

RESEARCH ARTICLE

Applying a co-design approach with key stakeholders to design interventions to reduce illegal wildlife consumption

Sifan Hu^{1,2}  | Zhijian Liang²  | Kaiwen Zhou²  | Diogo Veríssimo^{3,4}  |
Tien Ming Lee^{1,2,3}  | Xiangdong Ruan⁵  | Amy Hinsley^{3,4} 

¹School of Ecology, Sun Yat-sen University, Shenzhen, People's Republic of China

²School of Life Sciences and State Key Laboratory of Biological Control, Sun Yat-sen University, Guangzhou, People's Republic of China

³Oxford Martin School, University of Oxford, Oxford, UK

⁴Department of Biology, University of Oxford, Oxford, UK

⁵Academy of Inventory and Planning, National Forestry and Grassland Administration, Beijing, People's Republic of China

Correspondence

Sifan Hu
Email: huf3@mail.sysu.edu.cn

Tien Ming Lee
Email: leem@mail.sysu.edu.cn

Amy Hinsley
Email: amy.hinsley@biology.ox.ac.uk

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Abstract

1. Co-design, an approach that seeks to incorporate the experiences and perspectives of different stakeholders, is increasingly being used to develop audience-oriented behaviour change interventions.
2. The complexity of wildlife consumption behaviour makes the co-design approach an important potential tool for the design of conservation interventions that aim to reduce illegal wildlife trade. Yet, little is known about how to adapt and apply the co-design approach to the wildlife trade sector.
3. Here, we applied a co-design approach to develop interventions aimed at reducing illegal animal-based medicine consumption in China. We conducted three workshops with key stakeholders: consumers of animal-based medicines, pharmacy workers who sell them and traditional Chinese medicine (TCM) doctors who prescribe them. We then developed a theory of change to ensure the relevance of the co-designed intervention prototypes.
4. Our co-design process identified five main pathways of interventions, including two inclusive solutions that may have been previously overlooked in behaviour change work in this context. These were an intervention to promote the appropriate use of TCM and one to increase consumers' capacity to identify the legality of products. Our prototype interventions also enhanced existing views related to the role of medical practitioners in health-risk communication.
5. We used our co-design process and reflections on its application to this specific market to provide guidelines for future conservation program planning in the broader wildlife trade context. Some intervention prototypes produced during co-design may need wider stakeholder involvement to increase their feasibility for implementation.
6. We show that the co-design process can integrate multiple stakeholders' perspectives in the ideation stage, and has the potential to produce inclusive intervention designs that could drive innovation in conservation efforts to reduce illegal consumption of a range of wild species.

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KEYWORDS

animal-based medicine, behaviour change, co-design, demand reduction, illegal wildlife trade, theory of change, traditional Chinese medicine, wildlife consumption

1 | INTRODUCTION

Illegal wildlife trade can undermine efforts to conserve biodiversity and lead to social and economic harm to human societies (Sas-Rolfes et al., 2019). As the trade is often driven by demand from consumers, the need for conservationists to better understand consumer decision-making processes is increasingly recognized (Thomas-Walters et al., 2021; Veríssimo et al., 2020). However, the complexity of wildlife consumption behaviours can make designing behaviour change interventions challenging. For example, wildlife trade can involve numerous species and product forms from multiple sources (wild-captured vs farmed; illegal vs. legal), which requires consumers to make complex decisions (Sas-Rolfes et al., 2019). Meanwhile, there are diverse consumer motivations in the context of wildlife trade and a range of stakeholders who may influence wildlife consumption (Thomas-Walters et al., 2021). Fully considering these complexities in the design of conservation interventions is crucial to achieve the desired behaviour change (Hinsley & 't Sas-Rolfes, 2020).

Interventions originating from expert-led design have been widely used with the aim of influencing behaviour (Trischler et al., 2019). In many cases, target audiences are mere recipients, and rarely play any active role in informing the intervention design, which may limit the exploration of their unique insights and experiences (Bowie et al., 2020). Co-design is increasingly being used in the public service sector (health service) to effectively gather multiple perspectives on behaviour change interventions, where target audiences are actively involved as designers (Dietrich et al., 2016; Trischler et al., 2019). As a design thinking approach, co-design could help to collaboratively address complex societal problems and drive innovation (Bogomolova et al., 2020; David et al., 2019).

For wildlife trade, the complex and diverse consumer motivations and stakeholders in wildlife consumption make the audience-oriented approach particularly important during the intervention design process (Thomas-Walters et al., 2021). However, limited resources (budget and timelines) often impede academic researchers and/or conservation practitioners from conducting consumer research studies (Greenfield & Veríssimo, 2019). As such, intervention design may oversimplify drivers and the context of consumption, which might cause the intervention to be disconnected from local realities and culture, making it more likely to fail or even to result in the opposite effect to what was originally intended (Hinsley & 't Sas-Rolfes, 2020). Facing these challenges, co-design has been proposed as a nimble approach that can be superior to traditional qualitative methods (e.g. interviews), which are limited on the evidence collection stage which are not tailored to the specific goal of creating intervention prototypes and therefore require extra data-analysis steps to produce these outcomes. Co-design allows stakeholders

to contribute to the ideation process, which could incorporate stakeholders' attitudes and perceptions to intervention design in a more equitable, active and efficient way (Bogomolova et al., 2020; Bowie et al., 2020). While co-design has been explored in the broad biodiversity conservation sector (e.g. Bowie et al., 2020; David et al., 2019), there is still limited adoption and no guidance on how co-design processes could be conducted in a wildlife trade context.

The lack of a clear and organized process by which co-design ideas can be transformed into intervention prototypes is a key challenge to using this approach, as it limits understanding of diverse pathways and underlying assumptions. As a decision support tool, a theory of change (ToC) could be a feasible approach to better lay out how the co-designed interventions would work, by charting the gap between what an intervention does, and how it could lead to the desired outcomes and impacts (Biggs et al., 2017; Taplin et al., 2013). A ToC can clearly illustrate both the causal links and sequences of steps needed for an intervention and the assumptions underlying each step in the process of change (Biggs et al., 2017). This approach has been widely used in informing practice for planning activities and evaluating whether desired outcomes and impacts have been achieved (Salazar et al., 2019). Yet, these are not always designed in consultation with diverse stakeholders in a co-design process, which is critical to ensure the ToC is informative and reflects the conditions of wildlife markets on the ground.

To illustrate how the co-design approach can be applied to wildlife trade contexts, we apply a co-design approach to collect stakeholders' insights into the complex market for traditional animal-based medicine in China and translate them into realistic and inclusive intervention designs to reduce illegal wildlife consumption. Furthermore, we map a ToC to transform co-design ideas into feasible prototypes, illustrating what the co-designed interventions are, how they could be used to reduce illegal wildlife consumption and/or promote use of sustainable alternatives, and what pathways or potential barriers are for the desired outcomes to intervention implementation.

2 | CO-DESIGN APPROACH AND APPLICATION

Design thinking is an approach to solve complex problems and foster innovation by taking into consideration the perspectives of relevant stakeholders through a team-based approach (Bogomolova et al., 2020; Trischler et al., 2019). As a specific instance of design thinking, co-design can empower stakeholders to contribute as owners of unique knowledge and experiences (Dietrich et al., 2017; Trischler et al., 2019). It represents a shift away from design as the

task of experts towards using the collective creativity of a team from different backgrounds (Sanders & Stappers, 2008; Trischler et al., 2019), reflecting a bottom-up philosophy (Dietrich et al., 2016).

Co-design with multi-stakeholders could contribute to developing inclusive ideas or enriching existing ones, to better address the audience's needs (Bogomolova et al., 2020). It has been shown to be particularly helpful in exploring users' unique knowledge and latent needs in public service sectors (Trischler & Charles, 2019). In the wildlife conservation context, co-design has also shown the value in informing disruptive insights to reduce wildlife-pet interaction by shifting the focus of solutions from koala to dogs (David et al., 2019). With a focus of co-creation with stakeholders, such a user-driven ideation process could produce innovative insights for the designs of behaviour change intervention (David et al., 2019; Trischler et al., 2019). A seven-step framework has been proposed for public service design: resourcing, planning, recruiting, sensitizing, facilitating, reflecting, and building for change, emphasizing that the front-end and back-end phases are iterative in nature (Trischler et al., 2019), and applied to a sustainable use context with coffee consumers (Bowie et al., 2020). Here, we present an application of the seven-step co-design framework to the wildlife trade context (Figure 1).

3 | METHODS AND CO-DESIGN PROCESS

3.1 | Preparation for co-design process (steps 1–3)

3.1.1 | Resourcing

During the first step of co-design, *resourcing*, the research team applies multiple methods (e.g. literature reviews, expert interviews, surveys) to gain an initial insight of the underlying problem, and the task and aims to be addressed (Trischler et al., 2019). This is an important step to inform all subsequent co-design stages. Resourcing, planning and recruiting steps can be an iterative process to ensure the engagement of multiple stakeholders throughout the co-design process (Trischler et al., 2019). In the wildlife consumption context, we gathered information about traditional Chinese medicine (TCM), which involves the use of various flora, fauna or funga ingredients (Cheung et al., 2021). Illegal trade or unsustainable use of these wildlife products can threaten the survival of species and pose serious challenges to their conservation (Sas-Rolfes et al., 2019). To address the threats, we focus on animal-based traditional medicines in the wildlife trade context, aiming to reduce illegal wildlife consumption and/or promote use of sustainable alternatives.

Animal-based traditional medicines are highly diverse, so we used bear bile products as an example to frame our workshops around. We chose bear bile because its products exist in both legal and illegal markets (Liu et al., 2017), and the form and sale of legal and illegal products are relatively distinguishable in China. For example, legal packaged products containing bear bile powder must come from registered companies and display a product certification label in China (NFGA, 2004). In addition, illegal wild bear bile use continues

to be an issue of conservation concern (Hinsley et al., 2021). While we used bear bile as our key example, throughout the co-design process, we encouraged participants to think more broadly by sharing experiences and views about other animal-based medicines.

3.1.2 | Planning

During the *planning* stage, researchers need to select key stakeholders and plan the setting of co-design workshops, to prepare for the following five steps (Bowie et al., 2020). Co-design recognizes the people who are affected directly by a behaviour change intervention as ideal audiences to suggest possible solutions (Hurley et al., 2021). Therefore, we selected consumers of animal-based traditional medicine as one stakeholder group. Moreover, those who influence consumer behaviour are also key to changing illegal demand, and research reported that medical practitioners influence consumer treatment decisions in China (Hinsley et al., 2021). As such, we identified pharmacy workers and TCM doctors as two other groups of key stakeholders.

We planned three separate co-design workshops each with one of three key stakeholder groups (i.e. one workshop for consumers, one for pharmacy workers and one for TCM doctors) in the city of Guangzhou in Guangdong province in China in April 2021. We planned separate workshops to prevent groups influencing each other due to the power differentials that exist between, for example, doctors and patients in the context of medicine. Each workshop lasted approximately 3h and aimed to collect stakeholders' experience and knowledge of legal and illegal animal-based medicine consumption for developing feasible and inclusive interventions. As our workshops took place in early 2021, we also asked participants to consider the potential changing situation during the COVID-19 pandemic. To understand how ideas evolved, and the experiences shared by the participants, we audio-recorded and transcribed the co-design workshop, as well as considered the notes and photos taken independently by each researcher during the workshops.

3.1.3 | Recruitment

The next step, *recruitment*, is to recruit suitable participants based on the underlying problem to be addressed (Trischler et al., 2019). We recruited a total of 30 participants across three workshops: (1) 12 consumers who have used or purchased bear bile products in last 12 months; (2) 12 pharmacy workers who are working at pharmacies where legal bear bile medicines are sold; and (3) six TCM doctors who have knowledge of bear bile products. We used specific criteria to ensure participants' experience and knowledge of animal-based medicine consumption, as well as a balanced gender and age distribution for each workshop group (at least two participants aged 18–35 years, 36–45 years, and over 46 years, respectively). All participants were recruited by a local market research company (SMR: <http://www.smr.com.cn/>), and were remunerated

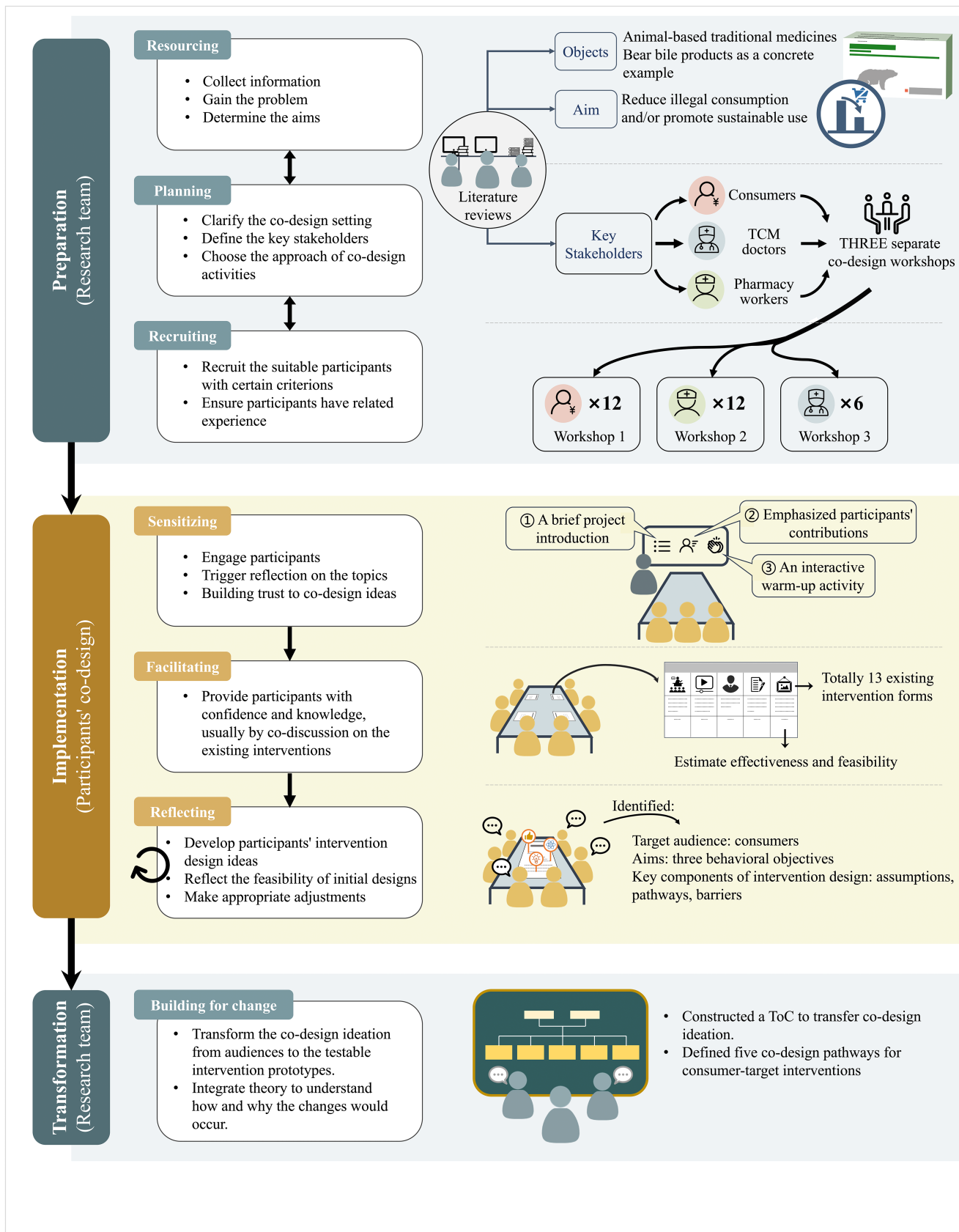


FIGURE 1 The process of the seven-step co-design framework and its application to the illegal wildlife trade context with three main stages: Preparation (resourcing, planning, recruiting), implementation (sensitizing, facilitating, reflecting) and transformations (building for change). TCM, traditional Chinese medicine; ToC, theory of change.

in line with the company's standard payment after the workshop. We did not ask participants about their personal behaviour on consumption, sales or prescription during the workshop. We received the written consent from all the participants before the workshop began. This research was approved by the University of Oxford Central University Research Ethics Committee (R73067/RE002).

3.2 | Implementation of co-design process (steps 3–6)

3.2.1 | Sensitizing

The *sensitizing* step is essential to engaging participants and triggering reflection throughout the co-design activities. This step helps participants perceive themselves as suitable candidates for the co-design process instead of their traditional role as simply recipients (Trischler et al., 2019). Moreover, this stage is critical in building trust with participants, allowing them to raise their views, particularly given the sensitive nature of illegal wildlife trade as a topic. At the beginning of each workshop, we provided a brief introduction on the aims and background of the project. We clarified that their experiences and reflections are valuable and important to raise new ideas or solutions, and that we are learning from them during the workshop instead of educating them. We also used interactive warm-up activities such as photo elicitation focused on the selling of different products, to let participants openly share views.

3.2.2 | Facilitating

During the *facilitating* stage of co-design, researchers first provide an overview of existing solutions related to the topic (e.g. on cards), which are summarized from the literature review during the resourcing stage. Participants are then asked to rank how they like and dislike these existing options (Trischler et al., 2019). This provides participants with fundamental knowledge during the reflecting step to develop their own ideas. Importantly, researchers in this process and throughout the implementation stage need to step aside as facilitators, rather than collaborate with participants, to reduce dominance and encourage the participants to take initiative and enter the co-design process (Bowie et al., 2020; Trischler et al., 2019).

In our three separate co-design workshops, we asked participants to work in sub-groups. We then asked them to discuss and evaluate the effectiveness and applicability of 13 existing interventions aiming at reducing illegal wildlife consumption for three target audiences. These were five interventions for consumers, four interventions for pharmacy workers, and four interventions for doctors (Figure 2). These intervention forms were summarized and depicted on card lists, and included educational talks, celebrity campaigns (e.g. Olmedo et al., 2020), legality-related interventions (i.e. laws/regulations at organization level, public anonymous whistle-blowing

in environment governance; e.g. Hu et al., 2022), outdoor advertising (e.g. posters, Chaves et al., 2018), letters of commitment and children's educational activities (e.g. nature drawing). Following the discussion, each sub-group summarized and shared their views on perceived effectiveness and limitations of each intervention form to other workshop participants.

As the results of the first round of co-design discussions, for interventions targeted at TCM practitioners (doctors and pharmacy workers), participants of all three workshops consistently perceived regulations set by hospitals or pharmacy companies as the most effective. Particularly, TCM practitioners explained they were likely to be deterred from prescribing or recommending unregulated products due to the risk of severe punishments. Doctors perceived educational talks (e.g. training lectures) and letters of commitment as ineffective for TCM practitioners, in part because these are already a routine part of their work. For interventions targeted at consumers, TCM doctors and consumers perceived public whistle-blowing (i.e. people are encouraged to report illegal wildlife trade to the authorities) as the most effective approach to stop illegal consumption. The rationale is that it could increase the chance of detection by law enforcement and thereby increase the risk perception of conducting illegal activities in markets with low social tolerance. Meanwhile, doctors and consumers considered outdoor advertising (e.g. posters in train stations) ineffective, due to the uncertainty in the time required to read the information, and the way that it was delivered (e.g. just a slogan telling people not to consume but not detailing the reasons). In addition, pharmacy workers doubted the effectiveness of celebrity-led campaigns for all targeted audiences, in part due to the wide variation in the popularity of celebrities across different groups of people.

3.2.3 | Reflecting

The *reflecting* step could be an extension of the facilitation stage, where participants develop intervention ideas collaboratively, either by modifying existing designs or by creating original ones (Trischler et al., 2019). Researchers need to remind participants keeping in mind their discussions around effectiveness and limitations in the previous step. Moreover, participants need to reflect on whether the initial solutions they identified are beyond their and/or the project team's control (e.g. laws and regulations reform), to make the design more feasible (Bowie et al., 2020). Such reflection also happened in our workshops. Regulations were consistently perceived as the most effective approach for interventions targeting TCM practitioners to reduce illegal animal-based medicine consumption in the first round of co-design discussion. However, all workshop groups identified consumers as the key target audience for the design of new tailored interventions, as all stakeholders view the importance of changing consumer preferences in shifting demands that affect trade and supply, which is consistent with other research in the illegal wildlife trade context (Hinsley et al., 2022; Thomas-Walters et al., 2020).

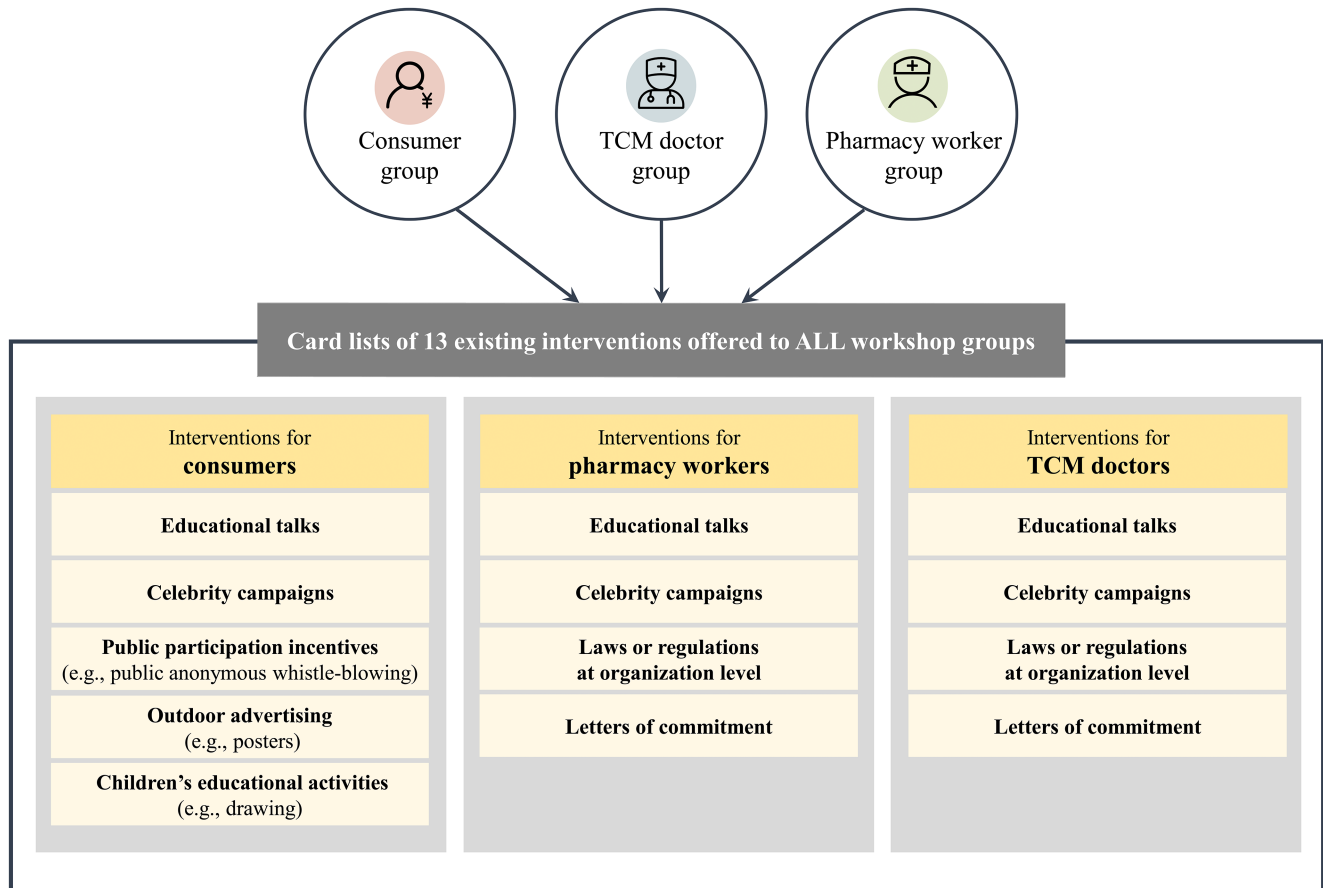


FIGURE 2 The card list of 13 existing interventions for all three workshops discussed in the facilitating step of co-design. TCM, traditional Chinese medicine.

This co-design stage is also key to allow participants to reflect on the initial goal and clarify the specific aims of user-generated ideas, since the initial problem is often defined by experts; this process permits participants' ideas to feature throughout the co-design process (Trischler et al., 2019). In line with our desired impacts in the wildlife trade context of reducing illegal animal-based product consumption and promoting sustainable product use, participants identified three overall behavioural change objectives during the co-design discussion: (1) stop consumption of illegal products, (2) switch to legal alternatives and (3) use TCM appropriately (i.e. only use appropriate products and only when needed). The latter was proposed uniquely by the TCM doctors.

Reflecting and forming solutions is an iterative process, since various participants' ideas need to be progressively modified into feasible intervention prototypes (Trischler et al., 2019). A further round of sub-group discussion was conducted to design new interventions, meanwhile making explicit the key design components that researchers proposed during the resourcing stage: objectives, assumptions, potential pathways, key messages, intervention forms and/or messengers, and barriers to success. Reflection and discussion around proposed ideas were encouraged throughout the design process until participants reached a consensus.

Following the discussion, each sub-group illustrated their intervention components and designs to other participants in their workshop.

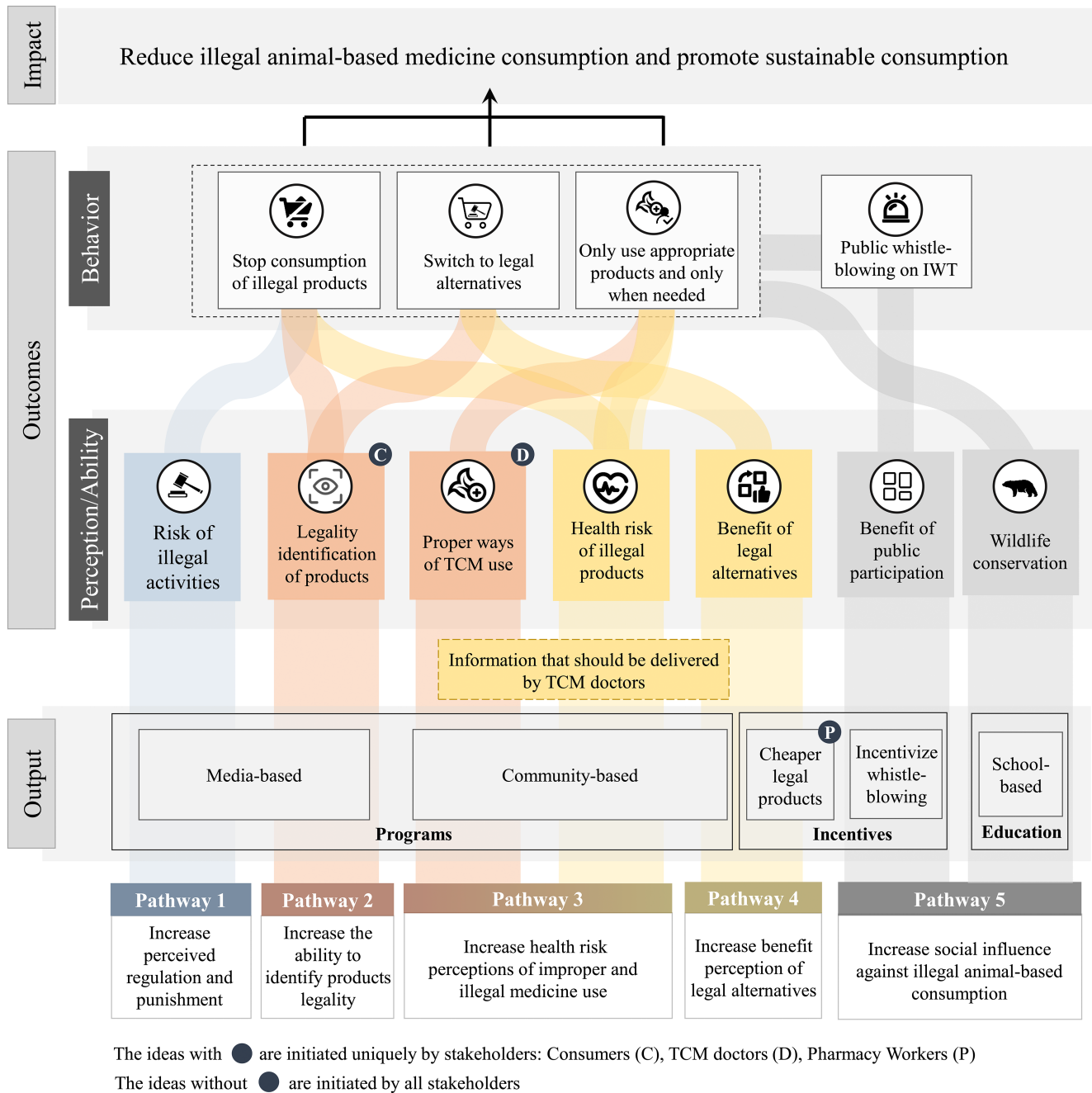
3.3 | Transformation: Building for change (step 7)

The *building for change* stage allows the project team to define the testable intervention prototypes (Trischler et al., 2019). After the workshops, we used thematic analysis on qualitative data (i.e. audio recording, field notes and diagrams) to identify themes of intervention components and the rationale among them to form pathways (Braun & Clarke, 2006; Kim et al., 2020). A key challenge was to ensure objectivity when facing differing ideas. We used a cross-rater process where two researchers (author S. H. and Z. L.) independently coded the data to produce themes and rationales for various pathways, and a third researcher (author K. Z.) cross-checked the discrepancies to reach the final agreement. The analysis phase was completed when there were no new themes extracted from the views from all participating stakeholders. Then, we mapped possible pathways with objectives, key messages, intervention forms and underlying assumptions, finally constructing a comprehensive ToC.

4 | PATHWAYS OF CO-DESIGN INTERVENTIONS

We defined five pathways for consumer-targeted interventions (Figure 3). Pathway 1 focused on increasing the awareness of the regulation and the perception of severity of punishment for illegal consumption to stop people from buying illegal products. This was based on the assumption that some illegal consumption happens

when consumers perceive the risk of being caught and punished as being low. For this pathway, workshop participants identified social media (e.g. videos on TikTok, known in China as 抖音 [dǒu yīn]) as the intervention form to best communicate messages about regulations and punishment for illegal consumption to consumers. Pathway 2 was on increasing the ability of consumers to identify product legality, to halt the buying of illegal products and promote a switch to legal products. It was based on the assumption that



The ideas with ● are initiated uniquely by stakeholders: Consumers (C), TCM doctors (D), Pharmacy Workers (P)
 The ideas without ● are initiated by all stakeholders

FIGURE 3 The proposed theory of change for reducing illegal wildlife-based medicine consumption by transforming the co-design ideation and mapping possible pathways with key components of co-design and underlying assumptions. The colours of interventions represent the different status of our co-design ideas: the orange ones are the co-design ideas that are inclusive ones; the yellow ones represent the co-design ideas that enrich the existing ones; the blue ones represent the co-design idea that is existing; the grey ones represent the co-design ideas that may need more consideration with wider stakeholders involved. TCM, traditional Chinese medicine.

some consumers cannot distinguish legal and illegal products, leading to unwitting consumption. As in Pathway 1, participants selected media-based programs to communicate ways in which consumers could recognize legal products. Pathway 3 highlighted the health risk of using illegal products and of overusing legal products when they were not needed. It was based on the assumption that some illegal consumption was related to the inappropriate use of TCM, and that consumers who underestimated the health risk of such inappropriate utilization tend to overuse such products. For this pathway, all stakeholders regarded health professionals (e.g. TCM doctors) as the best messengers and/or influencers to deliver health-related information, including health risks of illegal products and the correct way of taking TCM, through community-based programs. Pathway 4 was aimed at increasing consumers' perceived benefits of legal alternatives to switch their choice from illegal to legal products. It was based on the assumption that some consumers of illegal products were not aware of the benefits of legal alternatives. Participants identified either community-based programs with health professionals to emphasize the safety of legally sourced products or discounts for legally sourced products, to make consumers perceive legal products as more beneficial. Pathway 5 focused on increasing the social influence against the consumption of illegal animal-based products. It was based on the assumption that illegal consumption occurred because consumers perceived social legitimacy of illegal behaviour. For this, participants suggested providing incentives for public whistle-blowing to facilitate public participation in combating illegal wildlife trade or conducting school-based wildlife conservation activities for families to foster inter-generational influence for a long-term effect on reducing illegal consumption. Finally, based on the literature review in the *resourcing* step, we categorized the co-design interventions according to their contribution statuses: (a) inclusive, (b) enrich the existing, (c) existing and (d) need more consideration from wider stakeholders. We also identified different stakeholders' contributions on each intervention idea (Figure 3).

5 | DISCUSSION

We applied the co-design process to involve multiple stakeholders in developing intervention designs in the wildlife consumption context. As a qualitative method, co-design can be an efficient approach to incorporate stakeholders' views into the ideation process, particularly with a limited budget (Bowie et al., 2020). Nevertheless, the potential generalizability of co-design approaches may be restricted if participants are not fully representative of the intended audience. As such, there is a need to carefully discuss the applicability in a broader context. Moreover, while the co-design process could have the value in contributing inclusive solutions for future interventions (Dietrich et al., 2017), we acknowledge that the focus of co-design is largely limited to the ideation stage. Therefore, the effectiveness of co-design prototypes should be tested with the intended target audience.

5.1 | Contribution of co-design

One of the important contributions of co-design is to develop inclusive and feasible solution ideas, which could be better tailored to the stakeholder's needs, and identify potential barriers to success (Bogomolova et al., 2020; Dietrich et al., 2017; Trischler et al., 2019). These inclusive views may be previously overlooked, some of which may be related to the social and cultural context specific to where the intervention would take place (David et al., 2019). In the context of wildlife trade and TCM use specifically, legality identification was a challenge from the demand-side interventions, which was noted by both the consumers in our co-design workshops and previous research (e.g. Hinsley et al., 2021). The success of interventions depends on consumers' ability to distinguish if a product is legal or not, however, knowledge about source legality may be beyond the average consumer's understanding or there may be a misalignment between the actual legality and perceived social legitimacy of certain products (Hinsley et al., 2021; Sas-Rolfes et al., 2019). Although previous research has proposed that a certification system could be considered in addressing the problem and regulating the farmed products from supply-side (Challender et al., 2019; Tensen, 2016), few existing consumer-oriented interventions have considered this (Xie, 2020), which made our co-design Pathway 2 (i.e. promote the ability to identify products legality) a priority. Moreover, there is an existing official legality certification system under the Wildlife Protection Law of China (Challender et al., 2019; NFGA, 2004; Wang et al., 2019; Xie, 2020), which made this pathway particularly feasible. Potential solutions for this may include a broader outreach program for consumers on the existing certification system, such as the visible labels in China, to reduce the unwitting illegal consumptions.

Moreover, TCM practitioners in our co-design workshop stressed the need to understand the relationships between specific ingredients, the illness type and recipients' characteristics for TCM treatment, following the key philosophies of TCM (Cheung et al., 2021). Such considerations have rarely been discussed in existing interventions but were emphasized in our co-design Pathway 3 (i.e. increase perceived health risks of improper TCM use), making our co-design valuable in contributing unheard perspectives. This consideration is also widely applicable to other TCM products not only animal-based but also herbal. This design was uniquely proposed by the TCM practitioners, which also shows the importance of co-design with diverse stakeholders for collecting inclusive views and mitigating cognitive biases especially during the idea generation phase of intervention designs (Trischler et al., 2019).

Another key contribution of co-design is that it can enrich existing solutions by generating incremental ideas (Trischler et al., 2019). In the TCM context for example, health-risk communication is considered as information campaigns to reduce overconsumption of health remedies that contain wildlife ingredients (MacFarlane et al., 2022). In our workshops, all stakeholders highlighted the key role of health professionals (e.g. doctors) as influencers in health-related interventions. They all perceived that medical practitioners influence consumers' treatment decisions, which also supports previous findings in China (Hinsley et al., 2021). Moreover, some

consumers may pursue medicinal functions of wildlife products and some of them may believe legal products are often of better quality (Thomas-Walters et al., 2021; Wang et al., 2019). In this scenario, our co-design Pathway 4 (i.e. increase perceived health benefits by highlighting the quality and authenticity of legal products) might be particularly effective. These health-related consideration could also be applied to a wider wildlife trade context where diverse species face over-exploitation due to trade in complex legal-illegal markets (e.g. Challender et al., 2019; Ribeiro et al., 2019).

5.2 | Lessons for conservation researchers and practitioners

Although our co-design demonstrated the valuable contributions in intervention design, there are possible unintentional and undesirable effects of co-design intervention prototypes that should be carefully considered. For example, interventions to reduce animal-based medicine consumption by promoting sustainable alternatives (our Pathway 4) might recommend plant-based products (Cheung et al., 2021), but if these plants are wild-harvested then this might lead to overexploitation. Therefore, when highlighting benefits of legal products, the messages of appropriate use (Pathway 3) should also be used to encourage sustainable consumption. Moreover, our co-design process suggests that using health professionals as messengers could influence consumer perceptions, but some practitioners may believe that illegal products are effective and communicate these messages too, undermining the intervention's aims (Hinsley et al., 2021). To address this risk, consumer-targeted efforts could be considered alongside other types of behaviour change, such as improving the regulation of practitioners (Bowie et al., 2020).

We acknowledge that some co-design intervention prototypes may need more consideration from a wider range of stakeholders (e.g. public authorities or policymakers) during the creation of the final concept, though these prototypes could provide insights for researchers to build upon in further consultation (Trischler et al., 2019). For example, all stakeholders in our co-design considered public whistle-blowing as an effective approach to reduce illegal consumption (Pathway 5), since whistle-blowing has been normatively encouraged as a pro-social engagement in China. This method has been shown to be effective particularly when related laws are consistent with prevailing norms (Acemoglu & Jackson, 2017) and has been explored in the context of law enforcement against illegal wildlife trade in China (e.g. Hu et al., 2022). However, an open dialogue between other key stakeholders or partner organizations (e.g. enforcement officers) is required to identify the potential barriers and assess the feasibility of these ideas.

We also recognize that, while a co-design approach results in a more inclusive intervention design, it does not guarantee effectiveness. Future research is needed to investigate whether co-design does ultimately influence the effectiveness of interventions (Dietrich et al., 2016; Trischler et al., 2019). Our case study innovatively applied the co-design process to interventions aiming to reduce illegal wildlife consumption but evidence for the effectiveness of these prototypes

is still lacking, particularly for the more innovative or inclusive alternatives. It is critical to evaluate their effectiveness in specific contexts. For those existing solutions that were enriched by co-design, it may be possible to gather evidence by reviewing the literature, even from other contexts, to assess its effectiveness before implementation. For example, in the health sector, highlighting health risks for reducing consumption has been shown to be effective, while educational approaches have shown mixed results (MacFarlane et al., 2022). Nevertheless, we suggest that intervention prototypes from co-design should be carefully evaluated for their potential effectiveness.

Co-design approaches are sometimes criticized as being too user-centric (Bowie et al., 2020; Dietrich et al., 2017). As such, one of the difficulties that researchers may have during the co-design process is how to balance the insights from the target audience with knowledge and practical experience of the researchers (Dietrich et al., 2016). This leads to the discussion on the role of researchers in refining, assessing and conceptualizing user-generated ideas to generate feasible solutions (Trischler et al., 2019). In practice, our co-design application in wildlife trade context showed that the participation of researchers in conducting the literature reviews in the resourcing stage is essential in tapping participants as a unique source of knowledge and stimulating their engagements in the following co-design steps (Bowie et al., 2020). In the last stage (i.e. building for change), researchers are also indispensable in converting the co-design insights into feasible concepts and transforming the concepts into theoretical constructs to inform the planning and evaluation of pilot interventions (Hurley et al., 2021), such as developing a ToC to illustrate how the suggested co-design interventions could meet desired objectives. However, too much involvement from the researchers may also lead to another risk where the original stance of researchers (e.g. wildlife conservation) may dominate the co-design outputs. As such, leaving enough space for the multiple stakeholders to voice their views, and respecting their ideas is fundamental (Trischler et al., 2019). In practice, the underlying problem that researchers defined at the beginning from the resourcing step needs to be general enough (e.g. illegal wildlife consumption), in order to let stakeholders reflect on the initial problem and identify the specific behavioural objectives during the co-design process. Meanwhile, the aims that researchers defined should be as neutral as possible. For example, in our context, the aim of reducing illegal wildlife consumption may be biased from a conservation perspective; therefore, promoting the use of sustainable alternatives needs to be added as another aim to balance the different stances. Furthermore, researchers or practitioners need to bear in mind that the effectiveness of pathways may not be known during the transformation stage. Thus, we would need to respect all the themes of the intervention components and their rationales from all the stakeholders.

6 | CONCLUSIONS

We applied the co-design process to illegal wildlife consumption, demonstrating its value in consolidating multiple stakeholders'

perspectives to produce more inclusive intervention designs (Biggs et al., 2017; Bowie et al., 2020). Based on the contribution of co-design on developing innovative and feasible solutions, future interventions aiming to reduce illegal wildlife trade should consider co-design. Future work could also include a broader range of stakeholders in co-design, such as enforcement officers and online pharmacy operators. We suggest that a comprehensive understanding of the experiences of multiple stakeholders involved in the consumption process through our co-design can help design practical intervention prototypes and reduce the risks of unintended consequences, as it can efficiently develop inclusive ideas and identify barriers that may have been previously overlooked. In the face of the ongoing COVID-19 pandemic, a co-design process becomes more important to account for changes in public perceptions and updated legality regulations (e.g. the revision of China's Wild Animal Conservation Law: Fang & Song, 2021). Moreover, there is substantial cultural specificity to wildlife trade (Thomas-Walters et al., 2021; Verissimo et al., 2020), making inclusive interventions that consider local context and multiple stakeholders' perspectives even more vital to achieving the desired conservation outcomes.

AUTHOR CONTRIBUTIONS

Sifan Hu, Tien Ming Lee, Diogo Verissimo and Amy Hinsley designed research; Sifan Hu, Zhijian Liang and Kaiwen Zhou performed research and analysed data; Sifan Hu wrote the paper; and all co-authors revised the paper.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Due to the sensitivity of research topic and the type of data collected, it is not possible to make the audio recording of the conducted workshops publicly available. We guaranteed anonymity and confidentiality to our workshops in compliance with the ethics approval granted by the University of Oxford Central University Research Ethics Committee.

ORCID

Sifan Hu  <https://orcid.org/0000-0002-7445-6284>
 Zhijian Liang  <https://orcid.org/0000-0002-7654-8801>
 Kaiwen Zhou  <https://orcid.org/0000-0003-0475-8620>
 Diogo Verissimo  <https://orcid.org/0000-0002-3519-6782>
 Tien Ming Lee  <https://orcid.org/0000-0003-2698-9358>
 Xiangdong Ruan  <https://orcid.org/0000-0001-8994-9500>
 Amy Hinsley  <https://orcid.org/0000-0002-5590-7617>

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