attempts to reassess issues that arose with the Moderate Alcohol and Cardiovascular Health (MACH) trial that were addressed by the National Institutes of Health (NIH) in 2018 through extensive evaluation and recommendations by the independent Advisory Committee to the (NIH) Director (ACD; https://acd.od.nih.gov/documents/presentations/06152018Tabak-B.pdf), and NIH's response (https://acd.od.nih.gov/documents/presentations/12132018MACH_report.pdf). Although the authors reference the ACD recommendations, they neglect to reference NIH's full response to those recommendations. More notably, the article conflates emails sent and received before 2018 with current practices, as well as overly emphasizes email correspondences with industry groups without the context of interactions NIAAA has with all its constituents.

As a federal agency, NIAAA interacts with the full range of organizations interested in its research, including many scientific, professional, and advocacy organizations, such as the Community Anti-Drug Coalitions of America (CADCA), FASD (Fetal Alcohol Spectrum Disorders) United, National Association for Children of Addiction, Research Society on Alcoholism, American Association for the Study of Liver Diseases, Society for Prevention Research, American Society of Addiction Medicine, and many others. The overall number of interactions NIAAA has with all its constituents far exceeds interactions with industry interest groups. NIAAA also engages with the Friends of NIAAA, an independent, nonprofit advocacy group comprising organizations with an interest in the NIAAA mission and research. NIAAA participates in Friends of NIAAA–sponsored events by presenting research-based information to policymakers and the public. The emails discussed in the JSAD article do not provide this context and should not be conflated with the unacceptable interactions surrounding the MACH trial.

NIAAA recognizes that all levels of alcohol consumption confer some health risk and that recent scientific evidence has undermined support for any positive impact of alcohol on health (GBD 2016 Alcohol Collaborators, 2016). As a result, NIAAA has updated its conceptual framework based on the growing body of evidence that there is no healthy amount of alcohol consumption. In parallel, the nation's conversation around alcohol has changed dramatically in recent years, and NIAAA has played a significant role in the shift toward reexamining our societal relationship with alcohol.

NIAAA-supported research has informed the public discourse around alcohol in multiple areas. This includes the publication of high-visibility articles on trends in increased alcohol-related emergency department visits, hospitalizations, and deaths, especially among women (Chen & Yoon, 2018; White et al., 2018, 2020). Messages from these findings are disseminated in numerous press interviews, social media posts, and presentations and also note that the risk for breast cancer increases with each drink (Yoo et al., 2022). NIAAA has been working with the National Cancer Institute in disseminating information on the role of alcohol in cancer. Importantly, NIAAA-supported research has contributed to the decline in underage drinking, and we continue to work with such organizations as CADCA to disseminate evidence-based information. Emerging data on alcohol's effect on the developing adolescent brain have been especially compelling to parents and community leaders. NIAAA's broad research portfolio is intended to inform practice and policy around health, given the adverse impacts of alcohol use.

NIAAA will continue to support research that informs the prevention, diagnosis, and treatment of alcohol-related problems. Assessing the risks associated with all levels of alcohol consumption as they affect individuals across the life span will inform practice and policy that improve public health.

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Correspondence

Response to Letter to the Editor by George F. Koob (2023)

Dear Editor,

I appreciate Dr. Koob's (2023) willingness to respond to our article (Mitchell & McCambridge, 2023) and would like to respond to his comments on National Institute on Alcohol Abuse and Alcoholism (NIAAA) interactions with stakeholders in the context of the Moderate Alcohol and Cardiovascular Health (MACH) trial. The alcohol industry has a significant conflict of interest in relation to public health. This is because it makes a large proportion of its profits from sales to heavy drinkers, who experience a large proportion of the harm (Babor, 2023; Maani & Lauber, 2023). It is unclear why this conflict of interest and the scientific literature underpinning it have not shaped or informed NIAAA's engagement practices. For example, as we report in the article, an NIAAA senior leader introduced and endorsed a Heineken corporate social responsibility leader to a National Association for Children of Alcoholics representative, which is one of the groups Koob lists among the organizations NIAAA interacts with. We also report that the Friends of NIAAA, which Koob references, lists the industry-funded "social aspects" organization, the Foundation for Advancing Alcohol Responsibility (FAAR), as a member, and that the two groups co-organized an NIAAA event in March 2018. It is precisely this apparent treatment of the alcohol industry as just one of many stakeholders the NIAAA interacts with that is problematic.

What Koob describes as the "unacceptable interactions" surrounding the MACH trial are presented in his correspondence as separate from wider email correspondence. In the article, we discuss how the MACH trial facilitated relationship-building between NIAAA staff and industry. It is difficult to argue that the MACH trial is an isolated incident of industry influence when, for example, an NIAAA official advised industry on how to frame their concerns regarding the wording and content of an influential report on alcohol (Sassi, 2015) before publication. This is one set of interactions among many we report in the article.

In our article, we make it clear that we do not know whether any changes in terms of NIAAA interactions with industry over time (pre- and post-2018) were a result of the MACH trial scandal or an artifact of the data set. It is important to note, however, that interactions with FAAR, the trade associations DISCUS and the U.S. Beer Institute, and the "social aspects" organization the International Alliance for Responsible Drinking (IARD, formerly ICAP) continued up to January 14, 2021, the end date of the Freedom of Information Act (FOIA) request. This suggests that the larger issue of institutional conflicts of interest has not been addressed. Our call for an independent investigation remains.

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Correspondence

As Clear as Mud: Response to Letter to the Editor by George F. Koob (2023)

Dear Editor,

George Koob (2023) writes to clarify the assessment made in Mitchell and McCambridge (2023). It is disappointing that what looks like an entirely defensive public relations piece has not engaged with the important scientific issues raised. We did not go over old ground as claimed, although there are a number of interesting features of this response. The suggestion of conflation with the MACH trial debacle has no substance. Such data were excluded by design, and it is hard to see any indications of subsequent learning on the part of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) in this response. Identification of various NIAAA stakeholders does not provide useful context but instead deflects attention from the close relationships studied. It would be very interesting to examine the updated NIAAA conceptual framework, although no citation is provided. This obviously needs to include the companies who are perpetrators of so much alcohol harm, including via influence of science and policy (Babor & Robaina, 2013; McCambridge et al., 2023).

Koob (2023) claims that "NIAAA has played a significant role in the shift toward reexamining our societal relationship with alcohol" (p. 346). On what basis are such claims made? Has NIAAA funded robust evaluation studies that evidence this shift and NIAAA's role in it? Note this also works as the basis for a straw man argument; Koob goes on to describe the dissemination of good research work that NIAAA has funded, as if we had suggested that they did not. Koob claims that "NIAAA-supported research has contributed to the decline in underage drinking" (p. 346). This is interesting. This is an international phenomenon in which research appears to play little direct role (Raninen et al., 2022), and the public health implications may be more complicated than it first seems (Livingston et al., 2023).

Koob (2023) ends with the following: "Assessing the risks associated with all levels of alcohol consumption as they affect individuals across the life span will inform practice and policy that improve public health" (p. 346). Perhaps regarding the public's health as more central to the mission of NIAAA would involve funding research on how major alcohol companies' marketing and political strategies undermine health (Babor & Robaina, 2013; McCambridge et al., 2023).

The National Institutes of Health (NIH) has much to consider. There are lessons to be learned on alcohol from the MACH trial (Mitchell et al., 2020), our recent report (Mitchell & McCambridge, 2023), and indeed the Koob letter (2023). The NIH response to the MACH trial (NIH, 2018) made reasonable-seeming recommendations, although it now appears that it did not go nearly far enough. The nature of the letter to the editor (Koob, 2023) amplifies the issues identified in our study (Mitchell & McCambridge, 2023) that NIAAA appears not to have learned the necessary lessons because the institutional problem is so deep.

Around a decade ago, NIH was seriously considering merging the drugs and alcohol branches, and there may be merit in examining why that did not happen. It is hard to imagine that it is defensible to continue avoiding funding research on alcohol industry political, scientific, and marketing strategies and determining when, how, and why NIAAA became so open to industry influence. I agree with Koob that clarity is much needed, although muddying the waters obviously does not achieve that. How about the National Institute of Alcohol and Public Health as a way forward that articulates a clear sense of purpose? The leadership of such an entity might be expected to have quite a different relationship with the alcohol industry than has had the NIAAA.

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