The role of agency in social tipping processes

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10 **Abstract.** Positive social tipping processes – nonlinear, transformational change that improves long-term sustainability and well-being of people and planet – have recently witnessed growing interest in socio-ecological research. In addition to structural and systemic changes, shifts in prevailing social norms and worldviews are key for accelerated societal transformation. Enabling conditions include human agency - the capacity or ability to influence the outside world. Drawing on literature from different disciplines, we present an *agency in social tipping framework* that examines the notion of agency
15 and its determinants, the relationship between individual and collective agency, and how collective agency can trigger social tipping points, potentially leading to large societal transformation. We use the framework and a case study of the shift to plant-based diets to illustrate the role of agency in positive social tipping processes. And finally, we identify and discuss a range of intervention points that might increase perceptions or feelings of both individual and collective agency, potentially overcoming the knowledge-action gap that is preventing large-scale societal action.

1 Introduction

Collectively, we have agreed to limit global warming to 1.5 degrees in the Paris Agreement in 2015. Concrete milestones such as the SDGs give us a 'roadmap' to a sustainable future but in many of those goals, "we are far from where we need to be. We are off track", according to Antonio Guterres, UN Secretary-General (Guterres, 2019). The discrepancy between the societal goals we have set based on knowledge about possible solution pathways and the actions that are currently taken to achieve the
25 goals is commonly referred to as the 'knowledge-action gap' (Vogel and O'Brien, 2022). Several causes for the gap have been identified. Climate policy approaches often focus on the technical causes of undesirable outcomes rather than the underlying beliefs, values and worldviews. Climate education programmes that are purely based on transmitting climate knowledge do not necessarily lead to a change in behaviour (Allen and Crowley, 2017). Educational interventions are much more effective at translating knowledge into action when they also increase collective efficacy through participation and create a feeling of
30 relevance and interconnectedness. A key lever to bridge the knowledge-action gap is a sense of human agency (Otto et al., 2020a; Wamsler et al., 2022; Winkelmann et al., 2022).

While there are a plethora of ways to engage in climate change mitigation and adaptation, there is wide consensus on the importance of identifying the specific intervention points that might trigger positive social tipping (Otto et al., 2020b)—characterised by rapid, non-linear, accelerated and self-reinforcing social change. Most social tipping points will require a mindset shift in a share of the population large enough to change prevailing social norms and laws. Studies in the field of environmental and climate change use methods such as systems dynamic modelling (SD) or multi-level perspective (MLP) to describe dynamic patterns of change in socio-technical systems from an outcome-oriented perspective. However, the role of agency regarding the capacity or ability to influence the outside world has received little attention to date. Only recently, papers on mindsets, paradigms and beliefs have begun to pick up the topic (Wamsler et al., 2022; O'Brien, 2018; Wamsler et al., 2020). There is a growing interest in research on the psychological factors driving collective action (Nardini et al., 2021) and in collaboration between scientists, technical experts, and policymakers to help citizens overcome psychological barriers to climate action (Gifford, 2011).

Using an *agency in social tipping framework*, this article will examine (1) individual agency and its determinants, (2) the relationship between individual and collective agency, and (3) how collective agency can trigger social tipping points, potentially leading to large societal transformation. We identify and discuss a range of intervention points that might increase perceptions or feelings of both individual and collective agency, potentially overcoming the knowledge-action gap that is preventing large-scale societal action. We will use the framework and a case study of the shift to plant-based diets to illustrate the role of agency in positive social tipping processes. We draw on literature from a range of disciplines, including physics, social psychology, neuroscience to social and environmental sciences.

1.1 Contextualising the *agency in social tipping framework*

This article recognizes that social tipping processes require change and action across many different interrelated scales. Social change and transformation frameworks that describe the big picture of change include e.g. Meadow's 'Leverage Points: Places to Intervene in a System' (Meadows, 1999), which identified systems change intervention points ranging from a change in constants and parameters such as increased tax rates or air quality standards to changes in mindsets and paradigms such as the definition of a 'fair' society. Meadow's framework has been picked up, e.g. by (O'Brien, 2018) who divides the leverage points into three spheres of transformation: the practical, political and personal sphere. The practical refers to specific behaviours, strategies and interventions on individual and collective levels, such as a change in consumption or transportation patterns. The political refers to rules and regulations and infrastructures but also to cultural norms. Concrete examples of the political sphere are social movements or social innovations such as circular economy. Agency as it is defined in our paper falls mostly into the personal sphere, which describes the beliefs, values and worldviews that influence behaviour but also define systems and structures. Scoones et al. distinguish between structural, systemic and enabling approaches towards transformation (Scoones et al., 2020). Structural refers to perceived underlying foundations of politics, economy and society such as markets, commodity forms or class relations. Systemic refers to power, politics and institutions. In includes technology, regulations and policies. The enabling approaches emphasize the role of agency. They create social capacities that empower individuals and

65   communities to take action. In accordance with our understanding of agency, enabling approaches focus on processes and

      capacities rather than just outcomes. Further relevant transformation and social change frameworks and concepts include

      Beddoe et al. (2009))'s 'Evolutionary Framework for Change' that focuses on evolutionary changes and regime shifts in culture

      which is defined as an interdependent set of worldviews, institutions and technologies and Stadelmann-Steffen et al. (2021)'s

      'Social Tipping Dynamics Framework', which distinguishes between interlinked technological, behavioural, and political

70   subsystems that can be potentially involved in social tipping processes.

      These frameworks offer an important foundation for thinking through processes of social change. Here, we expand on this

      literature by focusing on the role of agency as described in the personal sphere and enabling approach. It follows O'Brien's

      line of thought who argues that 'directly recognizing and engaging people as agents of change can drastically speed up low-

      carbon transformation processes because everyone is part of a system, and everyone has a sphere of influence' (O'Brien, 2018).

75   This is by no means meant to shift responsibility (and blame) to individuals, as often criticised by activists, or to let

      governments and large organisations off the hook. Rather, it is meant to activate human agency, which has the power to shift

      norms and institutions and lead to desirable social tipping processes. Additionally, we hope to contribute to literature on the

      psychological processes that empower people to build social movements and engage in collective action (Nardini et al., 2021).

      1.2 Agency

80   Agency is the 'capacity of individual and collective actors to change the course of events or the outcome of processes' and to

      make purposeful choices (Pattberg and Stripple, 2008; Alsop et al., 2006). Agency is 'what a person is free to do and achieve

      in pursuit of whatever goals or values he or she regards as important' (Sen, 1985). Neuroscience uses the term 'sense of agency'

      (SoA), which is defined as 'the sense that I am the author of my own actions' (David, 2012). According to social cognitive

      theory, there are four core properties of human agency: intentionality (forming plans and strategies), forethought (anticipatory

85   self-guidance), self-reactiveness (motivating and regulating the execution of plans), and self-reflectiveness (self-examination

      of one's own functioning and corrective adjustments) (Bandura, 2006).

      The development of the sense of agency starts early in life and influences perceptions and behaviour throughout the lifespan

      (Wen and Imamizu, 2022). Self-agency is involved in most affective and cognitive processes, including the processing of

      experience, emotion and motivation, but also allows individuals to shape their environments through the decisions they make

90   (Gecas, 2003). Personal agency is already developed in the first few months of life, primarily through the interaction between

      an individual and its environment (Bandura et al., 1999). A responsive environment promotes the development of causal

      agency. Beyond infancy, other interactions, such as observing others (vicarious experience), verbal persuasion in one's

      abilities, emotional arousal such as fear and the individual experience of actions and their consequences, influence the

      development of agency (Bandura et al., 1999). Agency is generally considered to be vital for positive youth development

95   (Christens and Peterson, 2012).

      Self-efficacy is an important manifestation of human agency and refers to people's beliefs in their causative and agentic

      capabilities (Bandura et al., 1999). Efficacy beliefs contribute to individual motivation, performance, accomplishments, and

emotional well-being. Individuals with high self-efficacy think of themselves as effective, competent and able, while those with low self-efficacy are likely to see themselves as helpless, powerless, and to become fatalistic. There is also a motivational

100   component of self-efficacy. Motives such as the motivation for achievements or power influence preferences and decision-making. Research from psychology, neurobiology and behavioural economics define seven distinct motives: achievement, power-status, affiliation, care, anger, fear, and consumption (Chierchia et al., 2021). Power and achievement have been linked to agency defined as a person's striving to be independent, to control one's environment and to assert one's self (Abele et al., 2008). Motives are seen as both trait-related dispositions and context-sensitive states that lead individuals to strive for certain

105   types of goals and related decisions (Atkinson, 1964; Rheinberg and Engeser, 2010). While some studies conceive motives as stable personality traits (McClelland, 1958), other studies assume that motives can be trained and modified (Rheinberg and Engeser, 2010; Klimecki et al., 2013; Bosworth et al., 2016). That begs the question of whether it is possible to increase feelings of agency.

Another component of agency, sometimes even used synonymously, is empowerment which refers to a mechanism by which

110   people or groups gain control over their affairs (Christens and Peterson, 2012). At the psychological level, empowerment depends on intrapersonal and interpersonal components. Intrapersonal refers to perceived self-efficacy. motivation sociopolitical control. Empowerment through activism is beneficial for the formation of identity and related to perceptions of agency (Budziszewska and Głód, 2021).

The sense of agency has also been used in social theory. For example, the undermined sense of agency and feelings of

115   powerlessness among workers that can result from a lack of control over the products of one's labour is an important aspect of Marx's critique of capitalism (Gecas, 2003).

Agency can also take place on a collective level when individuals pool their knowledge, skills, and resources, and act together to shape their collective future (Bandura, 2006; Bhowmik et al., 2020). 'Political agency' has been defined as 'the capacity to positively influence the collective future through transformative change' (O'Brien, 2015). It recognizes that actions by groups

120   of individuals can have widespread effects across the globe (El Khoury, 2015). Studies suggest that a small group of committed people, by some estimates totaling between 10% (Xie et al., 2011) and 30% (Rogers et al., 2014) of a population, can be sufficient to overcome a prevailing opinion or behaviour in a population. In the US, for example, a subgroup of 35% of the population was able to create a belief system that there is not enough evidence for global warming despite the overwhelming evidence on climate change (Hoff and Stiglitz, 2016). The term 'transformative agency' refers to collective action that impacts

125   social structures in an observable way (Marshall et al., 2018). It describes the potential for transformation articulated and coordinated by alliances of diverse actors. Transformative agency can be enhanced by actively creating spaces for action and interaction to empower groups that challenge dominant agendas and narratives. This refers, e.g. to forming alliances of stakeholder groups to produce and communicate knowledge, mobilise resources and collectively create new imaginations of the future in order to change dominant knowledge systems.

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Limitations

Agency is associated with 'independence' or 'achievement' but can also be linked to more excessive forms of agency such as 'superiority' and 'hunger for power' (Chierchia et al., 2021). In this paper, we focus on the role of agency as a reinforcing driver of desirable social tipping processes towards a sustainable, low carbon future. In the case of adaptation limits and adaptation tipping points (soft adaptation limits in which agency can help absorbing risk, e.g. by shifting to a drought or alt-tolerant crop variety), human agency can constitute a negative feedback mechanism by absorbing risks (Juhola et al., 2022). This could be adaptation by migration out of a climate hotspot that has become uninhabitable and poses a threat to livelihoods. This paper will consider agency only as reinforcing feedback mechanism towards desirable social change. Further, it acknowledges that human agency and action might be used to hinder tipping and could have unintended consequences as actors do not always foresee the consequences of their behaviour on entire systems (Stadelmann-Steffen et al., 2021).

1.3 Social tipping

The term 'social tipping point' in social-ecological-systems (SES) research refers to a tipping point in a social system that is linked to or embedded within an ecological system. A social tipping point has been defined as a point where 'a small quantitative change inevitably triggers a rapid, non-linear change in the social component of the SES, driven by self-reinforcing positive feedback mechanisms that inevitably and often irreversibly lead to a qualitatively different state of the social system' (Milkoreit et al., 2018). Key characteristics of a social tipping point are 'multiple stable states', 'irreversibility', 'non-linear change' and 'feedback as driving mechanism' (Milkoreit et al., 2018) but it is also referred to as 'historic moments of opportunity', a feeling of 'now or never' and a 'social revolution' (Skrimshire, 2008). A social tipping point entails a process of significant change in individual and collective behaviour and in institutional settings (Juhola et al., 2022). The social tipping process entails social tipping interventions (e.g. removing fossil-fuel subsidies or strengthening climate education) that activate social tipping dynamics (contagious processes of rapidly spreading behaviours, social norms, knowledge, technologies and structural reorganization) (Otto et al., 2020b; Stadelmann-Steffen et al., 2021). Once triggered, those dynamics are difficult to stop or change and are often irreversible. In addition, social tipping processes are complex and often difficult to track as they do not contain easily observable macroscopic thresholds or temporal markers for change (Winkelmann et al., 2022). Agency plays a key role in social tipping processes. Political change is often a consequence of actors influencing decision-making by participating in social movements or lobbying for policy changes (Stadelmann-Steffen et al., 2021). Examples are social movements such as Friday for Future who have radically changed the political scene (Otto et al., 2020b; Budziszewska and Głód, 2021) or political decisions such as the phasing out of chlorofluorocarbons (CFCs), a class of chemicals that depleted the ozone layer, that had been strongly reinforced by a group of concerned policymakers and scientists (Stadelmann-Steffen et al., 2021). Other terms that have been used to describe large tipping processes are contingency (Ermakoff, 2015), diffusion (Rogers et al., 2014), regime shifts (Beddoe et al., 2009; Folke et al., 2004) or transformation (O'Brien, 2018).

2 The *agency in social tipping framework*

Human functioning is influenced by an interplay of intrapersonal (level of agentic personal resources), relational, behavioural (types of activities) and environmental (situational circumstances) determinants (Bandura, 1986). There are many frameworks

165   describing the factors that shape human behaviour in different contexts. However, due to the complexity of the topic, they cannot be incorporated in a single model or framework (Kollmuss and Agyeman, 2002). Our framework (shown in Figure 1) focuses on individual and collective agency as drivers of social tipping processes and is based on a wide range of literature from psychology, philosophy, economics, neuroscience, environmental sciences and sociology.

Psychological influences

170   Psychological factors that contribute to agentic feelings include personality traits, but also a sense of moral obligation, intrinsic motivation, or emotions such as climate anxiety, among other factors. Personality characteristics influence the level of self-agency and are relatively stable over the course of life (Gecas, 2003). Personality traits such as openness to experience, agreeableness and dispositional empathy as well as a belief in one's agency have been linked to pro-environmental behaviour (Tam, 2013). Moral obligation has been linked to a sense of responsibility to act (Fragnière, 2016). A study about the Youth

175   Climate Strike in Poland identified a feeling of moral obligation as key driver behind the involvement in climate action (Budziszewska and Głód, 2021). Study participants experienced activism as a necessity driven by an awareness of the global climate emergency, concern for others, and the motivation to safeguard one's own future. Intrinsic motivation refers to a positive feeling that is derived from taking action without expecting an external reward (Shrum, 2021; Kollmuss and Agyeman, 2002). It has also been linked to 'environmental consciousness', which describes a combination of awareness of climate

180   change, environmental values and emotional concerns (Hall et al., 2010). Emotions can play an important role as a source of information and part of a framing process and are an important predictor of engagement in social action. Participation in social movements can invoke feelings of pride and dignity but there can also be negative emotions such as shame or guilt about one's identity as well (Norgaard, 2006). A study of British youth finds that those with a higher level of climate anxiety showed a higher sense of agency (Lawrance et al., 2022), suggesting that some (non-clinical) level of worry might facilitate engagement.

185   A global study across 28 countries shows that climate distress and a negative belief about the future correlated with higher self-efficacy and pro-environmental behaviour (Ogunbode et al., 2022). Involvement in social movements has also been shown to help youth transform negative emotions, such as anxiety and fear, into organised collective action, which can in turn elevate despair but also hope to a collective level and lead to a feeling of collective agency (Budziszewska and Głód, 2021). A study from Mexico, on the other hand, finds that the feeling of being overwhelmed is associated with a lack of self-efficacy and

190   control (Gonzalez-Perez, 2016). Similarly, a study of Swedish citizens found that people who believe that environmental impacts are already out of control do not believe in individual or collective agency (Wamsler et al., 2022). An environmental psychology study suggests that fear, pain, sadness and anger are more likely to lead to pro-environmental behaviour than guilt, and that a sense of control is a decisive factor for action (Kollmuss and Agyeman, 2002). Further, it finds that strong emotions together with a feeling of helplessness on the other hand, may lead to inaction.

Social environment

From a social psychology perspective, the quality of the individual-environment interaction, especially the possibility to engage with a responsive environment, is key for the development and maintenance of self-agency throughout an individual's life (Gecas, 2003). Social systems help organise, guide and regulate human functioning (Bandura, 2006). The sense of agency is not limited to one's own behaviour but is influenced by others and can influence others (Wen and Imamizu, 2022). There are two competing narratives regarding peer-effects. One narrative assumes that engagement, worry, and action are contagious and motivated behaviour by some individuals can thus draw more people in. Discussing climate change with a peer group, for example, can influence one's level of concern (Bandura, 1986). Experimental studies, however, have shown that the presence of others can also reduce the sense of agency due to diffusion of responsibility and a perceived lack of control over the outcome (Beyer et al., 2017; Sidarus et al., 2020). Especially in behaviour with negative consequences such as harming the environment a sense of personal agency gets obscured by diffusing personal accountability (Bandura, 1999). This could explain the lack of collective action regarding climate change and environmental destruction and the problems with the use of common goods. For example, the atmosphere or clean water are common-pool resources from which everyone can benefit and that are often overused, something economists call the 'tragedy of the commons' (Hardin, 1968).

Knowledge and information are further important factors that can influence a feeling of agency through the social environment. Climate literacy, for example, defined as knowledge and skills that enable individuals to make informed decisions and actions regarding climate change, can empower informed responses and actions, e.g. regarding anthropogenic climate change (Simpson et al., 2021). While knowledge about climate change can increase individual's awareness of the topic and, together with building one's confidence, support a sense of agency, studies have shown that in addition to factual information, climate education needs to emphasise personal relevance, acknowledge emotions and integrate social and scientific dimensions in order to trigger action and change (Trott, 2020). Information and knowledge can also be communicated by media. Media exposure to climate change topics can influence social learning and lead to a higher level of awareness of a topic (Chai et al., 2015). Media influences one's psyche and lifestyle and overall cultural norms, e.g. related to consumption patterns. Social media can influence consumer behaviour and enables mobilisation and organisation of consumer activism (Saffer et al., 2019). Online conversations between concerned consumers provides individuals access to information, shapes their perceptions and offers opportunities for collective action (Makarem and Jae, 2016).

Most human functioning is socially situated and depend on societal values and norms (Bandura, 2006).[20] A feeling of self-agency may be less important in cultures or societies that are less individualistic and more collective.[22] A study found that Asians reported a lower level of perceived personal control in their lives than Americans which was interpreted in terms of Asian collectivist values compared to individualistic Western values.[65] While in Western cultures, agency and control are associated with higher psychological well-being, this was not the case in Asian countries. Others suggest that efficacy beliefs within a group depend on the type of social system (Bandura, 2001). While individuals in individualistic cultures perform best under a individually-oriented system, individuals in collectivistic cultures felt most efficacious when they worked under a group-oriented social system.

Socio-economic variables such as education and occupational conditions are further indicators of human agency (Gecas, 2003).

230   As individuals gain knowledge, they gain self-efficacy. In addition, education, income and access to resources increases a sense of personal control, another facet of agency. And lastly, research has shown that individuals who are more likely to be affected by negative environmental and climate impacts and perceive them as a threat to their personal own welfare, are more likely to feel a sense of agency (Barr, 2006).

A feeling of individual agency

235   Here, we adopt Lawrence et al. 's dimensions of agency (Lawrance et al., 2022) for our *agency in social tipping framework*. It includes awareness of actions that individuals could take, the capability to change behaviours, self-efficacy as belief that one's action will make a difference, the ability to influence and encourage others, a feeling of control over a (crisis) situation, the believe that the external situation can actually change, the experience of urgency to act and a sense of responsibility to act. Examples for the different dimensions of agency will be given below in the example of dietary change.

240   *Barriers to action*

A feeling of agency does not necessarily lead to behavioural change. Whether agency translates into action depends on a number of internal and external factors. Self-management of inner life or self-influence is an important factor that determines whether an individual takes action or not (Bandura, 2006). Whether a person votes or engages otherwise in politics does not only depend on the level of democracy and the freedom to vote but also on the degree of self-influence someone brings to

245   bear. People who develop self-regulatory skills, competencies or beliefs in their efficacy are more successful in realising their desired futures and create more impact than people with fewer agentic resources (acknowledging that some people are systematically denied agentic influence and are structurally excluded from realising their futures) (Bandura, 1986). A study in Sweden found that people who believe that individuals have influence regarding climate change can better describe tangible solutions such as acquiring new knowledge about organic farming or resisting dominant social paradigms such as excessive

250   consumption (Wamsler et al., 2022). Culture is another important factor determining whether a feeling of agency translates into action and there is cultural variation in the factors driving pro-environmental behaviour. Personally held environmental concern, for example, is a stronger predictor for environmental activism in more individualistic countries such as the US whereas social norms predict the choice of pro-environmental products more in collectivistic cultures such as Japan (Eom et al., 2016). Commonly referred to as 'value-action gap' (Chai et al., 2015; Barr, 2006) or 'attitude-action gap' (Gifford, 2011;

255   Newton and Meyer, 2013), a wide range of psychological barriers has been identified that prevent people from engaging in action, independent of their feeling of agency (Gifford, 2011). Barriers include limited cognition which refers to our brain's bounded rationality. Perceived or real uncertainty about a topic such as environmental threats can be used to justify delays in action. An optimism bias describes how people downplay risks of environmental hazards and tend to be overly optimistic about the future. Further, habits can pose a barrier to action as many habitual behaviours are resistant to change or only change

260   over long periods of time (e.g. dietary habits). A study about household consumption patterns in Australia found that persistent

habits and practices among individuals and the lack of social norms and values promoting environmental conservation in the population are large barriers to pro-environmental behaviour (Newton and Meyer, 2013). Growing mistrust in science and government can also pose barriers. Behavioural change requires trust that change is effective and valuable and a lack of trust can lead to resistance to change (Gifford, 2011). Additionally, many people are risk-averse and changing behaviour can entail

265 a range of risks and costs (e.g. installation of rooftop solar).

In addition to psychological factors, the socio-economic context plays an important role on whether individuals decide to take action or not. The decision to act depends on factors such as incentives, access, possibilities and resources of individuals as well as economic, educational or political contexts (Bhowmik et al., 2020). Structural factors include a lack of information and knowledge about a problem (Shi et al., 2016). Economic factors can prevent action such as adopting clean technology and

270 the lack of access to financial capital can prevent to invest in climate friendly technology due to high upfront costs (Gonzalez-Perez, 2016). In addition, a lack of enabling policies or other support mechanisms can prevent individuals from taking action. In some cases, agency of individuals or groups is actively constrained by the power relations of the incumbent system (Marshall et al., 2018). Structural injustice deprives large categories of people of the means to exercise and develop their capacities (Young, 2006). In addition, the cultural context matters. A significant link between climate anxiety and environmental activism

275 was mostly found in European, democratic and affluent countries. In the Global South, people may be unable to participate in climate action due to political or financial barriers, insufficient knowledge or the lack of opportunity (Ogunbode et al., 2022; Gonzalez-Perez, 2016). A gender component was identified in African countries where female small-scale farmers were more likely to adopt climate-resilient crops when they were aware of climate-adaptation options than men (Acevedo et al., 2020).

Forms of inaction

280 While emotions such as guilt or anxiety can be an impetus for social action, the desire to avoid unpleasant emotions can prevent participation in social movements. A study about a rural community in Norway found that, despite being well informed about climate change and understanding anthropogenic impacts, 'collective avoiding' and public apathy on global warming took place (Norgaard, 2006). Emotions such as fear of the future of guilt over their own actions led to denial within the population and to social movement nonparticipation. What individuals choose to pay attention to or to ignore is linked to social norms

285 and the broader political and economic context (Zerubavel, 2002). In addition to denying their own responsibility in contributing to a problem, people might blame others for it (Obradovich and Guenther, 2016). Environmental psychology distinguishes between primary and secondary psychological responses to environmental degradation (Kollmuss and Agyeman, 2002). Primary emotional reactions include fear, sadness, anger or guilt. Secondary psychological aim at a relief from those negative feelings and include denial, rational distancing, apathy and delegation. Such defence mechanisms help individuals to

290 cope with distress but often prevent them from action.

Forms of (individual) action

Once a sense of agency has been developed and the individual decided to take action, climate action can take many different

295 forms. The most common and easiest type of action is a change in personal behaviour such as a shift in consumption or behavioural patterns. It includes recycling garbage, choosing renewable energy, switching to a more plant-based diet or using public transport instead of a car (Wamsler et al., 2022). Those changes might be easy to adapt to, but they don't necessarily challenge existing systems and paradigms such as materialism and economic growth. The next level of engagement might be engagement in social media debates. Political discussions in social networks can initiative dialogue between society and

300 businesses and may indirectly hold corporations accountable to citizens' expectations (Saffer et al., 2019). Climate action may also refer to individual behaviour and decision-making within one's personal sphere of action, for example in a professional context. This might include a school teacher who brings a climate action educational programme to his school (Alméstar et al., 2022) but also an investor who is implementing environmental, social and governance (ESG) strategies in her investment portfolio (SSGA, 2019). Going beyond the individuals' daily lives, climate action can take the form of 'active citizenship'

305 which includes donating to climate organisations, writing blogs and articles, writing one's political representatives, lobbying or even running for office (Fragnière, 2016). The next stage is participating in social movements which can take many different forms of action. Types of 'mobilisation' range from protests, strikes or complaints to filing lawsuits, sabotage or physical disruption. Some of those actions can be summarized under the term 'civil disobedience' which refers to 'public, nonviolent, conscientious yet political act, contrary to law, carried out to communicate opposition to law and policy of government' (Smith,

310 2013). More contemporary forms include hacktivism and electronic civil disobedience which refers to the use of computers to attack digital or cyber infrastructure (Sovacool and Dunlap, 2022). Hacktivists add political messages to government websites or prevent organisations from using information and communication technology.

From individual to collective agency

Peer effects are important in determining the uptake and spread of new behaviours, norms or technologies (Barton-Henry et

315 al., 2021). Peer effects are a mechanism that influences individual behaviour or norms, based on behaviour or norms of the peer group such as neighbours, family members or others in the same socio-demographic or educational group. Peer effects can be passive, e.g. through the behaviour of neighbours (geographic effects) or active through direct influence of the own socio-economic group (social network effects). A study on solar panels in the US showed that the adoption of household photovoltaic installations largely depends on the peer effect, namely the proximity to others who have installed them (Barton-

320 Henry et al., 2021). In Germany, so-called 'solar parties' are organised by 'ambassadors'- volunteers who want to support the energy transformation. After having taken part in a small training, they provide information and technological knowledge about the installation of PV to interested people in their neighbourhood (Saegesser, 2023). One 'ambassador' explains his feeling of individual agency: "It takes people who don't just talk about goals, but actually get to work. That's my thing." A study on households in Mexico found that the peer effect depends on the connections with neighbours and community

325 members. Building trust and mutual respect among peers will assist in fostering collective agency while in some cases,

neighbours had negative effects on the desire to take action as participants perceived that their peers did less than they did (Gonzalez-Perez, 2016). The study suggests increasing neighbourhood-oriented forms of civic participation such as social gatherings, community activities and increasing shared resources such as green spaces. Framing a problem as collective responsibility was shown to be a more effective way to encourage a change in behaviour than stressing personal responsibility

330   in a social experiment (Obradovich and Guenther, 2016).

A socio-psychological study on collective agency identified perceived injustice, perceived efficacy and social identity as key influence on social movements (Van Zomeren et al., 2008). Group efficacy, an important part of collective agency, gives people a sense of collective power based on the shared belief that they are capable of transforming the situation and destiny of their group. It includes a sense of control, strength, influence and effectiveness to change a group-related problem (Bandura,

335   2006; Van Zomeren et al., 2008). Participation in egalitarian collective agency has shown to be more likely to elicit a sense of shared agency than taking part in a hierarchically structured action (Pacherie, 2012). Agency in collective action and social movements are further influenced by systemic and socio-structural factors such as social capital, socioeconomic status, political opportunity structure or the size of the social movement network. Vested interests, concerns of social unrest or collapse, institutional inertia as well as subsidies and investments that maintain the status quo pose potential barriers to

340   collective agency in social tipping processes (Bhowmik et al., 2020).

Feedback mechanisms

The *agency in social tipping framework* is not a linear process but rather a complex construct including feedback mechanisms. Feedback (depicted as loops in Figure 1) refers to the engagement in individual and collective action that reinforces one's own individual feeling of agency. The feeling of being in charge of an emergent movement, being able to work out the rules of

345   operation and constructing a message for the movement increases the sense of personal and collective agency as well as a feeling of empowerment (Budziszewska and Głód, 2021). Climate strike participants experienced a sense of decision-making, responsibility and leadership and a control over their own affairs and actions which altogether had a positive impact on their personal growth. Engaging in collective action was portrayed as a solution to young people's perceived lack of agency. Inaction as a consequence of feeling overwhelmed and helpless, in turn, can further decrease the individual's feeling of agency

350   (Wamsler et al., 2022).

Social tipping

Individual and collective action can drive social tipping processes, drastic, non-linear and irreversible change processes. There are several theories and frameworks that try to capture this complex process. Three of them shall be introduced here.

Social tipping processes can, for example, be viewed under a lens of contingency (Ermakoff, 2015). It describes a causal

355   disruption endogenous to social processes and the process of individual and collective agency leading up to breaks in patterns of social relations. There are four types of impacts in which small causes can yield large effects: pyramidal, pivotal, sequential and epistemic. In a hierarchical system of power relations, an individual actor has been granted the right to determine the

behaviour of the group and this leader's requests, commands and directive lead to a pyramidal impact. Pivotal impact describes one or few individuals that are able to reconfigure the balance of forces between two well defined camps. Typical examples are legislative politics when the passing of a bill depends on a few actors. Most social tipping point events follow sequential and epistemic structures of contingency. Individual action leads to sequential impacts when it triggers a process of behavioural alignment. The individual action influences the behaviour of others who, in turn, motivate more individuals to switch their behaviour. The behaviour of the individuals is observable and takes place sequentially. Examples could be a switch from omnivorous to plan-based diets. Lastly, epistemic impact describes a change of beliefs and of expectations about collective outcomes that influences the beliefs of other people. In contrast to sequential impacts, epistemic impacts are triggered by known group members. An example is Greta Thunberg initiating the Friday for Future movement by publicly protesting in front of the Swedish Parliament in 2018 (Budziszewska and Głód, 2021).

The 'Powers of 10 (P10)' framework examines leverage points to scale up social change (Bhowmik et al., 2020; McCaffrey and Boucher, 2022). It uses the ten orders of magnitude between a single individual (10^0) and the projected global population by 2050 (10^{10}) as framework for scaling societal action and suggests a 'sweet spot' between the community (10^4) and urban (10^6) levels for forming agency and maximizing impact concerning climate action. At those levels, stakeholders, change agents and decision-makers who shape policy and control funding can be easily engaged and actions can be customized to location, culture and circumstances. At the same time, the P10 framework recognizes that the implementation of climate adaptation and mitigation solutions require policy and infrastructure support at all scales.

The term quantum leap is used as part of quantum social theory that relates concepts from quantum physics to societal issues (O'Brien, 2016). It is based on the assumption that people are the solution to climate change and uses quantum concepts such as entanglement, complementarity, uncertainty and superposition to show that people can trigger profound social change and social tipping through entangled, collective impact. Quantum social theory recognizes that paradigms and worldviews influence how problems are framed and addressed and that social theories influence social actions. As societal responses to climate change lag far behind its drivers and dynamics, using quantum social theory might open up possibilities for profound societal transformation. For instance, it recognizes that judgement and decisions are influenced by context (Haven et al., 2013) and that a sense of agency can empower individuals and groups to influence societal change in non-linear ways. A quantum leap does not describe a causal trajectory but an actualization of possibility and thus, potential societal tipping processes.

2.1 Plant-based diets as social tipping point

Numerous papers have analysed historical social tipping events including the role of agency (Otto et al., 2020a; Stadelmann-Steffen et al., 2021; Juhola et al., 2022). We will use the case of a desired social tipping point that has been identified in various studies, the shift to a predominantly plant-based diet (Otto et al., 2020b; Lenton, 2020; Nyborg et al., 2016) to illustrate our *agency in social tipping framework*.

390 Acknowledging that many populations in Sub-Saharan Africa and South Asia would benefit from increased consumption of animal-source foods through improved nutrition, the Global North needs to reduce its overconsumption of red and processed meat (Beal et al., 2023; Gaupp et al., 2021). High levels of red and processed meat increase health risks such as diabetes, cardiovascular disease and colorectal cancer (Ekmekcioglu et al., 2018). In addition, the livestock sector is a key contributor to agricultural greenhouse gas emissions, accounting for 14.5% of global emissions annually (FAO, 2009). Adopting a healthy,

395 predominantly plant-based diet would avoid 11 million deaths per year in 2030 and thus poses a potential positive social tipping point (Springmann et al., 2018). A predominantly plant-based diet largely consists of fruits, vegetables, whole grains, legumes, nuts and unsaturated oils (Willett et al., 2019). It includes low amounts of seafood and poultry and no or low quantities of red meat, processed meat, added sugar and starchy vegetables. Although low-meat diets are rising across European countries and supermarkets report high growth rates of plant-based products, the share of vegetarian and vegan diets is negligible and

400 globally, meat consumption is steadily increasing (Vermeulen et al., 2020). Shifting to a predominantly plant-based diet requires agency of behavioural change on the level of individuals, families and communities (Bhowmik et al., 2020). Based on our *agency in social tipping framework*, what factors could support a tipping process towards a predominantly plant-based diet in industrialized economies?

A feeling of individual agency regarding dietary choices is increasingly seen as important dimension of food security and

405 refers to an individual's or group's power to shape what and how to consume food (HLPE, 2020; Tkaczyk and Moseley, 2023). Yet, prices and taste can influence food preferences in a way that is detrimental to nutritional health and thus, agency can be problematic for food security as well. Here, we refer specifically to the agency to change to a mostly plant-based diet in the Global North where meat consumption is too high.

Following Lawrance et al. (2022), we define the agency to adapt to a planetary health diet as being aware of actions an

410 individual can take to change dietary habits, as feeling capable of changing behaviour, e.g. the ability to acquire new cooking skills and habits, as believing that a change in dietary preferences will make a difference on a global scale and might encourage others to do so as well and as a feeling of control over the individual's situation. In addition, the individual senses an urgency to eat more vegetables and fruits and a sense of responsibility to reduce meat consumption.

Psychological factors that could support dietary change include an intrinsic interest in healthier and sustainable eating habits

415 or curiosity to try new foods. Moral obligations include a motivation to reduce animal suffering and a feeling of worry and guilt towards meat consumption (Milfont et al., 2021). In addition to psychological factors, the social environment yields high potential to increase the feeling of individual agency to eat mostly plant-based foods. Research has shown that food preferences are partly genetic in nature but they are also dynamic and a product of culture, norms and habits (Hoff and Stiglitz, 2016; Smith, 2004). Culture can create mental models and change the individual's preferences, cognition and behaviour (Hoff and

420 Stiglitz, 2016). Social norms have been described as self-enforcing behavioural patterns within a group (Young, 2015). Those norm dynamics are influenced by a desire to coordinate, a fear of being sanctioned by the group or the desire to belong to a group. Related to dietary preferences, this means that preferences are influenced by the exposure to eating habits of parents, peers and role models (Hawkes et al., 2015). If a less meat-intense diet became the social norm, individuals might change

eating habits, partly due to social pressure (Nyborg et al., 2016). In general, preference learning starts early in life and learnt

425 preferences are often persistent and resistant to change. Thus, healthy and mostly plant-based eating preferences are best encouraged early in life. A study on adolescent agency and the food environment showed that the adolescence is a unique opportunity to foster healthy eating as teenagers transition from primary dependence on caregivers to more diverse roles related to food acquisition, preparation and consumption (Neufeld et al., 2022). Adolescents can be empowered with skills, motivation and knowledge to navigate towards a mostly plant-based diet. Another important factor of influence of dietary habits is food

430 marketing such as product placements in films or television advertisements, celebrity sponsorships, billboards or social media. Especially advertisements embedded in social media feeds include highly engaging and interactive content that blurs the lines between advertisement, entertainment and social interaction (Fleming-Milici and Harris, 2020). While most food-marketing focuses on nutrient-poor, energy-dense foods, this could be reversed and healthy, plant-based alternatives could be advertised. Celebrities and influencers can support social movements, e.g. by promoting vegetarianism (Vermeulen et al., 2020). Media

435 influence opinions and behaviour by connecting information with emotions and by using specific framing. Two documentaries about veganism from the US used filmmaking techniques such as emotional storytelling and shocking footage of factory farming to evoke horror, disgust and anger about industrial meat production (Christopher et al., 2018). In addition, vegetarian and vegan diets were framed as 'whole foods plant-based diet', a less value-laden and more nutritional-oriented term. More objective sources of information about the advantages of plant-based diets include nutrition education in schools, food labelling

440 and the provision of information on healthy diets (Hawkes et al., 2015; Temme et al., 2020).

Being exposed to all of the above mentioned psychological and social influences can but does not necessarily lead to action in the form of dietary change. Barriers to change include culture and norms that portray meat-eating as symbolizing masculinity, human mastery of nature, festivity and economic and social progress (Dagevos and Voordouw, 2013). If dietary change towards a mostly plant-based diet is forced from outside, it might be perceived as a violation of individual autonomy, agency

445 and privacy and evoke resistance (Nordgren, 2012). Further barriers include insufficient knowledge about nutrition and environmental impacts of meat-intense diets that prevents a change in diets despite the feeling of individual agency regarding food choices. Even if individuals have complete information regarding nutritional values, underestimated health risks, combined with an optimism bias, may lead people to choose diets that are less healthy than recommended diets (Smith, 2004). Consumers weigh health consequences against immediate pleasure of consuming unhealthy food options.

450 Assuming that an individual has developed a feeling of agency concerning her food choices and shifted to a mostly plant-based diet, how can dietary changes turn into collective action? Lifestyle changes can influence family members and peers and slowly change cultural norms. A mostly plant-based diet could become the new 'normal' thing to choose. More active forms an individual can engage in include joining a social movement around vegetarianism or veganism that forms a common identity around health, animal rights advocacy or environmental concern (Christopher et al., 2018). Active citizenship could empower

455 consumers to use their market force and demand healthier environments from restaurants, employers, and the retail sector (Bauer and Reisch, 2019). Individuals can use their decision-making power to support dietary changes on a collective level. This could be head teachers that demand changes in school canteen food or a decision-maker in the retail sector who decides

to forego cheap meat that was produced on low animal welfare levels (Gode, 2021). A feeling of collective agency to shift to a predominantly plant-based diet will lead to a high rate of meat-reduction in Western countries. History shows that dietary

460 preferences can change rather quickly, even within one generation (Vermeulen et al., 2020). A social tipping point would be reached if plant-based diets would become the norm on individual and collective levels. A process leading to social tipping might include social sanctioning of meat-heavy consumption, conditional cooperation (willingness to change when change of others is observed) and social learning (Nyborg et al., 2016). Plant-rich diets are most likely to be achieved in O'Brien's 'personal sphere' which translates into the P0 (individual) to P2 (personal network) cohorts in the 'power of 10' framework.

465 In addition to norm and paradigm shifts, regulations and policies such as tax and subsidy schemes can accelerate the social tipping process. Comprehensive summaries of policy interventions can be found, e.g. in Temme et al. (2020) and Hawkes et al. (2015). As discussed above, they belong to political and systemic spheres of change and thus go beyond the scope of this paper.

3 Enhancing agency

470 Citizen empowerment and increased political engagement play an important role in opening up new pathways towards sustainability and positive social tipping. A belief in agency is considered part of 'inner' qualities such as hope or a feeling of interconnection that foster both well-being and increase engagement. Mechanisms and structures that support personal and collective agency must thus be motivecreated and increased (Wamsler et al., 2022).

According to motivation psychology, engagement in action is influenced by an interconnection of motives, dispositional

475 factors (personality traits and beliefs) and social settings (Bosworth et al., 2016). Motives such as 'care' but also agency-related motives such as 'power' and 'achievement' can be enhanced by social settings. Cooperation can, e.g., be fostered through teamwork in education environments such as classrooms. Mental training can enable individuals to experience more gratification from care and thus increase the prevalence of cooperative social settings in society (Bosworth et al., 2016). Similar exercises could be applied to increase a sense of agency.

480 According to environmental psychology, interpersonal as well as public discussions about climate change are important for triggering societal change and increasing agency. Individuals in a social experiment who received information and knowledge that communicates climate change information reported increased efficacy beliefs (Geiger et al., 2017). Knowledge-based interventions such as watching videos with science-based climate change information increased the individuals' perceived ability to discuss the topic and increased their self-efficacy. Participants were more likely to engage in climate change

485 discussions compared to their peers who didn't receive information. Further, knowledge-based interventions increase the perception that proposed solutions could address the issue and were worthy of discussion (Norgaard, 2011). Whether an increased sense of agency shifts actual behaviour has not been measured though and other studies found that only when education includes participation, relevance and a sense of interconnectedness, knowledge leads to actual behavioural change (Allen and Crowley, 2017).

490 The rise of new communication channels such as social media has changed the way of community agency building (Jasper and Goodwin, 2014). Social media provides individuals an accessible platform to raise their voices and to quickly reach a broad audience. Further, social sharing in the virtual world helps people to signal their identity, manage their self-concept and share their emotions (Nardini et al., 2021). People are able to increase their feeling of individual and collective agency when they share ideas, educate themselves, build relationships and feel inspired.

495 **3.1 Practices to enhance agency**

Creative, collaborative and experiential learning provides new perspectives and increases agency (Bentz et al., 2021). Trust building, local knowledge production and community involvement has shown to increase transformative agency and challenge dominant narratives, agendas and norms (Marshall et al., 2018). There is a plethora of participatory practices that have shown to increase individual and collective agency. Four of them are introduced here.

500 *Participatory Action Research*
Collective agency and especially social movement organization can be increased through participatory action research (PAR) tools. PAR enables individuals to empower themselves and to collectively develop agency to bring about policy and social change. A PAR study about citizen groups-initiated legislation in Australia identified double-loop learning as key component to increase individual and collective agency within a social movement (Hall et al., 2010). Double-loop learning is a dynamic
505 process in which participants regularly revisit and adjust their actions and behaviours (Argyris, 2002). Action strategies are developed, implemented, observed in action and reflected on. Reflections might critically review underlying assumptions and lead to further, revised action. Undertaking those reflections collaboratively ensures that ownership for the group's actions is taken and that a sense of collective agency is developed when action leads to visible outcomes such as changing a law. PAR increases inspiration and motivation and shows that collectively envisioning alternative futures can lead to real-world changes.
510 Participants gain confidence in their legitimacy and lobbying power and in their self-awareness as powerful and effective advocates for community action.

'*Praxis*'
Social transformation at the collective level can be increased through 'praxis', a dialectical process of theory, action and reflection (Freire, 2018). It refers to a participatory problem-posing approach and transformative community-based learning
515 that increases collective agency. Being influenced by the military dictatorship and oppression in Brazil in the late 1960s, 'praxis' was developed as part of the critical pedagogy movement. It is based on the assumption that liberation from the oppressed cannot be purely intellectual but must involve action. It includes critical and liberating dialogue, reflection and communication and is based on a trust in the group's ability to reason. 'Generative praxis', including 'generative dialogue' has been applied, e.g., in projects across the US and Mexico where dialogue has catalysed new ways of seeing, understanding and
520 generating collective action at household and neighborhood-levels (Wilson et al., 2018). It integrates objective observations

about a place and its ecological system with subjective knowledge of the local people and includes, for example, imagining positive futures. Practitioners build trust, create new conversations and foster agency.

Participatory theatre

Theatre performance can help an audience to experience a multitude of emotional reactions to environmental topics by
525 connecting empathetically with the actors and their narratives (Bentz et al., 2021). It can be seen as a form of knowledge and a means to transforming society. In contrast to classical theatre, participatory theatre allows for interaction with the audience who actively engages and impacts the narrative. The first forms of participatory theatre were developed in the 1970s as the 'Theatre of the Oppressed' and 'Forum Theatre' (Freire, 2018) by reframing the roles of actors and spectators. Today, there are a multitude of participatory theatre forms. In 'devised theatre', the script is developed through improvisations and
530 collaborations carried out by the ensemble (Garcia, 2013). In that way, the participants' ownership and agency regarding the topic of engagement is increased. Participants of a 'devised theatre' performance in Portugal that dealt with climate change and sustainability reported a deeper sense of personal agency that emerged through the reflective exercises in the project (Bentz et al., 2021).

'Pathways Theatre' provides reflective and responsive space for participants. Alternative future pathways can emerge through
535 dialogue and enables the audience to experience transformation (Nabavi, 2022). By participating in the creation of future worlds, the audience can feel its own agency. In general, theatre and other forms of art have the ability to create agency among people by providing moments of learning and inspiration (Bentz and O'Brien, 2019).

Participatory visioning

Transformations towards more sustainable and equitable futures require an understanding of what those preferable futures
540 might look and how there is no single more desirable endpoint, but rather a plethora of options based on different values, contexts and preferences (Bennett et al., 2016; Pereira et al., 2020). Participatory visioning is one method for unpacking what these futures might be according to a diverse group of people whilst also building the capacity to imagine what could be and therefore building agency (Soria-Lara et al., 2021). A key aspect in building futures literacy is reflexivity which describes a critical awareness towards what we can know about the future, how it affects the present and how to create pathways for action
545 (Mangnus et al., 2021). It allows for a diverse and holistic range of future possibilities including underlying power structures. Participatory visioning acknowledges the agency that is inherent in the crafting of futures. The way decisions are taken in society limit or create space for transformation and thus, futuring processes are shaped by an interplay of agency and structure (Hebinck et al., 2018).

4 Discussion

550 This paper investigates the role of agency in closing the knowledge-action gap in environmental and climate topics by reviewing literature across different disciplines such as psychology, economics, environmental sciences and sociology. It

presents an *agency in social tipping framework* that identifies a range of leverage points that influence how individual and collective agency translate into positive social tipping processes. We acknowledge that the knowledge-action gap is a complex topic and cannot be fully captured through one single framework or diagram. There are similar frameworks that look

555 specifically at the value-action (Chai et al., 2015; Barr, 2006) or attitude-action gap (Newton and Meyer, 2013; Gifford, 2011) and frameworks that address psychological barriers to action in particular (Gifford, 2011; Kollmuss and Agyeman, 2002; Norgaard, 2006). There might be overlaps and differences between different conceptual frameworks regarding definition and categorization. Most of them directly link a range of structural and psychological drivers with behavioural change and ignore the role of agency. Others examine drivers of a feeling of individual and collective agency. By bringing together social and

560 psychological drivers of individual agency, determinants of behavioural change, collective agency and finally social tipping processes, our framework expands on the existing literature and informs current discussions about the role of agency in accelerating positive social tipping processes.

The depicted processes in the presented framework are highly complex and the framework should by no means be seen as a mechanistic and linear construct of cause and effect. Suggested interventions are meant to empower individuals and groups to

565 take action according to their beliefs and preferences. It is not meant to manipulate people into specific action or to nudge anyone towards exogenously pre-determined outcomes.

5 Conclusion

This paper examines the role of agency in enabling positive social tipping processes. A proposed *agency in social tipping framework* provides an overview of external and internal determinants of agency, how individual agency can culminate in

570 collective agency, and how collective agency can trigger social tipping points and lead to large-scale societal transformation. We illustrate the framework using the example of rapid and widespread dietary change. Additionally, we identify intervention points, such as participatory action research, theatre and visioning, that might increase feelings of individual and collective agency.

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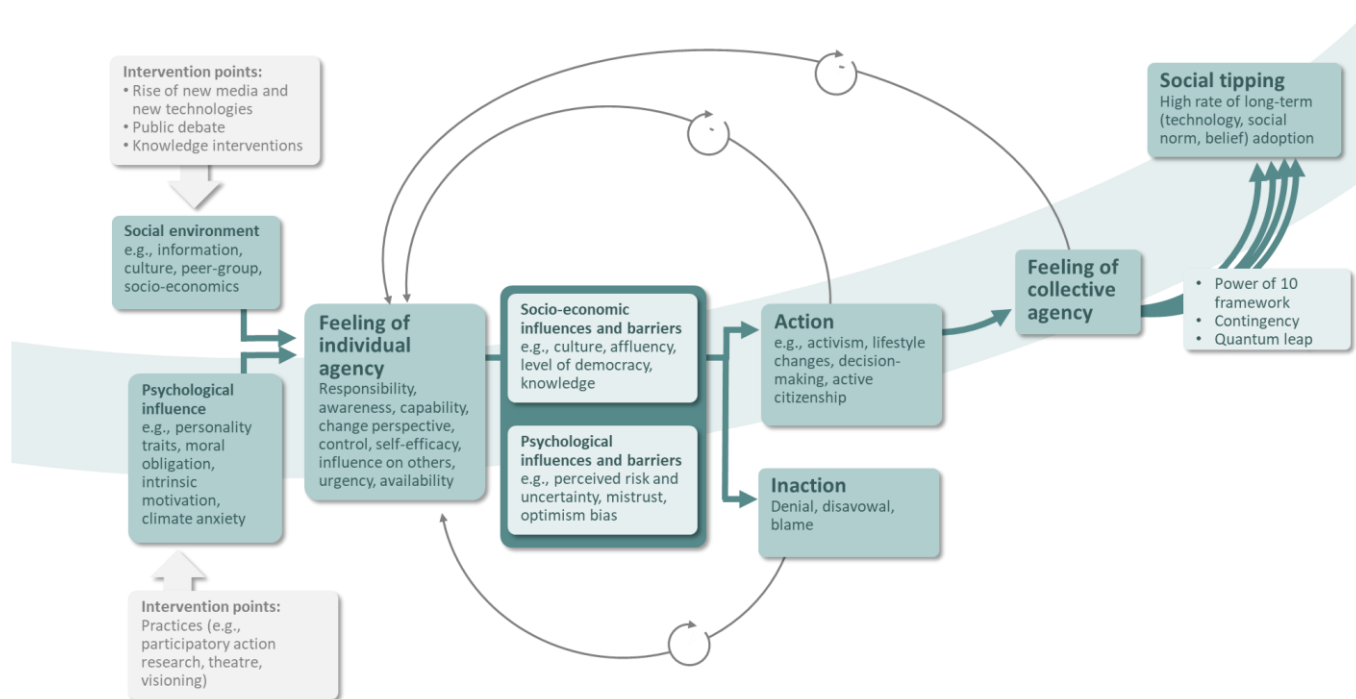
Figure 1: Agency in social tipping framework.

Code availability

830   Does not apply.

Author contribution

FG developed the framework with contributions from SC and LP. FG prepared the manuscript with contributions from SC and

LP.

Competing interests

835   There are no competing interests.