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# Encouraging Cooperation in Climate Collective Action Problems

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# ENCOURAGING COOPERATION IN CLIMATE COLLECTIVE ACTION PROBLEMS

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# Table of Contents

## Executive Summary

Our everyday decisions around food, transportation, or energy use create carbon emissions that impact the climate and therefore other people's lives. Likewise, other people's choices and emissions impact our ability to enjoy a liveable climate. The best collective outcome is achieved if we all reduce our emissions. However, in many climate contexts a mismatch between collective and individual interests can harm climate action.[1] For example, if everyone else reduces their emissions by living car-free, it is tempting for me to free-ride on their efforts and keep my car, as my personal emissions won't significantly harm the climate by themselves. Even more importantly, if others do *not* reduce their emissions, it seems pointless to take action for the same reason: individual action is not enough if others free-ride. This is the climate collective action problem.

This report examines how behavioural science can help solve the climate collective action problem. Behavioural science studies how people make decisions, such as whether to cooperate or free-ride when faced with collective action dilemmas. The report reviews existing research to find relevant evidence and identify concrete policy implications for Ireland. The report has three aims:

1. Summarise behavioural science research on collective action ("narrative review")
2. Systematically review evidence on climate collective action ("scoping review")
3. Draw policy implications for encouraging climate collective action in Ireland

### When do people cooperate towards collective goals?

The narrative review in this report draws on decades of behavioural science research in multiple domains and synthesises the evidence about whether and when humans engage in collective action successfully. The takeaway is that people can and often do cooperate to reach collective goals, but that specific elements of the decision context are hugely influential in determining success.

To understand what mechanisms influence cooperation in collective action, researchers often use experimental "games", undertaken in behavioural economics laboratories or online. Participants are given tokens (redeemable for real money) and are asked to choose whether and how much to contribute to a common investment pool. Investments are then multiplied and split equally among all participants regardless of their contributions.[2] The best collective scenario is for everyone to contribute all their tokens, but the best individual

[1] Individual and collective interests are not always misaligned. For example, retrofitting one's home to be energy-efficient can create both long-term individual benefits that outweigh the initial outlay (warmer home, lower bills) and collective benefits (reduced emissions). However, even when climate action has private benefits, people may not be aware of them, may perceive risks in obtaining them, or behavioural mechanisms such as biases may lead to an under-estimation of benefits. For example, in the case of dietary changes, Espinosa and Azambuja (2024) find that people considerably underestimate the health benefits of plant-based diets. The collective action framework is relevant to any behaviour change where the benefit for wider society features as part of the individual's reasoning when making their decision.

[2] This is the "public goods game". Variants include the "threshold game", where players contribute tokens to a pool to reach a target amount in order to avoid a collective "catastrophe" such as wiping out all private tokens; and the "common-pool resource game", where players can draw tokens from a pool over several rounds but have to balance this with the risk of depleting the common pool to the extent where it doesn't replenish itself anymore. See Text Box 2 for a more detailed explanation of these economic games.

scenario is to free-ride by contributing no tokens but receiving shares from everyone else's investments. Experimental findings from these games have helped identify factors behind cooperation that have then been tested in real-world field settings. This large body of research has generated an understanding of the most important factors behind successful collective action:

- ***Reciprocity***: Few people are complete altruists or selfish free-riders. Most people seem to act as "conditional cooperators", willing to make sacrifices for the common good if others do so too. In other words, many people reciprocate what they see others do – or what they *think* others do.
- ***Punishment***: While free-riders can destroy cooperation by discouraging conditional cooperators, being able to punish free-riders can restore cooperation, as people are willing to punish free-riders (even at their own cost) and reward cooperators. Punishment can be as simple as social disapproval.
- ***Communication***: Being able to communicate with others and make promises to them improves cooperation, especially if communication happens face-to-face, though non-verbal or social cues also help. Communication has stronger effects in larger groups.
- ***Identity***: Cooperation is higher in groups with a strong group identity, whether this identity is pre-existing or built by engaging in collective action together. (However, cooperation is sometimes needed across groups who may need to take different actions, e.g. farmers vs. urban dwellers).
- ***Inequality***: Groups cooperate less when there is inequality within the group (for example, wealth inequality). Fairness perceptions seem to drive this, as people with different levels of wealth have different perceptions of what is fair for each person to contribute (e.g. proportionally, in total).
- ***Leadership***: Leaders who "walk-the-talk" by setting a good and consistent example, especially when it comes at a cost to them, can encourage others to cooperate. People reciprocate leaders' cooperative behaviour, especially when they share a common group identity with the leader.
- ***Rules***: Being able to decide together on the rules and systems governing collective action (such as expected contributions and punishments) can improve cooperation. In addition, rules are more effective when people decide on them together than when the same rules are imposed on people.
- ***Awareness***: Simply whether and how people conceive the individual versus collective nature of problems likely influences cooperation, although more direct evidence is needed. It is presently unclear, for example, how much the public recognises the collective dilemma nature of different kinds of climate action.

When these factors are present in a collective action problem, they can facilitate successful cooperation, as in the case of the Killarney Coffee Cup Project in County Kerry (see Text Box 1).

## What evidence do we have on climate collective action?

The scoping review in this report systematically identified and analysed existing research that applied the lens of collective action to study climate behaviour. This helped us to confirm that the factors identified in the narrative review apply in a climate context; to identify new behavioural factors of cooperation specifically relevant to this context; to understand the scope of existing research on climate collective action; and to identify gaps in this research when seeking to apply collective action insights to Irish climate policy. The scoping review mapped 272 studies. We found three types of behavioural factors, summarised below:

### Contextual factors.

- As seen in the narrative review, rules, and systems, as well as communication, matter (especially opportunities to "signal" one's own cooperative behaviour).
- The multi-level nature of climate change makes collective action challenging, as the problem occurs on a large scale and over several nested levels. Potential solutions include focusing on local goals, making them complementary to global goals (e.g. dividing groups into local sub-groups with sub-goals), and using a polycentric governance approach[3] involving many interconnected centres.
- Lack of information impedes action. How information is framed also matters, for example people appear more likely to cooperate when doing so is justified using pro-social reasons (e.g., helping others) than environmental reasons (e.g., saving the planet).
- As climate change is a multi-generational problem, overvaluing the present over the future inhibits cooperation with peers and future generations. Leveraging legacy motives may encourage action.
- Uncertainty, for example around critical thresholds (such as the 1.5 degrees Celsius target), harms cooperation as it makes it more difficult for people to assess risk and coordinate around a target.

[3] The polycentric approach to climate change governance, proposed by Elinor Ostrom (2009 Economics Nobel Laureate), tackles climate change at multiple scales and levels, using small and medium-scale interconnected units with active oversight of local, regional, and national stakeholders, who experiment and learn from each other.

### *Social factors.*

- The scoping review confirms the role of fairness (including the self-serving use of fairness ideas to avoid action), punishment, reciprocity (including that beliefs about others drive our behaviour), leadership (especially leaders making credible or costly commitments), and group identity in climate collective action.
- Social norms are another powerful driver of climate cooperation, but they are often context-specific. Importantly, current norms may be to not cooperate, and people may under-estimate norms for cooperation.
- Culture and trust play a role, with higher-trust cultures more successfully reducing their emissions.
- There is mixed evidence on group size, as some studies find higher cooperation in small groups whereas others show larger groups cooperate more.

### *Individual factors.*

- People's risk perceptions influence cooperation, with higher perceived risk leading to more cooperation to avoid climate catastrophes in games. More risk averse individuals also cooperate more often.
- Lack of self-efficacy (i.e., believing one is not capable of impactful action) can discourage cooperation, while self-efficacy encourages climate action and may interact with collective (group) efficacy.
- Status quo bias makes it difficult to act when unsustainability is the default. Making sustainable alternatives the defaults can help. Our tendency to rationalise the status quo (motivated reasoning) discourages action.
- Emotions can both help and harm cooperation (e.g. guilt from free-riding vs. anger at free-riders).
- Pro-environmental attitudes and feeling responsible for the climate encourage action, though the impact of attitudes depends on other factors such as cost or social preferences.
- Other individual factors like pro-social preferences and moral and political values also matter.

Important limitations to existing knowledge on climate cooperation emerged from the scoping review:

- There is little to no evidence from Ireland. Many studies come from the US, Germany, and China.
- Much of the evidence base comes from laboratory or online experiments with abstract or generic frames and stakes (e.g. investing tokens in a climate fund) as opposed to specific climate policies or problems, often with convenience samples such as students who may differ from other groups.
- Experiments and games typically asked players to take the same cooperative action (contributing tokens/money), but in the real-world different groups are asked to

contribute in different ways (e.g. an urban dweller living car-free, a farmer taking up agro-forestry).

## Policy implications

The findings of the review have implications for good *communication* of climate policies such as:

- Communicating rules using collective action language ("if we all do X, we can all enjoy Y benefit").
- Emphasising fairness in how the rules have been agreed upon, and their distributional effects.
- Communicating the likelihood of punishment if rules are broken (fines, social disapproval).
- Highlighting the extent of cooperation rather than non-cooperation (positive social norm, reciprocity).
- Communicating "success stories" (ideally from similar peers) to signal social norms, trigger reciprocity, correct misperceptions about others' beliefs and behaviour, and raise efficacy beliefs.

There are also implications for *leadership* such as:

- Leaders making visible, credible, costly commitments to set a good example (walk the talk).
- Communications coming from leaders at the same level as the goal (e.g. city goal and leader).

Finally, there are implications for leveraging a *polycentric* (multi-level) approach, i.e. using many groups and methods for climate action at different scales, instead of one large plan or set of rules (footnote 2):

- Identifying subgroups of the population with their own collective goals, instead of one large goal.
- Using visible and local actors and desired outcomes, which will also make the collective nature of the problem salient and allow for more direct communication.
- Leveraging existing local group identities (e.g. county or community identities) and in-group favouritism when framing challenges and setting goals.

## Open research questions

As there is almost no evidence from Ireland on when and how people cooperate on climate action, it is important to know which aspects of climate action people in Ireland view as a collective action problem and how this might impact the green transition.

Another crucial question is what makes people think of different climate policies as fair, and how this might impact their actions. Fairness perceptions influence cooperation, yet there is little evidence on what drives these perceptions. Understanding this could help design better climate communications.

Research that investigates what areas the public perceive the government to be leading by example – or in what areas they are perceived as lagging behind or even compromising climate goals – may help identify priority areas for public sector leadership and for ensuring it is recognised as a green leader.

Finally, as most research uses stylised abstract games to model climate cooperation decisions, there is much to be learned from games that better reflect real-life climate cooperation problems that Irish people face, how they differ between groups (e.g. farmers, urban dwellers), and how people's experiences of cooperation in one context may (positively or negatively) impact their behaviour in other contexts.

## 1. Introduction: Climate action is collective action

Almost all of the planned reductions in greenhouse gas emissions envisaged by governments to mitigate climate change require somebody, somewhere to change their behaviour. Householders need to adopt and use new technologies to heat homes and water. Motorists need to take fewer journeys powered by internal combustion engines and to switch to active, public, or electrified forms of transport. Manufacturers need to migrate to less carbon-intensive production processes. Consumers need to purchase lower emission products, including the food they buy and eat. Farmers will need to change how they farm and what they produce. The speed and scale of climate action required to meet carbon targets has to be matched by the speed and scale with which citizens change how they act in everyday life.

From a simple accounting perspective, some of the necessary behavioural changes are likely to be beneficial for those undertaking them, meaning private and collective benefits are not always misaligned. More energy efficient homes may save you money in the long run. Active travel is cheaper and better for you, as is moving towards a plant-based diet. For businesses, including farms, investment in greener production may increase future profits. Thus, many of the changes required can be viewed as investments with a positive return both for the individual and for society. In the language of economics, the agent increases their own utility while the negative externality of harmful emissions is reduced. Phrased this way, climate action sounds like an uncontestably great idea – a win-win. This is precisely why many economists are sceptical of this logic. Why, if all of these behaviours are of net benefit to the agent, are people not doing them already?

Both traditional economics and behavioural economics offer potential answers to this question. From the traditional perspective, which views humans as rational pursuers of self-interest, people may lack the necessary information, face hidden costs, or be averse to some risks or uncertainties involved. From the behavioural perspective, people may not pay attention to the issue, misperceive the pros and cons, weigh losses more heavily than equivalent gains, steeply discount future outcomes compared to immediate ones, worry about how others will perceive their decision, or simply be confused. However, despite all of these possible explanations (and doubtless some others), the original question still has force. The fact that people and businesses are not engaging in climate action already is likely to mean, in many instances, that they presently feel that the behaviour concerned is in some way not worth pursuing – otherwise they would be doing it. Therefore, climate action is often experienced as a collective action problem, regardless of the potential private benefits involved in the action.

This observation is vital to the underlying logic of this report. Climate action requires you to do something you would probably not otherwise do. The “ask” may come in multiple forms and at multiple scales, ranging from the simple need for you to pay sufficient attention to make a change, to the requirement to spend thousands of euros on your house, to reforming your entire business practice. Yet in all cases it is an ask. This fact is crucial, because when it comes to impacting emissions, the societal benefit of your individual actions is a proverbial drop in the ocean. Your behaviour will make a meaningful difference

to the climate only if lots of other people change their behaviour as well. So, there is a cost, in terms of attention, effort or expense, for a benefit that depends on the actions of everyone else.

In the jargon of behavioural science, this means that climate action is a “collective action problem”. There is a mismatch between the individual incentive to act and the collective incentive to act. For any one individual, often there may be few (if any) immediate benefits from acting, but if everybody acts then there is a large gain for society as a whole. Unfortunately, there are multiple jargon terms that, with somewhat different emphases, all refer to this situation of when individual incentives and collective incentives are in contradiction. These include “prisoner’s dilemma”, “tragedy of the commons”, “social dilemma”, “public goods game” and “common pool resource problem”. In this report, although we define and refer to specific terms when appropriate, we adopt the expression “collective action problem” as the most appropriate umbrella term for all of these situations where individual and societal incentives are mismatched.

The insight that climate action is, fundamentally, a collective action problem is important for several reasons. Firstly, it provides a useful conceptual framework that links climate action to other societal issues, allowing both similarities and differences to be identified. Secondly, it immediately alerts us to the fact that the behaviour change required for climate action is different from many other contexts where public policy aims to change behaviour. For instance, when government seeks behaviour change in areas such as health promotion and financial decision-making, the primary beneficiary is the individual who undertakes the desired behaviour change. Thus, policy approaches to behaviour change that work in these contexts may not work in a collective action problem where incentives are not the same. Conversely, behaviour change approaches that are specific to collective action problems may be effective for climate action but not for healthy behaviour or sound household finance. Thirdly, and most importantly for the current exercise, recognising that climate action is a collective action problem implies that researchers and policymakers can draw upon a rich literature of findings from approximately 40 years of research in the social and behavioural sciences. Lastly, the same logic applies to research designed to provide evidence for policy to promote collective action. There are existing methods and techniques that can be adapted and deployed for studies specific to climate action.

### 1.1. Research aims

The current study set out with three specific aims, which inform the structure of the report.

**Aim 1: Summarise behavioural science evidence on collective action.**

Our first aim was to summarise the large body of research on collective action, generally, in order to draw lessons about how best to promote collective action. This aim is reflected in Section 2, which contains a narrative review of the collective action literature. The review is undertaken from the perspective of seeking evidence to inform efforts to promote climate action.

**Aim 2: Systematically review available studies on climate collective action problems.**

Our second aim was to produce a comprehensive overview of research that has previously drawn on collective action frameworks to address climate action specifically. It was evident at the beginning of this process that many researchers, working across multiple disciplines and addressing a variety of research questions, had conceptualised climate action as a collective action problem. Given this, we undertook a scoping review designed to document how researchers have previously linked collective action frameworks to climate action problems. In doing so, we were able to map the available evidence on how behavioural factors influence people's willingness to engage in pro-climate collective action, as well as to identify research questions that have not been addressed by research to-date and yet might be important for pro-climate policy. The scoping review forms Section 3 of the report.

**Aim 3: Draw policy implications to encourage climate collective action in Ireland.**

Our third aim was to draw policy implications from the available evidence. This is done in Section 4. While most of these implications centre on what can be done to promote climate action (and to avoid factors that might undermine it), we also include some implications regarding additional research that might help policymakers to bring about a collective change in behaviour.

## 2. The behavioural science of collective action: A narrative review

The first and most important thing to understand about human behaviour in collective action problems is that many people choose the behaviour that favours societal benefit over the behaviour that favours self-interest (Ledyard 1995; Ostrom 2000). The evidence for this conclusion is, at this stage, overwhelming. Willingness to override individual incentives in pursuit of the common good has been recorded in laboratory, field, and observational studies, including case studies of responses to emergencies (Fehr and Schurtenberger 2018; Mawson 2005). This is the good news. The bad news is that this willingness to sacrifice individual outcomes for a better collective outcome is far from universal, highly unstable and variable across contexts.

This section summarises these empirical patterns. The underlying logic is that an understanding of when collective action is most likely, when it is unlikely and when it is liable to unravel can provide guiding principles to inform policy and communication on climate action, given the inherently collective nature of the climate issue. The scientific literature covered in this section does not relate specifically to climate action, but to when and why humans are successful in undertaking collective action across contexts in general. The research that we draw upon is so extensive that a comprehensive review is, at this stage, impossible. The review is therefore narrative rather than systematic, relying on previous reviews and meta-analyses of specific research questions, together with some seminal studies. It also relies heavily on laboratory studies of cooperation in pursuit of collective goals, although there is good evidence from the field that effects found in laboratory studies do generalise to real-world situations (Fehr and Schurtenberger 2018).

### 2.1. The Public Goods Game

Before considering the individual differences, trajectories and contextual factors linked to variation in collective outcomes, it is worth describing the most commonly studied collective action problem, in order to make what we mean by collective action more concrete and to define some terms and parameters. The public goods game is the workhorse of the academic study of collective action problems. In the standard version of the game a group of individuals (“players”) are each given an endowment of money. The money is theirs to keep, but they have the opportunity to donate some or all of it to a “collective fund”. After everyone in the group has decided how much to contribute, all the money donated to the collective fund is multiplied by a factor, often two, before being split evenly among the players.

The underlying logic of this collective action problem is straightforward. Suppose there are ten people in the group, and each has an endowment of €10. If all players donate all money to the collective fund, which is then doubled, the result is that all players end up with €20 instead of €10. This is the socially optimum outcome; the group as a whole can do no better. However, an individual always does better by not contributing anything to the fund. Any single euro contributed to the collective fund is doubled to two and then split among ten people, so the individual who donates it gets just 20 cents of it back. If nine individuals contribute the full €10 and just one contributes nothing, the collective fund is doubled to €180, so the nine all leave with €18 while the one who refused to cooperate bags €28. If five

contribute the full €10 and five give nothing, the fund is doubled to €100, so those who tried to cooperate to reach the best collective outcome make no gain, leaving with €10, while those who refused to cooperate make €20. In short, for the individual, it is never beneficial to contribute anything to the collective fund, while for the group it is always beneficial to contribute everything.

The public goods game is perhaps the economic game most commonly deployed to study collective action. There are a number of others that are described in more detail in Section 3 (see Text Box 2), where we consider how different kinds of collective action scenarios map on to climate action. For now, we use it to demonstrate some central concepts and to introduce the range of variables that can be studied. As a short-hand, in the rest of this report, we use the term "cooperate" to refer to instances where the individual chooses the behaviour that benefits the collective over their own narrow self-interest.

It turns out that cooperation in public goods games (and other similar situations) varies with different contextual factors. Researchers have investigated reasons why people choose to cooperate, in particular by varying specific factors and recording the impact on the level of cooperation. These factors include structural aspects of the game. For instance, increasing the multiplier that determines the collective benefit unsurprisingly increases cooperation. The public goods game is also rarely conducted as a one-shot game but is instead generally undertaken as a repeated game over a number of rounds, with players receiving feedback on their outcomes after each round. Some of the most interesting manipulations concern more social aspects of the setting. These include whether and how people are allowed to communicate, whether there is the possibility of punishment, whether players have different endowments (i.e. whether there is inequality), how much the group shares a common group identity, whether and how there is a leader within the group, and institutional arrangements designed to improve cooperation (e.g. agreements, voting, etc.). Researchers have also looked at individual differences in behaviour and how these relate to other individual characteristics.

We introduce the standard laboratory public goods game here to aid understanding of how researchers have studied behaviour in collective action problems and to demonstrate the kind of variables that might influence behaviour. The findings in the following subsections are taken not only from laboratory public goods games, but also from similar laboratory collective action games, field studies of collective action problems and case studies.

## 2.2. Recognising a collective action problem

While most of the factors behind cooperation described below have been the subject of extensive research literatures, there is a potentially important issue for understanding behaviour in collective action problems that has received far less scholarly attention. One of the earliest papers to use an experiment to test people's willingness to cooperate in foregoing personal gain for the common good is Kelley and Grzelak (1972). At the end of their study, these researchers asked participants to complete comprehension questions to see whether they had fully understood the nature of their dilemma, i.e. that there was a conflict between what was best for them and best for the group as a whole. In fact, they

recorded that cooperation was higher among participants who answered the comprehension questions correctly.

This early paper has been cited many times, but it has generally been used by other researchers to justify initial screening questions to ensure that experimental participants understand the situation facing them before an experiment begins. This is because researchers are primarily interested in the forces that lead people to cooperate or not. They regard failure to comprehend the situation fully as a source of noise in their data and therefore to be minimised.

However, when trying to apply the scientific literature to applied policy situations, the link between cooperation and recognising the dilemma at the heart of the collective action problem is itself an interesting and potentially important issue. In the case of climate action, Section 3 reports some limited evidence that people appreciate the need for collective action on climate change. Yet, given the vast literature on collective actions problems, how members of the public conceive of the individual versus collective nature of policy problems, including climate policy problems, has probably received too little attention.

### 2.3. Individual differences in cooperation

Much of the evidence that follows concerns measuring what happens to the average level of cooperation in a collective action problem when one specific variable is manipulated to isolate its impact. However, from the earliest experiments, it became clear that there are individual differences in how people respond when their own interests collide with societal interest. Axelrod and Hamilton (1981) found that most people cooperate more out of reciprocity than altruism – they either respond to the behaviour of others or expect others to cooperate if they do. Following several decades of research in public good games, we know that a majority of people can be considered "conditional co-operators" who will make sacrifices for the common good provided that others do so too (Chaudhuri 2011). A more recent systematic estimate is that over 60% of people studied[4] behave as conditional cooperators in anonymous laboratory settings, i.e. when interacting with a group essentially as strangers (Thöni & Volk 2018). This same study also found that less than 20% of people studied in such settings behave as “free-riders” who do not cooperate, but instead prioritise their own self-interest to the detriment of the societal outcome.

Despite the relatively low incidence of straightforwardly selfish behaviour in collective action problems, it is crucial to understand how destructive it can be. This destructive influence stems from the influence that free-riders have on conditional cooperators and is most easily illustrated by considering a public good game that is repeated over many rounds. Initially, in the first round, it is not uncommon for the large majority of endowments to be contributed to the collective fund. However, the presence of one or more selfish types

[4] It can be important to distinguish between the population studied and the general population. Specifically, behavioural experiments have been criticised for extrapolating from samples that are likely to be biased towards people who can be characterised as Western, educated, industrialised, rich, and democratic, or WEIRD (Henrich, Heine and Norenzayan 2010). However, in the context of policy to promote collective action within the population of Ireland, it seems reasonable to treat this figure as a useful approximation of the likely level of conditional cooperation.

influences the subsequent behaviour of the majority conditional cooperators, who don't like contributing to the common good if other people aren't going to pull their weight. So, contributions begin to lower in subsequent rounds. The pattern is self-reinforcing and, typically, by perhaps the tenth round contributions to the collective fund can be driven to a very low level. Put simply, the presence of free-riders can cause collective action to unravel completely.

From a policy perspective, there is another important aspect to conditional cooperation. In repeated games studied by researchers, players typically get feedback about the behaviour of those around them or can infer how much others are contributing from their own outcomes. In a real-world setting, this may not be the case. For instance, assume that in addition to long-term financial savings, lowering emissions is a factor in people's willingness to invest in domestic energy efficiency. Such investment has a positive benefit for society as a whole. Yet it is very difficult for households to observe how much other households do, or do not, make such investments, or indeed undertake efforts to reduce energy use within their homes. That is, when it comes to domestic energy efficiency, conditional cooperators do not have accurate information to go on. Indeed, in many cases where policymakers might promote desirable collective action, conditional cooperators are likely to act reciprocally based on perceptions of how much others are cooperating. These perceptions may or may not reflect the reality around them.

We return to issues of conditional cooperation and self-interest specifically with respect to climate change in section 3.3.2 "Reciprocity" and section 3.3.3 "Self-interest"

## 2.4. Punishment

The finding that cooperation in repeated collective action problems can be destroyed by a combination of free-riders and conditional cooperators might initially seem despairing. It may be taken to imply that selfishness will inevitability puncture collective action and lead to its collapse. Fortunately, research shows that there are mechanisms for keeping selfish types in line.

Fehr and Gächter (2000) is a seminal paper. These researchers added the possibility of punishment to a standard public goods game, such that players could spend some of their own money to punish other players after each round. They found that many of the majority of people who cooperated in a collective action problem were also willing to punish free-riders. Follow-up work indicated that once punishment is possible in a collective action problem, cooperators experience strong negative emotions when encountering free-riders, leading them to be willing to pay to punish, while free-riders expect to get on the end of strong emotional responses and adapt their behaviour accordingly (Fehr and Gächter 2002). The result, in simple terms, is that instead of contributions to collective action being driven to the floor over repeated rounds, they rise towards the ceiling.

These studies have inspired a large subsequent literature that has explored many aspects of punishment (and also reward) in support of collective action. One notable result from a policy perspective is that punishment for non-cooperation can be effective in boosting cooperation even if it exists in the form of only social disapproval, i.e. without monetary

consequences (Masclet et al. 2003). In fact, monetary punishment can sometimes backfire if fines are perceived as a "price" for defecting or if fines signal that others are free-riding (e.g., Xu, Qin & Rawlings, 2022). Another is that where punishment is itself perceived as unjust or antisocial, it can backfire (Herrmann, Thöni, & Gächter 2008). A meta-analysis of subsequent studies (Balliet, Mulder and van Lange 2011) confirmed additional results. Rewards are similarly effective in reinforcing collective action. Rewards and punishments are more effective if others have paid to administer them, perhaps because they indicate the strength of feeling behind the action. Punishment (although not reward) is more effective when it is administered by other people within the overall group rather than by a centralised authority and when there are repeated interactions between these individuals. Moreover, these effects of punishment applied not only across public good games, but other collective actions problem (e.g. common-pool resource problems, prisoner's dilemmas). Finally, there is evidence that punishment is more effective in promoting collective action in countries that already exhibit higher levels of trust between strangers, where for example adherence to and enforcement of social norms is already high (Balliet and van Lange 2013). We discuss the evidence for punishment with respect to cooperation in climate collective action problems in section 3.3.1 "Punishment".

## 2.5. Communication

One of the earliest findings in the study of factors that enhance collective action is that communication improves cooperation. In an early meta-analysis of social dilemmas, Sally (1995) found that the number of opportunities for communication and the ability to make promises to others were positively linked to cooperation. Ledyard (1995) similarly confirmed that opportunities to communicate improve cooperation in public goods games.

An updated meta-analysis (Balliet 2010) added some specific findings with respect to the type of communication and how it might work. Communication is most likely to increase cooperation when it consists of face-to-face discussion rather than written messages. While this may in part reflect the fact that face-to-face communication is more interactive than communication through messages, there is separate evidence that non-verbal and social cues matter. For instance, simply being able to see other individuals in a social dilemma makes cooperation more likely (Boone, Declerck and Suetens 2008). Face-to-face communication may have a particularly pronounced effect on the likelihood of keeping promises (Bicchieri and Lev-on 2007). Perhaps more surprisingly, Balliet's meta-analysis also finds that communication has a stronger effect the larger the group that is trying to engage in collective action is. While the reasons for this finding are not obvious, it should certainly be of interest to policymakers, who are typically attempting to promote collective action among communities that are much larger than the kinds of experimental samples used in most studies.

We discuss the role of communication in climate collective action problems in section 3.3.1 "Signals".

## 2.6. Group identity

Closely linked to the benefits of communication is the finding that cooperation in collective action problems is more likely the stronger the group identity between the individuals

involved. Group identities need not necessarily pre-exist but can form rapidly when faced with a repeated collective action problem. In experiments undertaken over multiple rounds, cooperation holds up more reliably when the participants are continually paired with the same group members than when the groups are drawn afresh each time (Croson 1996; Zelmer 2003; Balliet, Mulder and van Lange 2011).

In collective action problems, common membership of existing groups also influences cooperation (Ruffle and Sosis 2006). This effect can occur even if the groups are essentially randomly formed. A striking example is provided by Goette, Huffman, and Meier (2006), who undertook a series of collective action experiments with and without punishment among members of the Swiss army undertaking officer training. Trainees would be assigned randomly to platoons for a four-week training period, during which they would interact with their own platoon, but after which the platoons would be dissolved. This group membership was enough to result in substantially higher cooperation in a collective action problem when interacting with people from the same platoon versus interacting with people from another platoon. Furthermore, participants in the study were more inclined to punish those who did not cooperate when the victims of the non-cooperation were members of their platoon.

From a policy perspective, this kind of reinforcement of collective action through group identity might be a double-edge sword. The effect can be beneficial to the extent that it is possible to foster a common identity among those working towards the collective goal, such as members of a local community. However, some forms of collective action might require cooperation across group boundaries. Climate action is a case in point, where the actions towards a common goal of lower emissions are required from different groups within society and may consist of different actions for each group (e.g. commuters, farmers, energy intensive firms, exporters, etc.).

The direct evidence with respect to group identity and climate action is discussed in section 3.3.2 “Group identity”.

## 2.7. Inequality

Cooperation in collective action is more difficult in the presence of inequality. This finding arises in an early meta-analysis of public goods games in which participants were endowed with different wealth levels (Zelmer 2003) and also in more careful studies that have focused not only on the impact of inequality but also on its origins. Cooperation is lower when there is inequality between people working towards a common goal regardless of whether the inequality arises from windfall amounts or income that is earned (Cherry, Kroll and Shogren 2005; Hargreaves Heap, Ramalingam and Stoddard 2016).

More recent work has investigated more precise reasons for the negative impact of inequality on cooperation. Those with wealthier endowments tend to view regressive contributions to a collective fund as fair (i.e. richer contributors should give more in absolute terms, but less in proportionate terms), while those with less wealthy endowments tend to view progressive contributions to a collective fund as fair (i.e. richer contributors should give more in proportionate terms too), with consequences for how much people are willing to contribute and the likelihood of reaching a collective goal (Malthouse et al. 2023).

The role of inequality in undermining collective action is of obvious importance for policy that aims to promote it. Society has pre-existing disparities in income and wealth that are likely to be unhelpful for obtaining cooperation, unless agreement can be found on what constitutes a fair contribution. Moreover, although it has been less systematically studied, the capability of wealthier or less climate-vulnerable individuals to free-ride on others' collective action (e.g. those who can afford private jets or gas-guzzlers, versus cooperators who reduce flights and vehicle emissions) may be particularly corrosive to the collective effort. The implications for perceptions of fairness on climate collective action are discussed in section 3.3.2 "Fairness" and in Text Box 4 on inequality.

## 2.8. Leadership

Most collective action studies take place in contexts where those involved all decide on a course of action simultaneously. Most real-life situations are more dynamic than this; people have the opportunity to lead or to follow. Studies have therefore tested, in particular, whether leadership by example has a beneficial effect on overall cooperation. Given the high proportion of people who act as conditional cooperators, a leader who promotes cooperation and "walks-the-talk" may be able to increase overall cooperation levels among followers who are happy to reciprocate.

The first studies to test this idea indeed found that when leaders set a good example the overall level of cooperation in a collective action problem went up (Moxnes and Van der Heijden 2003; Güth et al. 2007). Some work since has also linked leadership to group identity, finding that where leaders share common identity with others in the group, they are more likely to set a good example (Drouvelis and Nosenzo 2013). A subsequent meta-analysis of studies that have tested the role of leadership confirms the general finding that people respond reciprocally to a leader's good example (Eichenseer 2023). Further findings of this meta-analysis show that the effect is enhanced where the leader has power to punish or exclude non-cooperators, but diminished where leadership is rotated between individuals. In general, therefore, leaders who set a good and consistent example of how to contribute to a collective goal increase the contributions of others to that goal. We discuss the relevant evidence for the effects of leadership on climate cooperation in section 3.3.2 "Leadership".

## 2.9. Rules and systems

A final factor that has been shown to influence the level of cooperation in collective action problems is the opportunity for those involved to agree to or choose rules and systems[5] to support cooperation. In more concrete terms, people facing a collective action problem might themselves choose a system to tackle it, including perhaps fines or exclusions to deter selfishness and promote cooperation. The rules might be enforced by those involved, for example by voluntary agreement to punish transgressors, or by signing up to a system enforced by a third-party.

[5] Economists often use the term "institutions" to mean the rules and systems by which economic interactions take place. As "institutional solutions" might be understood differently in other disciplines, we use "rules and systems" here instead.

There is evidence that allowing people to agree to rules and systems can increase cooperation. A concrete example of the kind of study involved may help to make the point. Suppose experimental participants in a public goods game can either choose to join a group that will play the standard game or choose to join a group that will play the game with an additional option for players to pay to punish others after each round. On average, people initially prefer to play the standard game without punishment. However, they discover over time that punishment makes cooperation work better and, seeking better cooperative outcomes, begin to migrate to the game with punishment (Gürerk, Irlenbusch and Rockenbach 2006; Gürdal, Gürerk and Yahşi 2021). Providing examples of past experiences can speed up this process of social learning (Gürerk 2013).

Many studies have also tested whether cooperation is higher when groups of people choose their own system of rules for solving the collective action problem versus when the same system has been imposed upon them. Reviewing these studies, Dannenberg and Gallier (2020) find clear evidence that cooperation is higher when people choose their own set of rules for handling it. Available evidence specific to climate action is outlined in section 3.3.1 “Rules and systems”.

### 2.10. What doesn’t matter (or matters less)

Finally, having reviewed factors that have significant effects on the level of cooperation in collective action problems, it is worth pausing to consider factors that people might assume would be important, but evidence suggests are not. It is hard to be definitive, not least for the reason that one cannot easily prove a negative, but also because there may be small differences that studies lack the statistical power to measure. Nevertheless, there are conclusions that can be drawn.

One important finding is that the influence of socio-demographic background characteristics is, in general, small. For example, while some studies have recorded some differences, meta-analyses find no effect of gender on cooperation (Zelmer 2003; Balliet, Li, MacFarlan and Van Vugt 2011). Given the sampling difficulties involved, there is less evidence concerning socio-economic differences, although there are studies that have found no differences in cooperation by socio-economic status (e.g. Gächter, Herrmann and Thöni 2004). There is some evidence that cooperation generally increases with age (Charness and Villeval 2009), although it is difficult to separate this from the finding that people generally become more altruistic with age (Sparrow et al. 2021).

Rather than grouping people by their background characteristics, researchers studying collective action have tended instead to group people according to their social values. There is a more consistent link between cooperative behaviour and other measures of “social value orientation” – how much people value their own outcomes versus the outcomes of others (Pletzer et al. 2018). Put simply, there is a minority of more selfish types from all social backgrounds, and this is the more consistent predictor of behaviour. (See section 3.3.3 on individual decision-making factors.)

Two more findings are of particular note from a policy perspective. First, intuitively one might think that cooperation is harder to achieve the more people there are in the group.

Indeed, early researchers found some evidence that cooperation was harder to achieve in larger groups, but this finding has not stood the test of time when other factors are controlled for in a meta-analysis (Zelmer 2003). More recent experiments suggest that the effects of group size may depend on different features of the collective action problem, and that group size does not necessarily deter cooperation and may even encourage it (Barcelo and Capraro 2015; Pereda et al. 2019; Wu et al. 2020). This is an important conclusion given that policy problems typically involve larger groups than are studied in experiments, where "large" groups typically include 40 or fewer people (see also "Group size" in section 3.3.2). Second, despite a widespread view that cooperation in modern society may be declining, an analysis of the many studies of collective action conducted through the decades in the USA does not support this (Yuan et al. 2022).

## 2.11. Summary

There are multiple factors that influence whether a group of people can act to collectively reach a socially desirable outcome when individual incentives conflict with the behaviour required to achieve this outcome. Cooperation is more likely when people recognise the nature of the problem, when there is a proportionate degree of punishment for those who behave selfishly, when there is more communication between the people involved, when there is a stronger group identity, when there is less inequality, when leaders lead by example, and when people are involved in choosing the rules by which they try to solve the collective action problem. Text Box 1 on the Killarney Coffee Cup Project is an example of successful Irish environmental collective action that illustrates how the factors above can help facilitate cooperation.

Perhaps most importantly of all, in the right circumstances, many people are able to override individual incentives and to act collectively for the common good.

Research in this area is continuing to expand and it may be that some of these factors will turn out to matter more than others. They may also interact with each other (for example, leaders may help foster a strong group identity among group members). However, there is not yet an evidence base that allows us to draw conclusions about how the different factors that promote cooperation compare or combine. This is an important avenue for future research.

**Text Box 1.** The Killarney Coffee Cup Project

The town of Killarney in County Kerry has recently provided a concrete and instructive example of successful, pro-environmental collective action. The town is a popular tourist destination in an area of outstanding natural beauty, but had a problem for years with waste volume and litter from disposable coffee cups.

One potential solution to this problem is for coffee outlets to cease providing disposable cups, requiring customers to bring or purchase reusable ones. For any one outlet, however, this is a potential ticket to going out of business – suddenly becoming more expensive or less convenient than your competitors is rarely a recipe for success. However, if all coffee outlets agree to stop providing disposable cups and cooperate by following the agreed policy, this competitive disadvantage disappears. Thus, the individual incentive is at odds with the collective goal of improving the town's environment for everyone's benefit; in other words, this is a classic collective action problem.

In Killarney, this collective action problem was solved. Providers of take-away hot drinks agreed to a system of providing reusable cups. Consumers have to pay more upfront for their drink by paying a deposit on the cups but can reclaim this deposit by returning the cup to any participating outlet (including at some locations they might travel to outside the town, such as airports). The scheme is running successfully, and the town's waste and litter problems have been greatly reduced.

One of the authors of this report visited the project and discussed it with those involved. The comparison with the international literature on how to promote successful collective action is instructive.

The people who set up the scheme stressed that clear and repeated **communication** of the problem and of the benefit of the collective solution was vital to the project's initial success. The first question many businesses asked on being told of the plan was whether the other local businesses were in; that is, many proprietors were **conditional cooperators**. Getting as many of them together to help **devise the rules** of the deposit system helped to get buy-in and trust. Those proposing the scheme were themselves hot drinks providers and were willing to show **leadership** by changing their own practice. Businesses were treated on an **equal** basis.

The success of the project is now an undoubted matter of pride for the town. The forces of **group identity** are therefore helping to maintain cooperation. A "free-rider" who suddenly started advertising cheaper coffee in disposable cups would risk substantial social disapproval – often an effective **punishment** but one that hopefully won't be needed.

Challenges had to be overcome. Some businesses had to install dishwashers and to train staff to explain the scheme to customers who might respond negatively. These initial costs and risks were borne only because they were taken on simultaneously by all the businesses, who benefitted from sharing experiences. In the end, the view is that the large majority of customers like the scheme. Moreover, because outlets no longer need to purchase disposable cups, long-term costs have reduced.
The alignment between Killarney's experience and the scientific literature on promoting collective action is quite striking.

# 3. Cooperation in climate settings: A scoping review

Section 2 provides a narrative review of factors that influence cooperation in collective action problems. In section 3, we used a scoping review to map available evidence on behaviour in *climate* collective action problems. This systematic approach helped identify key behavioural factors influencing cooperation in the climate context. This section describes the procedure and findings of the scoping review.

## 3.1. Scoping review method

Scoping reviews identify and map available evidence on a specific research topic using rigorous and transparent methods. They are useful for broader topics where the body of evidence may be large and diverse. This review aimed to answer the question: "**How have insights on behaviour in collective action problems been used to study climate action?**". We followed best practice on systematic scoping reviews (Peters et al. 2020; Tricco et al. 2018) and also used Cochrane guidance on rapid reviews as needed given time and resource constraints (Garritty et al. 2021).

In line with best practice, the scoping review followed three steps (in addition to the initial study design and final analysis and reporting). Below is a summary of these steps. The full methodology is detailed in the study protocol registered on the Open Science Framework website at: https://osf.io/myk5z.

### *3.1.1. Search*

We systematically searched five databases to identify potentially relevant texts: Scopus, Web of Science, Science Direct, JSTOR, and Google Scholar. We searched for sources that contained:

- **Collective action problems** keywords (e.g. collective action/cooperation problem, social dilemma, free-riding, common-pool resource, public good…); and
- **Climate** keywords (e.g. greenhouse gas, climate, global warming); and
- **Behaviour** keywords (e.g. decision-making, psychological mechanism, game, behaviour).

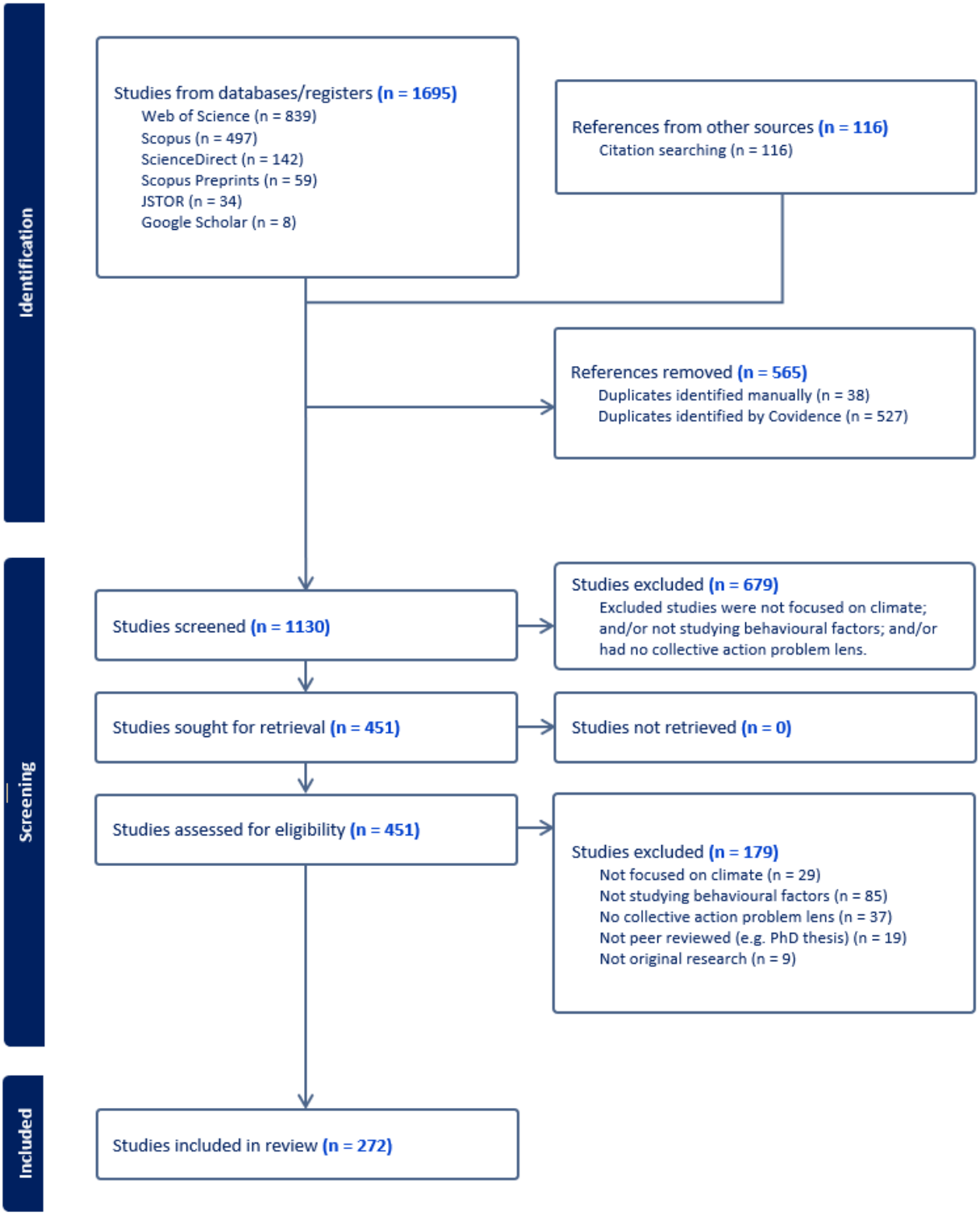
We also searched the bibliographies of included sources to identify further relevant texts.

### *3.1.2. Screening*

We screened the 1130 unique search results against pre-registered selection criteria to ensure they were relevant to the scoping review question. The screening step included two separate rounds: a **title and abstract screening** round using basic information about each source, followed by a **full text review** of the sources included after the first screening round.

To meet selection criteria, a study had to use a **collective action problem lens** to study **climate action**, focusing on **behavioural factors**. We included English language texts published from 2000 onwards. Figure 1 shows the search and screening process. A final number of 272 studies were included in the review.

**Figure 1.** Scoping review PRISMA diagram




Notes: The PRISMA diagram (Page et al. 2021) summarises the search and screening process. As shown in the diagram, the software Covidence identified most of the 565 duplicates. "Studies screened" refers to the title and abstract round. "Studies assessed" refers to the full-text round.

### *3.1.3. Charting*

Data on the 272 studies included in the review was recorded according to a data charting plan. The list of all included studies is in Appendix A. The data charting plan is in Appendix B.

Following the charting plan, key data recorded for each study included:

- Basic identifying information about each study (bibliographic reference, year, country…);
- Aim, findings, and primary contribution of the study to the topic of climate cooperation;
- **Climate outcomes** of interest, such as the policy area or type of climate action studied;
- **Research methods**, for example whether the study was an experiment;
- **Population**, such as the study sample size, location, and demographic characteristics;
- **Collective action concepts** used, and how the study maps them onto real climate action;
- **Behavioural mechanisms** studied, e.g. social, contextual, and decision-making factors;
- If and how **inequality** was studied, for example differences in wealth or background.

The findings reported in the rest of section 3 are based on this data.

## 3.2. Mapping the evidence on climate cooperation

This section presents general findings on the studies included in the scoping review, such as what climate actions or outcomes they examined, what research methods they used, what populations they studied, and how well (how realistically) the studies' research designs or methods mapped theoretical or stylised collective action problem concepts onto real-world climate problems overall. We provide estimates of the number of relevant studies throughout. Some studies fit into multiple categories (or none) and so totals may add up to more or less than 272 (or 100%). Note that, where there was ambiguity in whether a study should be counted in a specific category, we opted to exclude it, meaning the numbers in this section can be considered lower bounds.

### *3.2.1. Climate outcomes*

One of the goals of the review was to identify what climate actions have been studied as collective action problems from a behavioural perspective. Most studies examine **climate mitigation problems** (246 studies, i.e. 90% of the studies reviewed) such as reducing carbon emissions, while 33 (12%) of the studies also or exclusively study climate adaptation problems such as managing water resources under climate change (6 studies, i.e. 2%, also study geoengineering).

A surprising finding of the review is that relatively few studies focus on specific climate actions. Instead, more than half of the studies in the review examine more general topics such as:

- **International climate agreements**. 84 texts (31% of all studies) study international climate policy. They most often involve abstract economic games (see Text Box 2) in

which experimental participants decide on climate cooperation. This helps researchers test how features of policy negotiations, such as the opportunity to communicate, impact cooperation. Other studies test public support for policies and for the design and features of climate agreements.

- **General, abstract, or symbolic climate action**. 85 texts (31%) study climate cooperation without a concrete climate outcome. In 41 of these studies (15%), similarly to many of the international policy studies above, researchers observe cooperation in abstract games where participants take from or give to a group fund (sometimes symbolically framed, e.g. carbon emissions), then draw lessons for climate action. Other symbolic studies focus on general climate attitudes, beliefs, and support for (non-specific) national policy to reduce emissions, among other outcomes.
- **Proxy climate donations**. In 29 (11%) of the studies (some overlapping with the first two bullets), study participants can donate money, usually a share of their compensation payment. Donation decisions are implemented by the researcher and go to climate charities, tree planting, climate ads, or carbon credits. This helps observe "real" climate choices in laboratory or online settings.
- **Cross-cutting policies**. A group of studies examines high-level cross-cutting policies, for example support for carbon taxes, pollution regulation, or carbon offsetting (11 studies / 4%), country-level fossil fuel use (5 studies / 2%), and willingness to change consumer habits in general (12 studies / 4%).

However, 99 studies (37% of all studies) do address specific climate actions, most commonly:

- **Agriculture, land-use, and the marine environment**. These studies often focus on the challenges of managing common-pool resources like fishing reserves, forests, and water resources especially for irrigation purposes, often using economic games (35 studies / 13% of all studies). Other studies measure real-world outcomes such as seed choice or flood insurance.
- **Energy / electricity**. 17 studies (6% of studies) focus on energy topics including households' energy use and energy saving behaviour (observed or self-reported), adoption of green electricity such as solar panels, economic games framed around community energy sharing, and surveys on support for energy policies such as taxing fossil fuels or subsidising green electricity.
- **Pro-environmental behaviours**. In 24 studies (9%), the outcome of interest is a survey of multiple pro-environmental behaviours or intentions spanning across policy areas, including items such as saving energy and water, recycling and buying recycled products, carbon offsetting, cutting back on driving, buying energy-efficient appliances or a fuel-efficient car, choosing renewable energy, reducing meat and dairy intake, among others. A number of studies use the same survey datasets.

- **Climate citizenship**. 5 studies (2%) focus on behaviours and intentions such as donating to charities (excluding the proxy donations discussed above), signing petitions, volunteering, joining an environmental group, or attending protests (sometimes measured in surveys of pro-environmental behaviours as above).
- **Transport**. 6 studies (2%) focus on transport behaviours (in addition to studies using lists of pro-environmental behaviours) such as air travel, car size, or transport mode choice.

### *3.2.2. Methods*

**Disciplines**. Collective action problems have been widely studied in economics through models of prisoner's dilemma and free-riding, which helps explain why 108 (40%) of the studies in the review are economics studies (54 are economics, including behavioural economics, and another 54 are multidisciplinary studies with ecology, environmental science, or psychology aspects among other disciplines). As expected, many studies also come from environmental science (63 studies / 23%) including some multi-disciplinary studies (political science, sociology). There are also 39 psychology studies (14% of the studies reviewed). Finally, small groups of studies are included from ecology, political science, sociology, law, physics, and business, among others.

**Empirical or theoretical?** Most studies in the review (219 studies / 81%) are empirical, reflecting the screening criteria that studies should provide insights about behaviour in climate cooperation problems. The vast majority of these studies use a quantitative approach, reflecting the prevalence of economics studies, though 17 studies (6%) also or exclusively use qualitative methods. 25 empirical studies (9%) also include a theoretical or conceptual contribution, such as an economics or psychology model. Looking at non-empirical studies, 22 (8%) are theoretical or conceptual including game designs, psychology models, philosophy and law essays, and political theory studies, among others. Finally, the review identified 24 non-systematic literature reviews (9%; excluding those contained in other types of studies) and 6 systematic literature reviews (2%; none of the systematic reviews focused on the review question but sections of the reviews were relevant to climate cooperation).

**Experiments.** Most empirical studies use an experimental approach (158 studies, or 58% of all studies). This includes mainly laboratory experiments (94 studies / 35%) and online or survey experiments (41 studies / 15%), but also field (including "lab-in-field") experiments (15 studies / 6%), and combinations of these methods (8 studies / 3%). Most of these experiments (128 studies / 47%) use economic games[6] to study climate cooperation (see Text Box 2).

[6] Economic games are not to be confused with educational (e.g., board) games about climate change, which a number of studies in the scoping review focus on. These studies propose game designs and show how these games can help students, citizens, or policy-makers understand the climate change collective action problem and foster cooperation (e.g. Chappin et al. 2017; Druen and Zawadzki 2021; Eisenack 2013; Castro Santa 2023).

**Text Box 2.** Economic games on climate cooperation

Economic games are widely employed to study collective action problems in simplified controlled experimental settings, as they allow researchers to model social interactions in different situations and to test the factors influencing pro-social behaviour (Thielmann et al., 2021). In economic games, players are asked to make choices that benefit either the collective or the individual. The social dilemma comes from the incentive to "free-ride" on other people's cooperative behaviour (that is, to be selfish). 131 of all studies (48%) in the review use or discuss economic games, including mainly public goods games (51 studies / 19%), threshold games (48 studies / 18%), and common-pool resource games (19 studies / 7%).

♟ **Public goods games:** Players choose whether and how much to give to a public good (for example, a climate fund), often over multiple rounds. The experimenter then increases the value of the fund and redistributes it equally among all participants, even free-riders who did not contribute. In most studies reviewed, payoffs use symbolic tokens paid out as real monetary earnings after the experiment. (See also section 2.1 for a detailed discussion of the basic design of the public goods game.)

♟ **Common-pool resource games**: Players decide how much and how often to take resources from a common pool; in the reviewed studies this often involves a fishing, forest, or irrigation system. Extracting resources increases private payoffs but decreases the resources available to others, and it risks depleting the common pool to the point it can no longer replenish itself in future rounds.

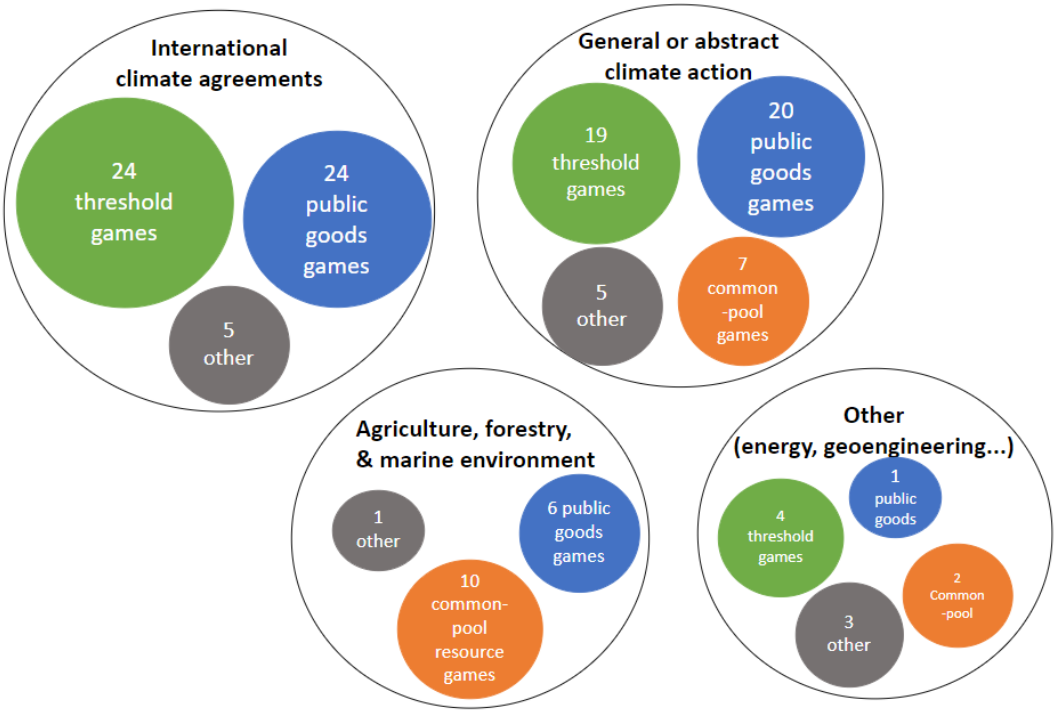
♟ **Threshold games**: In threshold games, players either want to reach a threshold (such as emissions reductions), or avoid reaching a threshold (such as a global temperature increase). The most common threshold game is the "collective-risk social dilemma": players contribute to a climate fund over several rounds as in a public goods game, but if the fund fails to reach a minimum threshold value, players have a high chance of losing some of their remaining tokens (which decreases their earnings).

Figure 2 below shows how the types of games identified in the scoping review vary by the climate policy area studied. Some characteristics observed across game types include:

- Most games (89 studies / 33% of all studies) are played over **multiple rounds**: people can see how others have behaved in earlier rounds.
- Most games (97 studies / 36%) are studied in-person in **laboratory** settings, with others taking place "in the field" (that is, in participants' natural environments such as farming villages) or online.
- All games are **incentivised**: participants earn real money, with total earnings depending on game outcomes (i.e., the overall level of cooperation).
- 68 games (25%) have a **climate frame**, while others are framed neutrally (abstract setting).[7]
- 28 studies (10%) have **real climate outcomes** (e.g. climate fund used to buy carbon credits).

[7] It was not possible to record the frame used in all games, as some studies do not disclose this information and do not share study materials that could help identify the frame (e.g., information sheet shown to study participants).

**Figure 2.** Types of economic games used to study different climate policy areas




Notes: there is likely overlap between the "international" and "general" categories as some studies were assigned to "international" based on generic references to climate treaties or global climate goals. The "other" category includes ultimatum games, trust games, and dictator games, among other games. Minor discrepancies in numbers are due to a small number of studies using several types of games.

Finally, non-experimental empirical studies use original surveys (22 studies / 8% of all studies) or existing data (23 studies / 8%), for example from large-scale international survey datasets, while a small number of studies use interviews and focus groups, observation and ethnographic methods, or a combination of different empirical methods (fewer than 10 studies / 4% each).

### *3.2.3. Populations*

**Countries**. Most studies in the scoping review focus on countries with high carbon emissions, such as the USA, which has the highest emissions per capita (56 studies / 21% of all studies, including some that sample American as well as German or Chinese participants); China, the biggest worldwide carbon emitter (13 studies / 5%); and Germany, the biggest EU emitter (50 studies / 18%) (country emissions statistics in Friedlingstein et al. 2023).[8] There are also 11 UK studies (4%). Most international studies use large existing survey datasets (14 studies / 5%), or original surveys (10 studies / 4%), for example when sampling climate policy professionals. Several studies also examine climate adaptation and common-pool resource topics in global South countries like Colombia (5 studies / 2%) or

[8] Note that country differences in climate knowledge and attitudes (such as climate change denial levels) likely impact results and thus the extent to which international evidence can be applied to Ireland. Many studies measure participants' climate attitudes and account for these in the analysis, while others use student samples (that are not representative of country-level beliefs in the first place), but it is still an important limitation.

Ethiopia (3 studies / 1%). There is no evidence from Ireland (though we found at least 3 studies using international datasets that include but do not focus on Ireland).

**Participants**. The samples of study participants vary based on the research methods. For example, many studies (108 / 40% of all studies) use student samples, likely due to the convenience of recruiting such samples as most of these studies are laboratory experiments (92 studies / 34%). Many studies also study the general public (98 studies / 36%), mainly through experiments (53 studies / 19%), surveys (18 studies / 7%), or using existing data (25 studies / 9%). Smaller groups of studies target participants whose work directly ties into climate change, such as workers in relevant fields (e.g. fishermen, farmers – 15 studies / 6%) or climate professionals (13 studies / 5%), for example policy professionals who participated in international climate summits.

**Sample sizes**. As with participants, sample size depends on research methods and varies widely across studies.[9] Most laboratory experiments include dozens to (most often) hundreds of participants, while field experiments usually involve several hundred participants. Online or survey experiments allow for flexible sample sizes and can range from dozens to thousands of participants. Non-experimental original surveys likewise vary from several hundred to several thousands of participants. Administrative data or existing survey datasets provide the largest sample sizes and can include up to tens of thousands of observations. Finally, methods such as interviews and ethnography usually involve less than a hundred participants.

### *3.2.4. Mapping to Irish context*

An important finding of the review is that there are significant gaps in the evidence base when it comes to drawing policy lessons from existing studies on climate cooperation for an Irish context. This is due to limitations in how these studies translate collective action models into research designs that realistically map onto climate problems relevant to Ireland. In particular:

**Design of economic games**. Games are a valuable tool to identify factors of cooperation, but the extent to which we can draw policy lessons from them depends on how well they replicate real climate problems:

- **Starting point**. Most game designs (117 studies / 43% of all studies) start with no pre-existing or default (high or low) level of cooperation. Participants may have expectations for how others will behave but, unlike many real-world actions, they will not have previously observed how many people engage in the behaviour of interest (for example, how many people have given up eating meat).
- **Giving vs. taking.** Most game designs (85 studies / 31% of all studies) are about "giving" or not giving to a public good, with fewer designs about "taking" or not taking resources for oneself (27 studies / 10%), and 14 studies (5%) about both. Although

[9] Information about sample sizes are also not always provided consistently in all studies or in a comparable manner, hence we discuss general patterns here rather than compiling descriptive statistics about sample sizes. For example, some studies may provide the number of observations in a game but not the number of unique participants.

Jacquet (2015) notes that threshold games are more realistic than public goods games, climate collective action problems in Ireland may be experienced by individuals as "taking" problems involving reducing one's consumption of resources (for example using fossil fuels to power one's car or home heating), or even as "public bad" problems (9 studies / 3%) involving contributing to emissions that impact everyone or refraining from doing so.

- **Actions vs. externalities**. In most games (80 studies / 29% of all studies), climate change is a direct outcome of an action (e.g. players contribute tokens to a climate fund), but in the real world, climate change is often an externality of our actions such as consuming polluting resources (as studied in 34 sources / 13%).
- **Gains vs. losses**. The most frequent game design is to give to a public fund to avoid a catastrophe (57 studies / 21% of all studies). Other common goals in economic games include splitting gains from a public good (30 studies / 11%), avoiding shared losses (5 studies / 2%), or both (27 studies / 10%). Depending on the context, this framing of avoiding a catastrophic event that harms monetary payoffs may or may not be salient to Irish people's climate-relevant choices.
- **Diversity of choices**. In economic games, participants who want to cooperate all do so in the same way, for example by giving money to the game's climate fund. However, in the real world, people can contribute to climate protection in many ways (for example via their diet, transport, or energy choices) and it is not clear that people view others' choices in other domains as part of the same cooperation problem. In addition, positive choices involving inaction (like conserving energy) may be considered separately from positive choices involving action (like installing solar panels).
- **Spillovers between contexts**. Most experiments involve repeated rounds or games (89 studies / 33% of the studies reviewed), but there is no evidence on whether and how people's experiences in one collective action problem or context impact their expectations and behaviours in a different one. Most people face multiple collective action problems (e.g., about how they travel, what they eat, what energy sources they use…) at multiple levels (e.g., local, and national), so their experiences of free-riding or cooperation failures in one context may impact their choices in another.

**Relevance of study context**. More broadly, the studies in the scoping review often focus on identifying mechanisms of cooperation, but not always on mapping these mechanisms onto specific climate issues:

- **Incentives and lab settings**. As shown above, empirical studies often use laboratory or online experiments, which can limit their external validity. For example, incentives are typically monetary and short-term, although as discussed above, some studies use charity donations. Goeschl et al. (2020) found only a weak link between in-game cooperation and a climate donation choice task with real-world impact.
- **Abstract climate outcomes**. More than half the empirical studies in the review are about abstract or generic climate action (e.g. reducing emissions) rather than specific

actions. The most frequent specific topic is international climate policy negotiations, but the trade-offs involved are unlikely to map closely onto everyday climate problems in Ireland, such as energy saving.

- **No studies from Ireland**. We found no studies specifically on the Irish context or population. Studies that focused on policy areas relevant to Ireland, such as energy or farming, often did so in contexts likely to involve different attitudes (e.g. USA) and challenges (e.g. global South).

While keeping these limitations in mind, section 3.3 below reports the key behavioural factors influencing climate cooperation identified in the scoping review.

## 3.3. Factors influencing climate cooperation

The factors influencing climate cooperation identified in the scoping review can be classified into three broad and often overlapping categories:

- Contextual factors such as cooperation rules or the information people have;
- Social factors such as fairness preferences or expectations about other people's beliefs and actions; and
- Individual decision-making factors such as biases or beliefs.

### *3.3.1. Contextual factors*

The features of climate change problems have significant implications for cooperation. Examples of such features include the uncertainty of climate change consequences, and the generational differences in climate trade-offs (as the current generation will not feel the consequences of climate change to the same extent as future generations, nor will they experience as much benefit from taking climate action). Below we summarise contextual factors of cooperation in climate collective action problems including levels, time, information and framing, rules, signalling opportunities, and the role of thresholds.

**Levels**. Climate collective action is challenging because climate change is a large-scale problem occurring over several nested levels (for example, at the individual, local, country, and global level). As a large-scale problem, climate change creates large stressors and hampers spontaneous collective action (Jagers et al. 2020), and people struggle with placing responsibility for climate change at the individual level given wider social processes (Capstick 2013). Several experiments show the impact of levels. High-level goals (saving the planet) are less effective than low-level goals (saving energy at work) at promoting pro-environmental behaviours (Moussaoui and Desrichard 2016), likely because the gap between small individual actions and a big global goal is too large. In an economic game that incorporates multi-level externalities by making contributions complementary between the local levels (sub-groups of players) and the global level (all players), players adjust their behaviour to local conditions but not global behaviour (Güth and Sääksvuori 2012).As climate change is occurring on several levels, single global policies (such as the Carbon Development Mechanism) are unlikely to generate enough trust among citizens and firms for impactful collective action, and using a single government unit for solving a global collective action problem is inherently weak to free-riding problems (Ostrom 2010).

Research on polycentricity (see Text Box 3) argues that a more promising solution is to tackle the problem on several interconnected levels, with different sites learning from each other (Ostrom 2010; review in Cole 2015).

**Text Box 3**. A polycentric approach to promote climate collective action

The polycentric approach to climate change governance, proposed by Elinor Ostrom (2009 Economics Nobel Laureate), tackles climate change at multiple scales and levels, using small and medium-scale interconnected units with active oversight of local, regional, and national stakeholders.

A polycentric governance approach helps resolve collective action problems by allowing stakeholders (such as households or businesses) to achieve direct benefits from climate action that offset the costs of this action, such as installing solar panels or investing in greener construction equipment (Milinski and Marotzke, 2022). The polycentric approach encourages experimental efforts across levels, by developing costs-benefits analysis methods to assess strategies in specific ecosystems that can then be compared to results from other ecosystems (Ostrom 2010). Hence polycentricity can help achieve benefits at multiple scales and encourage learning from experience with diverse policies.

As an example, Milinski and Marotzke (2022) test a polycentric approach in a climate threshold game that divides participants into sub-groups with their own incentivised goals (adding up to the global goal). They find that a polycentric approach is significantly more successful than the single-group approach, though sanctioning free-riding subgroups does not work. There are also several case studies of polycentric approaches in the scoping review, including sea level rise adaptation in the San Francisco Bay area (Lubell et al. 2021), low-carbon development in Indonesia (Suratin et al. 2023), and climate adaptation in natural resource management in Lesotho (Bisaro et al. 2010).

**Time**. The effects of today's carbon emissions will be felt by our future selves and by future generations. Hence a barrier to climate action is intertemporal and inter-generational discounting – the lower value people place on the future (or future generations) compared to today (Hurlstone et al. 2017). Economic games show that decoupling emissions from (delayed) damages impacts mitigation decisions (Ghidoni et al. 2017), that inter-generational discounting significantly decreases cooperation (Jacquet, 2013; Hurlstone et al. 2020), and that people act short-sightedly as they have limited incentives to care about future generations (Sherstyuk et al. 2016; Böhm et al. 2020). Negative inter-generational reciprocity (retaliating against selfish prior generations) may hamper cooperation, with participants in an inter-generational common-pool resource game over-exploiting the resource most when the prior generation was selfish (Chang et al. 2021). In terms of solutions, future orientation affects climate perception and mitigation (Zhu et al. 2020), and asking people to forecast future generations' actions increases contributions to a public good and neutralises negative reciprocity (Bosetti et al. 2022).

Legacy concerns are another potential solution as promoting death awareness restores cooperation and reduces negative reciprocity (Hurlstone et al. 2020). Making legacy-related information public today and for future generations via a registry may make legacy concerns more credible via social sanctions and rewards from contemporaries (Vandenbergh and Raimi 2015). Overall, Jacquet's (2015) evidence review argues that policies should incorporate climate actions with both immediate and long-term benefits, while Van Lange et al. (2018) recommend using kinship cues to make the future less distant.

**Information**. People's climate cooperation decisions are influenced by the information available to them. This includes information about the climate (and information about others' behaviours, see section 3.3.2). This is especially important as lack of information is a noted barrier to climate engagement, for example in the UK (Lorenzoni et al. 2017). Experimental evidence shows that providing information about the scientific consensus on climate change can affect climate attitudes, policy support, and behavioural intentions (as did norm-based messages; Bolsen et al. 2014b) and increase contributions to a group fund which was donated to climate action (Milinski et al. 2006). Van Vugt (2009) highlights that simple information (e.g. in labelling interventions) is often most effective, especially when individuals are already conscious of the environmental impact of their decisions.

Finally, information not just about the climate but also about one's own behaviour can encourage cooperation. For example, studies on climate information interventions often focus on providing feedback, for example about household energy use (review in Velez and Moros 2021), and in common-pool resource games, warnings about resource depletion due to participants' over-extraction of the resource were found to increase cooperation through a behavioural lever of experienced guilt (Baumgartner et al. 2021; Wyss et al. 2021).

**Framing**. How information about cooperation problems is presented can influence climate action (review in Velez and Moros 2021). For example, framing cooperation in an economic game as going from "polluting" to "clean" investments encouraged behaviour change (but also reduced groups' ability to coordinate, so payoffs were unchanged; Gerlagh and van der Heijden 2024). Using gain or loss frames (depending on the emotions induced in participants) and negative (versus positive) climate frames can also increase climate cooperation (Nelson et al. 2020; Tarditi et al. 2020). Pro-social frames (e.g., motivating cooperation as helpful to other people) are more powerful than pro-environmental frames (e.g., cooperation as helping to save the planet; Fleiss et al. 2020; Klein et al. 2017, 2022), but their impact may depend on the policy (subsidy or sanction) and audience (community or nature oriented) (Merrill and Sintov 2016).

Interestingly, framing a game as a "giving and taking" game by setting default levels of contributions to a common climate fund increases cooperation compared to a pure "giving" frame, as people are reluctant to take from the fund (Gallier et al. 2017), but in another game there are no differences between "give" and "give and take" settings (Cloos and Greiff 2021). Finally, people typically understand that climate change is a collective action problem (Capstick 2013; McEvoy and Cherry 2016), but the impact of this internal framing on climate cooperation has not been extensively studied.

**Rules and systems**. Rules around climate cooperation, such as taxes and binding minimum contributions, can increase cooperation more than voluntary mechanisms or nudges (section 2.9; My and Ouvrard 2019; Brick and Visser 2010; Bruns and Perino 2021; Alt et al. 2023). Among binding rules, taxes may crowd out intrinsic motivation while emission standards are neutral (Goeschl and Perino 2012). However, some binding rules can lead to strategic behaviour that reduces cooperation (ratchet-up rules in international agreements; Gallier and Sturm 2021). Several economic games test whether voting on common rules as a group rather than making choices individually increases cooperation. Deciding on common

uniform rules such as a carbon price may lead to more successful outcomes than individual commitments (Schmidt and Ockenfels 2021; Hofmann et al. 2023).

Pönitzsch (2017) finds that making choices as a group leads to higher contributions to the public good, but in Uehleke and Sturm (2017) the positive effect of a majority voting procedure only works for hypothetical choices. Feige et al. (2018) find that a non-binding unanimous voting procedure facilitates cooperation, but that groups who do not reach agreement are worse off. Finally, some games examine rules that cannot be enforced fully. In international policy contexts, Cherry, and McEvoy (2013) find that enforcing voluntary commitments is effective under full participation, but can be detrimental when agreements only require partial cooperation. In low-enforcement common-pool resource contexts such as deforestation, Tambunlertchai and Pongkijvorasin (2021) find that a strict rule is not always the best strategy and allowing higher levels of Consumption can help motivate conservation.

**Signals**. Allowing communication between players in economic climate games promotes cooperation, as it means players can send signals about their planned commitments (Dannenberg and Tavoni 2017). For example, communication significantly increases the chance of successful cooperation (Tavoni et al. 2011), and groups that can communicate invest persistently, seldom give up, and have fewer free-riders (Wang et al. 2020). However, in one game coalition signals were not enough to reach a sizeable coalition of investors in a "clean" technology to avoid a climate catastrophe (Bosetti et al. 2017). Several games test the effect of pledges. Non-binding anonymous voting leads to frequent agreement and high rates of compliance (Feige et al. 2018) and non-binding pledges increase investments in climate change mitigation, though only if both public and private good options exist (McEvoy et al. 2022).

However, studies on "pledge and review" mechanisms (when actors make a commitment that is reviewed by others, as in the Paris Agreement) find that they serve a safeguarding purpose but do not by themselves increase cooperation (Cherry et al. 2021), or that they mainly impact targets with only small effects on actual contributions (Barrett and Dannenberg 2016). Commitment nudges offer the opportunity to send a strong signal, and can be effective to increase cooperation (Koessler 2019) but they may not be enough to reach optimal inter-generational contribution levels (Böhm et al. 2020). Finally, communication opportunities may have polarising effects, as two main behavioural profiles – free-riders and full cooperators – emerge in those scenarios (Brick et al. 2016; Brick and Visser 2010).

**Thresholds**. Climate change is a problem characterised by a high level of uncertainty about the location of key thresholds (such as a temperature increase of 1.5 versus 2 degrees) and about the impact of these thresholds (such as the size or risk of potential catastrophes). As discussed in Dannenberg and Tavoni's (2017) and Hurlstone et al.'s (2017) reviews of threshold games, threshold uncertainty significantly harms cooperation (Barrett and Dannenberg 2012; Dannenberg et al. 2015; Brown and Kroll 2017; Dengler et al. 2018), whereas a certain threshold can help collective action compared to an uncertain threshold or no threshold, even under inequality or impact uncertainty, as it changes the game from a cooperation to a coordination problem (Barrett and Dannenberg 2014a; Dannenberg et al.

2015). The level of threshold uncertainty matters: under large uncertainty, free-riding is too attractive and the catastrophe happens, while under small uncertainty the incentive to coordinate is strong and the catastrophe is often avoided (Barrett and Dannenberg 2014b).

Impact uncertainty has a small positive effect on collective action (Barrett and Dannenberg 2012). Several games examine the role of risk. Thresholds matter even if the risk of catastrophe is uncertain (Brown and Kroll 2017), and risk reductions lead to reduced contributions that almost maximise payoffs (Hagel et al. 2017). Introducing a residual risk even if the threshold is met keeps contributions high until the end, as players stay in "alarm mode" (Farjam et al. 2018). Finally, evidence from common-pool resource games suggests that resource users facing thresholds on average maintain cooperation to maximise their earnings while ensuring future group opportunities (Rocha et al. 2020). This holds for uncertain thresholds, but inequalities and community attributes can mitigate or eliminate this effect (Schill and Rocha 2019).

### *3.3.2. Social factors*

Over 200 studies examine social factors of climate cooperation. Some of the most important social factors are summarised below including fairness, punishment, reciprocity, reputation, leadership, norms, group identity, culture and trust, and group size.

**Fairness**. Perception of inequality is well established to undermine cooperation in collective action problems (section 2.7). The scoping review further shows that cooperation in climate collection action problem often depends on whether people perceive the costs and benefits of cooperation to be fairly distributed (Boon-Falleur et al. 2022). The role of fairness has been extensively studied in the context of burden-sharing rules in international climate agreements. Studies with international samples find that both the general public and policy-makers care about fairness principles, such as capacity to pay and historical responsibility (Bechtel and Scheve 2013; Gampfer 2014; Anderson et al. 2017), but fairness principles are also often used in a self-interested manner in climate negotiations, in other words, when they happen to coincide with one's financial interests (Lange et al. 2007; Lange et al. 2010; Brick and Visser 2015).

The strength of equity and environmental preferences are positively related (Lange and Schwirplies 2017). Another group of studies uses economic games with added inequalities – for example participants are assigned higher wealth or climate vulnerability levels – to test how fairness impacts cooperation. For example, Malthouse et al.'s (2023) threshold game finds that fairness beliefs are not enough to ensure successful cooperation, as if all players acted according to what they thought was fair, cooperation would fail.

Additionally, participants' wealth alters their fairness beliefs and poor participants consistently contribute a higher proportion of their wealth to climate efforts, which further increases inequality. On the other hand, Mahajan et al. (2022) find that players who are less vulnerable to climate change do not take advantage of more vulnerable players and instead act more generously (see Text Box 4 on inequality in section 3.3.3). Finally, fairness perceptions often underpin punishment and reciprocity behaviours, discussed below.

**Punishment**. Allowing people to punish free-riders without having to withdraw their own cooperation promotes cooperation in collective action problems (section 3.4) and may also promote climate cooperation (reviews in Irwin, 2009; Hurlstone et al. 2017). For example, in an energy sharing game, participants acted fairly under the risk of a fine, though the risk did not deter all free-riders (Skatova et al. 2016). In a deforestation game, peer sanctions helped reduce free-riding (Naime et al. 2022). Several studies find high support for sanctions (Bechtel and Scheve 2013; Tingley and Tomz 2014; Nhim et al. 2023), and in an experiment on shared electricity with smart meter feedback, participants reported sanction intentions towards identified free-riders (Leygue et al. 2014).

However, the features and context of punishments may determine whether they are effective, as shown in several games. For example, although high punishment risks increase the likelihood of resolving the collective action problem (Jiang et al. 2016), costly punishment can fail – for example, sanctioning a local group whose contributions are too low in a game with multiple local groups working towards a common global goal punishes fair individuals within that local group, who then reduce their contributions (Milinski and Marotzke 2022). Small fines are not enough to deter free-riders as they under-estimate risk, but high fines ensure cooperation is achieved by deterring free-riders; however, high fines also demotivate some of the most altruistic players, hence cooperation is achieved mainly by cooperators paying only their fair share (Jiang et al. 2023).

An international game with the opportunity to enact costly sanctions on other players finds that sanctions are effective, and that German and Russian groups cooperate more when playing with each other than in within-country games (Grimalda et al. 2022). Finally, games with social punishments such as shame find that they can deter free-riding (Akpalu et al. 2017) and work as well as costless financial punishment (Abatayo and Lynham 2023).

**Reciprocity**. As outlined in section 2.3, climate cooperation decisions may be conditional on other people's cooperation. For example, in an emissions reduction experiment, participants were more likely to contribute if two thirds of the other participants also contributed (Sturm et al. 2019). Support for international climate policy or domestic action depends on other countries' behaviour (Gampfer et al. 2014; Tvinnereim et al. 2016; Stroik et al. 2019; Beiser-McGrath and Bernauer, 2022), though Tingley and Tomz (2014) find support for extrinsic reciprocity (leveraging trade) rather than intrinsic reciprocity (withdrawing cooperation). Some studies find evidence of unconditional cooperation, including in carbon credit purchases (Löschel et al. 2017) and support for unilateral policy or specific policy designs (Bernauer and Gampfer, 2015; Bernauer et al. 2016; Beiser-McGrath and Bernauer 2019).

People may also decide whether to cooperate based on their beliefs about others' behaviour. For example, worries about free-riding and beliefs about others' behaviour impact pro-environmental behaviour (Bohr 2014; Yang et al. 2021; Becchetti et al. 2023; Wyss et al. 2023), though in Europe, most people report high energy savings behaviour despite low cooperation beliefs (Lübke 2021). Finally, there is mixed evidence about the role of second-order beliefs (beliefs about other people's beliefs). Some studies find that people's second-order beliefs influence environmental behaviour and policy support more than their first-order beliefs (that is, their own environmental beliefs) (Jachimowicz et al.

2018; Schuldt et al. 2019). However, in other studies second-order beliefs do not impact behaviour (Wyss et al. 2023).

**Reputation**. Experimental evidence on climate cooperation finds that the chance to acquire a reputation can drive climate action (review in Jacquet 2015). When people can demonstrate to others that they are cooperating, this helps build their positive reputation as cooperators, and thus facilitates conditional cooperation from others (Van Lange and Rand 2022). Social approval from gaining a reputation as a "moral" person (for example via green awards) may help motivate cooperation (proposed in Van Lange et al. 2018).

Economic games find that investments in climate protection are higher when information about these investments is public, and that those with a good reputation are rewarded by others (Milinski et al. 2006; Kumar and Dutt 2019). Avoiding a negative reputation can also motivate cooperation: further economic games find that avoiding public shame from the disclosure of selfish behaviour can reduce free-riding (Akpalu et al. 2017) and that avoiding a negative reputation (shame) is a more effective motivator than seeking a positive reputation (pride or gratitude) (Alpízar and Gsottbauer 2015). Finally, signalling one's intent to cooperate can help build a reputation to facilitate solving collective action problems (as discussed in section 3.3.1 "Signals").

**Leadership**. Leaders who exemplify how to contribute to a collective goal increase cooperation (section 2.8). Leaders can foster cooperation by triggering fairness, reciprocity, and norms effects; by credibly signalling their preferences; and by decreasing the costs of cooperating for followers (Schwerhoff 2016). Economic games show the effects of leadership in international climate policy: "first-mover" leaders who lead by example foster higher follower cooperation, and cooperative signals from privileged players are particularly effective at encouraging cooperation (Nockur et al. 2022). This effect is stronger when leaders face higher monetary costs of leading (Van der Heijden and Moxnes, 2013).

However, Weimann and Sturm (2004) find that leading by example most often fails to induce sufficient cooperation, and that this is because high efforts by the leader and cooperative followers are exploited by free-riders. In addition, when leaders have a competitive mindset (wanting to be re-elected), they extort fair representatives (Milinski et al. 2016). Leaders' credibility matters: their conditional promises increase followers' contributions only if the promise is credible and improves followers' welfare substantially (Helland et al. 2018), and when leaders are incentivised to exaggerate costs, followers trust them less and contribute less (Andrews et al. 2023).

Beyond economic games, in a large field experiment, community organisers who had installed solar panels were more successful in encouraging residents to install solar panels due to their higher credibility (Kraft-Todd et al. 2018). Finally, the desire to lead by example is a key motivator of pro-environmental behaviours and support for unilateral climate initiatives (Schwirplies and Ziegler 2016; McEvoy and Cherry (2016).

**Norms**. Social norms are a powerful and well-studied driver of climate cooperation. Several review studies on norms were identified in the scoping review (Biel and Thogersen 2007; Irwin 2009; Carattini et al. 2019; Bechtoldt et al. 2021; Sparkman et al. 2021; Velez and Moros 2021; Boon-Falleur et al. 2022; Constantino et al. 2022; Raymond et al. 2023). Key takeaways include that norms can both help or harm cooperation; are often context-specific; and need to be part of people's decision-making process (though this is often subconscious) in order to encourage climate action. Potential interventions include publicly emphasising the benefits of cooperation and associated norms; framing normative messages so that they appeal to people across the ideological spectrum; using messages that describe what people currently do well (descriptive norms) as well as messages that describe what people should do (injunctive norms) to mitigate risks; and leveraging the internalisation of norms, as they become part of people's own intrinsic preferences, among others.

Empirical studies find that beliefs about norms predict climate action (Koessler 2019; Sturm et al. 2019; Andre et al. 2024) and that highlighting norms or correcting mistaken beliefs about norms impacts attitudes, policy support, and climate action (Bolsen et al. 2014b; Marek 2018; Andre et al 2024; Bartel and Kesternich 2022). Importantly, current norms may be negative, or behaviour may be unobserved. For example, social norms are a barrier to climate engagement in the UK (Lorenzoni et al. 2007), and workers in pollutive industries are less likely to support climate action (Bechtel et al. 2019).

In such contexts, Sparkman et al. (2021) suggest using dynamic norms and framing normative appeals as an invitation to work with others towards a common goal. Finally, norm effects may depend on whether they have reached a "tipping point": Welsch (2022) found that people's willingness to engage in climate change mitigation decreases the more others are perceived to do it, up to a threshold, but past this threshold, willingness to engage increases with the proportion of others perceived to engage.

**Group identity**. As discussed in section 2.6, the likelihood of cooperation increases with stronger group identity. Indeed, social and group identity can impact climate cooperation both positively and negatively. For example, teenagers' social identity influences their intentions to drive despite their climate concerns (Line et al. 2010), while group identity explains differences between green and non-green buyers' choices (Gupta and Ogden 2009). People base their actions on local rather than global reference groups, as local groups are more salient, as seen in an economic game (Güth and Sääksvuori 2012).

As a real-life example, Kenyan farmers seek climate adaptation advice from similar, nearby, or related peers (Giroux et al. 2023). In-group bias is identified as a key factor of cooperation failures between groups, for example if people in one country see their own consumption and associated emissions as deserved and unavoidable, but the same emissions in another country as wasteful and excessive (Johnson and Levin 2009). Humanising out-groups increased cooperation in an economic game (Huang et al. 2022). Despite this, in other games, there is inter-group cooperation (Safarzynska 2017) and attitudes about other countries are irrelevant to cooperation (Grimalda et al. 2022) or willingness to pass climate problems along to others (Ponte et al. 2017).

More broadly, Masson and Fritsche's (2021) social identity model argues that building inclusive (e.g. global) social identities may provide opportunities for climate interventions; Van Vugt (2009) and Rashidi-Sabet et al. (2022) also advise building group consciousness and a sense of belonging. Finally, increasing perceptions of group efficacy (one's group being seen as able to enact change) can increase pro-environmental intentions, but only if it simultaneously increases self-efficacy (Jugert et al. 2016).

**Culture and trust**. Cultural factors at the community or country level may influence climate cooperation. For example, in a deforestation game in climate-affected locations, communities with a history of collective action were more successful at using monitoring to stop free-riding (Naime et al. 2022), and in countries that institutionalise cooperation (via welfare states), pro-climate beliefs have a greater impact on climate action (Doyle 2018). Policy attitudes may also be impacted, as Merrill and Sintov (2016) find that strong community ties increase preferences for green subsidies over sanctions.

There are also cultural differences in behavioural mechanisms of cooperation; for example, German consumers are driven by green identity, but social norms are more relevant in the USA (Schwirplies and Ziegler 2016). One important aspect of culture for climate cooperation is trust. For example, low trust levels are likely important factors of failure in international climate policy (Frey and Burgess 2023) and Amazon deforestation (Bastos Lima et al. 2021).

Many empirical studies between and within countries find a positive association between (local, social, or generalised) trust and climate cooperation, for example in terms of emissions reductions, energy use, and pro-environmental behaviours (Irwin and Berigan 2013; Bohr 2014; Carattini et al. 2015; Volland 2017; Tam and Chan 2018; Gür 2020; Arora et al. 2021; Jo and Carattini 2021; Lübke 2021; Suratin et al. 2023). Finally, several studies argue that since global policies are unlikely to generate sufficient trust, a decentralised, polycentric approach is needed to foster cooperation among citizens and firms (Ostrom 2010; Cole 2015) (as discussed in Text Box 3 on polycentricity in section 3.3.1).

**Group size**. Some economic games on climate cooperation find that people cooperate more in small groups when communication is allowed (Fan et al. 2019). In large groups, failure rates and bystander effects increase, while contributions decrease (Wang et al 2020; Jiang et al. 2021). Larger groups also require larger punishments to deter free-riding (Jiang et al. 2016; 2023). Hence some studies advise that reducing group size may help solve the climate collective action problem (Rashidi-Sabet et al. 2022). However, in the broader literature on group size effects, the evidence is mixed and suggests that large groups are not necessarily detrimental to cooperation (see section 2.10).

### *3.3.3. Individual decision-making factors*

Individual-level decision-making factors based on people's incentives, biases, and beliefs, can impact climate cooperation. Below we summarise the role of risk perceptions, efficacy beliefs, status quo bias and other biases, emotions, environmental attitudes, self-interest and pro-sociality, and moral values. Inequality between people, for example in terms of wealth or payoffs, also matters (see Text Box 4).

**Risk perceptions**. People's perceptions about the risks they face from not cooperating in climate collective action problems impact their behaviour. Hurlstone et al.'s (2017) evidence review identifies the perceived risk of collective failure as a major driver of outcomes in climate games, as higher or sustained levels of risk can encourage cooperation (Milinski et al. 2008; Güth et al. 2015; Farjam et al. 2018) while a reduced risk leads to lower contributions (Hagel et al. 2017).

However, even with high levels of risk it is difficult to achieve cooperation in threshold games, and people often misinterpret uncertainty in scientific estimates about climate change by underestimating risk (review in Jacquet 2015). Risk preferences also matter. For example, being risk averse was associated with lower resource consumption in a fishing common pool resource game (Arroyo Mina et al. 2016) though it did not impact behaviour in a threshold game (Dengler et al. 2018), and willingness to take risks increased investments in climate adaptation in an irrigation common-pool resource game in China (Heinz et al. 2022). Finally, perceived risk is directly and positively related to climate policy support and pro-environmental behaviours (Lubell et al. 2007).

**Efficacy beliefs**. Collective climate action is less likely to occur if people do not think they have the ability to carry out impactful behaviours. For example, perceptions of powerlessness reduce climate action (Aitken et al. 2011), self-reported barriers to climate action include lack of efficacy (Quimby and Angelique 2011), lack of self-efficacy contributes to apathy towards climate change (Line et al. 2020), and climate change is often seen with resignation and fatalism (Capstick 2013).

On the flipside, personal efficacy is positively related to pro-environmental behaviour (Lubell et al. 2007), people's self-efficacy and belief in the efficacy of climate adaptation behaviours predict their engagement in these behaviours (Bechtoldt et al. 2021), perceived efficacy is a differentiating factor between green and non-green consumers (Gupta and Ogden 2009), and climate action is often motivated by one's actions being seen as meaningful at the cumulative level (Capstick 2013). Finally, self-efficacy and collective efficacy may interact in influencing climate action (Koletsou and Mancy 2011). For example, collective efficacy manipulations (increasing the belief that one's group is capable of enacting meaningful change) can increase pro-environmental intentions, but only if they simultaneously raise self-efficacy (Jugert et al. 2016).

**Status quo bias**. When unsustainability is the default, it can be difficult to switch to greener behaviours. Conceptual studies argue that status quo bias makes us more likely to stick with defaults and thus hampers climate cooperation (Gsottbauer and van den Bergh 2011, 2013; Velez and Moros 2021). However, status quo bias may also be leveraged to help cooperation. For example, default nudges increased contributions in a public goods game (Gallier et al. 2017), in an inter-generational game though not to the optimal level (Böhm et al. 2020), and in an experiment with a real climate donation (Bruns et al. 2018). However, in some settings defaults can fail to increase contributions and discourage those who are already intrinsically motivated (Bruns and Perino 2021).

Status quo bias is especially powerful because of the tendency to rationalise the status quo. For example, people with stronger tendencies towards system justification are more likely to deny climate change, have less favourable attitudes toward the environment, and are more likely to fail to set useful environmental goals or engage in climate action (Feygina et al. 2010). Motivated reasoning may help people justify the status quo to satisfy their psychological needs: self-reported defectors in real-world cooperation problems used motivated reasoning to justify their behaviour ("impossible for me to cooperate due to my circumstances") (Attari et al. 2014) while on the flipside, pro-cooperation social preferences impact people's engagement in pro-environmental behaviours partly by influencing their climate change beliefs (Claessens et al. 2022).

Finally, habits are a particular type of status quo built up over time that impact climate action (e.g. in waste management, Briguglio 2016) and several literature reviews note the importance of habits for climate action (Gowdy 2008; Huckelba and van Lange 2020).

**Other biases**. While the aim of this scoping review is not to document biases and heuristics relevant to climate action in general (given our focus on collective action problems), several conceptual studies and literature reviews identified in the review argue that bounded rationality can hamper climate cooperation (e.g. Gsottbauer and van den Bergh 2011; Raihani and Aitken 2011; Gsottbauer and van den Bergh 2013; Jagers et al. 2020).

For example, relevant biases in passenger air travel may include availability bias, confirmation bias, probabilistic reasoning, anchoring, and scope insensitivity (Higham et al. 2019). Interventions that address or leverage these biases can encourage climate action. For example, Velez and Moros' (2021) review on the role of behavioural science in environmental policy, which is based on two systematic reviews, identifies factors such as status quo bias, present bias, and loss aversion, and documents recent behavioural interventions focused on providing feedback, manipulating framing, using green nudges, or activating social norms on urban contexts.

**Emotions**. Emotional responses to climate change impact cooperative behaviour. Climate change distress – feeling angry, anxious, and sad about climate change – predicts pro-environmental behaviour (Hepp et al. 2023), while other feelings such as disappointment and defeat discourage climate action (Quimby and Angelique 2011). Feeling guilty about unsustainable behaviour can help restore cooperation: economic games show that when people receive warnings about their unsustainable behaviour, they experience feelings of guilt which prompt sustained behaviour change (Tarditi et al. 2020; Baumgartner et al. 2021; Chang et al. 2021; Wyss et al. 2021), though not feeling guilt after the warning is associated with unchanged or more unsustainable behaviour (Baumgartner et al. 2021).

Finally, two studies tested the role of guilt and anger in household energy sharing cooperation problems. The first study (Skatova et al. 2017) found that anger harms cooperation via retaliation and defection, while guilt helps repair cooperation. Participants' social preferences mattered: pro-socials were less likely to act on their anger, while selfish individuals were motivated by anger to retaliate but not by guilt to repair. The second study (Leygue et al. 2014) found that information about average household energy over-use generated guilt and fear and intentions to reduce use, but when the information identified free-riders, this led to anger and punishment intentions (Leygue et al. 2014).

**Environmental attitudes**. Beliefs and attitudes about the environment affect climate cooperation. Many studies in the scoping review examine (or include) the effect of climate attitudes on cooperation. For example, concern about climate change and environmental awareness impact willingness to act to protect the climate (Schwirplies and Ziegler 2016; Becchetti et al. 2023) and environmental attitudes explain participation in a green energy programme (Clark et al. 2003), while climate attitudes and beliefs predict behaviour in a carbon emissions task (Berger and Wyss 2021). In terms of policy support, attitudes impact preferences over fossil fuel regulation (Attari et al. 2009), and a stronger connection to nature is associated with higher preference for policy sanctions (Merrill and Sintov 2016). However, the impact of climate attitudes on behaviour depends on other factors. For example, beliefs that environmental problems are important impact behaviour more in societies with institutionalised systems to address collective action problems (i.e. social welfare systems, Doyle 2018) and environmental attitudes encourage only low-cost, low-impact climate actions, which are prioritised above higher-cost but high-impact behaviours (Farjam et al. 2019).

Climate attitudes also interact with social preferences and are closely related, although social preferences more strongly impact behaviour (Lange and Schwirplies 2017; Fleiss et al. 2020; Klein et al. 2017, 2022) and beliefs about others predict policy support more strongly than own climate beliefs (Schuldt et al. 2019; Wyss et al. 2023). Finally, a closely related set of attitudes that impacts climate action is people's sense of responsibility for the climate. People who feel responsible for contributing to reduce climate damages are more willing to buy carbon allowances (Lindman et al. 2013), and notions of responsibility drive support for unilateral climate efforts in the USA (McEvoy and Cherry 2016), while a lack of sense of responsibility hampers action to halt Amazon deforestation (Bastos Lima et al. 2021). Economic games show that historical responsibility for climate change can encourage fairer behaviour (See Text Box 4).

**Self-interest**. The conflict between self-interest and collective interest is at the centre of the climate change collective action problem (Huckelba and van Lange 2020). People often prioritise self-interest. For example, self-interest drives energy use in district heating systems in Croatia (Maljković et al. 2022) and has a greater impact on energy saving than social interests in the USA (Ohler et al. 2014). Defectors cite self-interest reasons for their behaviour in a survey across policy domains, while cooperators cite social reasons (Attari et al. 2014). In economic game settings, people willingly create climate problems when those problems are passed along to others (Ponte et al. 2017), and successful cooperation is more likely when a coalition of cooperators can appropriate the benefits of their contributions (Bosetti et al. 2017).
Financial incentives were also a driver of cooperation in a laboratory carbon emissions task with real-world impact (Berger and Wyss 2021). In the context of international policy, a number of studies shows that self-interest drives negotiations and support, and that support for unilateral policies is higher when the cost of the policy is lower (e.g. Bernauer and Gampfer 2015; Brick and Visser 2015; see section 3.3.2). Finally, while environmental attitudes can encourage less self-interested behaviour, Farjam et al. (2019) find that they only encourage low-cost climate actions, rather than high-cost actions with greater impact.

**Pro-sociality**. Social preferences – how much we care about what happens to other people – play an important role in climate cooperation. Pro-social preferences (wanting others to have good outcomes) influence cooperation in contexts spanning from electricity sharing in the UK, to water conservation in the USA, to managing shared risks from climate change among farmers in Nepal and Ethiopia (Bolsen et al. 2014a; Skatova et al. 2017; Claessens et al. 2022; Choquette-Levy et al. 2024). More generally, Van Lange and Rand's (2022) review on cooperation and climate change finds that social preferences underpin cooperation. Heinz and Koessler's (2021) review of experimental evidence finds that interventions that leverage pro-social preferences can encourage pro-environmental behaviour by raising awareness about consequences, prompting empathic concern or perspective-taking, and encouraging people to see a broader scope of "others" as morally worthy of concern (expanding their "moral circle"). Interestingly, economic games identify behavioural "types", with people acting as altruists (who cooperate regardless of others' behaviour), cooperators (who cooperate if others do), or free-riders (who do not cooperate).

Altruists play a crucial role in driving cooperation (Wang et al. 2020; Jiang et al. 2021). Altruism correlates with real-world cooperation, for example in conserving energy (Clark et al. 2003; Attari et al. 2014) and altruists and cooperators are more supportive of climate policy (Bechtel et al. 2017). Beyond pure altruism, climate action may be associated with "warm glow" motives: receiving satisfaction from one's pro-social actions (Schwirplies and Ziegler 2016; Schleich et al. 2018). Finally, although pro-social and environmental values are closely related, social preferences may be prioritised over environmental values, and desire for social recognition can lead people to act unsustainably (Line et al. 2010; Fleiss et al. 2020).

**Moral values**. Beyond climate-specific attitudes, general moral values influence climate action (Newell et al. 2014). Universal (as opposed to community or in-group) moral values predict pro-climate donations in the USA (Andre et al. 2024) and endorsing universal moral foundations (care, fairness, liberty), and to a much lesser extent group-focused moral foundations (loyalty, authority, sanctity), is related to climate-friendly behaviour in Western Europe (Welsch 2021). Universal moral foundations such as fairness and care strongly predict pro-environmental behaviours and attitudes, while group-focused foundations are of little direct relevance (in Western Europe, Welsch 2020). Notions of morality contribute to support for unilateral climate policy in the USA (McEvoy and Cherry 2016). Moral intuitions were also shown to play a role in resource extraction in a common-pool resource game in Turkey, with extraction in the first round being positively related to loyalty and authority values while average extraction over the game duration was negatively related to harm values and positively related to loyalty values (Ertor-Akyazi and Akcay 2021).

However, a survey of energy consumers did not find significant differences in the energy use of households with different value patterns in the Netherlands (Vringer et al. 2007). Finally, political values may be relevant to climate cooperation, partly due to their close relationship with moral values (e.g. in the USA, Newell et al. 2014). For example, pro-environmental behaviour in a carbon emissions task correlated with political orientation (in Switzerland, Berger, and Wyss 2021) and right-leaning political orientation is negatively linked to several pro-environmental behaviours and policy support (in Western Europe, Welsch 2020). However, frequent voters regardless of political ideology were more responsive to resource conservation nudges during a drought (in the USA, Bolsen et al. 2014a).

**Text Box 4**. Inequality and cooperation in economic games

Inequality between the actors involved in climate collective action problems is a barrier to cooperation. Over 20 games study cooperation under inequality (reviews in Jacquet 2015; Hurlstone et al. 2017).

Different kinds of inequality matter for climate cooperation:

- Some people or countries are **richer** than others, for example due to effort or luck
- Some are **more impacted** by climate disasters or face higher risks of disasters
- Some are historically or currently **responsible** for larger shares of emissions
- Some will incur **higher costs** from taking climate action, in total or relative to others

In general, **inequality makes it harder to cooperate**, for example inequality in wealth (Milinski et al. 2011; Tavoni et al. 2011; Marotzke et al. 2020 also includes migration between rich and poor countries), in wealth and vulnerability (Burton-Chellew et al. 2013, but Reindl 2022 find opposite results), in climate protection costs (Brick et al. 2016; Brick and Visser 2020), and in benefits and productivity (Kreitmair and Bower-Bir 2021). Yet other games find no or small differences between rich and poor players (Gallier et al. 2017; Calzolari et al. 2018; Cloos and Greiff 2021), and Waichman et al. (2021) find that groups with unequal vulnerability to climate change cooperate more successfully than equal groups.

**Fairness**. When players differ in wealth, vulnerability, or responsibility, fairness often informs behaviour (Gampfer 2014; Anderson et al. 2017; Kline et al. 2018; Waichman et al. 2021 depending on the type of inequality; Mahajan et al. 2022; Reindl 2022). Yet more advantaged players may act unfairly towards vulnerable players as they know vulnerable players have incentives to contribute (Burton-Chellew et al. 2013; Gampfer 2014). Disadvantaged players may also lower their contributions (Gampfer 2014; Kline et al. 2018). Malthouse et al. (2023) find that fairness beliefs are not enough for cooperation, and that poor participants make higher relative contributions, increasing inequality (also in Vicens et al. 2018).

**Uncertainty**. Uncertainty about the threshold of climate investments that needs to be met to avoid a climate disaster can damage cooperation in games with wealth inequality (review in Dannenberg and Tavoni 2017), but contributions can remain high even under uncertainty; impact uncertainty is less harmful than threshold uncertainty (Brown and Kroll 2017).

**Solutions**. Potential solutions to promote cooperation under inequality include binding rules (Brick and Visser 2020), institutions that facilitate coordination (Feige et al. 2018), voluntary redistribution from rich to poor players and commitment signals (Tavoni et al. 2011; Brick et al. 2016; Brick and Visser 2020; Greif and Kempa 2023), public information about contributions (Kumar and Dutt 2019), emphasising reciprocity towards some actors (Kreitmair and Bower-Bir 2021), and providing certainty over the threshold that needs to be met, among other mechanisms, while findings from evolutionary theory support polycentricity and minilateralism (review in Dannenberg and Tavoni 2017).

# 4. Policy implications

In this section, we draw some inferences from the findings of the narrative and scoping reviews for implementing climate policy and we highlight gaps in evidence that require future research. The primary implications come in two forms: (i) lessons for leadership and communication and (ii) the potential benefits from taking a polycentric approach to climate policy implementation. Given the breadth of research covered in this report, we make no claim here that the following thoughts constitute an exhaustive set of policy implications. There are doubtless many other ways that policymakers could make use of these findings on collective action.

## 4.1. Leadership and communication

The evidence covered provides at least three broad implications for leadership and communication. First, once established, **communicating rules using collective action framing** is likely to boost cooperation. Although rationalising the practical purposes of a rule is intuitive (e.g., we need to reduce car journeys by 20% to cut carbon emissions), the broader literature on collective action problems shows that communicating clearly why widespread adherence makes everyone better off is well established to improve cooperation (e.g., that if everyone cuts out one day of driving per week, we will all enjoy less traffic congestion and better air quality, while lowering our emissions) (sections 2.5 and 3.3.1 on "Framing"). This collective action framing of rules can be further strengthened by emphasising fairness in how rules have been agreed upon and set, alongside their expected distributional effects, given that people's **beliefs about fairness and inequality significantly influence whether and how much they cooperate** (sections 2.7, 3.2.2 on "Fairness" and 3.3.3 , Text Box 4).

Where appropriate, it is further worth considering communicating the likelihood of punishments (e.g., fines, social disapproval) if rules are broken by free-riders (sections 2.4 and 3.3.2 on "Punishment"), although given findings on conditional cooperators (section 2.3) it is important to highlight the extent of cooperation over non-cooperation. Note that (differences in) individual-level factors that shape identity and climate perspectives may be important to take into account, so that communications are effective across the population (see section 3.3.3 on individual factors, as well as the ongoing Environmental Protection Agency-funded research projects on person-centred models of climate attitudes and on world views and climate attitudes).

Second, communications from leaders on the nature of and rationale for rules can determine whether individuals decide to cooperate or free-ride. Of particular importance is the credibility of leadership. Where **leaders themselves engage in the same kinds of costly cooperation** that is being expected of others (i.e., they 'walk-the-talk'), the evidence suggests that cooperation is likely to be higher. Note that the findings relate to leadership from within the wider group. Thus, if a goal is set at the community-level, communications are likely to be more effective if they come from community-leaders. Importantly, perceptions of fairness are a strong determinant of cooperation and so, where hypocrisy from leaders is perceived, cooperation is likely to breakdown (sections 2.8 and 3.3.2 on "Fairness" and "Leadership"). Research that investigates what areas the public perceive the

government to be leading by example – or in what areas they are perceived as lagging behind or even compromising climate goals – may help identify policies that the government should prioritise in terms of both actions and communications. The evidence reviewed here indicates scope for public sector leadership and for ensuring it is recognised as a green leader.

Third, the findings on reciprocity imply that **communicating success stories** is likely to motivate further cooperation. Such stories function not merely to signal a helpful social norm that people may copy or adhere to, they also leverage reciprocity; people are more likely to cooperate if they can see that others are doing so (sections 2.3 and 3.2.2 on "Reciprocity" and "Norms"). Decisions to cooperate can be determined by beliefs about others' behaviour and so these success stories, particularly if originating from similar others, may also help to correct any existing misperceptions of others' beliefs about climate change and mitigation. For instance, the ongoing mapping exercise of Irish climate initiatives undertaken by the Department of the Environment, Climate and Communications, might be used to identify successful climate actions that can be highlighted in relevant contexts or communities to signal local norms and trigger reciprocity. Success stories may be particularly effective when paired with findings from the importance of efficacy beliefs, for example by communicating them with accurate information on the effectiveness of the action taken and how similar actions could accumulate to produce even larger positive effects (section 3.3.1 on "Information" and 3.3.3 on "Efficacy beliefs").

### 4.2. Polycentric governance

The findings on contextual factors that foster cooperation in collective action problems provide reasonably strong support for the polycentric (multi-level) approach to climate change policy (section 3.3.1 on "Levels", Text Box 3). This involves using many different groups and methods to tackle climate change at different scales, rather than relying on one large plan or set of rules. For each climate action, identifying subgroups of the population with their own collective goals is likely may be more effective than setting a larger, global goal, even if then latter is incentivised at a broad level. The essence of polycentricity is the mantra 'think global, act local.' The Killarney Coffee Cup Project (Text Box 1) is a great example of this in an Irish context.

The **polycentric approach is in keeping with multiple pieces of evidence** contained in this report. Where other actors and desired outcomes are more local and visible, people are more likely to grasp the essentially collective nature of the problem (section 2.2), to communicate with other actors more directly (section 2.5) and to possess a common group identity (sections 2.6 and 3.3.2 on "Group identity"). The latter relates to one of the most robust findings from social psychology research, namely the human tendency towards in-group favouritism and cooperation. Group identities form most readily at local rather than global levels. While there is some evidence that fostering over-arching, global identities may boost cooperation in climate collective action problems, it is likely to be more efficient to **work with existing group identities** when framing challenges and setting goals, such as community or county identities. In this respect, Ireland is perhaps fortunate in the strength of its identity associated with people's home counties. Note that to guide and appraise a polycentric approach, it is essential to understand what actions are being taken in and

across different centres and how they may fit together to foster learning and innovation; again, the ongoing mapping exercise in the Department of the Environment, Climate, and Communications may be a useful starting point, as it provides an inventory of these actions.

In general, smaller group levels also make it easier to **observe the behaviour of others**, meaning that cooperators can more easily send signals that facilitate further conditional cooperation (sections 2.2, 3.3.1 on "Signals" and 3.3.2 on "Reciprocity"). Observation may also mitigate misperceptions that others are not cooperating, foster higher levels of trust between individuals, place greater importance on reputation and reduce the probability of being a bystander, all of which are linked to better cooperation (e.g. sections 2.3 and 3.3.2 on "Reputation"). Lastly, operating at a more local level can **facilitate participatory decision-making processes** to establish common rules as a group, which is also linked to better cooperation (section 2.8 and 3.3.1 on "Rules").

Applying the polycentric approach involves setting **short term, collective goals at sub-national levels that provide direct benefits to cooperative stakeholders at this level** (e.g., regional-, county- or community-level goals, aiming for lowest feasible level). As an example, the Climate Action Plan 2024[10] sets concrete Key Performance Indicators for 2025 at a national level (e.g., 120,000 dwellings retrofit to BERB2 or above). The polycentric approach would supplement this with more regional and local targets, perhaps with varying targets depending on the housing stock in the area. One advantage is the ability to communicate short-term abatement achievements more directly to householders. These achievements can then be associated with locally and directly experienced benefits for householders, such as savings from more energy efficient dwellings.

### 4.3. Open questions

The breadth of evidence retrieved from the scoping review shows that climate action has been widely conceptualised as a collection action problem, at least by academic researchers. However, it is presently unclear **if the public in Ireland recognise the broader implications of the individual versus collective nature of climate policy problems**. This realisation is a basic foundation for cooperation. As such, there would be considerable benefit to diagnostic research on how the public conceptualise multiple climate policy problems, whether they recognise the collective action nature of them and to test ways of addressing any misperceptions. This research could also contribute to understanding any potentially fatalist beliefs about climate action (e.g., there is no point if others are not contributing).

Perceptions of inequality and fairness are important drivers of cooperation more generally. They also emerged as a strong predictor of cooperation in climate collective action problems (sections 2.7, 3.3.2 on "Fairness" and 3.3.3, Text Box 4). However, determining what people perceive as fair is not straightforward. The evidence shows that fairness principles can be exploited (e.g., those with more wealth advocating for equality of resource inputs rather than equity in distributional effects). Moreover, reasonable people may disagree on what

[10] Government of Ireland. (2023). *Climate Action Plan 2024*. Available at: https://www.gov.ie/en/publication/79659-climate-action-plan-2024/

can be judged as fair. What are perhaps more straightforward to measure are the determinants of perceptions that a rule or behavioural expectation is unfair. As such, investigating **the drivers of the perceived fairness of different climate actions in Ireland** would likely prove a fruitful avenue for behavioural research. This research would be likely to produce, for example, strong '*Don'ts*' to avoid in policy communications about climate change.

More broadly, while we encountered more evidence on collective climate action problems than initially anticipated, there are gaps in the design of the economic games often used to produce this evidence that limit strong inferences (section 3.2.4 on "Mapping to Irish context"). There would be merit to **research that employs games designed to better mimic the psychological profile of collective climate action problems**. For example, games researched to date typically start with no default level of cooperation (i.e., they begin with a neutral equilibrium where historical cooperation is unknown). Encouraging climate action, however, requires a shift from non-cooperation (whether intentional or not) to cooperation. It is further unclear how differential inputs might interact with the abovementioned drivers of cooperation. For example, if different groups are expected to engage in different actions that contribute to the same wider goal, it's unclear whether and how these diverse actions will be conceptualised as cooperation (e.g., if a farmer in Kerry reduces her herd size, does this alter a Dublin commuter's intention to switch to public transport?). Furthermore, most Irish people are likely to face multiple climate collective action problems across policy areas (e.g. what they eat, how they work and travel) and levels (e.g., local, and national). This means that "spillover effects" from one collective action problem to another could impact cooperation if people's experiences and perceptions of cooperation and free-riding in one policy area or level impact their expectations and behaviour in another. These problems are not straightforward, but using game designs informed by the Irish context could substantially contribute to understanding how to improve the communication of social norms.

## 5. Conclusion

Rapid and widespread behaviour change is required across multiple sectors of society to meet emissions reduction targets. Many of the necessary changes come with a cost – attentional, effortful, monetary, or otherwise – for a benefit that may not be immediately observable, and indeed may not be achieved unless many others take the same action. Fortunately, there is a large body of evidence from behavioural science showing that most people are willing to incur costs for the benefit of the collective. However, this tendency is not guaranteed and is highly dependent on social and contextual factors. In addition, there is a need to generate more evidence from Ireland on this topic, so that policymakers can rely less on research from countries where climate beliefs are significantly different, such as the US. In this study, we presented a narrative review of the behavioural science of cooperation in collective action problems (Section 2), a systematic scoping review of the international evidence on cooperation specifically with respect to climate collective action problems (Section 3) and we drew implications for Irish policy based on this evidence (Section 4).

The narrative review in Section 2 shows that cooperation is more likely under some specific conditions: when people recognise that cooperating improves outcomes for the group as a whole, when there is scope for proportionate punishment for those who try to take advantage of the sacrifices of others, when communication between people is easy, when people feel part of a group, when equality is promoted, when leaders provide strong examples, and when people are involved in determining the rules and systems in which they are expected to act. The scoping review in Section 3 supported these inferences with international literature on climate change specifically. Additional factors identified as important for cooperation in climate collective action problems include approaching the challenge with a polycentric lens, leveraging lower-level goals and behaviours where possible (e.g. community level); the importance of information on how others are behaving; the opportunity to signal one's own cooperative behaviour; and the belief that one's action can make a difference. Section 4 provides implications for communications and policy implementation based on the strength of the evidence generated by both reviews.

Importantly, many of the factors identified in this study as important for climate cooperation do not feature in traditional frameworks of behaviour change. Hence, evidence relevant specifically to climate action, as opposed to health or financial behaviour change, may be likely to be overlooked. However, the evidence from the collective action literature is not exhaustive. Section 4 also highlights research gaps, particularly with respect to data generated in Ireland, including the need to investigate how the public conceptualises climate action as a collective action problem, to design collective action problem experiments that better reflect the complexity of the challenge, and to understand what the public considers as fair and unfair behaviour change expectations. Finally, different research strands need to be better linked. Strategies to communicate or encourage collective action should build on existing research mapping climate initiatives in Ireland and take into account the role of person-level factors such as individual identity and differences. None of these gaps are straightforward to address, but the current study provides strong foundations for rapidly developing novel methods to do so.

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## Appendix B. Data charting plan

Study basics

**ID** (open-text)
**Reference** (open-text)
**Aim** (open-text)
**Country** (open-text)
**Year** (open-text)
Is the study a working paper? (Yes/No)

Collective action problem set-up

How is the collective action problem primarily framed?

- Collective action problem
- Public goods game
- Common-pool resource
- Tragedy of the commons
- (Collective-risk) Social dilemma
- Prisoner's dilemma
- Trust game
- Free-rider problem
- Cooperation problem
- Coordination problem
- Other

Good or bad starting equilibrium?

- Good (e.g. most cooperate)
- Bad (e.g. few cooperate)
- Neither (start from scratch)
- Unclear
- n/a
- Other

Is this a "taking" or a "giving" problem?

- Taking / not taking (pool, income, emissions...)
- Giving (resource pool...)
- Both
- n/a
- Other

What is the desired outcome of the collective action?

- Split gains
- Reduce/avoid shared losses
- Reach a threshold to avoid catastrophe
- n/a
- Other

Is climate change a direct action or indirect externality?

- Direct action (e.g. choose emissions level)
- Indirect externality (e.g. choose resource use)
- n/a
- Other

Direct link to climate policy?

- Yes, based on specific policies / actions
- Yes, refers to general policies
- Yes, via funder, grant, or author affiliation
- Yes, via publication (e.g. climate policy journal)
- No

Any other elements relevant to climate realism? (open-text)

Behavioural mechanisms

Are any social factors studied?

- Fairness preferences
- Punishment of free riders
- Norm compliance
- Peer effects
- Conditional cooperation / reciprocity
- Beliefs/expectations re: others' beliefs/actions
- Social identity or group identity
- Communities and culture
- Group size and composition
- Self-image (pro-social, pro-environmental)
- Desire to avoid guilt
- Role of leader
- Communication (content / social aspects)
- Other

Are any environmental factors studied?

- Rules about authorised consumption levels
- Group stability (partner vs stranger matching)
- Framing (e.g. community vs market game)
- Opportunities for communication
- Type and quality of information provided
- Length of problem (once-off vs repeated)
- Salience of climate as social dilemma
- (Credibility of) central enforcing authority
- Multi-level / nested problem (global/local)
- Multi-generational problem
- Transaction costs
- Other

Are any decision-making factors studied?

- Uncertainty
- Emotions/affective states
- Perceived risk or reward (except punishment)
- Perceived coherence/justification for action
- Ease of understanding/implementing action
- Priors about climate (knowledge, concern)
- Personalised information or feedback
- Other

Climate outcome of interest

What policy area(s) are studied?

- International climate agreements/negotiations
- National climate policy
- Other general/cross-cutting (CO2 emissions...)
- Electricity
- Industry
- Built environment
- Transport
- Agriculture
- Land use, land use change, forestry
- Marine environment
- Circular economy
- Climate adaptation
- Citizen engagement (e.g. education)
- Public sector (e.g. procurement)

- Other

What climate strategy is studied?

- Mitigation (cut emissions)
- Adaptation (minimise effects of climate change)
- Geoengineering
- n/a
- Other

What type of climate action or outcome is studied?

- Reduce consumption/emissions (generally)
- Reduce consumption/emissions (spec. action)
- Changing behaviour (switch to better option)
- Supporting a policy
- Complying with a policy
- Agreeing on a policy (treaties)
- Other

What specific climate action or outcome is studied? And how is it measured? (open-text)

Summary of findings. E.g. how the identified mechanism impacts climate (open-text)

Methods

Primary discipline

- Economics (including behavioural)
- Psychology
- Environmental science
- Ecology
- Law
- Computer Science
- Political Science
- Other

Is the study theoretical or empirical?

- Theory or conceptual study (new angle/insight)
- Overview
- Empirical study
- Review (systematic)
- Review (non-systematic)
- Book chapter

- Other

(If theoretical or conceptual) What is the study method?

- Psychological model
- Economics model
- Evolutionary science model
- Law essay
- n/a
- Other

(If empirical) Is the study qualitative or quantitative?

- Qualitative
- Quantitative
- Mixed
- n/a

(If empirical) How was data obtained?

- Experiment (lab, field, randomised survey...)
- Administrative (or other) existing datasets
- Interviews or focus groups
- Surveys (online/paper/etc.)
- Observation/ethnography/etc.
- n/a
- Other

(If exp.) Experimental method?

- Lab
- Online or survey
- Field (incl. lab-in-field)
- n/a
- Other

(If exp.) Incentives within experiment?

- Yes
- No
- n/a
- Other

(If experiment) Is the experiment a "game"?

- Yes - public goods game
- Yes - (collective-risk) social dilemma

- Yes - common pool resource game
- No
- n/a
- Other

(If game) Is the game one-shot or repeated?

- One-shot (single round)
- One-shot (over multiple rounds)
- Repeated (multiple games)
- n/a
- Other

(If game) How do players experience choices?

- Hypothetical or symbolic
- Monetary (play with endowment)
- Real climate-relevant choice
- n/a
- Other

(If game) How do players experience payoffs?

- Hypothetical or symbolic
- Monetary (receive/lose endowment)
- Real climate outcome (e.g. charity donation)
- n/a
- Other

(If game) Do people know they're in a *climate* game? (Yes / No / Unclear / n/a / Other)

(If game) Do people know if others contributed? (Yes / No / Unclear / n/a / Other)

(If exp.) Summarise treatment / intervention / game (open-text)

(If exp.) Any other relevant features? (open-text)

(If systematic review) Further details: (open-text)

(If general conceptual piece) Further details: (open-text)

Does this study introduce any new element, concept, method, or idea? I.e. what is the innovation of this study? (open-text)

Population

At what level is behaviour studied?

- Individual
- Community
- Country
- International
- n/a
- Other

(If empirical) What is the sample size? (open-text)

(If empirical) What is the location? (open-text)

(If empirical) Who is the study sample?

- General public
- Students
- Climate professionals/decision-makers
- Workers in relevant sectors (e.g. oil, fishing)
- n/a
- Other

(If empirical) Any other socio-economic characteristics? (open-text)

Heterogeneity

(If empirical) Is inequality / heterogeneity considered? (Yes / No / n/a / Other)

What dimension of heterogeneity is studied?

- Gender
- Age
- Wealth / resources
- Professional background
- Psychological factors (personality, beliefs)
- Heterogeneity in impact of outcomes
- n/a
- Other

How is heterogeneity studied?

- Observed (without manipulation)
- Manipulated (endowments, group make-up...)
- Both
- n/a
- Other

(If empirical) Provide details on heterogeneity (open-text)