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A critical exploration of adaptation heuristics

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ABSTRACT

A large body of knowledge has been evolving to guide efforts in how we adapt to climate change. This knowledge is underpinned by a set of standardised rules of thumb (heuristics) that define what climate adaptation is and what it means. For example, it is widely accepted that adaptation is a local issue that is best achieved by urgent anticipatory action by using participatory processes. Yet, the validity and relevance of these heuristics have rarely been tested or questioned. If these heuristics are not based on sound empirical evidence, their inclusion and use in scientific studies, policy development, planning and implementation processes can generate inappropriate solutions for highly complex problems. This research critically examines and tests a set of common climate adaptation heuristics and investigates the extent to which they correspond to with the lived experiences of practitioners who are engaged in climate adaptation planning in Queensland, Australia. The findings provide new insights into the applicability of adaptation heuristics, and point to several new rules of thumb that underpin climate adaptation in practice. For example, adaptation was mainly seen as a regional/transboundary issue with broader stakeholder involvement that is best pursued through an incremental 'learn-as-we-go' approach. Retaining flexibility in the policy- and decision-making systems was preferred as were no-regret, value- and risk-based approaches. Future research is needed to explore further the different types of heuristics and how these best support adaptation science, policy, planning and decision-making processes.

1. Introduction

Each science and policy domain has its own rules that guide the choices and decisions that scientists and/or practitioners make in a particular field (Hey, 2016; Preston et al., 2015a; Ravetz, 1972). These rules of thumb (herein heuristics) are mental shortcuts that enable more rapid decisions on policy/project design, development and implementation, and directly impact on which methods or implementation strategies are seen as legitimate. As Crandall et al. (2006, p. 41) note: "what practitioners know and believe about their domain – rightly or wrongly – is critical to their decision-making". Yet, we know surprisingly little about how such heuristics develop and evolve in different domains and the extent that these correspond with the practical realities of decision-making and planning.

Heuristics consist of the collective experiences and knowledge within a particular domain, complemented by lived experiences and insights (Crandall et al., 2006; Klein, 2004). Such rules of thumb, if sound, are often useful in assisting decision-making processes for highly complex problems (Artinger et al., 2015). They become problematic when they are not supported by evidence but are still widely used to justify particular policy positions or funding decisions (King and Pucker, 2020; Leach et al., 1997). Furthermore, once

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particular ways of thinking enter the mainstream and start manifesting themselves in policy texts, strategies, and speeches, they become common knowledge and are rarely questioned (Dilling et al., 2015; Hey, 2016; Preston et al., 2015a; Kuhn, 1962).

Such heuristics have emerged in climate adaptation science, policy and practice via reports from the Intergovernmental Panel on Climate Change, and global policy processes within the United Nations Framework Convention on Climate Change (UNFCCC), which in turn impact national and local policies and their implementation (Morgan et al., 2018; Preston et al., 2015a). An adaptation heuristic is “a common sense, rule of thumb guiding the conceptual framing of adaptation, the prioritization of adaptation policies and measures, and/or the pathways by which they are implemented” (Preston et al., 2015a, p. 469). For example, the ‘local’ heuristic defines adaptation to be mainly a local issue and local responsibility (Anguelovski et al., 2016; Betzold, 2015; Shi et al., 2016) that is often best implemented through urgent anticipatory action by using participatory processes (Nalau et al., 2015; Preston et al., 2015a). The “no-regret/low-regret” and “win–win” concepts are also prevalent across literature that are used to justify particular adaptation decisions (Dilling et al., 2015; Dittrich et al., 2016).

Heuristics are critical in progressing adaptation decision-making and actions: “*Adaptation cannot advance if conceptual understanding of adaptation processes must be rediscovered and renegotiated at the onset of every research endeavour or planning process*” (Preston et al., 2015a, p. 479). For example, the United Nations Framework Convention on Climate Change (UNFCCC) provides a Pocket Guide to Adaptation (Sharma and Venturini, 2019) that assists new negotiators to easily grasp what adaptation is, its key concepts, and main adaptation negotiation items. Similar guides have emerged, such as the recent World Bank’s guide on Adaptation Principles that intends to assist in the process of designing adaptation strategies (Hallegatte et al., 2020) and the ISO Standard [ISO 14090: 2019] for adaptation. All of these aim to speed decision-making and understanding of adaptation, and are part of reinforcing particular ways of thinking about adaptation (Benzie and Persson, 2019; Dewulf, 2013).

However, there are three reasons why we should worry about adaptation heuristics. Firstly, once formulated, they begin to steer and inform research priorities, policy debates, and funding agency guidelines. Australia’s National Climate Adaptation and Resilience Strategy (2015) for example states that: “effective responses to climate change are context-specific, and often addressed best at the local and regional levels” (Department of the Environment and Energy, 2015, p. 5). Likewise, research on financing climate adaptation in Australia highlights the persistent existence of the belief in the localness of adaptation amongst Federal bureaucrats (Banhami-Zakar et al., 2016). This heuristic has contributed to an increasing burden of climate adaptation planning, policy development and implementation for local governments in Australia, which often lack the capacity and/or local political leadership to take action (Nalau et al., 2015; Torabi et al., 2018), with similar observations in urban climate adaptation planning globally (Anguelovski et al., 2016; Shi et al., 2016). Similarly, heuristics around participation in policy development and project design face similar challenges when public participation is expected, yet not proven to always result in better outcomes (Arnstein, 1969; Burton and Mustelin, 2013; Cameron and Grant-Smith, 2014).

Second, following untested decision-making heuristics may be both costly and risky for the lives and livelihoods of vulnerable people (Dilling et al., 2015). Not challenging embedded assumptions can steer us towards particular policy pathways even when they are not optimal (Jagannathan et al., 2020; Magnan et al., 2020; Nalau and Handmer, 2015; Patt, 2012). For example, in Africa, detrimental environmental and development policies have flourished due to a shared assumption amongst donors on the causes of environmental degradation and how it has to be dealt with, even if empirical evidence points to the contrary (King and Pucker, 2020; Leach et al., 1997). Research into Australian disaster management agencies has shown an existing preference to “mainstream” climate adaptation across state agencies, even though there are concerns this approach dilutes responsibility and potentially leads to less implementation (Nalau et al., 2016). Hard infrastructure protection measures, such as seawalls and flood levees, framed as no-regret measures, often lock in communities and the public sector into long-term investment cycles, while allowing more development in highly vulnerable areas and increasing vulnerability (Dilling et al., 2015).

Third, there is the challenge of changing assumptions, especially when they get embedded into decision-making and become unchallenged ‘expert knowledge’ within an organisation or institution. Akin to the black boxes of Kuhn’s scientific paradigms, such rules of thumb will only get tested and over-turned by ‘revolutions’ when they fail to address the anomalies thrown up by normal practice or the institution undergoes significant change (Kuhn, 1996). In policymaking, where there is the need for relatively rapid decision-making and limited time for reflection (Thuraisingham and Lehman, 2013), such shortcuts are necessary and so heuristics are highly likely to become embedded, with less of the ‘checking’ that the scientific process instils. In fact, heuristics are called “unthinking routine” as they often help in quickly defining concepts and problems (Thuraisingham and Lehman, 2013, p. 181). They may be based on past successes or trends, which means that they are less likely to hold true in the face of climate change (Milly et al., 2008), they may be biased by disciplinary dominance of a sector (e.g. engineering focus within the water management) (Braga, 2001; Woodhouse and Muller, 2017), or they may reflect the prevailing political biases and values of the day (e.g. assumptions about globalisation and neoliberal economics) (Friedmann, 2005; Jessop, 2002; King and Pucker, 2020; Morgan and Cole-Hawthorne, 2016). Hence, heuristics become part of the way things are done and absorbed into tacit knowledge, passed on through training and experience, rather than written down – making them less likely to be challenged.

A critical examination of existing adaptation heuristics is crucial as the adaptation science agenda moves forward. In fact, a robust science of adaptation should: “theorize and test the fundamental assumptions, processes, and principles of adaptation to a changing climate so as to provide an evidence base for the science for adaptation” (Swart et al., 2014, p. 5). Such fundamental research has the capacity to provide more theoretically and empirically sound reflections on the inner workings of climate change adaptation, including the weaknesses and strengths of heuristics (Nalau et al., 2015; Preston et al., 2015a, 2015b). Yet, to date, there is a lack of empirical research that engages stakeholders to reflect on these core rules of thumb and to evaluate their usefulness for practitioners.

This paper sets out to fill this gap by evaluating the usefulness of some of the most common adaptation heuristics, as previously identified by Preston et al. (2015a), and their relevance to practitioners’ lived experiences of adaptation planning and policymaking.

The research uses an exploratory research design in the form of a reflective workshop method that engaged practitioners and academics in Queensland, Australia. The next section provides an overview of the methodology including the research questions, workshop design and process. The third section presents the results on the heuristics, including the interlinkages and complexities while also presenting several new dimensions. The fourth section discusses the significance of our findings for adaptation science, planning, policy and decision-making, and how future research can progress this emerging area of research.

2. Methods

The research reported in this paper is part of a larger research project “*Re-evaluating climate adaptation principles for a more resilient Australia*” that investigates core assumptions about adaptation, how these have evolved over time and the extent these are useful guides for adaptation decision- and policymaking. The term heuristic is used to describe the fundamental assumptions and rules of thumb that relate to the conceptual framing of climate adaptation (Preston et al., 2015a, 2015b).

The original work on adaptation heuristics by Preston et al. (2015a) identified eight adaptation heuristics (Table 1) by using a multi-method approach to examine their prevalence in adaptation literature. These heuristics were identified based on the authors’ own work and experiences working in climate change adaptation and other authors’ work (e.g. Hulme et al., 2011). The original research used Google Scholar to search documents during 2003–2012 with search terms relating to each heuristic. The identified documents were quantitatively studied to the extent whether they either endorsed or critiqued these heuristics, while a qualitative analysis was also undertaken that enabled a more specific inquiry into the nature of each heuristic (Preston et al., 2015a).

Given the previous study used the literature as a basis for identifying adaptation heuristics, this study’s main objective was to evaluate the relevance and usefulness of these eight adaptation heuristics based on practitioners’ experiences in Queensland, Australia. We focused specifically on two key questions:

- 1) To what extent do the recognised adaptation heuristics apply in an operational and practical contexts?;
- 2) Are there other potential heuristics recognised by practitioners?

Heuristics are often implicit because they are based on experience and align with what practitioners believe about the field they work in (Crandall et al., 2006; Klein, 2004), so they require personal reflection and probing in order to be found and expressed (Crandall et al., 2006; Klein, 2009). Qualitative approaches are therefore well placed to allow deeper reflection and harness a range of perspectives and insights (Shakeela and Becken, 2015). Reflexive approaches can enable broader and more inclusive conversations and incorporate deeper discussions of inherent problems and opportunities with particular concepts (Westling et al., 2019) with the aim of gathering a variety of insights rather than producing statistics (Denscombe, 2007; Warren and Karner, 2010).

In this context, we used an exploratory small-scale research design that was specifically focused on reflexivity. We created a space for reflection using a workshop format during the *Queensland Coastal Conference*, that was held on the Gold Coast, Queensland, Australia in August 2019. The conference provided an excellent opportunity to attract a wide range of government and private sector practitioners, including coastal engineers, planners and consultants, as well as researchers. Next, we outline the workshop design and process before presenting the results.

2.1. Workshop design and process

Prior to the workshop, the research team (authors) met to co-design a format that would capture multiple perspectives on heuristics through individual and group reflections. The key challenges of data collection were identified as: the possibility of side conversations happening and having multiple speakers at some tables; possible poor quality of audio recordings due to background noise; and the

Table 1
Eight adaptation heuristics as defined by Preston et al. (2015a, p. 471).

Current Heuristics	Consequence	Critique
Adaptation is a local issue	Local actors should implement and be responsible for adaptation	More nuanced understanding of responsibilities among actors needed (legal and perceived)
Adaptation is novel	Adaptation is a novel issue where we cannot rely on our experience.	Collective experiences exist in separate domains in dealing with novel complex problems that can inform climate adaptation.
Adaptation is urgent	Adaptation needs to be implemented as soon as possible, without waiting for other options to emerge.	It is highly unclear which actions best support benefits in short- and long-term.
Adaptation is participatory	Adaptation is most effective when all actors participate in each decision.	Little empirical evidence exists between extensive participation and more effective decision outcomes.
Predict and respond	Knowledge about future conditions enables decision making on adaptation policies and measures, we need more assessments	Future conditions are highly uncertain, often with irreducible uncertainty; more information is not necessarily going to help
No-regrets adaptation	No-regrets is a good starting point for adaptation planning and implementation	Few adaptation options are truly no-regret and win-win only, always issues around trade-offs
Reactive adaptation	Reactive adaptation is more costly and less efficient than proactive planned adaptation	Both reactive and proactive adaptation are important for cost-effective and efficient responses
Residual risk	Adaptation deals with residual risk left over from global mitigation actions	Adaptation can deliver benefits despite and independent from global mitigation efforts

possibility of certain speakers dominating discussions and/or potential conflict of ideas (Warren and Karner, 2010). To address these challenges, we had 1 or 2 facilitators at each table to facilitate reflections and discussions and during the process capture extensive notes to complement audio recordings.

The 20 participants sat in three large tables that they chose randomly as they entered the workshop space. Each participant was provided with a research information sheet, and asked to sign an informed consent form as per the university ethics approval for this research (GU 2019/234). The session started with an initial presentation by the lead author explaining the prevalence of adaptation heuristics, how these heuristics are constructed in everyday language and outlined workshop activities. The presentation introduced the eight previously identified adaptation heuristics (Preston et al. 2015a, see also Burton and Mustelin, 2013; Nalau et al., 2015) (Table 1). We deliberately used the term assumption when referring to the heuristics and highlighted that some assumptions (when not questioned) over time become rules/principles. This approach reduced confusion as assumption is a more commonly understandable term than heuristic.

The participants were first prompted to reflect on their own decision-making processes and which heuristics they identify/use. They then moved into a shared reflective exercise (collective discussion) with the group, following the set of questions below (Table 2). In practice, the individual and group activities overlapped as individuals started to collegially discuss their reflections amongst their peers as they discussed their assumptions of climate adaptation in practice. We provided paper and pens and post-it notes for each participant to capture their individual and group ideas. To capture all insights, the facilitators listened to the recordings and relied on their notes for the collection and analysis of data. In this circumstance, the role of the facilitator became paramount in the data analysis process.

For data analysis, we undertook a systematic and iterative data analysis approach (Braun and Clarke, 2006; Harper et al. 2015). This included a series of steps: data familiarisation (defining principles, assumptions, and heuristics), identification of deductive/theory-driven codes (following Preston et al., 2015a), identification of inductive/data-driven codes (Fereday et al. 2006; based on the missing principles/assumptions identified by the participants), identification of other themes (reflective notes, memos) and creating concept maps (Daley, 2004), development of the project codebook (DeCuir-Gunby et al. 2010), and data coding and review (Miles and Huberman, 1994). All data was de-identified to ensure the anonymity of participants in the transcription and analysis stages as per the university research ethics requirements.

The workshop notes and transcripts were analysed in the qualitative data analysis software NVivo 12 (Bazeley, 2007) that enabled the development of coding categories (Appendix 1).

We first constructed top level nodes for each of the eight heuristic. We then coded further insights into these top-level nodes while also making free nodes on items that seemed important but did not fit neatly under one heuristic (Fereday et al., 2006). Statements that did not seem to fit under any of the previous heuristics were also placed under new top-level nodes, such as “risk-based” and “values-based” (Miles and Huberman, 1994; Silverman, 2003). For the validation of the qualitative findings (Creswell and Miller 2000), we discussed the findings within the research team and compared the text within nodes to also identify linkages between heuristics. This phase also included concept mapping the linkages (Daley, 2004), and identifying core reasons for why people supported or did not think a heuristic was relevant. Next, we present our findings and focus specifically on the two key research questions.

3. Results

The overall results present an intriguing array of experience-based insights into why, how and when particular adaptation heuristics make sense (are useful) and when these do not correspond with the reality on the ground. Here, we first focus on the applicability of each heuristic and the conditions and context when these are not useful or applicable, and then focus on discussing some of the other emerging heuristics not covered in the original eight.

3.1. The applicability of adaptation heuristics to practice

The eight heuristics generated lively discussion in how they were applicable or not in the decision contexts that the practitioners work in (Table 4).

3.1.1. From local to regional/transboundary

The *adaptation is local* heuristic was one of the most discussed heuristics amongst the participants. While it received some support, participants across all three tables critiqued its practicability as a decision guide about the scale of adaptation. Given the nature of some of the required adaptation actions (e.g. infrastructure provision and services) and multi-stakeholder involvement (service providers, levels of government, communities, interest groups), adaptation was seen more as a regional/transboundary issue. For example, one

Table 2
Workshop activity guiding questions and data sources.

Questions	Data sources
Which assumptions do you use when you make decisions on adaptation?	Post-it Notes + writing
Under which contexts/situations are they applicable/don't work at all/should be revised?	Audio recording
Are there some assumptions that are missing?/Other assumptions that you recognise as useful?	
Things you wish people did think about more when they make decisions/develop policy for adaptation?	

Table 4
Summary of the key insights on supporting and critiquing each heuristic.

Current Heuristics	Support	Critique	New framing
Adaptation is a local issue	Adaptation actions are undertaken at the local scale; Importance of neighbourhood and smaller scales Community participation	Need for a more coordinated, integrated regional approach (whole-of-coastline); regional infrastructure provision and services Multi-stakeholder action that goes beyond the local scale Dependent on other levels and legislative responsibilities (e.g. state, Federal)	Adaptation is more often a regional/transboundary issue Scale depends on “governance and infrastructure” Adaptation as “pragmatic”
Adaptation is novel	New extent and intensity of climate change impacts New need to integrate science into planning processes New scale (regional/ whole-of-government approaches)	Humans have always adapted Indigenous communities have always adapted and know how to deal with change Only new because we call it new	Links to transboundary adaptation
Adaptation is urgent	Adaptation planning and changing existing systems and thinking is urgent We are running out of time and need to act now	Need more direction and information first to reduce potential maladaptation Implementation is not urgent yet	–
Adaptation is participatory	Increases a shared understanding of issues, what is at risk, and shared responsibility Gives voice to minority Enables better transboundary/regional coordination	Community members do not always know the right answer/strategy Community involvement should not be tied to every decision and part of the process	–
Predict and respond	Need to build short-term resilience to climate-related events	Accept that we are not going to be always totally right Need to act despite uncertainty of impacts	Adaptation is incremental and experimental, and aims to build in and retain flexibility within systems to respond over time
No-regrets adaptation	No-regrets at least enable some action to be taken Increases flexibility in the system and reduces decision lock-in Keep doing what we know is right anyway	Need to have a shared understanding of “no-regrets” Difficult to know what will be regretted in the future	Adaptation is a sacrifice (giving things up) and about hard decisions, so it always includes regrets
Reactive adaptation	Reactive adaptation is easier to implement Adaptation is always reactive	Both reactive and proactive adaptation are important for cost-effective and efficient responses	Adaptation is dynamic and enables change over time
Residual risk	Adaptation deals with residual risk left over from global mitigation actions	Adaptation can deliver benefits despite, and independent from, global mitigation efforts	–

participant noted that “it’s local because it’s got to happen somewhere and there may be unique things. But there are broad principles or actions that you can do that could fit multiple locations. So, it’s not necessarily local in that sense”. Another participant highlighted the importance of statutory boundaries for defining adaptation actions and assigning responsibilities: “[even if] adaptation is local, you can only respond within the parameters set by other (higher) levels of government”. In this case, “local” was dependent on other levels and legislative responsibilities rather than being simply a place-based issue. This led to a discussion of adaptation being “pragmatic and practical”. Given that dominant/powerful regional organisations can play a more significant role in shaping region-wide adaptation responses for others, it is more practical and pragmatic for other players (including councils and communities) to follow similar adaptation options across the regional scale.

3.1.2. Novel aspects of adaptation

The novel aspects of adaptation related to the increased intensity of impacts, the need for new and more integrated approaches, and new requirements and demand for scientific knowledge to inform planning. One participant noted in particular that “you can’t adapt to a year’s worth of rain in a couple of days. You can’t adapt to a five-metre storm surge”, signalling that the impacts and the context have changed. Adaptation had spurred new more holistic approaches that required a “whole-of-council”, “whole-of-coastline” and “coordinated and integrated” approaches. Also, “integrating science in state statutory planning processes” and in local planning schemes had not been done before to such an extent. A broader coordinated state-wide guidance approach was considered new as was the increased need to bring different kinds of knowledge systems together. Yet critique of this heuristic also abounded. Many noted that “humans have always adapted” and that “adaptation is continual, Indigenous communities have always been adapting... We have just created a system for it to be a ‘thing’”. For example, Aboriginal communities have centuries/millennia old oral history and knowledge about past sea level rise and it is mostly new for Westerners because they have not had to deal with it before. In this context, adaptation was seen just as a part of broader adaptive management and the only thing that had really changed is “a longer timeframe that we now have to consider”.

3.1.3. Urgency of adaptation

Many participants underscored the importance of prioritising adaptation actions and their rapid implementation, in particular in the context of shorter-term “imminent threats and catastrophic impacts that have a high probability”. Adaptation was considered urgent because we were at crossroads now and needed to act fast even if we just “do it for the planet”. The urgent parts of adaptation planning included “getting good data, doing risk assessment, and setting up monitoring frameworks” that were a part of “getting prepared and understanding”. One participant noted that “My most important [heuristic] is that it [adaptation] is urgent and by that I do not mean that we need to start adapting now, but any decision made has to be made knowing that in 20, 50 years’ time things will be different”. The need to change internal policy and decision-making systems was seen as more urgent than implementing actual actions at this stage. However, other participants criticised this view, noting that the urgency of adaptation is “not relevant to emerging (future) threats and tolerable impacts that have a lower priority”. This also related to when to take action: “we need to wait until there is clear direction, so we are not wasting funding and maladapting” or taking action “when more information is available”.

3.1.4. Participation in adaptation

The importance and value of participation (and particularly effective involvement and engagement of the communities) was highlighted for “having a shared understanding of issues, what is at risk and why/when we need to act” as well as having “a shared responsibility”. Some participants tied this to a regional approach rather than local to increase the “shared benefits of participation between neighbouring government”. Participation was seen as a mechanism to give a voice to “those who are not loud”, including minorities. While this was generally seen as important, participants also noted that the level and timing of participation differed as “the community should be involved, but not in every decision”. Other participant noted that “the community does not always have the answer... sometimes potential solutions are unknown or not comprehensible”. One participant talked about a small local council in Queensland, where, despite local council’s efforts to involve the community in the development of a *Coastal Hazard Adaptation Strategy*, the community opted to get involved in later stages when the adaptation options were narrowed down and some of the complexities in the decision-making process had been simplified.

3.1.5. Predicting and responding

The predicting and responding heuristic did not invite as much discussion as the other heuristics. The participants did note the importance of predicting the impacts to build short-term resilience to climate-related events as well as the necessity of undertaking regular monitoring and reviews to embed new knowledge, technology and understanding of issues. Drawing on this, some participants suggested an emerging new heuristic that of adaptation being *incremental and experimental*. Incremental adaptation actions should build on or evolve from current and past decisions. Adaptation in this context should be “evidence-based”, “educational” and “continual” over the longer-term. An experimental and incremental approach to adaptation was seen as helping avoid lock-in effects in the long-term and to maintain flexibility. However, some participants highlighted the importance of pursuing adaptation actions despite irreducible uncertainty. One participant discussed the fundamental aspect of forecasting getting fuzzy over longer-term, highlighting the importance of “accepting that we are not going to be as ‘right’ as we once thought” and “lack of total or absolute uncertainty becomes justification for inaction”. The participants suggested the need to take a “risk-based”, “adaptive”, and “precautionary” approach to account for the inherent uncertainty in decision making to allow flexibility.

3.1.6. No-regrets

No-regret or win-win adaptation options were considered as a desirable starting point for adaptation decision making while

articulating what can be potentially regretted. Some participants highlighted the importance of “*at least doing something*” but warned that actions should be aligned with values so that decisions made today are not regretted in the future. The need for a common understanding of ‘no regrets’ was echoed by some participants: “*you do not know what future circumstances will be, that is what you may regret*”. Some noted that no-regrets introduced flexibility for future decision-making, keeping opportunities open for continuous change and not locking in actions too early. For others, no-regrets was about incremental decisions that we already know are right: “*a riparian vegetation, we know that it is going to help with stream bank stability, so that is a no regret strategy. Keep doing what we know is right*”. No-regrets was not perceived as a feasible strategy by some, however, given that adaptation is in direct conflict with the current consumer culture and so adaptation was “*about sacrifice*” and to “*actually to adapt means to give things up*”.

3.1.7. Reactive adaptation

For many participants, adaptation was a reactive response in the short-term only, requiring a move to longer-term planning in the long-term. Some considered reactive adaptation as a least preferred option, while others considered it easier to implement in reality and more “*politically palatable*”. One participant suggested “*due to the time to implement change, [adaptation] is always reactive*”. In the context of uncertainty, the participants suggested the heuristic that adaptation is *dynamic*. In this view, adaptation should allow for changes with time, social norms and moral context. One participant noted “*what we do now is going to be far different to what we do in the future... you are not going to throw everything up in the air, you are going to take what is there and adapt*”. Some participants suggested “*it is assumed that the status quo can be maintained, that is what everybody wants, but we should not go blind to the notion that there could be something that will never be the same again*” and “*business as usual is no longer acceptable*”.

3.1.8. Residual risk

The residual risk heuristic did not invoke much discussion and revealed some confusion as to what the heuristic meant. While some related this to mitigation efforts, others considered it as “*the risk beyond you can economically afford to plan for*”. Some participants considered adaptation as residual risk (after accounting for greenhouse mitigation efforts) as a principle highly relevant to the local government context. One participant noted “*[local governments] have already assumed that the state’s framework targets an amount of global warming, so we are planning in and around that*”. Other participants questioned the usefulness of this heuristic and noted that that adaptation can deliver benefits despite or independent of mitigation efforts, in other words “*adaptation can generate its own opportunities*”. One participant criticised the heuristic of adaptation as residual risk, by suggesting that “*it promotes a ‘rent seeking’ type behaviour*” where people say “*why would I do [adaptation] if my neighbours are not*” or think “*your effort is too small compared to all other things, that it is not going to make a difference*”.

3.2. Adaptation as value- and risk-based

Several new heuristics that practitioners found useful were adaptation’s relevance to risk, which was tied to values-based adaptation. Participants highlighted the importance of understanding risk and the nature of problems to effectively take actions. One participant especially considered adaptation to be “*asset-based and dependent on our level of acceptance of losing that asset*”. Others, however, warned about a lack of clarity around risk as an important issue because “*risk by its nature is subjective. Probability is the formula, but the consequence is going to mean different levels of things to different people, at different times*”. Some participants pointed to the differences between people’s ‘understanding’ and ‘knowing’ of climate risks. This can cause issues regarding community’s willingness to accept climate risk as “*information-based messages do not necessarily lead to understanding. There is a big extrapolating issue on how people actually understand the risk... we are a long way away from having that mature conversation about the seriousness of risks*”. The perceptions and levels of acceptable risks are based on values and therefore an adaptation approach needs to consider how values might change over time. Yet, values were not just place-specific or community-specific and in a regional context you have a broader set of values to consider. This was seen to further complicate the localness of adaptation.

Three main topics emerged in this context: consideration of *intergenerational equity*, *competitive opportunity*, and *politics*. Adaptation planning involves people who are alive today, making decisions today for those who will be impacted in the future. This was exemplified in the context of involvement of younger generations (below voting age): “*they get it from climate change perspective but they do not know this whole adaptation conversation is happening... certain actions may be implemented or decided upon, but as the future voters and ratepayers, they will be lumped with it*”. Another important factor shaping values was seen to be political leadership. Every decision regarding infrastructure and investment in cities is a political decision. Reflecting on the high relevance of this issue to Queensland local governments, some participants suggested “*adaptation should be removed from politics*” and “*should be independent of the media*”. Yet, one participant noted that politics should be seen as opportunities-based adaptation: “*politics, we frame it as negative, but actually it delivers a lot for us, right?*”. In this view, the politics could be an opportunity to get adaptation done rather than a deterrent.

4. Discussion

This paper has examined climate adaptation heuristics and the extent these correspond with practitioners’ lived experiences of planning for climate change adaptation in Queensland, Australia. Here we unpack our findings and look at the applicability of adaptation heuristics, the reasons why heuristics matter, and end with limitations and learnings from this research.

4.1. Applicability of adaptation heuristics for operational and practical contexts

Our findings show that the practitioners recognised many of the pre-identified heuristics but there were very diverse views on their validity and usefulness. We found that ‘local’, ‘urgent’, ‘participation’ and ‘novel’ were the most discussed in defining adaptation. The other four (‘no-regrets’, ‘reactive’, ‘residual risk’ and ‘predict and respond’) did not attract the same level of discussion as some of them were harder to understand (e.g. residual risk).

We uncovered a broad range of views and the interlinkages between different the heuristics. For example, while the ‘Local’ heuristic was strongly linked to the ‘Participation’ heuristic and community engagement, it was not seen as an applicable decision guide when it came to infrastructure services and provision decisions. In this context, the regional/transboundary heuristic was seen more applicable given it was more pragmatic to streamline similar approaches across local governments. Notably, many participants had been involved in a Queensland State Government initiative delivered by local councils that aims to deliver a state wide approach to coastal hazard management (QCoast2100). This is in line for example with [Lukasiewicz et al. \(2016\)](#) who point out that often adaptation strategies like ecosystem-based approaches require a whole-of-landscape approach to be effective ([Lukasiewicz et al., 2016](#)). This broader scale linked also with the ‘Novel’ heuristic, where whole-of-coastline approaches (regional scale) and the closer integration of scientific knowledge into government planning processes were new challenges that adaptation was bringing to operational contexts.

However, the preference for a regional scale approach is in contrast to [Betzold \(2015, p. 483\)](#) who argues that “the scholarly consensus is clear: adaptation is fundamentally a local issue, and local involvement, participation and ownership is a central precondition for successful adaptation”. Yet, in our study the regional scale applied mostly to adaptation as a technical and governance problem rather than one about what happens to people’s lives in a place that involves values and intergenerational equity ([O’Brien and Selboe, 2015a](#); [O’Brien and Selboe, 2015b](#)). The literature on multi-level governance and mainstreaming increasingly points out the need to use multiple scales in adaptation action ([Biesbroek et al., 2010](#); [Keskitalo, 2010](#); [Juhola and Westerhoff, 2011](#); [Russel, 2019](#); [Corfee-Morlot et al., 2011](#)) rather than defining adaptation at one singular scale, and links with seeing adaptation as a transboundary ([Benzie and Persson, 2019](#)) and even a global issue ([Persson, 2019](#)). This opens up a useful discussion as to which heuristic is actually an applicable decision guide in what decision context.

We observed also other linkages between the heuristics. For example, the ‘No-regrets’ heuristic was often tied to incremental change where ‘Urgency’ was not in the implementation but rather in starting to change the policy, economic and decision-making systems and the mindsets. Viewing adaptation as an incremental and experimental approach dominated in most discussions, as it was seen to retain flexibility in the systems to change course when needed. This echoes [Preston et al. \(2013, p. 163\)](#) who note that “the calls from many academics and governments for far-sighted and well-planned anticipatory adaptation to climate change conflict with the ongoing preference among many local actors for a more reactive and incremental approach”. In this context, focusing on no-regrets was supported by our participants, as no-regret actions were seen to deliver benefits regardless and to be seen at least doing something while reducing the risk of maladaptation ([Magnan et al., 2020](#)).

However, [Dilling et al. \(2015\)](#) warn that, as long as it is unclear what “no-regrets” means in practice, it is difficult to justify how such actions enable more robust decisions on adaptation. Finding a balance between what is a regret now and what regret looks like in the future is a key question in how the concept of no-regrets can be made more applicable for adaptation practitioners ([Dilling et al., 2015](#); [Preston et al., 2015a](#)); a question our practitioners also raised. The no-regret concept is related to “win–win” that is touted to offer “pain-free solutions” where everybody benefits, even when in reality this is not so ([King and Pucker, 2020, 39](#)). The participants recognised that adaptation was about “sacrifice” and having to make difficult choices between values and resource investments. This relates directly also to trade-offs where hard decisions have to be made as to where investments go, for example in coastal communities deciding which areas are no longer a priority for coastal protection and need to consider retreat.

The practitioners also identified a range of other heuristics. Flexibility featured across in responses to ‘No-regrets’ (maintaining flexibility and not locking in adverse decisions), ‘Reactive’ (maintains system flexibility, avoid lock-in and maladaptation by too early decisions), ‘Predict and Respond’ (increase flexibility by waiting for more certain information) and ‘Urgency’ (urgency to change mindsets but not urgency to implement; use watch-and-learn approach). The emergence of this heuristic poses interesting questions – in particular in how this concept is being used in decision-making and which adaptation pathways it supports.

The other two key emerging heuristics – risk- and values-based adaptation – have a long history in the adaptation literature that brings a sharper focus on more implicit and intangible issues such as justice, equity, identities and sense of place ([Adger et al., 2011](#); [Dilling et al., 2019](#); [O’Brien, 2009](#); [O’Brien and Wolf, 2010](#); [O’Brien and Selboe, 2015a](#); [Pelling and Garschagen, 2019](#)). The practitioners articulated the very practical struggle that occurs in accommodating current priorities and future potential changes in values, and trying to enhance coordinated adaptation action across multiple sectors and stakeholder groups over the long term. This may force greater deliberation on no-regrets and incremental solutions as a means to negotiate conflicts and increase calls for deliberative and participative approaches ([Beza, 2016](#); [Romsdahl et al., 2018](#)). It will also place greater emphasis on political leadership, the politics of adaptation ([Eriksen et al., 2015](#)) and the social limits of adaptation as to where communities’ risk tolerance levels lie ([Adger et al., 2009](#); [Dilling et al., 2019](#); [Leal Filho and Nalau, 2018](#)).

4.2. Why do heuristics matter?

Heuristics play an important role in how a policy issue or problem becomes understood given that “the wording of the problem can influence how people frame it, and as a result, how they decide to deal with it” ([Beach and Connolly, 2005, p. 19](#)). Yet, heuristics, if not reflected upon, can easily become our blind spots in decision-making especially if we do not look at decision outcomes ([Duke, 2020](#)).

Heuristics can drive research and policy agendas by defaulting to commonly used approaches (King and Pucker, 2020; Leach et al., 1997). For example, perceiving adaptation only as a local issue and the responsibility of local communities and governments (Anguelovski et al., 2016; Betzold, 2015; Shi et al., 2016) can encourage researchers to keep producing only place-based studies and discourage approaches that could detect larger lessons and trends about adaptation across cases. Similarly, a strong focus on a singular scale/actor can lead to maladaptation where each scale is pursuing conflicting adaptation actions. In addition, championing the “knowledge deficit” heuristic (Dessai et al., 2009) leads us easily towards a policy approach where adaptation implementation should only proceed when more certain climate information is available. Although valid in some cases and decisions contexts, this significantly reduces the potential for adaptation actions that can already significantly reduce vulnerabilities; decisions that could be taken based on the precautionary principle commonly used in environmental policymaking (Sharma, 2017).

Waller and Barnett (2015) have observed that the Australian adaptation policy environment for example has heavily focused on first investing in science rather than making concrete decisions on how to adapt (Waller and Barnett, 2015). This lack of implementation urgency could be linked partly to the fact that climate change is still questioned within some government agencies/departments and is a sticking point for the political machinery of government (Beeson and McDonalds, 2013; Fielding et al., 2012; Tranter, 2011) where the Federal government largely missing in action (Beeson and McDonald, 2013). In this context, addressing adaptation through a multilevel governance approach that acknowledges the linkages between the local, regional and state levels is likely a more effective approach (Nalau et al., 2015).

Nonetheless, there is an increasing appetite in Australia for climate action in the broader community, particularly in response to ‘unprecedented’ climate events, such as the recent Summer bushfires 2019–2020 and ongoing coral bleaching in the Great Barrier Reef (Morrison et al., 2018). Yet, adaptation strategies such as coastal retreat “require long-term plans with thresholds that trigger specific responses, accompanied by a monitoring program to evaluate conditions and modify plans over time” (Siders et al., 2019, p. 763). While lack of urgency has often been cited as a major barrier to adaptation (Massey et al., 2014), urgency for policy action can be spurred by large events (Althaus et al., 2007; Howes et al., 2013). Our specific results on the urgency of adaptation could look very different if we conducted this workshop again in the aftermath of the unprecedented Australian bushfires of 2019–2020.

Understanding which heuristics are driving the discussion in policy and scientific communities is a key underexplored research topic that could reveal the deeper underpinnings of our assumptions and beliefs about what adaptation can, should and could be. This includes how we define concepts such as maladaptation, which strategies we think reduce vulnerability the most (and who is the most vulnerable) and even how adaptation can or cannot be measured and monitored. In order to properly identify and define the causal linkages between heuristics, and the role they play in decision processes, new methodological approaches and a more clearly defined research agenda are required. This could take place, for example, by developing a robust framework or typology of what counts as a heuristic, methods for how to identify these clearly, and further work in examining the examples that demonstrate how heuristics influence directly our decisions and in which contexts. Having a clear understanding on which heuristics are robust guides for adaptation decision-making and under which circumstances and contexts, could significantly improve the way we approach adaptation decision-making.

4.3. Limitations and learning from this research

There are naturally limits to this study, including the methodology and generalisability. Firstly, our workshop was an optional session in the *Queensland Coastal Conference*, which means that the participants were conference participants from the State of Queensland who self-selected to attend this conference session. This can pose challenges as the perceptions on different heuristics are treated and understood within particular governance structures and may not necessarily translate directly to other contexts and regions. While self-selection can also bring bias into the results, the participants were all knowledgeable about climate adaptation given that most of them worked in this domain. Future research could include more diverse stakeholder groups in order to explore how these and other heuristics translate across knowledge domains and professions.

Given the exploratory nature of our research, the aim was to enable the participants to dig deep through reflection and allow insights to emerge from the process. To our surprise, many participants expressed relief in being able to reflect on the heuristics. Comments such as “I can never talk about these things at work” or referring to our session as “therapy” provided evidence of the benefit that creating these kinds of spaces has. This allowed the participants to take time to truly reflect at a deeper level how some of these heuristics are useful, identify the contexts where they are not, and examine their own thoughts about the practice of climate adaptation. Within policymaking and decision-making there is little time or opportunity to challenge existing assumptions and do second order thinking (Thuraisingham and Lehmacher, 2013) and creating such spaces remains critical to improve our thinking about adaptation (O’Brien and Selboe, 2015b; see Westling et al., 2019 for a great example in the water sector).

Our approach and choice of Preston et al.’s (2015a) heuristics does not mean that only these heuristics exist. In fact, given the explosion of adaptation literature, policies, plans, guidance documents and frameworks, there are an increasing number of adaptation heuristics that influence how adaptation is being conceptualised. In fact, adaptation scholars are increasingly starting to question many concepts in common use. For example, Jagannathan et al. (2020) question the very concept of “co-production”, its use in climate adaptation and the underlying often simplistic assumptions associated with this concept. Similarly, Schipper et al. (2020) question more broadly the overall assumptions around the concept of climate resilient development pathways and adaptation in a COVID-19 world, while Nightingale (2016) questions the very processes of how knowledge is constructed in adaptation science. A fundamental challenge for adaptation is also that it always sits alongside other policy agendas (Dupuis and Biesbroek, 2013) that have each their own heuristics at play. Examining this broader range of heuristics is challenging but such an enquiry could help us to challenge some of the deep seated and at times false beliefs we hold (King and Pucker, 2020).

The call for more reflexivity in adaptation science, policy and practice could be seen as a heuristic itself (Preston et al., 2015b; Swart et al., 2014; Westling et al., 2019). Yet, Thuraisingham and Lechman (2013, p. 179) note that such deeper second order thinking ('thinking about your own thinking') enables individuals to reflect on their own assumptions and it actually "*improves the quality of decision making*". As O'Brien and Selboe (2015b, p. 9–10) also note, "When an individual or group starts questioning assumptions and relationships that have been taken for granted, meaning making shifts and problems and solutions are viewed from a different perspective". This is exactly why probing adaptation heuristics through reflection can open up new spaces for conversations about the nature of adaptation and results in even changed mindsets.

5. Conclusion

Adaptation heuristics are necessary to progress the adaptation science agenda and they can bring coherence and coordination to the adaptation science enterprise by proposing a set of commonly agreed ways of thinking about adaptation. Yet, if these heuristics are faulty, they can lead to inappropriate solutions being applied to highly complex issues. Our findings show how adaptation heuristics were perceived, debated and reflected upon by a group of climate adaptation practitioners in Queensland, Australia. Instead of simple agreements, we found diverse perceptions and multiple interpretations in defining the scale and speed of climate adaptation planning and implementation, including a set of experience-based ideas that practitioners view as useful decision guides to support decision- and policymaking practices on the ground.

Capturing this kind of experience-based knowledge on which heuristics are helpful and in what context will become even more crucial in the future as climate adaptation moves more rapidly towards broader implementation. By opening up spaces for collaborative reflection, we can increase the adaptation mindshare, which is the capacity of people to think in a more reflective manner about adaptation and its underlying components and dimensions. Future research is needed to identify the full range of adaptation heuristics beyond these initial eight, and whether, when and how these can work as robust guides for decisions in science, policy and practice. This can hopefully generate a global conversation as to what we collectively believe to be true of the field that we work in and lead towards more innovations in the way we develop knowledge about and for climate change adaptation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix 1. Qualitative analysis coding categories as developed in NVivo 12.

Codes		Key sub-codes
Adaptation a local issue	Endorse	Community participation; local scale
	Critique	Collaboration; regional/transboundary; infrastructure; governance
Adaptation is novel	Endorse	No previous experience; new impacts
	Critique	Historical adaptation and experience
Adaptation is urgent	Endorse	Rapid planning and implementation; priority
	Critique	Increased potential for maladaptation; focus on system change; mainstreaming
Adaptation is participatory	Endorse	Community participation for buy-in;
	Critique	Community not always knowledgeable; choosing to participate later
Predict and respond	Endorse	Need more scientific information
	Critique	Adaptation planning and implementation can already commence
No-regrets	Endorse	No-regret options help to kickstart adaptation
	Critique	No-regret options do not exist; changing and different values
Reactive	Endorse	Reactive adaptation enables learning
	Critique	Reactive adaptation is too late
Residual Risk	Endorse	Adaptation addressing risks after mitigation efforts
	Critique	Benefits independent of mitigation efforts
Other potential adaptation heuristics		
Adaptation is pragmatic		Fitting with other activities;
Adaptation is incremental and experimental		Experimental learning; incremental
Risk-based adaptation		level of acceptable risk by governments and the community; risks on assets; different timeframes
Value-based adaptation		intergenerational equity; competitive opportunity; politics

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