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Addressing illegal practices: intergenerational transfer and creative engagement as a way to compensate boomerang effects

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Introduction: This study investigates the effectiveness of using an educational comic book to facilitate the intergenerational transfer of knowledge and intentions concerning dynamite fishing in Borneo, Malaysia. The aim is to explore how children can influence their parents' understanding of the issue and their willingness to address it within the community. Additionally, the research examines unintended reactions within the participant groups.

Methods: The study employed a controlled experimental design with two groups: a treatment group exposed to the educational comic book and a control group without this intervention. Participants were families residing in communities where dynamite fishing is still practiced. Data collection included pre- and post-intervention surveys and follow-up measurements to assess short-term and long-term effects on knowledge and intentions.

Results: The findings revealed a successful intergenerational transfer of knowledge from children to parents, evident both in the short and long term. Furthermore, the intergenerational transfer of intentions demonstrated a two-fold pattern. The intention to discuss the dynamite fishing problem within the community was transferred from children to their parents at the second measurement point, highlighting the time required for the development of new intentions. A boomerang effect was observed for the intention to cease dynamite fishing among individuals reliant on fishing for their livelihood. This rebound effect was solely observed in the control group but was effectively mitigated in the treatment group, where engagement with the comic book influenced positive outcomes.

Discussion: The study's results underscore the power of intergenerational transfer of knowledge and intentions from younger to older generations, facilitated by educational comic books as a communication tool for addressing environmental issues. Moreover, a boomerang effect seen in the control group highlights the complexity of behavior change in economically motivated practices like dynamite fishing. Engaging interventions, such as educational materials, can play a crucial role in curbing these behaviors. Furthermore, the study emphasizes the necessity of carefully monitoring unintended reactions within participant groups, particularly in research related to sensitive topics.

KEYWORDS

intergenerational transfer, environmental education, boomerang effect, creative engagement, destructive fishing

Intergenerational transfer

The transfer of knowledge, attitudes or behaviors from children to parents—a significant part of intergenerational learning—has been suggested as a promising pathway to addressing social and environmental problems such as climate change (Lawson et al., 2019), plastic pollution (Hartley et al., 2021), energy saving (Wallis and Klöckner, 2020) and sustainable purchase decisions (Grønhøj and Thøgersen, 2009; Aruta, 2023). Intergenerational learning is a natural part of the lifelong learning process, including both, traditional knowledge and practices, as well as new information, skills, and values. Most of the time, intergenerational learning takes place automatically and informally, but it can also occur in purposeful and specifically designed activities (Istead and Shapiro, 2014). Potential pathways of intergenerational transfer can be from older to younger generations (e.g., parents or grandparents to children) which represents the most studied area of this phenomenon (Liu and Kaplan, 2006), as well as vice versa. This latter pathway can be facilitated through simultaneous engagement of children and parents with selected topics, and also through children talking about new topics or simply changing their own behavior and thereby becoming role model for their parents. Istead and Shapiro (2014) explain that children often bring home the timeliest information on many topics such as environmental conservation or technology, and thereby influence their family members.

Intergenerational learning can be a particularly effective strategy to address sensitive topics as it takes place within the family or community (Peterson et al., 2019), where people might be less resistant to consider behavior change as they trust their family or community members as information sources. An example of an intergenerational learning program in Malawi shows that daughters-in-law were able to improve their child care practices by embracing the knowledge provided by the mothers-in-law and participating in collective brainstorming between generations (Satzinger et al., 2009). Another example is gay and lesbian sons and daughters influencing their parents in adjusting their knowledge and attitudes about homosexual relationships through emotion-focused dialogues (LaSala, 2004).

Children can serve as a potent force for promoting change by advocating against their parents' immoral or unsustainable practices. Due to their greater receptiveness to new knowledge and practices, they may facilitate a shift in their parents' rigid attitudes by jointly practicing alternatives, regularly reminding, and advising their parents, and questioning conservative behaviors. Previous research has applied a variety of methods to assess intergenerational transfer such as an assessment of parents' perceptions (Mosavel et al., 2006), interviews involving both children and their parents (Istead and Shapiro, 2014), correlational designs (Grønhøj and Thøgersen, 2009; Wallis and Klöckner, 2020), and quasi-experimental (Ballantyne et al., 2001) and experimental settings (Boudet et al., 2016; Lawson et al., 2019). These studies have predominantly focused on assessing dependent variables such as knowledge, attitudes, concerns, or self-reported behaviors in the environmental or health domains (e.g., consumer choices, energy conservation, and healthcare visits).

Creative communication as a pathway to intergenerational transfer and behavior change

Effective communication is crucial for facilitating intergenerational transfer in a systematic manner. Communication can take various forms such as structured education programs, information leaflets, or movies. It is essential to ensure that the content is accessible and comprehensible for the target age group, especially for children who have limited literacy and understanding of their surroundings compared to adults. Therefore, the learning material, content or program is recommended to be engaging, inclusive and locally relevant (Monroe, 2019), and previous research has also shown that tailored, co-created means of communication are more effective than pre-produced, standard forms of communication (Mycoo, 2015). Programs that allow parents and children to interact with the learning content in a creative way have been shown to have positive effects such as an increase in positive emotions or motivation and problem-solving skills (Jindal-Snape et al., 2013). Interactive engagement with environmental challenges has been shown to effectively increase concern and awareness and self-reported actions (e.g., producing short films (Veiga et al., 2016) or collages (Löfström et al., 2021) about challenges and solutions connected to marine litter). Engaging creatively with future scenarios has also been shown increase pro-environmental behavioral intentions and consideration of future consequences (Richter et al., 2021). Creative means of communication have also been found to bridge barriers in the engagement of different audiences, including communities of low socioeconomic status or educational level (Mycoo, 2015). In combination with social interaction and teamwork, creative engagement can facilitate a feeling of collective empowerment (Rosso, 2014; Zhang et al., 2014; Löfström et al., 2021) and enjoyment (Fjællingsdal and Klöckner, 2017).

Dynamite fishing

Dynamite fishing is a form of destructive fishing that results in direct damage to marine life and habitat (Hampton-Smith et al., 2021). Dynamite fishing can threaten human health in that there is a risk of injury (or even death) due to premature explosion and due to long term effects of depleted fish stocks and reduced food sources. Fishers use this technique by locating a school of fish, and subsequently throwing a lighted bomb into the middle of the school. After the explosion, the fishers collect the fish, either dead or stunned. This activity is prevalent due to its (short-term) economic benefits and ease of execution (Hampton-Smith et al., 2021), and hence is usually practiced in less economically affluent countries around the world such as Tanzania (Kamat, 2019), Malaysia (Pet-Soede, 2001) or the Philippines (Tahiluddin and Sarri, 2022).

Even though dynamite fishing is illegal in most countries it is a persistent practice in many coastal communities. Conflicts between local and foreign fishing vessels have intensified in recent years, pushing local fisherfolk to intensify their effort (Mendenhall et al., 2020). Oftentimes the practice is considered a taboo topic despite its common occurrence. To address this sensitive issue,

we are combining creative communication and intergenerational transfer to increase both, knowledge about dynamite fishing as well as behavioral intentions to talk about and to stop the practice.

A person's level of knowledge about dynamite fishing and its consequences can be an important antecedent of behavior since it motivates behavioral choices or helps justify why behavioral change is necessary (Arlinghaus and Johnston, 2018). Only if people know why a certain behavior should be performed and what its consequences are, might they develop an intention. It is important to acknowledge that knowledge is an important precondition but often not sufficient for changing behavior (Abrahamse et al., 2007). Behavioral intentions can reliably predict subsequent behavior (Sheeran and Webb, 2016) and are an often-used and easy to collect proxy used in survey research where measuring behavior is difficult or impossible (Chandon et al., 2005). The stronger one's intention and the closer the alignment between specific intentions and specific action, and the less barriers are perceived, the more likely it is that the behavior will be performed (Kaiser, 1998).

The present study

In this present study, we examined the combined potential of intergenerational transfer and creative engagement. For this, we assess the transfer of knowledge about dynamite fishing as well as of behavioral intentions to talk about the issue as well as the intentions to stop dynamite fishing in the future in coastal communities in Northern Sabah, Malaysia from children to their parents or other key family members. The involved coastal communities in this study reside in a multiple-use marine park, Tun Mustapha Park at Northern Sabah, Malaysia (Figure 1). Besides serving as important source of livelihood and economic activities (e.g., fishery and mariculture) to the at least 85,000 coastal inhabitants, the marine park also holds strong cultural belief and values for the ethnically diverse coastal communities (Lim et al., 2021).

Here, we recruited schoolchildren aged 13 to 17 from a secondary school to participate in our project, where each child will be given a comic book about fish bombing, and they are required to be accompanied by an adult family member aged 18 and above during the questionnaire surveys. Coincidentally, this project took place during the COVID-19, and the lockdowns as a countermeasure against the pandemic created an environment where parents and children were spending more time together. This provided an opportunity to examine the extent of the intergenerational transfer of knowledge from children to parents. Furthermore, the parents and relatives (e.g., older siblings, aunts, and grandparents) were also willing to participate in the questionnaire survey, though they were mostly females, likely because they see this an opportunity to bond with their children.

This study is part of a larger project funded by the Early Career Researcher Grant as part of the GCRF Blue Communities project (<https://www.blue-communities.org/>). As part of this ECR grant, the potential of educational communication via a co-created comic book should be assessed, which was then divided into two focus areas: (1) the educational potential for children and (2) the intergenerational transfer of knowledge and action intentions. The first part is subject to another article (Lim et al., under review).

Research questions

- RQ1a: Does the engagement with a co-created comic book lead to a change in knowledge in children?
- RQ1b: Does the change in knowledge in children lead to changes in knowledge in adults?
- RQ2a: Does the engagement with a co-created comic book lead to a change in behavioral intentions to talk about the problem in children?
- RQ2b: Does the change in behavioral intentions to talk about the problem in children lead to changes in intentions in adults?
- RQ3a: Does the engagement with a co-created comic book lead to a change in behavioral intentions to stop using fish bombs in the future in children?
- RQ3b: Does the change in behavioral intentions to stop using fish bombs in the future in children lead to changes in intentions in adults?

Sample

The sample used in this study consisted of a total of $N = 139$ participants, of which 99 (71.2%) were children and 40 (28.8%) were their adult family members. The mean age was $M = 22.19$, $SD = 12.26$ years (age range 13–59 years). Further, 101 (72.7%) females and 37 (26.6%) males participated in the study. Of the 99 children, 71 were female and 27 were male, one child participant did not indicate a gender identity. When it came to the adults, 30 were female and 10 were male. Fifty-five percentage of the sample did not depend on fishing for living whilst the remaining participants fully or substantially depend on fishing activities for survival. The participants identified themselves with a wide range of ethnicities that can be found in Northern Sabah, such as Bajau, Dusun, Kadazan or Suluk. A full list of ethnic groups and the distribution across the sample can be found in the [Supplementary files](#).

Data collection

Due to the movement restrictions in Malaysia as response to COVID-19 pandemic, the data collection was postponed from an in-person setting in February 2020 to a virtual setting in April and May 2021. The video conferencing platform Zoom (<https://zoom.us/>) was used to conduct the three sessions of virtual face-to-face activities, where each session included a short guest lecture about the environment, not related to fish bombing, and the supervised responding to the survey. For the questionnaire surveys, the responses were collected through the online form service Google Forms (www.google.com/forms). The schoolchildren recruited for this study were divided into treatment ($n = 42$, received comic book) and control group ($n = 57$, did not receive comic book). Both groups were asked to complete three questionnaires before, 5 days after and 1 month after the comic book distribution. In addition to the children, close adult family members (parents, grandparents, siblings) of participating children have been recruited who also responded to the survey at the same time points. Of the family

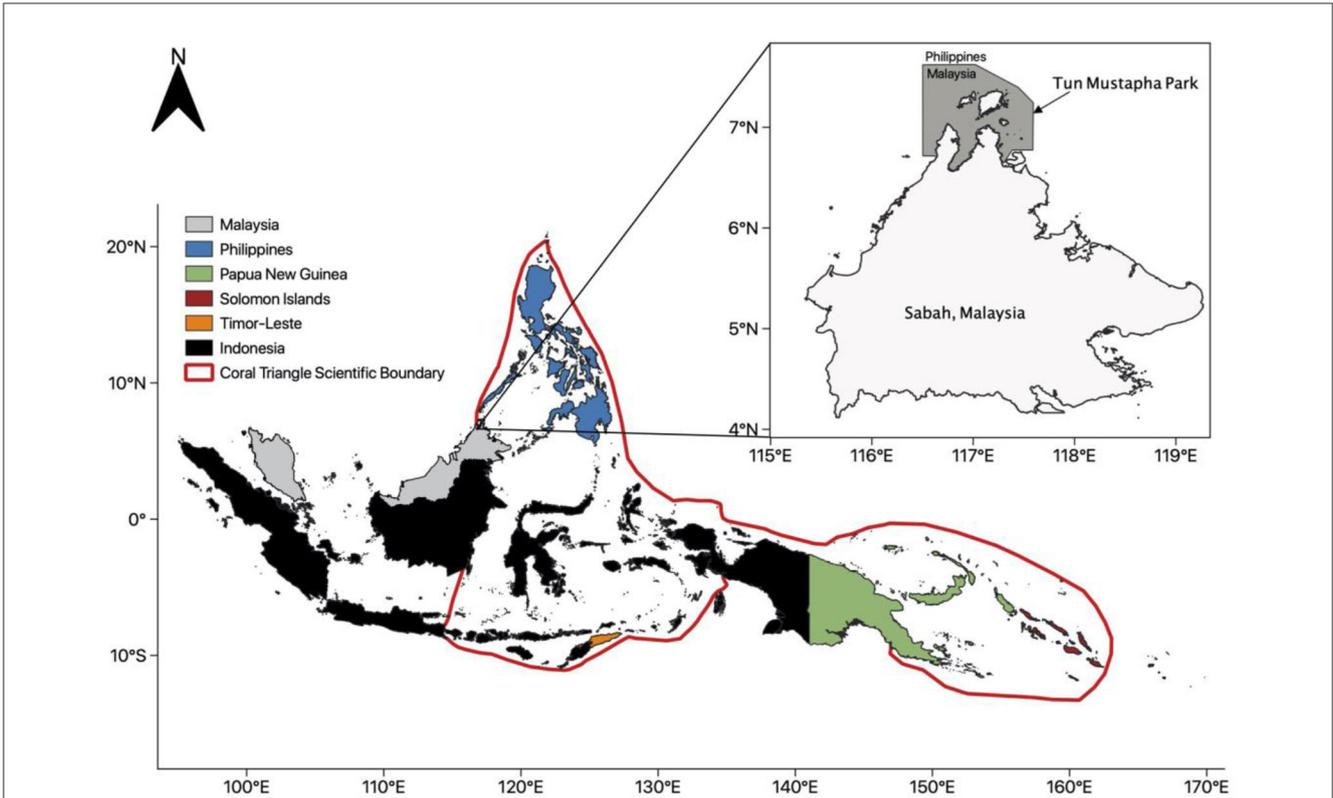


FIGURE 1 The location of the study site, Tun Mustapha Park, is located at Northern Malaysia. This map was created using QGIS (www.qgis.org) with shapefiles publicly available at www.cdc.gov/epiinfo/support/downloads/shapefiles.html.

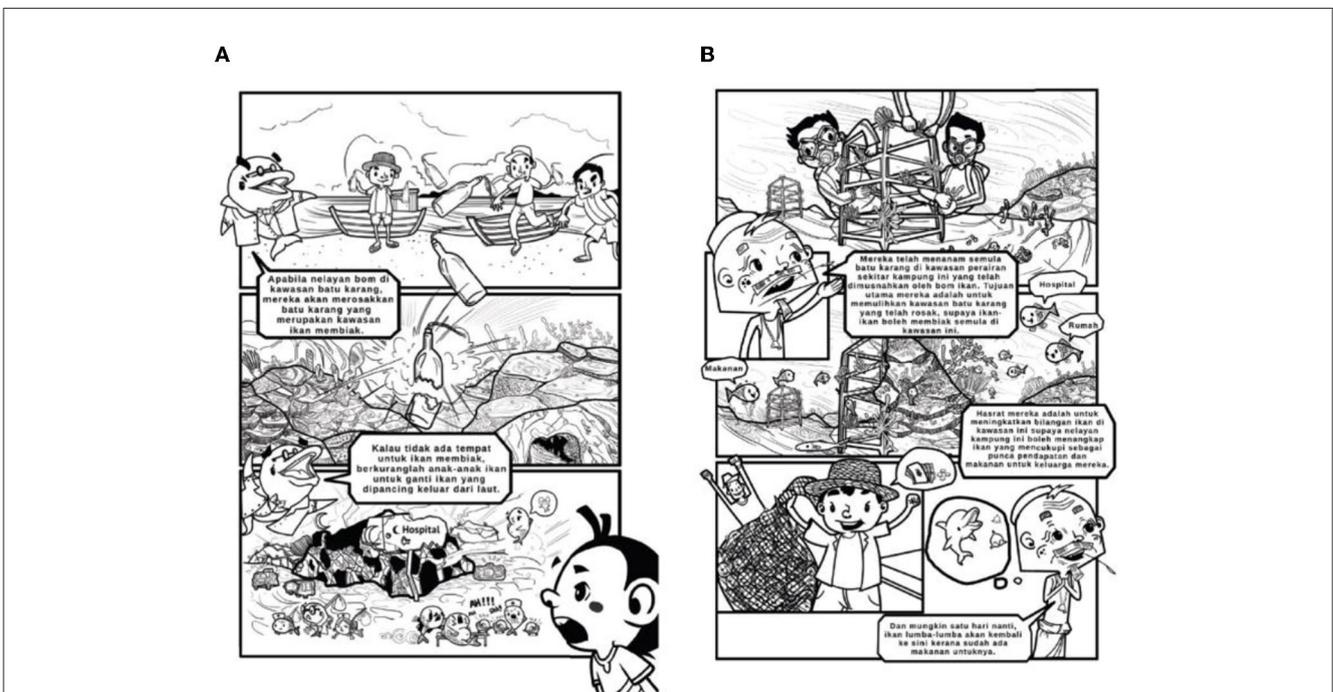


FIGURE 2 Two pages of the educational comic book depicting fish bombing issues in Tun Mustapha Park (A) impact of fish bombing on the coral reefs including statements such as "Fish bombing destroys coral reefs" and "Fishes breed in coral reefs"; (B) coral replanting to restore coral reefs to be breeding grounds for fish relating to statement "If I take care of coral reefs in the sea, my family can catch more fish."

8. Based on your opinion, do you agree with the following statements?
 Pada pendapat anda, adakah anda bersetuju dengan kenyataan di bawah?

	Strongly disagree Sangat tidak setuju	Disagree Kurang setuju	Neutral	Agree Setuju	Strongly agree Sangat setuju
I want to talk about fish bombing to other community members Saya ingin bercerita mengenai pengeboman ikan kepada ahli komuniti lain					
I will use fish bombs to fish in future Saya akan gunakan bom ikan untuk menangkap ikan pada masa akan datang					

FIGURE 3 Excerpt from the original survey displaying the two dependent variables and the child-friendly answering scale in English and Malay language.

member cohort, $n = 32$ formed the treatment and $n = 8$ formed the control group.

Materials and measures

The educational comic book was co-developed in collaboration with a local artist from Kuala Lumpur, Malaysia, in Malay language (Figure 2), a local government agency (i.e., Sabah Parks), a community-based organization (i.e., Banggi Coral Conservation Society) and a non-governmental organization (i.e., WWF-Malaysia). The final draft was published by University of Malaya Press in hardcopy.

The surveys designed for this study book comprised open-ended questions, and statements measured on a five-point Likert scale (see complete surveys for children and their family members in the Supplementary files). As the schoolchildren and their family reside in rural areas, we accounted for potential low literacy and included smileys as options for responses (see Figure 3), following (Toepoel et al., 2019). The surveys for the treatment and the control group were identical, except that the treatment group received additional questions about their opinions regarding the comic book itself, which were not the focus of the analysis presented in the present article. To ensure the comprehension of the questionnaire within the target group, a pilot survey was conducted in October 2019 with 35 schoolchildren and six adults. These responses were not included in the final analyses.

The survey questions relevant for this study have been questions 8a and 8b (*I want to talk about fish bombing to other community members* as well as the item *In the near future, I will use fish bombs to fish*) representing the measurement for behavioral intentions. Respondent’s agreement to this statement was measured on a 1(*Strongly Disagree*)-5(*Strongly Agree*) Likert scale. Selected intentions that are relevant for this study are (1) the intention to talk about the problematic aspects of dynamite fishing with other community members (encourage a more active dialogue) and (2) the intention to stop using dynamite for fishing in the future (reduce the prevalence of dynamite fishing activities). Furthermore, questions 17a-e (*Fish bombing destroys coral reefs,*

Fish breed in coral reefs, Fish bombs are expensive, Dolphins like fish bombs, If I take care of coral reefs my family can catch more fish), representing the measurement for knowledge have been included into the analysis, also measured in the same 1(*Strongly Disagree*)-5(*Strongly Agree*) Likert scale. The complete list of survey items as well as their underlying constructs can be retrieved in the Supplementary files.

Data analysis strategy

After the dataset was screened for outliers and missing values according to Creswell (2009) all variables were inspected for their distributions. Subsequently, descriptive statistics have been inspected across measurement points (Table 1). To facilitate the analysis, question 5 representing the dependency on fishing for survival has been dichotomised to represent families *not depending* (0) or *depending* on (1) fishing for their livelihood. Items reflecting participant’s knowledge have been merged into one variable after checking for internal validity. The variable “*In the near future, I will use fish bombs to fish*” had to be reversely coded.

First, the effect of the comic book on children and their family members in the treatment group has been assessed, in comparison to the control group. For this, two-way repeated measures ANOVAs have been conducted on knowledge and intentions. Sphericity of differences was tested. Subsequently, difference scores have been calculated for all key variables representing the change from pre- to post-test as well as the change from pre- to 3 weeks after test. For the intention to use fish bombs in the future, we also controlled for the level of dependency on fishing as a livelihood. We used multiple linear regression analyses to model changes in child knowledge and child intentions as a function of pre-test scores. We also used multiple linear regression analyses to model changes in parent intentions for fish bombing activities as a function of pre-test scores of parent intentions for fish bombing activities, their child’s presence in a treatment group and their child’s change in intentions for fish bombing activities. Age and gender have been added to the model as covariates to see if they significantly add to the explained variance. Cohen’s d statistics were calculated for

TABLE 1 Demographic sample characteristics.

Gender		Children		Family members		Total
		N	%	N	%	
	Male	28	20.10	10	7.19	38
	Female	71	51.07	30	21.58	101
Age						
	13–18	99	71.22	0	0	99
	19–35	0	0	12	8.63	12
	36–45	0	0	19	13.66	19
	46–60	0	0	9	6.47	9
Dependency on fishing						
	Dependent	50	35.97	10	7.19	60
	Non-Dependent	45	32.37	34	24.47	79

each model and were categorized on the basis of accepted cut-off levels [$d \geq 0.2$, $d \geq 0.5$ and $d \geq 0.8$ for small, medium and large effect sizes, according to Cohen (2013)]. Effect size indicates numerically the size of the effect of the treatment, independent of the sample size. Detailed steps of the analysis can be found in the Supplementary files.

Results

The results section is divided into two parts, in line with the research questions. First, the effects of the intervention on knowledge will be presented, then the effects of the intervention on intentions to talk about fish bombing and intentions to stop fish bombing.

Three of five items have been used to generate an overall knowledge score before, after and long after the intervention (Cronbach's Alpha = 0.52, 0.68, 0.66). Item three and item five had to be excluded due to low internal validity most likely based on ambiguous formulation of the items. Adding gender and age as covariates did not lead to significant changes in the result patterns.

Knowledge

A significant effect of the intervention on knowledge was found for children as well as for parents from before to after the intervention, indicating an increase of knowledge $F_{(1,110)} = 4.63$, $p = 0.034$, $\eta^2 = 0.07$ (Figure 4). There was no statistical difference between children and parents and no significant interaction. A significant effect was also found for treatment from before to 3 weeks after $F_{(1,120)} = 5.00$, $p = 0.027$, $\eta^2 = 0.06$. Significant intergenerational transfer of knowledge has been found in the both, short and long term (post-and three weeks after measurement), the effect sizes were small.

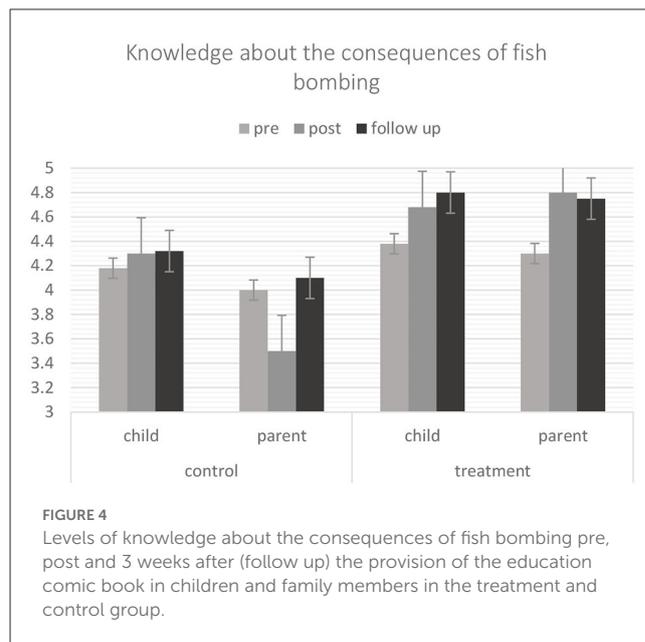


FIGURE 4 Levels of knowledge about the consequences of fish bombing pre, post and 3 weeks after (follow up) the provision of the education comic book in children and family members in the treatment and control group.

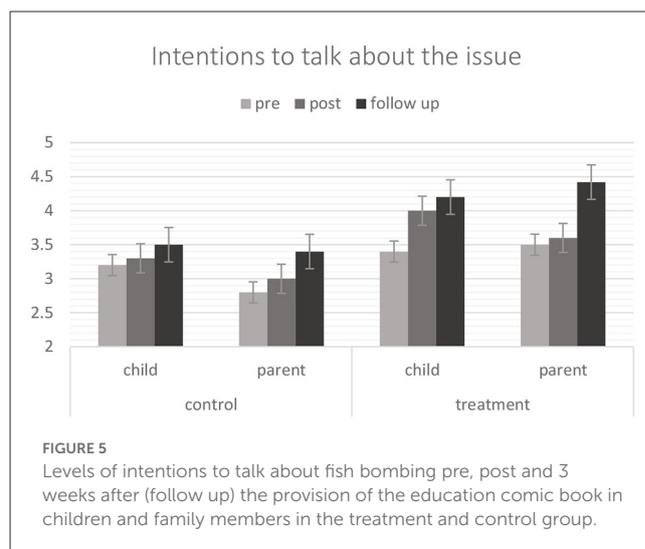
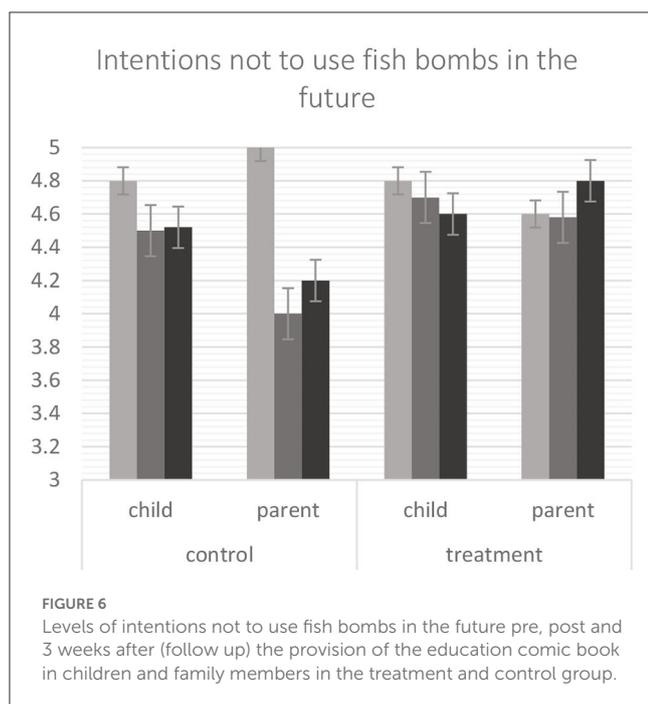


FIGURE 5 Levels of intentions to talk about fish bombing pre, post and 3 weeks after (follow up) the provision of the education comic book in children and family members in the treatment and control group.

Intentions to talk about fish bombing

For intentions to talk about fish bombing, a significant treatment effect has been found for children but not for parents indicating higher scores after the treatment $F_{(1,109)} = 4.28$, $p = 0.041$, $\eta^2 = 0.06$ (Figure 5). When comparing the difference before and 3 weeks after the treatment, both, children and parents showed positive treatment effects $F_{(1,121)} = 4.37$, $p = 0.031$, $\eta^2 = 0.04$ (Figure 5). It is important here to notice the difference in the time of change for children and parents. The effect in children could be measured right after the intervention, whereas the effect for parents was only measured in the follow up measurement, pointing toward intergenerational transfer. Significant intergenerational transfer of intentions to talk about fish bombing with the community has not been found in the short term, but has been found in the long term, the effect sizes were small.



Intentions to stop fish bombing in the future

A significant effect for the intentions not to use fish bombs in the future was found between the pre and post measurement, indicating that children as well as parents in the control group reduced their willingness to stop fish bombing in the future whereas rates in the treatment group did not show significant differences $F_{(1,109)} = 9.81, p = 0.002, \eta^2 = 0.11$ (Figure 6). Between the pre-treatment measurement and the follow up measurement the interaction was marginally significant $F_{(1,121)} = 2.09, p = 0.078, \eta^2 = 0.06$ indicating that a slight increase could be observed for parents in the treatment group whilst a decrease was observed for the parents in the control group. No effect was observed children between the pre and the follow up measurement (Figures 7A, B). Please note the large confidence intervals as well as the small control group for parents. Effect sizes are small.

Dependency on fishing as an important factor

To explore this effect further, the dependency on fishing for survival was added as covariate. The model for the differences between pre- and post-intervention, measurement showed significant main effects of treatment $F_{(1,109)} = 11.52, p = 0.001, \eta^2 = 0.10$, as well as for fishing $F_{(1,109)} = 6.80, p = 0.01, \eta^2 = 0.06$. In addition, a significant interaction between treatment and the dependency on fishing $F_{(1,109)} = 12.24, p < 0.001, \eta^2 = 0.11$ was found (Figures 8A, B). Effect sizes are small. These results indicate that administering the survey to participants who rely on fishing for survival and not exposing them to the comic book leads to significant boomerang effects and reduces their willingness to

fish more sustainably in the future. In comparison, not relying on fishing for survival as well as the engagement to the comic book act as a buffer for this effect. The model for the differences between pre- and follow up intervention measurement showed only marginally significant effects $F_{(1,121)} = 2.64, p = 0.054, \eta^2 = 0.03$ for the interaction between treatment and fishing with similar tendencies.

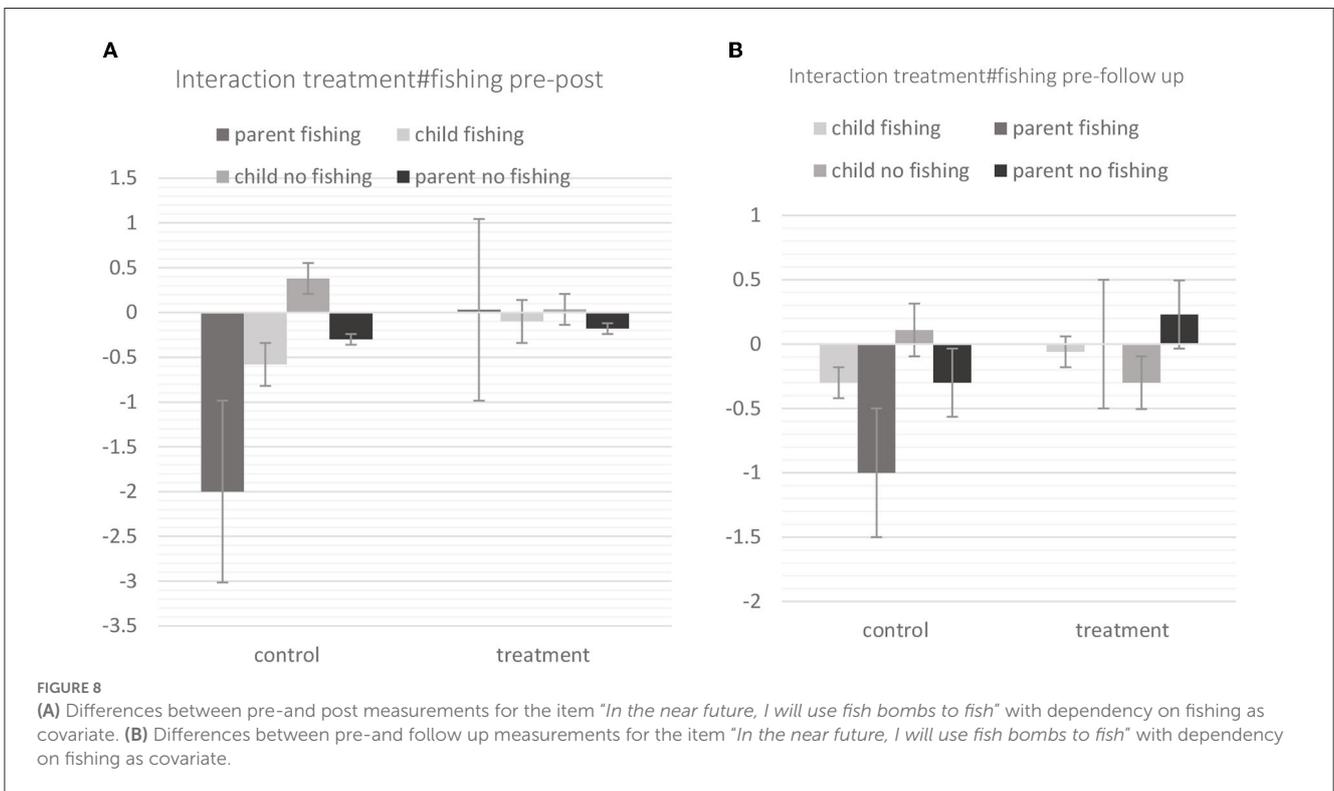
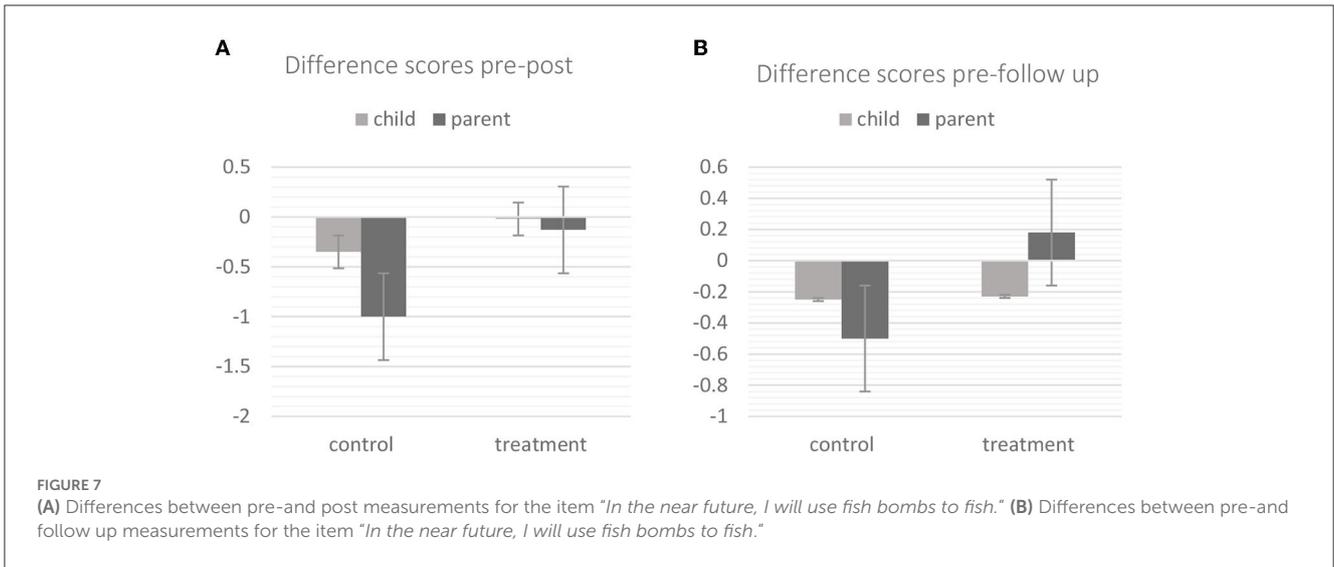
Discussion

Intergenerational transfer between children and their adult family members via engagement with an educational comic book on dynamite fishing has been explored in the short- and longer term. The assessed dependent variables were knowledge about the consequences of dynamite fishing as well as the intentions to (1) talk about dynamite fishing with other community members and (2) stop fish bombing in the future. The engagement did not include any direct interactions with adults, suggesting that any change in knowledge and intentions within the parent group occurred through children's engagement with the comic book and subsequent interaction with their parents.

The present study is addressing a variety of shortcomings from previous research on intergenerational transfer such as the lack of experimental designs and control groups as well as the need for longitudinal designs (Lawson et al., 2019). In addition, the study addresses a type of behavior that is inherently sensitive in a sample representing coastal communities in the Global South.

Responding to RQ1a and RQ1b, we found a significant treatment effect for knowledge about fish bombing in children and their family members, both in the short term (the difference between before and 5 days after the provision of the comic book) as well as in the longer term (before and 3 weeks after provision of the comic book). This effect is in line with the findings by Lawson et al. (2019) who demonstrated that the inclusion of climate change content in the curriculum for school children also leads to a change in climate change concern in their parents, assumably being generated by family discussions or joint engagement with the teaching material. In the present study, the increase in knowledge indicates that a comic book can be an effective way of educating a young audience as well as their family members. The children successfully transferred the content learned from the hypothetical narrative in the comic book to the knowledge questions in the survey and so did their parents. Having knowledge about something (in this case, the consequences of destructive fishing), then it is likely to not only being more conscious about such behavior but also to practice it less. However, since knowledge is only one element of behavioral change it alone is not sufficient in promoting it (Abrahamse et al., 2007; Aghilinejad et al., 2018). As an example, even though many possess knowledge regarding its negative health effects, smoking is still prevalent (albeit in decline) in the population, which suggests that additional factors may play a role (Arlinghaus and Johnston, 2018). Behavioral intentions need to act in tandem with knowledge before any meaningful behavioral change can occur which is why we measured the intentions for two distinct behaviors in addition (Adriaanse et al., 2011).

Responding to RQ2a and RQ2b we found a significant increase in the intention to talk about the problem with the community for children and parents. Analog to the effect we found for knowledge,



differences (i) between the pre-intervention measurement and the measurement 5 days after the intervention and (ii) between the pre-intervention measurement and the measurement 3 weeks later have been found. However, the difference between the pre-intervention measurement and the measurement 5 days after the intervention was only found for the children in the treatment group. The difference between the pre-intervention measurement and the measurement 3 weeks later was significant for both, children and their family members in the treatment group, indicating that children first needed to engage with the content of the comic book together with their parents for a while before

intentions in the parent group were built. This delayed effect can be explained with knowledge being a precondition for the development of behavioral intentions. It also makes repeated engagement with the comic likely in the form of coloring and family discussions. Finding an effect in behavioral intentions 3 weeks after the intervention can be an indication that children's and family members' intentions remain high and may potentially translate into actions.

Especially interesting was the effect we found for the intentions to stop fish bombing in the future, responding to RQ3a and RQ3b. We did not find a significant increase in intentions to stop fish

bombing in the future in children as hypothesized in RQ3 but a significant decrease in both, treatment and control group, a boomerang effect (Byrne and Hart, 2009; Hart and Nisbet, 2011; Levy and Maaravi, 2018; Richter et al., 2018). The term boomerang effect refers to the phenomenon where an action or message intended to produce a certain outcome ends up producing the opposite outcome. Boomerang effects are produced when a threat to one's freedom of choice is perceived (psychological reactance) and are accompanied by a heightened sense of emotional arousal (Byrne and Hart, 2009; Brehm and Brehm, 2013). The effect can be strengthened by the value one places on a commodity (the threat of having it taken away), fear control (defensive avoidance) and ironic processing (enhancing a thought in the attempt to suppress it) (Byrne and Hart, 2009). Campaigns aimed at reducing harmful or environmentally destructive behaviors have the potential to cause boomerang effects, with smoking being a prominent example. If an individual perceives their smoking behavior is being targeted, they may react by intensifying or perpetuating their smoking, even if they are not a regular smoker (Byrne and Hart, 2009). Much of the same can be applied to the context of dynamite fishing: The community members might have perceived the repeated questioning about dynamite fishing annoying, intrusive or threatening, they might have displayed boomerang effects in their answers. For the parent participants, a boomerang effect was found in the control group and no significant change in the treatment group. We assume that this increased willingness to continue the practice in the future could be due to the need for freedom and self-defense (Dillard and Shen, 2005). To maintain a positive self-image, people exposed to information regarding their own transgression behavior might be fortify their existing behavior or respective intentions (Sherman and Cohen, 2006; Schumann and Dweck, 2014).

We explored this interpretation of the effects by adding the dependency on fishing for survival to the analysis. The assumption behind this additional analysis was that participants who would directly depend on fishing for survival would show stronger reactance to the intervention than participants who make their livelihood with other professions. We found that it was indeed the group that directly depended on fishing for survival that showed the significant negative reactions, whereas the group not depending on fishing for survival showed no significant change in intentions. Further, this effect was only found for the control group that did not receive the educational comic book. In other words, we found that asking people, who depend on a certain behavior for survival, and who are repeatedly interrogated about this behavior (illegal fishing practices) without offering them a meaningful way to engage with the topic (such as the comic book), leads to reactance effects. Even if we did not find a significant increase in the intention to stop fish bombing in the future amongst the treatment group in children nor their family members, we found that the engagement with the comic book acted as a buffer against the boomerang effect, keeping participants intentions stable across the intervention period.

These findings are relevant for future research as it points toward the importance of meaningfully involving control groups to avoid unintended negative side effects. This is especially crucial when the interventions come from an outgroup (Graupmann et al., 2012). Even though the comic book was co-created,

the intervention might have been perceived as coming from "outside" the community. According to Graupmann et al. (2012) acceptance to any intervention is lower when it comes from an outgroup. The comic book was distributed to all children from the control group after the conclusion of this study. Ideally, the children from the control group then also engaged with the comic book's content, transferred their knowledge and intentions to their parents and thereby compensated for the uncovered reactance effects. As we did not conduct subsequent measurements, we cannot provide statistical evidence for this assumption, but insights from qualitative data can be found in Lim et al. (under review) on the same study and sample. This study also includes information on the typical parent-children dynamic in the region.

Another explanation for the different result patterns in the two intention variables assessed could be different levels of behavioral costs and difficulty (Truelove and Gillis, 2018). Generally, it is important to consider that the more difficult, time-consuming, or expensive a behavior is perceived to be, the weaker the importance of motivational factors and the lower the probability that this behavior is executed (Kaiser and Schultz, 2009). Talking about dynamite fishing to other community members can be considered an easy, low-cost behavior that does not imply direct financial losses or risks. According to the results from the survey questions on how the content of the book was shared between children and parents [for details please see Lim et al. (under review)], the comic has provided a springboard for active conversations within the participating families already. This is different for the second behavioral intention, stopping to use fish bombs in the future. Referring to the classification of pro-environmental behaviors by Truelove and Gillis (2018), stopping a behavior which in the past contributed to participants livelihood involves high financial and behavioral costs and is therefore less likely.

Limitations and future directions

There are several limitations in this research that we would like to point out. First, there are the methodological shortcomings typical in intergenerational transfer research. Establishing strong evidence for intergenerational transfer is inherently difficult because children and their parents share the majority of aspects of their lives such as demographics, household, neighborhood, peers and even genetic heritage. Our models controlled for demographics such as age and gender and to the best of our knowledge, the comic book was the only significant change that was introduced to the coastal communities during the study period.

The second limitation is that this study was conducted online instead of in person (due to the COVID-19 pandemic and movement restrictions), potentially leading to lower levels of commitment and higher levels of bias. The online setting made it difficult to avoid dropout over the course of the study. Especially the group of family members in the control group was very low ($N=8$) at measurement point two (5 days after the intervention) allowing us to only draw careful conclusions. As the researchers were not able to supervise the data collection themselves but had

to leave this task to local teachers, we cannot rule out the possibility that children interacted with each other while responding to the questionnaire or even that children from the control group have been exposed to the comic before the experimental period was over.

The third limitation is the small effect sizes. The relevance of results with small statistical effect sizes is a complex issue in statistical analysis and research. In many cases, small effect sizes may still be statistically significant and have important practical implications. However, the magnitude of the effect size should be considered in context and interpreted in light of the study design and relatively small sample size. In the case of field research with remote communities who may not be used to filling out surveys and who have economic pressures, there are several factors that can impact the validity of the results. These include low response rates, measurement errors, and the possibility of socially desirable responses. These limitations can impact the representativeness of the sample and the validity of the results and may explain why the effect sizes observed are small. Given these limitations, it is important to conduct additional research to replicate and validate the findings and to gain a better understanding of the phenomenon being studied. This may include collecting data from a larger sample, using multiple methods to assess the same construct, and considering the potential sources of bias and confounding.

Elements that have not been investigated in this study but could be of relevance for destructive fishing behaviors are habitual behavior, traditional values and social norms. People with strong habits around destructive fishing would be less likely to change their behavior unless they have a strong internal motivation (Thomas and Sharp, 2013), while those who hold traditional values are usually more resistant to engaging in novel pro-environmental actions (Stern, 2000). An example of how this could be used in future studies would be to emphasize that *traditionally* people fished with lines and nets and not with explosives (Ghazali, 2011). Social norms indicate the phenomenon of people imitating the behavior of people that are similar to them, hence, their ingroup. Social norms can encourage dynamite fishing if such a behavior is perceived as common in the community (Schuster et al., 2016) and people therefore do not want to deviate from an established standard (Schultz et al., 2007). A way to utilize this phenomenon in future studies is to establish a new, dynamic norm of a growing number of community members adapting alternative, more sustainable behaviors (Sparkman and Walton, 2017; Loschelder et al., 2019).

Conclusion

In conclusion, this study highlights the potential of educational comic books as an effective tool to transfer knowledge and intentions related to the harmful practice of dynamite fishing in Borneo, Malaysia from children to other family members. Knowledge and intentions for low-threshold behaviors such as talking about dynamite fishing have been transferred successfully between generations whilst high threshold behaviors such as to stop dynamite fishing in the future showed a more diverse result pattern with no effects of even negative effects amongst the control group. Our results further demonstrate that the intervention was

successful in mitigating a boomerang effect among those who rely on fishing for their livelihood. This study is the first indicating the danger of interventions against dynamite fishing causing boomerang effects. Future interventions against dynamite fishing should therefore be carefully introduced to the communities, ideally involving the entire community since this could lead to reactance.

Our findings emphasize the importance of considering both motivational and economic drivers of harmful practices, and the need for careful consideration of possible side effects when exploring sensitive research topics. Further research is needed to fully understand the potential of creative educational means to spill between generations and to optimize their use across settings and populations.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Ethics statement

The design of this study was approved by University of Malaya Research Ethics Committee (UM.TNC2/UMREC-762) in coordination with the Ethics Committee of the University of Plymouth. The permission to conduct the activities with schoolchildren was obtained from the Ministry of Education, Malaysia government [KPM.600-3/2/3-eras(9603)]. A secondary school (SMK Abdul Rahim) located in a marine park (Tun Mustapha Park) in northern Sabah, East Malaysia was recruited for this study [SEE5019/600-7/6(02)]. As the schoolchildren were aged below 18, they provided written consent form, and accompanied by their family member aged above 18 during the activities. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

IR: conceptualization, methodology, formal analysis, investigation, writing-original draft, and funding acquisition. VL: conceptualization, methodology, investigation, resources, writing-review and editing, project administration, and funding acquisition. KF: resources, visualization, and writing-review and editing. OR: writing-review and editing. SP: supervision and writing-review and editing. HG: resources, supervision, and writing-review and editing. All authors contributed to the article and approved the submitted version.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2023.1194099/full#supplementary-material>

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