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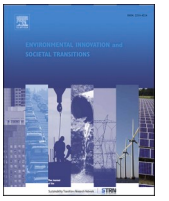

Framing for the protein transition: Eight pathways to foster plant-based diets through design

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ABSTRACT

Excessive animal protein consumption has led to calls for a plant-based protein transition. Plant-based diets can be fostered by design interventions, yet their effect on dietary choices depends on the framing that is chosen. The aim of this study was to understand which transition design frames (TD frames) are prevalent in existing consumer interventions in the Netherlands, to help transcend the dominant substitution pathway with alternative strategies for intervention. We explore framing through the lens of design, examining human-made interventions in a transition context, to complement the discursive lens that is common in transitions literature. Based on 62 existing consumer interventions and eight expert interviews, we identified eight TD frames. We find that market regulation and cultural interventions are strategic avenues to pursue. Reframing opportunities involve inclusivity, system breakdown and integrating multiple frames into single interventions. We observed that a design lens helped elucidate frame types that have not previously been identified in transitions literature.

1. Introduction

Environmental challenges worldwide like biodiversity loss, land scarcity, water depletion and the rising impacts of climate change often involve complex multi-sector dynamics (Béné et al., 2020; de Boer and Aiking, 2011; Springmann et al., 2018; Vermeulen et al., 2020; Weinrich, 2018). In several of these issues, the meat and dairy industry has been found a profound contributor, leading to calls for a plant-based protein transition: shifting the production and consumption from animal proteins to plant-based proteins (Aiking, 2011; Fourat and Lepiller, 2017; Hartmann and Siegrist, 2017). Societies increasingly recognize the benefits of adopting plant-based diets as a way to shift towards more sustainable food systems, specifically for the benefit of the environment, animal welfare, public health and justice within agricultural economies (Béné et al., 2020; Vermeulen et al., 2020; Weinrich, 2018). The chosen context of this study is the Netherlands, where the plant-based protein transition is well underway. Supported by the government, Dutch organizations are striving to change the consumption ratio of animal protein : plant protein from 60:40 to 40:60 by the year 2050 (Aiking and

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de Boer, 2020).

Various strategies are used to foster the plant-based protein transition. For instance, a popular strategy is to offer plant-based imitations of meat and dairy products as a way for individuals to adopt alternative products, whilst respecting their current food practices as much as possible (Bulah et al., 2023a; Tziva et al., 2020). Another strategy is to confront individuals with the exploitation of the environment and animals for the production of meat and dairy as a way to combat persisting collective ignorance about it (Harguess et al., 2020; Kranzbühler and Schifferstein, 2023). These examples demonstrate how diverse ways of framing take place in the context of the plant-based protein transition, illustrating varying perspectives on the issue and different pathways to navigate the transition.

The first strategy, characterized by mimicking, has been increasingly adopted and is gaining a relatively high amount of attention in the plant-based protein transition (Bulah et al., 2023a, 2023b; Mylan et al., 2019; Tziva et al., 2020). Meat and dairy 'analogues' represent an innovation pathway that is already in an advanced stage in the Netherlands, overshadowing other pathways towards a more just and sustainable food system (Bulah et al., 2023a; Pyett et al., 2023; van der Weele et al., 2019), which raises several concerns. Firstly, the analogous products are generally less healthy (Consumentenbond, 2023) and less environmentally sustainable (van der Weele et al., 2019) than unprocessed sources of plant-based proteins, such as beans and nuts. Yet, more noteworthy is the notion that they support a continuation of high consumption patterns, which is a core issue not only in the plant-based protein transition, but also in other societal transitions (Almaraz et al., 2022; Sandberg, 2021). This study aims to elucidate the alternatives to mimicking, expanding the solution space in the Dutch plant-based protein transition. We specifically look at the frames that are embedded in consumer interventions that currently foster plant-based diets, to identify opportunities for *re*framing, and as such, to identify new avenues to foster the transition through design.

In recent years, design is increasingly being acknowledged as a valuable complementary approach to transition studies with the aim to accelerate societal transitions (Loorbach, 2022; Öztekin and Gaziulusoy, 2020). This study serves the ongoing interdisciplinary quest to explore how the scientific fields of transitions and design may complement each other. The leading research question in our study is:

'Which frames are prevalent in consumer interventions that foster the plant-based protein transition, and how can this further shape the intersection of design and transitions?'

Consumer interventions can be seen as resources that are mobilized in transition contexts (Avelino, 2017). We define consumer interventions as technological, social, organizational and institutional innovations with a behavioral impact on consumers (Ceschin and Gaziulusoy, 2016; Irwin and Kossoff, 2017). While a focus on consumers is typical to the design field, it can serve as a fresh angle to understand transition dynamics. In dominant frameworks in the literature on transitions to date consumers have been largely understood as 'passive agents' with 'predetermined roles' (Randelli and Rocchi, 2017) instead of individuals who may actively shape transitions processes (see e.g., Geels, 2011; Hekkert et al., 2007). In this study, we view consumers as individuals who hold power to steer transitions and identify the variety of ways in which they can be involved.

In transitions literature framing is typically studied in communication, focusing on discursive dynamics among actors (Isoaho and Karhunmaa, 2019) and their associated consequences for the diffusion of (technological) innovations (Kriechbaum et al., 2023; Lee and Hess, 2019; Rosenbloom, 2018; Sovacool and Axsen, 2018) as well as for the visioning of novel pathways for a transition (Jensen, 2012; Tziva et al., 2023). Previous studies on frames in the plant-based protein transition have also focused on the discourse surrounding the transition (Maluf et al., 2022; Morris et al., 2018; Tziva et al., 2023), or on innovation strategies and pathways for the transition (de Bakker and Dagevos, 2012; Pyett et al., 2023). To our knowledge, this study presents a first attempt to studying framing in transitions through an *artificial* lens, i.e., by looking at the frames that are embedded in a broad variety of concrete interventions, which constitute the human-made context of a societal transition.[1] We explore the value of this artificial angle in frame analyses in transitions by examining what people *do*, complementing the discursive angle that has been deployed extensively already, which primarily considers what people *say*. Through this lens, we aim to identify diverse types of frames in the plant-based protein transition that are typically not brought to light in societal transitions through discourse analysis. Moreover, we consider an artificial angle to be especially interesting to adopt in the context of consumer behavior. Consumer behavioral research has demonstrated that consumers' decision making is deeply influenced by their physical, economic, social, and cultural environment (Thaler and Sunstein, 2008; Trudel, 2019; van Valkengoed et al., 2022), which can essentially be designed, or designed *for*. As such, consumer environments comprise relevant levers of change in transitions, including, but not limited to, the plant-based protein transition.

This paper is structured accordingly: in section 2 we lay out the theoretical foundation of the study by providing an overview of existing literature on framing, transitions, and design, and we introduce the concept of a 'transition design frame'. Our qualitative research method and materials are presented in section 3. Section 4 describes the results: eight transition design frames prevalent in the plant-based protein transition. In section 5 we reflect upon the implications of the results for further research and practice. Finally, in section 6 we present our conclusions and contributions.

2. Theoretical background

Societal transitions are commonly defined in the literature on transitions as multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable, just and resilient production and consumption

[1] We use the term artificial to refer to things that are not naturally occurring, but instead are created or constructed by human beings.

patterns (Hebinck et al., 2022; Markard et al., 2012; Pel et al., 2020). Societal transitions are characterized by deep systemic changes that are fostered by modifications in the technological, social, and institutional structure of an existing system (Ceschin and Gaziulusoy, 2016; Markard et al., 2012). They are often scoped within certain industries, such as the food and agriculture industry in the case of the plant-based protein transition, yet they are inherently linked to one another due to their systemic nature (Köhler et al., 2019).

2.1. Locus of design in transitions

Design is increasingly seen as a valuable complementary discipline to transition management (Loorbach, 2022; Öztekin and Gaziulusoy, 2020). Transition management is a prominent framework in the literature on transitions. Its origins link back to the early 21st century when the framework was introduced as a new theory for the governance of sustainability transitions (Rotmans et al., 2001). The transitions management framework is derived from core ideas in transitions literature relating to the need to move away from unsustainable socio-technical systems, which are predominately characterized by incumbent actors with vested interests. Such incumbents reinforce undesirable mechanisms of 'lock-in' and 'path dependency' (Loorbach, 2010, 2022b). Moreover, transitions management focuses on how governance processes can be influenced to foster transitions to more desirable modes of both consumption and production (Loorbach, 2010; Rotmans and Loorbach, 2009). The urgency and analytical strength to challenge existing powers that is associated with transition management, combined with the creative and mobilizing power of design, make room for a 'designing transition logic' (Loorbach, 2022b). Indeed, transitions can be considered technical, political and creative design challenges (Gaziulusoy and Öztekin, 2019).

Defining design, we make a distinction between design as a process, and design outputs. Design as a process essentially refers to the act of transforming an existing situation into a preferred one (Simon, 1996). As such, *"schools of engineering, as well as schools of architecture, business, education, law and medicine, are all centrally concerned with the process of design"* (Simon, 1996). In the context of societal transitions, we find it appropriate to adopt this broad understanding of design, whereby any actor who actively participates in the development of interventions with the intention of bringing about transformative change, is essentially designing. However, it is important to distinguish between 'diffuse design', practiced by people without professional training in design, who naturally have designing capacity, and 'expert design', referring to people operating as designers professionally (Manzini, 2015). Intertwining diffuse and expert design has been deemed necessary to achieve viable and legitimate outcomes (Lähteenoja et al., 2023).

A key competence of expert designers is 'reframing' (Bijl-Brouwer, 2019; Dorst, 2015; Fokkinga et al., 2020; Schön, 1984; Stompff et al., 2016), referring to the act of *"shifting one's thinking into a different system and structure of concepts, language and cognitions"* (Jerneck and Olsson, 2011). Reframing is recognized as a valuable instrument in approaching transition challenges (Jerneck and Olsson, 2011), as it evokes redefinitions of problems, exposing solution spaces that would otherwise not have been considered (Dorst and Watson, 2020; Irwin, 2020; Jerneck and Olsson, 2011; Mukherjee et al., 2020).

Regarding the outputs of design processes, design was originally only associated with the development of physical artefacts. Today, the discipline of design is increasingly applied to address complex, systemic, multi-sector issues, through technological, social, organizational, and institutional innovations (Ceschin and Gaziulusoy, 2016; Irwin and Kossoff, 2017; Norman and Stappers, 2015). Thereby, the outputs of design processes are diverse, ranging from visions, to insight reports, strategies, system maps, and concrete interventions. Focusing on the latter, design interventions can be products, services, campaigns, educational programmes, policies, public spaces, retail environments and more. They can be physical, digital, or a combination of both. Similarly, design interventions can be stand-alone or networked. While we choose to focus on consumers in this study, design interventions can be targeted at any system actor, including producers, innovators, service providers and non-humans. Design interventions can serve to support the interaction between actors as well. A commonality among design interventions is that they facilitate or steer human behavior and can be developed with a particular behavioral influence in mind. The fields of 'Design for Sustainable Behavior' and 'Transition Design' specifically aim to support sustainable lifestyles (Ceschin and Gaziulusoy, 2016; Lockton et al., 2008; Niedderer et al., 2016); an aspiration that is aligned with societal transitions.

To understand where design 'happens', we refer to the Multi-Level Perspective (MLP) (Geels, 2002). The MLP examines how transitions to new socio-technical systems unfold through the interaction between several analytical levels, namely the niche, the regime, and the landscape. The niche serves as a 'protective space' in which innovations are shielded from the wider selection environment and nurtured until they are able to compete on the mainstream market. The regime refers to the stable structures in a socio-technical system and encompasses the dominant values, rules, policies, user expectations, and technologies of the current system. The landscape comprises the wider context in which transitions unfold, including societal macro-trends (Geels, 2002). Positioning design in the MLP, the development and deployment of design interventions occur both within niches as well as in the established regime. Thereby, design interventions may challenge, alter or replace parts of the regime both 'from the outside' in niches, or 'from within' the regime (Loorbach, 2022; Mattioni et al., 2022). Underscoring the multifaceted and complex interaction between niches and the regime (Avelino, 2017; Smith, 2007), design activities and outputs have also demonstrated to perform a mediating role between these levels (Spaargaren et al., 2012). At the niche level, design can provide a shared framework for niche players, suggest the further development of certain novelties, and inspire action. At the regime level, it can question basic assumptions and rules, redefine central guiding concepts and norms, provide a common agenda and create opportunities for new forms of collaboration. As a result, design can be instrumental in aligning institutional action, agenda-setting, and problem definition, thereby 'allowing' novelties from the niches to set foot into the regime and to become mainstream (Loorbach, 2022; Spaargaren et al., 2012).

Regarding impact on transitions, design interventions can have the power to hinder or advance them, or to do both at the same time. When interventions fully 'fit-and-conform' to the existing regime, they are reinforcive rather than transformative (Avelino, 2017;

Smith and Raven, 2012). A restaurant promotion of 'all-you-can-eat spareribs' would be an example of a reinforcive intervention in the context of the plant-based protein transition, sustaining existing practices, structures, and cultures. Transformative interventions, on the other hand, can fundamentally reconfigure the regime, and can do so in a relatively moderate or radical way. Meat and dairy analogous products can be considered moderate transformative interventions, 'stretching and transforming' regime structures, while 'fitting and conforming' to existing eating practices (Mylan et al., 2019; Smith and Raven, 2012). In contrast, more radical transformative interventions predominantly apply a 'stretch-and-transform' strategy, especially challenging dominant macro-trends, such as 'capitalism', 'individualism' or 'globalisation' (Avelino, 2017). In this light, the Herenboeren circular farming initiative, which connects farmers to active citizens living in the vicinity of a local farm, can be seen as a radical intervention in the context of the plant-based protein transition (Herenboeren, 2024). In sum, the type of influence design interventions have on the course of transitions varies greatly, which can be linked to their underlying framing.

2.2. Framing in transitions

As stated by Goffman in 1981, "*frames are a central part of a culture and are institutionalized in various ways*" (Goffman, 1981). Frames are quite fundamental to the way we relate to each other and to the natural world around us, as they help us make sense of situations and guide our responses to them (Dorst, 2015; Schön, 1984). Frames can manifest in words, images, phrases and other human creations, such as innovations (Dorst, 2015; Druckman, 2001), presenting a selection of reality and potentially creating new realities (Borah, 2011; de Bruijn, 2011; Entman, 1993). As such, the effect of distinct frames on people's choices and behaviors can differ significantly (Druckman, 2001; Kahneman and Tversky, 1979, 1984).

Put simply, frames connect problems to solution directions. As previously mentioned, framing in transitions literature is typically approached from a discursive angle, examining the problem-solution 'packages' that are advocated for by actors within a certain transition context (Isoaho and Karhunmaa, 2019; Kriechbaum et al., 2023; Lee and Hess, 2019; Rosenbloom, 2018; Sovacool and Axsen, 2018). Moreover, framing involves the construction of narratives and storylines which often favor a particular solution direction over others. Frames are usually induced from written documents such as media content, with words and phrases as the units of observation. Distinct to frames in transition contexts is the consideration of various temporal and spatial scale levels, as societal transitions inherently involve systemic challenges. For instance, Kriechbaum et al. (2023) unpack the evolution of frames in the energy transition in Austria, by examining how the leading frame involving biogas shifted to a frame favoring the diffusion of biomethane. As these frames revolve around energy sources that are to be used for at least several decades and beyond the borders of Austria, they hold meaning of a large temporal and spatial scale. Similarly, Sovacool and Axsen (2018) lay out a typology of functional, symbolic, and societal frames in the mobility transition, demonstrating the relevance of a historical perspective on frames in the present, as well as the value of these frames across cultures worldwide. These examples demonstrate how macro-level considerations, focusing on society as a whole, are common in framing analyses in transitions. In contrast, design scholars commonly examine individuals' everyday actions, interactions, and subjective experiences at the micro-level (Ritzer and Stepnisky, 2007). As behavior change at a micro-level can ultimately lead to shifts at the macro level, we have integrated these intimately connected perspectives into our conceptualization of a 'transition design frame' in section 2.3.

To date, framing analyses in the context of the plant-based protein transition have led to the identification of several pathways to foster plant-based diets, such as mimicking meat and dairy (de Bakker and Dagevos, 2012; Morris et al., 2018; Pyett et al., 2023), veganism as a lifestyle (Morris et al., 2018; Pyett et al., 2023), cultural or paradigmatic change (de Bakker and Dagevos, 2012; Maluf et al., 2022) and alternative farming systems (Maluf et al., 2022; Pyett et al., 2023). Tziva et al. (2023) have demonstrated how plant-based proteins are positioned in the media either as a solution for public health issues, for food security or for food affordability. As these analyses were each approached differently and with varying scopes, they are not easily comparable to one another. However, we can note that none of these studies have analyzed the human-made environment influencing the dietary choices of consumers, which we established to be influential in shaping the course of transitions. As such, we expect novel and relevant frames to emerge from our data.

2.3. Transition design frame

The unit of analysis in this study is a 'transition design frame', or TD frame, integrating framing theory from transitions and design literature. To describe the foundation of the TD frame concept, we first shed light on the origin of a frame. Frames were introduced in sociology to explain human behavior in social contexts. Since its introduction in sociology (Bateson, 1972), frames have been explored widely in several fields and are typically studied from two angles; either sociologically, focusing on frames in communication, or

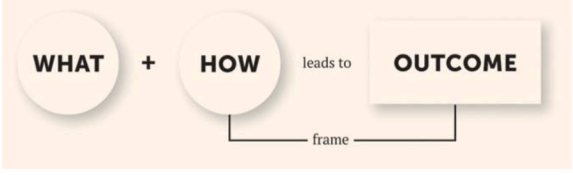

Fig. 1. *Logical formula describing a frame (from Dorst, 2015).*

Table 1
Conceptualization of a Transition Design Frame, the unit of analysis in this study.

	Transition design frame	
WHAT	HOW	OUTCOME
design interventions	behavior change mechanism + worldview	(societal-behavioral) transition impact

psychologically, focusing on frames in individuals minds (Borah, 2011). Merging this dual nature of frames, Schön and Rein regarded a frame as *"a diagnostic-prescriptive narrative, based on perceptions, underlying structures of beliefs, and selective appreciation"* (Schön and Rein, 1994). In other words, a frame is the connection of a certain issue to a specific kind of solution direction and arises from a particular view of the world and humanity. Thereby, frames are never neutral (Coyne, 1985).

Building on Schön and Rein's concept of a frame, design scholar Dorst's logical formula (2015) explains the role of a frame in abductive reasoning in design. Depicted in Fig. 1, Dorst perceives a frame as a way to hypothesize about potential mechanisms (*the how)* to achieve a desired result (*the outcome)*, which helps conceptualizing the design intervention (*the what*).

Given its relevance for design, we have expanded Dorst's notion of a frame to suit societal transitions. In a TD frame, the *what* refers to an intervention, for instance a tangible product or a service. The *how* refers to the change mechanism by which the intervention exerts effect on people, which is characterized by a behavioral influence at a micro-level and stems from a worldview. We define a worldview as *"a set of presuppositions which we hold about the basic makeup of our world"* (Sire, 2004). An example of a *how* in a TD frame is nudging, which is considered an appropriate behavior change strategy in a worldview that justifies libertarian paternalism for the purpose of environmental sustainability (Thaler and Sunstein, 2008; Veetil, 2011). The *outcome* in the formula refers to the actual systemic change resulting from the intervention, i.e. 'transition impact', which connects individual behavior at a micro-level to societal value at a macro-level (Ritzer and Stepnisky, 2007). For instance, a desired outcome of an intervention could be that consumers choose plant-based products in the supermarket instead of animal products, supporting lifestyle patterns with positive implications for society in terms of the environment and animal welfare. In short, a societal-behavioral issue combined with an artificial solution direction makes a TD frame (Table 1).

3. Material and methods

With this study we aim to provide a first attempt to analyze existing consumer interventions as manifestations of their underlying framing. We chose to identify the TD frames in a way that is similar to the use of 'frame packages' in discourse analysis (see e.g., Candel et al., 2014; Tziva, 2022; van Gorp, 2007). In our case, the frame package, or unit of analysis, is the TD frame. Each TD frame comprises a societal-behavioral issue (reflecting the effect, or *outcome,* of the intervention) and a change mechanism (reflecting the solution direction and worldview, or the *how*).

While discursive frame analyses typically deploy quantitative methods, we have chosen for a qualitative approach. When the units of observation are words and phrases – as is the case in discourse analyses – a quantitative approach is appropriate and meaningful when seeking to identify the relative prevalence of each frame. The units of observation in our study are consumer interventions, which are diverse along many dimensions and thereby difficult to compare to one another in terms of their relative prevalence. Therefore, we seek to merely elucidate the TD frames that can currently be found in practice and evaluate them qualitatively.

3.1. Interventions in the plant-based protein transition

Our primary source of data was a set of 62 consumer interventions. To contextualize the TD frames and understand their role in the transition, we interviewed eight experts. We deliberately chose a wide range of types of interventions, to account for the various ways in which the food regime (McMichael, 2009), can be influenced. The 62 consumer interventions included in this study were: products; services; product-service systems; packaging designs; retail environments; educational and social programs; exhibitions; books; policies, such as food subsidies and consumption regulations; campaigns; consumer guidelines; games; organized challenges; activistic provocations, such as petitions; artistic speculations; and digital media such as podcasts, websites, blogs, vlogs and television shows. We limited the set of interventions to 'end products', as those are generally the outputs of design practitioners and we seek to find opportunities *for design* in the plant-based protein transition. This means, for instance, that the technology behind plant-based meat products is not considered a consumer intervention, while a plant-based burger from Beyond Meat is. Similarly, the well-known EAT Lancet principles of a healthy and sustainable diet are not included in this study, while a restaurant menu based on these principles is.

We applied several additional inclusion criteria to the consumer interventions. Interventions needed to either promote plant-based protein consumption, demote animal-based protein consumption, or do both. Interventions were included if they inarguably fostered plant-based diets. For instance, the Herenboeren circular farming initiative does not necessarily promote a vegan diet, but it does facilitate consumption patterns that are 'plant-forward' (Herenboeren, 2024). Meat and dairy analogous products were included in the set, but special attention was paid to identifying other kinds of interventions, as we seek to find avenues in the plant-based protein transition that differ from the mimicking of animal-based products. Exclusion criteria involved interventions targeting actors other than consumers, interventions that were exclusively available outside of the Netherlands, and interventions that were not yet on the market at the time of our study (for instance lab-grown meat products.

Table 2
Three examples of consumer interventions included in this study.

Consumer intervention	Creator	Manifestation	Source
Herenboeren urban circular farm	Herenboeren	product-service system	herenboeren.nl
Original Fondue: plant-based cheese fondue	Willicroft	product	willicroft.com/original-fondue
The Game Changers	James Cameron	documentary	gamechangersmovie.com

We sought diversity in terms of the societal-behavioral issues the interventions addressed and the change mechanisms they applied, the two components of a TD frame. To ensure no important examples were missed, we collected the consumer interventions through various sources. We started with a search on Google's search engine using the Dutch keywords 'eiwittransitie' (protein transition) and 'eiwittransitie innovaties' (protein transition innovations), which led us to overviews of innovations contributing to the plant-based protein transition in the Netherlands, as identified by established Dutch innovation hubs (The Impact Hub Amsterdam, n.d.; The Protein Community, n.d.). The overviews served as a starting point for an extended search into the innovating parties that were mentioned and their concrete innovations. When we would encounter a consumer intervention that met our selection criteria, we included them in our preliminary set. We continued this online exploration until we did not find any new examples. In addition to the online sources, the expert interviews that were part of this study also provided suggestions for consumer interventions to be considered for inclusion. Three examples of consumer interventions can be found in Table 2. The full list as well as a visual overview of the interventions are included in appendices A and B.

3.2. Expert interviews

Eight experts were consulted through a 60-minute semi-structured interview. The interviews served various purposes: 1) to get a deeper understanding of the plant-based protein transition, informing the role of the consumer interventions in the transition, 2) to 'fact check' the first insights derived from the preliminary set of consumer interventions, and 3) to identify consumer interventions for inclusion in the study.

Indicated through preliminary desktop research, the participants were identified as experts with significant industry knowledge and could therefore provide a substantiated reflection on the plant-based protein transition and the influence of consumer interventions in this transition context. The experts were selected with the aim for diversity regarding their position in the food system. The list of experts can be found in Table 3. All interviews were conducted by the primary researcher, of which six via Zoom and two in person. The interviews were recorded with consent from the participants and supported by an interview guide, which is included in appendix C. Directly after the interviews, they were transcribed with Microsoft 365 Word software and manually checked by the primary researcher. Seven of the interviews were held in Dutch and one in English. Relevant citations from the Dutch interviews were manually translated into English by the primary researcher, who is natively proficient in both languages.

3.3. Thematic analysis

After collecting approximately 40 consumer interventions and speaking with the first three experts, the primary researcher held a workshop at the Relating Systems Thinking and Design conference (RSD10) in Delft, the Netherlands. During this 90-minute exploratory workshop, twelve conference participants analyzed four distinct consumer interventions, which are included in appendix A: the Herenboeren urban circular farming initiative, the Beyond Burger, the Do-It-Yourself-Chicken and the vegetarian meal box of Hello Fresh. The workshop served as a form of methodological triangulation; the participants helped with determining how to systematically identify the two components of a TD frame, namely the specific societal-behavioral issues an intervention addresses and the change mechanisms it applies, including the underlying worldview.

Next, three more interviews with experts were held and approximately 20 interventions were added to the study's collection. All six interviews were coded by the primary researcher with MaxQDA software. The first set of codes was directly aligned with the interview questions, which revolved around the components of a TD frame. After familiarization with the interventions and the interviews, the data was then grouped into emerging themes - each unique in their problem-solution combination, i.e. framing. This inductive approach resulted in several preliminary TD frames. Each TD frame was captured in a new code. Two more interviews were conducted

Table 3
List of experts included in the study.

Role		Organisation
1	VP R&D	Food innovation: insect proteins
2	Sociologist	Knowledge institute: university
3	Food transition expert	Consultancy: food and education
4	User experience manager	Food processor: dairy products
5	Farmer and business owner	Dairy Farm
6	Markting manager	Food innovation: meat analogues
7	Food artist	Independent
8	Protein transition ambassador	Network organization: connecting partners in food system

and coded to further deepen the understanding of the emerging TD frames. The set of consumer interventions was refined so that each intervention represented a unique combination of framing and manifestation type (e.g. product, service, campaign, etc.), as the latter correlates with behavioral influence. This meant that if two similar educational programs were included in the set, one of them was eliminated from the set. Yet, there are three books in the set that each show different framing (for instance, one of them aims to inform its readers, while another aims to inspire and yet another aims to create awareness), so they each remained in the set. The refinement of the set resulted in the final collection of 62 consumer interventions.

Throughout the entire period of data collection and analysis, a regular review of the emerging TD frames by cross-disciplinary research partners and by the co-authors was conducted to critically check against potential biases and interpretations of the primary researcher. After multiple rounds of constant comparison, discussions and refinement of the TD frames, we arrived at the final set of eight TD frames, as presented in section 4 (Results).

4. Results

Following the thematic analysis of the consumer interventions and expert interviews, eight TD frames emerged from the data: 1) *Tasty Doppelgangers*; 2) *Silent Steering*; 3) *Gentle Guidance*; 4) *Be the Transition*; 5) *Shifting Meaning*; 6) *Cracking the Discourse*; 7) *Changing the Rules of the Game*; and 8) *Beyond the Anthropocene* (Table 4). All TD frames target the same actor category in the system, namely the consumer, and are unique in terms of their behavior change mechanism. From a transitions perspective, however, the typology that resulted from the analysis shows variety along a few dimensions. For instance, some TD frames involve technological innovations, while others do not. Similarly, some may be more supportive at the initial phase of the transition, while others may be more effective once the transition has progressed further. Evaluations of the effectiveness or the appropriateness of each TD frame in transition phases were not part of this study and would require different kinds of analyses.

We found that the framing underlying several interventions was not singular. As depicted in appendix A, 26 of the 62 interventions demonstrate a single TD frame, while 36 demonstrate multiple TD frames. Each of the 36 more 'layered' interventions represents a unique combination of TD frames. None of these interventions required the formulation of a separate TD frame, as we found that the behavioral mechanisms embedded in them still matched the ones incorporated into the eight final TD frames.

In this section each TD frame will be described and supported by existing literature on transitions and consumer behavior. As presented in section 2.3, each TD frame comprises a societal-behavioral issue and a change mechanism with an underlying worldview. To relate the TD frames to the plant-based protein transition, we also shed light on the impact of each TD frame on the structures, cultures and practices that make up the current food regime (Loorbach, 2014; McMichael, 2009). With structures we refer to institutional, economic, physical, and regulatory settings. Cultures revolve around discourses, shared beliefs, values, perspectives, and paradigms. Practices involve daily routines, behaviors, actions, choices, and habits (Silvestri et al., 2020). The frames each 'stretch-and-transform' at least one of these three parts of the regime, though most also 'fit-and-conform' to other parts, for the benefit of their diffusion and adoption (Mylan et al., 2019; Smith and Raven, 2012).

4.1. Tasty doppelgangers

The *Tasty Doppelgangers* TD frame assumes that consumers are reluctant to change their diets. Due to ingrained habits (Kahneman, 2003), neophobia (Faria and Kang, 2022), or both, they want to continue eating as they do. To help these consumers shift to plant-based diets, this TD frame relies on the principle of 'learning by analogy' (Hoek et al., 2011), building on existing consumer

Table 4
overview of the TD frames and their impact on the plant-based protein transition.

	TD Frame	change mechanism	impact on the transition	type of consumer interventions
1	**Tasty Doppelgangers**	supporting existing consumption patterns with a convenient, sustainable alternative	structures	*(food) products*
2	**Silent Steering**	supporting consumers discretely with responsible choice architecture	structures	*retail environments; choice architecture; pricing models; product-service systems*
3	**Gentle Guidance**	giving the conscious consumer a helping hand	practices	*books; websites; social media accounts; instructions and guidelines; product-service systems; television shows; games; podcasts; product labeling*
4	**Be the Transition**	showing everybody can be a changemaker, by joining a movement	cultures	*organized challenges; documentaries; campaigns; petitions*
5	**Shifting Meaning**	celebrating plants as meaningful and appealing sources of protein	cultures; practices	*speculative designs; product-service systems; podcasts; art exhibitions; educational programs; games; books; documentaries; websites; restaurants*
6	**Cracking the Discourse**	challenging the status quo through public provocation	structures; cultures; practices	*campaigns; speculative designs; activistic provocations; art exhibitions; petitions; documentaries; books*
7	**Changing the Rules of the Game**	modifying food supply through coercion and regulation	structures	*policies; rules and regulations; subsidies; taxes; bans; pricing models; environmental restructuring; retail environments*
8	**Beyond the Anthropocene**	restoring our connection with nature, through alternative food networks	structures; cultures; practices	*alternative (food) networks; product-service systems; educational programs; books; podcasts; websites; documentaries; speculative designs*

Fig. 2. Examples of interventions based on the Tasty Doppelganger TD frame (from left to right): **plant-based milks** from Alpro; **'minced mushrooms'** from retailer Albert Heijn; the **Beyond Burger** from Beyond Meat; **seaweed bacon** by Seamore.

knowledge to support learning (Gregan-Paxton et al., 2002). As a consequence, such interventions incorporate plant-based analogues, i.e., products similar to meat and dairy in terms of cultural food appropriateness, appearance, structure, origin, and taste, and share the same goal or script (van der Meer et al., 2023) to meet consumer expectations (Tziva et al., 2020), requiring no or only little adjustments of habits and routines, which can be difficult to change (Onwezen et al., 2020). Thereby, the *Tasty Doppelgangers* facilitate incremental change, instead of radical change (Mugge and Dahl, 2013). This TD frame stems from a worldview appreciating technological innovation, a free market, global ambitions and 'champion products', such as the Beyond Burger (Lang and Heasman, 2015). As shown in Fig. 2, this TD frame has led to a plethora of novel product innovations deploying a meat resemblance strategy (Bulah et al., 2023a, 2023b; Hoogstraaten et al., 2023; Tziva et al., 2020). While *Tasty Doppelgangers* purposely align with existing eating practices and cultures, they do challenge existing structures, by increasing the demand for alternative resources and infrastructures, particularly within the meat and dairy value chains.

4.2. Silent steering

The *Silent Steering* TD frame focuses on unconscious behaviors, as consumers are heavily influenced by the retail environment. Most food environments currently still promote animal-based products, pulling consumers towards these options. Discretely supporting them to make different dietary decisions, *Silent Steering* intervenes by altering the choice architecture (i.e. the environment in which a decision is made) to steer behaviour in a certain direction, without prohibiting any choices (Thaler and Sunstein, 2008). As such, this frame focuses on the consumers' context (Bucher et al., 2016), rather than on motivating or empowering consumers via their cognition (Niedderer et al., 2018). Consumer interventions can make sustainable options more attractive by convenience or ease (Vandenbroele et al., 2020), by making plant-based proteins the new norm (van Valkengoed et al., 2022), by making them more accessible, by presenting them as the most popular option, and by providing discounts, thereby nudging desirable behaviors (Thaler and Sunstein, 2008) (Fig. 3). In the plant-based protein transition, nudging has been able to influence eating habits positively (Verplanken and Whitmarsh, 2021), e.g., through reversing the default from meat to vegetarian or plant-based, reducing the portion sizes (Meier et al., 2022), or through increasing the availability and visibility of plant-based options in the supermarket (Coucke et al., 2022). However, whether the effect lasts after the intervention has been removed, is often unclear (Meier et al., 2022). The *Silent Steering* TD frame directly challenges existing regime structures, such as pricing models, physical infrastructures in retail environments, and institutions affiliated with the meat and dairy value chains. Food practices, such as grocery shopping, are also impacted by *Silent Steering* interventions, while eating cultures remain unaddressed by this TD frame.

Fig. 3. Examples of interventions based on the Silent Steering TD frame, from left to right: **increased shelf space** for plant-based products at a large Dutch retailer; **discounts for the plant-based hot dog** at IKEA; **sustainable menu design**, promoting vegan and vegetarian options over animal-based dishes, from restaurant Le Nord in Rotterdam, the Netherlands.

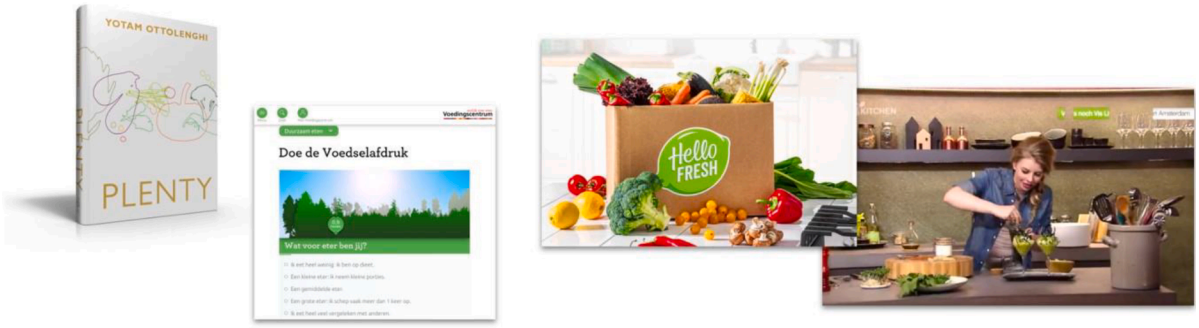

Fig. 4. Examples of interventions based on the 'Gentle Guidance' TD frame. From left to right: Vegan cookbook 'Plenty' by Yotam Ottolenghi; **'Doe de Voedselafdruk'**, a quiz from the Dutch Center for Nutrition for consumers to learn about the environmental impact of their diet; the **Hello Fresh vegetarian meal box** with recipes; vegan cooking show **'Vlees noch Vis'** from 24Kitchen.

4.3. Gentle guidance

The *Gentle Guidance* TD frame focuses on conscious behavior change by addressing peoples' rationality. Consumers are considered 'engaged agents' regarding their dietary change (de Bakker and Dagevos, 2012). This TD frame resonates with flexitarian consumers (Gonera et al., 2021) who are willing to adjust their food practices, yet still need to learn what a responsible diet entails or how to prepare plant-based meals. *Gentle Guidance* increases consumers' understanding of the benefits of plant-based diets and enhances their self-efficacy, i.e. the extend to which they believe they can adopt such a diet (van Valkengoed et al., 2022). *Gentle Guidance* consumer interventions offer information and practical guidance to support plant-based cooking, i.e., so-called 'boosting' interventions to foster consumers' competences through changes in skills, knowledge or decision tools (Hertwig and Grüne-Yanoff, 2017). The assumption underlying boosting techniques is that effects persist, even after the intervention is removed (Hertwig and Grüne-Yanoff, 2017). When collecting consumer interventions for this study, it was not difficult to find examples based on this TD frame (Fig. 4). From a transition perspective, the *Gentle Guidance* TD frame primarily challenges existing food cultures by transforming eating practices, such as grocery shopping and cooking. *Gentle Guidance* also impacts structures in the food system, by empowering retailers and (knowledge) institutes like the Dutch Center for Nutrition to steer consumption patterns.

4.4. Be the transition

The *Be the Transition* TD frame addresses the fact that consumers find it difficult to change their lifestyles for a larger purpose, such as the environment, animal welfare or their own health, as they do not always recognize their role in the plant-based protein transition (van den Boom et al., 2023). Regarding pro-environmental behavior, perceived outcome efficacy is indeed an important determinant, referring to the extent to which people perceive their behavior as effective in contributing to resolving societal problems (Gifford, 2011; van Valkengoed et al., 2022). The social perspective of joining a movement can help consumers feel empowered to make a change and to feel as part of a community (Reicher et al., 2022), thereby supporting their outcome efficacy (Cojuharenco et al., 2016; Jugert et al., 2016). The increase of flexitarians may indicate such a movement (Sparkman and Walton, 2019). Moreover, *Be the Transition* often tempts consumers to embrace the identity of a changemaker, supporting behavior change by boosting their environmental self-identity (van Valkengoed et al., 2022). Regarding the plant-based protein transition, *Be the Transition* primarily disrupts

Fig. 5. Consumer interventions based on the 'Be the Transition' TD frame. From left to right: the **'Nationale Week zonder Vlees'** (national meatless week) campaign; the Netflix documentary **'Game Changers'**, where celebrities and athletes promote a vegan lifestyle; an **Oatly advertisement** addressing consumers as heroes if they were to eat plant-based breakfasts.

Fig. 6. Consumer interventions based on the 'Shifting Meaning' TD frame. From left to right: **The Dutch Cuisine**, a collective of restaurants cooking with local and seasonal products, using 80 % plant-based and 20 % animal-based products; the '**Wortel Schieten'** initiative by het Eetschap, bringing citizens with various immigration backgrounds together to share and experience each other's culture's plant-based dishes; the **Vegan Junkfood Bar**, a restaurant chain presenting plant-based fast food as trendy and fun; **Farm Fundamentals**, a product line by designer Floris Meijer which translates the remnants of agricultural life into new everyday products.

existing food cultures, indirectly influencing eating practices and structures (Fig. 5).

4.5. *Shifting meaning*

The *Shifting Meaning* TD frame focuses on the issue of consumers regarding meat and dairy as essential and meaningful elements of their meals. Shifting towards a more plant-based diet is often perceived by consumers as though something is being taken away from them. In this TD frame, food is recognized as a cultural phenomenon with social and spiritual meaning (Anderson, 2005). By stimulating reflection, the role of 'meat as a centerpiece' is released (Elzerman et al., 2013), allowing a repositioning of traditional protein sources such as legumes and nuts (van der Meer et al., 2023). Through *Shifting Meaning*, plant-based foods and eating practices are demonstrated as meaningful, tasty, and fun, thereby addressing consumers' attitudes towards plant-based diets in a positive way (van Valkengoed et al., 2022). *Shifting Meaning* assumes that true change happens by influencing deeply rooted beliefs, and is thereby a relatively radical change strategy (Mugge and Dahl, 2013). The persistent nature of such beliefs as well as the numerous cultural differences between local communities, pose challenges to the implementation and scaling of interventions based on this TD frame (Fig. 6). The impact of the *Shifting Meaning* TD frame on the food regime evidently lies in its disruption of cultures and practices, indirectly impacting its structures.

4.6. *Cracking the discourse*

The *Cracking the Discourse* TD frame focuses on how people 'strategically ignore' their cruelty towards the environment, animals and public health (Onwezen and van der Weele, 2016), in order to sustain animal protein consumption. This TD frame addresses consumers' cognitive dissonance, referring to thoughts not being in line with behavior, i.e. we love animals, yet still farm, slaughter and consume them; also known as the 'meat paradox' (Bastian and Loughnan, 2017; Pyett et al., 2023). Assuming that eating animals at an industrial scale is a form of speciesm (Singer, 2009), *Cracking the Discourse* presents it as our moral obligation to abstain from animal proteins, challenging our personal norms (van Valkengoed et al., 2022). Through provocative interventions that stimulate negative affect towards farming and eating animals (van Valkengoed et al., 2022), the public is confronted about the irresponsible

Fig. 7. Consumer interventions based on the 'Cracking the Discourse' TD frame. From left to right: the Vegetarian Butcher's activistic gesture of a **request for a meat subsidy** for their plant-based meat analogues; a **campaign against the dairy industry** by the Dutch 'Animal & Rights' foundation; Lady Gaga's provocative **meat dress**; the **'Tosti Fabriek'**, a Dutch speculative consumer intervention where they set up a grilled cheese and ham sandwich production site in the middle of Amsterdam (with live animals being raised and slaughtered on site for its cause).

Fig. 8. Consumer interventions based on the 'Changing the Rules of the Game' TD frame. From left to right: a **100 % vegetarian canteen** at the faculty of architecture of the Delft University of Technology; a **prohibition of meat commercials** in public spaces by the Dutch municipality of Haarlem; **subsidized fruit at primary schools, subsidized** by the Dutch government.

reality of the food system, catalyzing the debate and creating room for alternative futures (Fig. 7). By evoking empathy for animals, disgust about eating meat, and by making cognitive dissonance salient, *Cracking the Discourse* consumer interventions have indeed shown to reduce the willingness to eat meat (Harguess et al., 2020; Kranzbühler and Schifferstein, 2023), yet also provoke resistance due to their aggressive nature. The *Cracking the Discourse* TD frame fosters the plant-based protein transition by criticizing the food regime as a whole: its structures, cultures and practices.

4.7. Changing the rules of the game

The *Changing the Rules of the Game* TD frame assumes that current food related regulations and policies sustain animal protein consumption. Without coercive measures and governmental influence, animal proteins are expected to continue dominating the food system and thereby also our diets. To facilitate the plant-based protein transition, well-informed public and private authorities, such as governmental actors, retailers and schools can therefore regulate the market (Fig. 8). While *Changing the Rules of the Game* interventions may not be perceived by consumers as such, the commonality among them is that an authority has made a decision for them, fundamentally restricting a free market and thereby consumers' freedom of choice. *Changing the Rules of the Game* relates to the strategy of regime change 'from within', namely by actors that are already part of the dominant regime, as opposed to change brought about by niche actors (Mattioni et al., 2022). Rules, laws and market regulations from authorities can indeed set change in motion (de Boer and Aiking, 2021). Authority-based legitimation is also a form of recategorizing: what was morally accepted becomes 'wrong', whereas what was marginal now becomes standard (e.g. successful change in rules around smoking; de Boer and Aiking, 2021). Coercive measures often include norm-related information that have backfiring effects in terms of autonomy and resistance (de Boer and Aiking, 2021), by consumers as well as other actors in the system. To overcome potential resistance, a combination of both pricing and information nudges may enforce effects (Vellinga et al., 2022). A meat tax is an example of a promising policy tool (Broeks et al., 2020), which has not been implemented in the Netherlands yet. The impact of this TD frame on the plant-based protein transition lies in its disruption of dominant system structures, indirectly influencing food cultures and practices.

4.8. Beyond the anthropocene

The *Beyond the Anthropocene* TD frame stresses that consumers have lost touch with nature and how it nourishes us, leading to the intensification of consumption patterns and the exploitation of natural resources. This TD frame fosters the extent to which consumers

Fig. 9. Consumer interventions based on the 'Beyond the Anthropocene' TD frame. From left to right: **Rechtstreex**, a platform for consumers to buy fresh produce from local farmers directly; **Herenboeren**, a circular farming initiative, connecting farmers to citizen members living nearby, producing mostly plant-based products; **edible plant-picking walks** organized by De Brede Moestuin.

personally feel responsible for the societal consequences of their actions, i.e. their ascription of responsibility (van Valkengoed et al., 2022). *Beyond the Anthropocene* assumes that we are part of nature; we should not aim to master it (Lang and Heasman, 2015). Our connection with nature can be restored through hands-on collaboration between producers, consumers and our natural environment, characterized by tailored, local food practices, a transparent supply chain and an extensification of consumption patterns (Lang and Heasman, 2015). Connectedness to nature is indeed observed to be positively correlated with environmental attitudes and pro-environmental behaviors (K. Lee et al., 2015). *Beyond the Anthropocene* increases people's effort to obtain food, relying on the active participation of 'prosumers' (people who are both producers and consumers, (Ritzer et al., 2012). Research shows that people value products more if they invest more time or effort to create or obtain a product (Ilyuk, 2018; Norton et al., 2012). For instance, people who cook a meal themselves, value their meal more (Dohle et al., 2014; Radtke et al., 2019). *Beyond the Anthropocene* interventions imply economies that are driven by qualitative growth instead of quantitative growth (Capra and Henderson, 2014), thereby valuing relationships and meaning over profits and power (Jackson, 2021). Due to their deviating economic nature, it is difficult for such interventions to be viable in the current capitalistic food regime, especially at a national or international scale (Fig. 9).

5. Discussion

5.1. Transcending the doppelganger

In line with expectations, each expert highlighted the dominance of meat and dairy analogues in the Dutch plant-based protein transition during their interview, and consumer interventions based on this frame were indeed easiest to find. Several experts speculated that *Tasty Doppelgangers* may serve as effective steppingstones for consumers in transitioning to more plant-based diets. The interviews elucidated that the Dutch government hardly intervenes in dietary patterns, allowing the market to shape food supply, resulting in the ubiquity of these analogous products. One expert with a large entrepreneurial network in the plant-based protein transition in the Netherlands, illustrates this as follows:

"And that is also something that the Dutch government simply does not want to get involved in. … So the government has sometimes tried campaigning, also on this theme. But then of course you quickly get a reaction like, 'yes, but you are not going to determine what I eat!'." (Participant 1F – protein transition ambassador, Pos. 145,146)

Governments have shown to intervene more proactively in other transitions, such as the energy transition and the mobility transition, accelerating and shaping these transitions significantly through measures such as subsidies, feed-in tariffs, and even taxing dominant regime technologies (Kungl, 2015; Smink et al., 2015; Wesseling et al., 2015). The interviews suggested that this reluctance of the government to influence the plant-based protein transition can be linked to vested interests of powerful actors in the food system, who benefit from maintaining the status quo. As the Dutch economy relies heavily on the export of animal-derived foods (Rijksoverheid, 2023), it is understandable that implementing policies in favor of transitioning away from trading these products is especially challenging in the Dutch context. Several interview participants stressed that without heightened regulation of consumption patterns, especially surrounding pricing, we can expect the *Tasty Doppelgangers* to continue being the dominant transition pathway in the Netherlands. One of the experts highlighted the potential risk of such a scenario:

"And to what extent is there also the risk of a premature lock-in? And that is, of course, certainly the case around the substitution transition path. It suppresses, as it were, the veganism movement, which actually started in the last century." (Participant 1B - sociologist, Pos. 74–75)

To avoid a premature lock-in, our study emphasizes the call for market regulation by actors with some form of authority in the food system, such as policy makers and retailers, essentially referring to the *Changing the Rules of the Game* TD frame. In doing so, the Dutch food system is not only driven towards a highly technological and market driven future state, but alternative states are also fostered. Next to the economic barriers that are associated with *Changing the Rules of the Game*, the decisive nature of the interventions based on this TD frame may fuel resistance from actors across the food system, including consumers who see their freedom of choice being limited, requiring thoughtful action by authorities. While the Dutch show a relative openness to alternative foods (Bremer, 2023), the recent ban of lab-grown meat by the Italian government as 'a defense of Italian tradition' (Kirby, 2023) exemplifies a significant cultural barrier for the plant-based protein transition in a different country, underscoring the contextual relevance of our findings.

In contrast with the *Tasty Doppelgangers* and the *Changing the Rules of the Game* TD frames, the TD frames *Shifting Meaning, Cracking the Discourse* and *Beyond the Anthropocene* fundamentally challenge the collective beliefs that are associated with the food regime. As such, these TD frames 'stretch-and-transform' the existing regime to a relatively great extent (Mylan et al., 2019). By questioning the role of animals in our diets, they advocate for an alternative food system that is 'plant-forward', while also fostering a new relationship between humans and other animals. One of the experts, a food artist from Hong Kong residing in the Netherlands, stressed the importance of cultural change to foster plant-based diets:

"He got a lot of inspiration from China, Japan and Korea and there's a huge belief that certain plants have [a] medical function. … If [you] want to implement more healthy eating, I think the first step is to implement [a] belief. Maybe not only in the medical way, also from [a] different perspective." (participant 1H – food artist, Pos. 161,165)

Indeed, the disruption of cultures is considered a deep systemic leverage point (Gaziulusoy et al., 2021; Leadbeater and Winhall, 2020, 2021) and a strategic avenue to pursue from a transition perspective (Loorbach, 2010). The influence of cultural interventions can transcend specific behavioral situations, by affecting the complete set of consumer practices surrounding food and eating, with a potential spillover effect into other behavioral domains as well (Thøgersen and Ölander, 2003). We see an opportunity for future research to explore implementation strategies for such transformative interventions, to support deep shifts in food cultures across society in a viable way.

5.2. Opportunities for reframing

At this point in the Dutch plant-based protein transition, nearly all interventions that we found resonate with consumers who are already willing or able to make a change, regardless of the underlying framing. Literature indeed suggests that healthy diets, characterized by more fruits and vegetables, are more accessible to, and accepted by, consumers with a higher socioeconomic position (Giskes et al., 2010; Maguire and Monsivais, 2014). Consumers with little financial, physical, or cognitive room to change their diet, are only supported through *Silent Steering* and *Changing the Rules of the Game*, TD frames that could be applied more in the transition in the Netherlands. Even though the spread of ideas and technology across society relies heavily on social capital, implying that the majority of consumers will follow eventually (Rogers, 2003), we see an opportunity to accelerate the diffusion of 'plant-based as the norm' throughout the Dutch population, by developing a novel TD frame explicitly focusing on inclusivity.

We also noticed that nearly all interventions focus on fostering new, 'better' diets, disregarding the simultaneous need to let go of existing dietary patterns. In line with the x-curve framework that is commonly referred to in transitions literature, the build-up of a new system is inherently connected to the breakdown of an existing one (Bogner et al., 2024; Hebinck et al., 2022; Loorbach, 2022). Building on the *Shifting Meaning* TD frame, we see room for interventions that explicitly support consumers to deal with 'transition pain', letting go of the belief that meat and dairy are abundant commodities (Bogner et al., 2024).

Next to the gaps surrounding inclusivity and system breakdown, we see a reframing opportunity of a different nature. As mentioned in section 4, some interventions in our study fit multiple TD frames, indicating that they apply a variety of change mechanisms to foster a specific type of consumer behavior. For instance, to stimulate the purchase of 'veggie dogs', IKEA has deployed a true pricing intervention. As depicted in Fig. 10, IKEA promotes their veggie dog (*Tasty Doppelganger*) at a lower price than the animal-based hotdog (*Changing the Rules of the Game*), and emphasizes this price difference visually as well (*Silent Steering*). By combining three behavioral change mechanisms, the chances of consumers purchasing a veggie dog are increased. We hypothesize that such 'rich' interventions are more effective and can be pursued more intentionally in the context of the plant-based protein transition. As a type of reframing, a combination of multiple TD frames can be integrated into single interventions.

When combining TD frames, it is important to consider that some frames are complementary to one another, while others are at odds with each other. For instance, we found that *Silent Steering*, characterized by nudging, and *Gentle Guidance*, where boosting is applied, are often effectively used together (Harguess et al., 2020; Peeters et al., 2022). On the contrary, *Tasty Doppelgangers* and *Beyond the Anthropocene* clearly compete with each other due to the very different worldviews underlying them (Lang and Heasman, 2015; Mann, 2019). A food transitions expert elucidated the tension between these two worldviews:

"These are fundamentally different views, so either 'we have to keep innovating, because that makes us more sustainable, then we get more money and then we can…' or you say 'no, we have to consume less, because…' That's really the crux of the discussion." (Participant 1C, Pos. 199)

We see an opportunity for further research to explore interactions between the TD frames when integrating them into one intervention or into a portfolio of interventions, informing which combinations can be deemed especially transformative in fostering plant-based diets.

Fig. 10. IKEA's true pricing intervention, demonstrating multiple frames (Tasty Doppelgangers, Changing the Rules of the Game and Silent Steering). Photo taken at IKEA Delft, the Netherlands in January 2023.

5.3. The value of design in transitions

Our frame analysis in the Dutch plant-based protein transition served as an empirical case to reflect upon the value of design in transitions research. In line with our hypothesis, we found that a 'designerly' focus on human-made consumer interventions has helped identify approaches to the plant-based protein transition that complement existing literature. Comparing our results to previous studies on frames and pathways for the plant-based protein transition (de Bakker and Dagevos, 2012; Maluf et al., 2022; Morris et al., 2018; Pyett et al., 2023; Tziva et al., 2023), we find overlap as well as some fundamental differences. For instance, Maluf et al. (2022) and Pyett et al. (2023) have identified pathways of alternative food systems, which are to some degree in line with our *Beyond the Anthropocene* TD frame, yet unlike our TD frame they are not actor specific and emphasize the production side of the food system. We see several similar partial overlaps between our results and those of other studies and notice that our TD frames are consistently distinct in stressing the type of meaning each pathway holds in the daily lives of consumers. We also find that our TD frames integrate behavior more granularly than the sociological and consumer behavioral studies examining the plant-based protein transition (de Bakker and Dagevos, 2012; Pyett et al., 2023). For instance, the 'Moderate Involvement' pathway from De Bakker and Dagevos (2012) proposes to set different norms, to promote meat-free days and to advocate for a flexitarian lifestyle. In our set of TD frames, we have split these three types of interventions into separate TD frames with distinct behavior change mechanisms, namely *Silent Steering, Be the Transition* and *Shifting Meaning*. We found that our relatively granular categorization allows for a deeper reflection on the designed environment of consumers.

Regarding frame analysis methodology in transitions literature (Maluf et al., 2022; Morris et al., 2018; Tziva et al., 2023), we notice that our choice for human-made interventions as artificial units of observation seems to inform concrete perspectives for design efforts to foster the plant-based protein transition, whereas the analyses of media in the mentioned framing studies do not consistently include such a specific reference for action. It must be said that these studies served different purposes, for instance to inform policy making or to speculate about alternative public narratives to foster the transition.

To increase the chances of certain pathways to come to fruition, we see a role for transitions theory to help understand and govern design in transition contexts. For instance, Kriechbaum et al. (2023) have highlighted the importance of narratives to improve the link between a frame and changing landscape developments; when the resonance of a frame is enhanced by connecting it to the wider socio-technical context, its legitimacy increases and therefore may result in wider adoption. In the context of this study, their finding suggests the potential of strengthening the narratives surrounding TD frames that are more desirable from a transition perspective, for instance those that do not involve mimicking. Similarly, Lee and Hess (2019) show that environmental arguments often lose from consumer-economic arguments, insinuating that it might be strategic to stress the consumer-economic benefits of interventions that foster desirable pathways, or at least to be discreet about the environmental drivers behind them, to avoid potential opposition. This would be especially applicable to the *Beyond the Anthropocene* TD frame, whose environmentalist narrative often evokes resistance, thereby 'losing ground' to other frames.

This study deliberately focused on consumers as 'individuals' and active change makers, a perspective that is common in the design field yet not as much in transitions research to date. The TD frames indeed highlighted the variety of ways in which system transformation can be brought about through one specific type of actor, connecting individuals' behavior at the micro-level to societal impact at the macro-level. However, since societal transitions involve a complex interplay of multiple actors, we acknowledge the value of a follow-up study targeting several other actors in the food system as well.

Lastly, the eight TD frames resulting from this study represent types of pathways for design that might be prevalent or aspirational in other societal transitions. For instance, in the mobility transition we see *Tasty Doppelgangers* in the form of electric cars, with similar lock-in related concerns as we find surrounding the meat and dairy analogues in the plant-based protein transition (Sovacool, 2017). Similarly, there are initiatives challenging our views on the entire concept of mobility (Sovacool and Axsen, 2018), which can be associated with the *Shifting Meaning* TD frame. We see an opportunity for further exploration of the generalizability of the TD frames we have found in our study, to serve design efforts in other societal transitions.

6. Conclusions

This study looked at 62 consumer interventions fostering plant-based diets in the Netherlands, to identify TD frames that are prevalent in the plant-based protein transition. Our results inform opportunities for reframing and shed light on the value of design in transitions research. Supported by expert interviews, we identified eight TD frames, each unique in their approach to societal-behavioral issues surrounding the adoption of plant-based diets, connecting micro-level behaviors to macro-level systemic shifts. We confirmed that the *Tasty Doppelgangers* TD frame, characterized by the so-called meat analogues, is currently dominating the transition in the Netherlands. Without increased market regulation through the *Changing the Rules of the Game* TD frame, this might lead to a premature lock-in, sustaining concerns surrounding environmental sustainability, public health and excessive consumption patterns. We also found that some TD frames fundamentally challenge the food system by shifting cultures, indicating that they might have more transformative power. We see opportunities for reframing around inclusivity, system breakdown and combining multiple frames into single interventions.

This study also demonstrated how a symbiotic relationship between the fields of transitions and design can take shape. Choosing human-made interventions as the units of observation in our frame analysis has shown complementary value to the prevailing focus on discourse in transitions research to date. Our artificial angle, which is common in the practice-oriented field of design, extends beyond technology and exposed pathways with concrete references for action, which have not been recognized through discourse analyses to date. At the same time, the analytical lens of transitions research helped elucidate how more desirable pathways for design might be

fostered moving forward.

Our findings were informed by the Dutch context; the prevalence and transformative potential of the TD frames are dependent on local economic and cultural factors. To identify opportunities for design and innovation in the plant-based protein transition in other countries, we recommend similar studies in each unique context. We also see an opportunity to extend our analysis of consumers towards other actors in the food system. To help navigate and accelerate other transitions by design, our approach could be adopted beyond the transition towards plant-based diets as well.

Finally, we found that most TD frames challenge the food regime only partially. Though they may intentionally disrupt some parts of the regime, they may simultaneously sustain or even strengthen other parts, thereby potentially fuelling undesirable lock-in effects. We want to highlight the risk associated with the conflicting impacts that a frame can have on transitions and invite researchers and practitioners to take responsibility, by reflecting upon these trade-offs in their transition related efforts.

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CRediT authorship contribution statement

Anna-Louisa Peeters: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nynke Tromp:** Writing – review & editing, Supervision, Formal analysis, Conceptualization. **Brit M. Bulah:** Writing – review & editing, Writing – original draft, Formal analysis. **Monique van der Meer:** Writing – review & editing, Writing – original draft, Formal analysis. **Lieke van den Boom:** Writing – review & editing, Writing – original draft, Formal analysis. **Paul P.M. Hekkert:** Writing – review & editing, Supervision, Formal analysis.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Data availability

Data will be made available on request.

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Supplementary materials

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