Received: 10 October 2021 | Accepted: 7 January 2022

DOI: 10.1111/ijmr.12289

IJMR INTERNATIONAL JOURNAL of MANAGEMENT REVIEWS BRITISH ACADEMY OF MANAGEMENT

DEBATE ESSAY

Resilience, robustness, and antifragility: Towards an appreciation of distinct organizational responses to adversity

Albert Munoz[1] | **Jon Billsberry**[1] | **Véronique Ambrosini**[2]

[1] University of Wollongong, Northfields Avenue, Wollongong, NSW, Australia

[2] Monash University, 900 Dandenong Road, Caulfield East, VIC, Australia

Correspondence
Jon Billsberry, University of Wollongong, Northfields Avenue, Wollongong 2522, Australia.
Email: jbillsbe@uow.edu.au

Hillmann and Guenther provide an extensive review of research into organizational resilience in which they examine the different conceptualisations of the concept and their associated measurement scales. Their article emphasises stability, rather than other domains such as growth, as core to organizational resilience. We argue that this emphasis does not acknowledge the overlap between resilience and associated but distinctly different concepts like robustness and antifragility as observable phenomena in organizational responses to adversity. To extend Hillmann and Guenther's work, we therefore conceptually contrast resilience with robustness and antifragility so that future research might craft a more nuanced understanding of the presence of all three concepts in management research, which is currently dominated by resilience.

INTRODUCTION

Hillmann and Guenther (2021) provide a comprehensive overview of the concept of organizational resilience and its place in management research. Echoing previous authors (e.g. Burnard & Bhamra, 2011), they begin by stating that the concept of resilience in management research lacks a consistent definition and highlight inconsistencies in definitions of resilience. They then systematically review the organizational resilience literature and organize it into six conceptual domains. Finally, following Breslin and Gatrell's (2020) miner-researcher path, Hillmann and Guenther (2021) focus on implementation in future empirical work and develop a conceptual integrative model of organizational resilience. We argue that their approach to organizational resilience could be extended by not presenting resilience as the singular outcome achievable by organizations following periods of adversity. As it stands, Hillmann and Guenther (2021) do not explicitly differentiate between the various outcomes that organizations can reach after such disruptive episodes. We explain that organizations can experience three distinct outcomes after facing adversity: (1) performance degradation followed by recovery (i.e. resilience), (2) insensitivity to uncertainty (i.e. robustness), and (3) upside gain (i.e. antifragility). In delineating these three different outcomes, we transfer theoretical knowledge across disciplinary boundaries, integrate literatures (Breslin & Gatrell, 2020; Cunliffe, 2018), and draw in knowledge from the uncertainty, risk, and systems theory literatures into organizational resilience. Teasing out the conceptual differences between the three outcomes brings clarity to our understanding of organizational responses to adversity. It is a much-needed step towards the development of theoretical insights (Levitas, 2013). Concentrating on outcomes also avoids the danger of logical inadequacy in arguing

that resilient behaviour, resources, and capabilities lead to resilience outcomes, as stated in Hillmann and Guenter's (2021) Figure 1. This affords a more rigorous disentangling of antecedents and outcomes.

While Hillmann and Guenther (2021) provide a much-needed review, we suggest that their analysis could be extended. Our purpose here is to draw attention to the potential causes of confusion and contradiction that may hamper the development of the literature (Duchek, 2020; Hillmann & Guenther, 2021; Linnenluecke, 2017). First, we want to highlight that decomposing the stability domain into elements of resilience and robustness enhances conceptual clarity. In their description of the domain of stability, they refer to two attributes of resilience: one, the 'ability to resist/maintain/cope', and two, the 'ability to bounce back or recover from'; but they collapse both into one single resilience concept, reducing construct clarity. Second, Hillmann and Guenther's (2021) exposition of the growth domain hints at the concept of antifragility, but does not bring it to the fore. By collapsing growth and the attribute of 'ability to prosper and benefit from adversity' into resilience, they mask the outcome and this weakens our understanding of resilience. We conclude this essay (Breslin & Bailey, 2020) by recognizing that resilience, robustness, and antifragility jointly contribute to understanding the outcomes that organizations can realize after facing adversity and we elaborate further Hillmann and Guenther's (2021) call for future measurement endeavours. We argue that future empirical developments should disambiguate these concepts paying attention to causal attribution between performance responses and strategic investments across more than just resilience.

DISAMBIGUATING RESILIENCE AND ROBUSTNESS

We first turn our attention to robustness and our argument that the review aggregates this concept into resilience. In their paper, Hillmann and Guenther (2021) explain that the most essential domain of the concept is stability. It involves 'abilities that aim to provide stability in times of disruption' and includes abilities whose intention is to mitigate the impact disruptions may have on performance. This notion is intuitive, as organizations cannot recover from disruption if they cannot maintain some stability during adverse times. Hillmann and Guenther (2021) unpack this concept to include: an ability to maintain some resemblance of the organization prior to the disruptive event, an ability to bounce back or recover from a situation, an ability to resist (or withstand) by bearing the impact of a disruption and remain functional, an ability to recover to a pre-event state, and an ability to cope as a mechanism to enact some alternative configuration that is feasible and functional, preserving organizational viability during disruptive times. We agree that these abilities are important, as any organization that is unable to exhibit some stability will likely suffer from sufficient performance degradation resulting in failure; a notion expressed in early ecology works (Holling, 1973). However, we argue that these do not form a single construct. They are attributes of two distinct constructs: robustness and resilience.

The ability to maintain, cope, and withstand is about robustness, whereas the ability to recover or bounce back is about resilience. So, for instance, taking an industry-level unit of analysis, during the COVID-19 pandemic, most organizations providing health care and education services withstood (i.e. were robust), whereas those in the travel and tourism industries suffered and then recovered (i.e. were resilient). An example at a business level of analysis is the taxi industry. Traditional taxi companies were resilient when their performance degraded at first with the lockdowns but then recovered as volume returned. Local disability specialized taxi companies were robust and somewhat insensitive. These examples reflect that they are different concepts and demonstrate that the mechanisms driving these outcomes are different.

Robustness refers to the degree a system is sensitive to exogenous influence (Duchek, 2020; Zhou et al., 2017; Žiha, 2000). Sensitivity can be exhibited as a system performance variation upon exposure to a stressor, with robustness being the ability to maintain, resist and withstand the influence of adverse events (Durach et al., 2015; Haimes, 2015). The primary characteristic of robust systems is the ability to either withstand or absorb strain (Durach et al., 2015), or withstand and absorb strain while maintaining functionality (Dubey et al., 2017; Haimes, 2009; Kahn et al., 2018; Kamalahmadi & Parast, 2016; Sutcliffe & Vogus, 2003). Robust systems are often required to change their mode of operation to maintain functionality (Kitano, 2004), but rare or unanticipated events can expose vulnerabilities, resulting in situations where they cannot cope and ultimately fail (Carlson & Doyle, 2002). The supply chain literature also characterises robustness as avoidance to adversity (Durach et al., 2015). Robust organizations often hold redundancies, reconfiguration options, slack, and safety stocks that absorb any adverse impacts of uncertainty (Gittell et al., 2006; Kobasa et al., 1982; Meyer, 1982). However, robust systems will only absorb disruption up to a point, beyond which the system suffers from performance degradation indicating that robustness has a finite capacity (Holling, 1973). For example, during the COVID-19 pandemic, many universities were able to adopt remote work and teaching for staff and students preserving continuity of educational delivery (Poleg, 2021). Yet, many educational settings have noted that prolonged remote learn-

ing has had detrimental effects on student learning (Hoss et al., 2021).

Conversely, resilient systems can recover to acceptable levels after experiencing performance degradation (Holling, 1973; Walker et al., 2004). Lengnick-Hall et al. (2011, p. 244) reflected on this as the ability to 'rebound from unexpected, stressful, adverse situations and to pick up where they left off' (Gittell et al., 2006; Mallak, 1998; Rudolph & Repenning, 2002; Sutcliffe & Vogus, 2003). Resilient organizations will often possess redundancies and flexibilities, and leverage them to support strategies that enable the resumption of business to prior performance levels (Sheffi, 2005). The classic example are firms whose costs are dominated by staffing costs who have the ability to lay-off staff in response to the downturn of business and the ability to re-hire them later when the adverse situation is easing. This was the case of Qantas during the COVID-19 pandemic who stood down more than 20,000 employees (Khadem et al., 2020). In contrast, the fall of passenger demand for air travel during the pandemic quickly drained the financial resources of many airlines, especially those with large ongoing leasing costs, leading some to collapse and fail (Amankwah-Amoah et al., 2021).

The conflation of resilience and robustness in Hillmann and Guenther (2021) reflects similar approaches in the literature. For instance, Linnenluecke et al. (2012) decompose resilience into impact resistance and recovery, the first being more analogous to robustness, while the second is more akin to resilience. Similarly, Williams and Shepherd (2016) include the ability to absorb and endure disruptions alongside recovery. Although the literature has long agreed that resilient organizations require some form of robustness to resist the downward pressure on performance placed by disruption (Kantur and İşeri-Say 2012), we argue this characteristic of organizations is distinguishable from resilience. Other research areas have also delineated resilience and robustness, noting that they represent different manifestations of system responses to changes in the environment (Gallopín, 2006).

Conflating robustness with resilience can lead to issues for future measurement research. Consider a hypothetical example of two firms experiencing a similar disruption; one firm contains sufficient resources to absorb most of the impact of the disruption, while the other possesses far superior recovery capabilities. Hillmann and Guenther's (2021) definition would categorize both as resilient, but which one is more resilient and what are the underpinning differences? With greater resources to absorb the impact of a disruption, the first firm will suffer lower performance variation, making it easier to recover. Conversely, the second firm may suffer greater performance degradation but is able to recover. The ability to withstand pressure on performance and remain insensitive to disruption (i.e. robustness) is distinct from the *ability to bounce back* or *recover*, which embodies traditional notions of resilience. This illustrates two separate situations and hence separating the concepts and using both robustness and resilience as a means of measuring post-disruption performance provides greater explanatory power.

DISAMBIGUATING RESILIENCE AND ANTIFRAGILITY

We now turn our attention to antifragility and our second contention that the review does not sufficiently take growth and organizational thriving into consideration. Given that adversity and uncertainty are omnipresent for most organizations, one cannot dismiss the growth domain as being 'non-essential'. It is easily argued that most managers want their organizations to go beyond perseverance or to recover from adversity, and instead would like to see their organization thrive and benefit from the situation (Ramezani & Camarinha-Matos, 2020).

Hillmann and Guenther (2021) describe resilience as having a growth domain that is separate from the stability domain. Growth refers to a net gain, observed as an increase in performance relative to pre-disruption performance levels. It is about thriving; flourishing despite adversity. The key resilience attribute, in this case, is the ability to emerge from a crisis strengthened. Following from our previous argument, this means that we have yet another distinct construct from resilience: antifragility.

While resilience is about recovery after performance degradation, antifragility is defined as a performance gain when exposed to adversity (Taleb, 2012). So, for instance, during the COVID-19 pandemic, following the previous ride sharing industry example, some taxi businesses thrived and demonstrated antifragility with their exploitation of the takeaway and online shopping booms by expanding to become local delivery companies. At the industry level, IT services gained a great deal due to people working from home and needing IT solutions. This illustrates that antifragility is distinct from resilience (Ramezani & Camarinha-Matos, 2020; Taleb, 2012) as gains from adversity are central to the former (Größler, 2020).

While systems that suffer performance degradations due to exposure to uncertainty are characterised as fragile, those characterised as antifragile will benefit, thrive, and grow when exposed to volatility, randomness, disorder, and uncertainty (Taleb, 2012). Taleb's (2012) work remains largely descriptive relying on repeated empirical observations of performance outcomes as a phenomenon, largely derived from financial markets and investments. As such, antifragility has been critiqued as an abstract

concept (Größler, 2020), leaving many interested management practitioners to interpret for themselves how they might drive antifragility as an outcome in their organizations. However, the scant literature on antifragility in organizations denotes a capability to regenerate, prosper, and improve when exposed to unpredictability and volatility (Ramezani & Camarinha-Matos, 2020; Taleb, 2012), whether it be through a process of actively learning and improving after a failure (Größler, 2020; Jaaron & Backhouse, 2014; Markey-Towler, 2018), or activating capabilities to change (Derbyshire & Wright, 2014).

Antifragile organizations typically employ redundancies such as additional capacity or slack, or have the ability to raise investment funds, that enable them to take advantage of periods of adversity. Such redundancies may also have latent functionality in stable environments, but achieve manifest functionality and realize gains in adverse conditions. These organizations also possess flexibilities that enable the reconfiguration of their capabilities and align with opportunities that arise in adverse environments, thus leading to performance gain (Cavanagh, 2017). For example, in the aforementioned IT services industry, Krisp, a company that uses Artificial Intellingence to reduce background noise on computer microphones, was able to rapidly expand due to their ability to raise investment to take advantage of the switch to working at home during the COVID-19 pandemic.

The conflation in the definitions of resilience and antifragility displayed in Hillmann and Guenther's (2021) article reflects some of the extant literature. Hohenstein et al. (2015) describe the growth domain explicitly as a post-recovery trajectory that results in improvement relative to pre-disruption performance and mentions that resilient organizations can improve. This reflects definitions of resilience that go beyond restoration to include performance enhancement or growth (Coutu, 2002; Lengnick-Hall & Beck, 2005; Lengnick-Hall et al., 2011; Madni & Jackson, 2009; Weick, 1998; Wied et al., 2020). Hillmann and Guenther (2021) cite many publications that contain definitions of resilience reflecting the conflation as they refer to resilience as including improved functioning post-disruption (Vogus & Sutcliffe, 2007), growth in the face of turbulent change (Fiksel, 2006), and movement towards a more efficient state after the disruption (Hohenstein et al., 2015).

Nevertheless, disambiguating resilience and antifragility is important when considering the measurement of resilience, which Hillmann and Guenther (2021) highlight as an area of concern. Consider another hypothetical scenario where two firms are affected by a similar disruption; one recovers to pre-disruption performance levels, while the other achieves superior performance relative to pre-disruption. Under Hillmann and Guenther's (2021) conceptualisation, they cannot be separated. Are both firms equally resilient? Is one more resilient than the other as it achieved superior performance? The second firm has to mobilize and access resources needed to recover from adversity, whereas the first one will require mobilising resources to exploit adversity towards a gain (Taleb, 2012). The former would imply that exposure to uncertainty should be minimised, while the latter would seek to increase exposure to uncertainty. Thus, resilience and antifragility are different, and teasing out these differences allows greater insight into the measurement of post-disruption performance. In other words, incorporating an optional upside gain into an umbrella notion of resilience denies the unique features of growth and dismisses it as being secondary. Crucially, stability is also an important feature of growth, meaning that antifragility and resilience belong to the same domain. In effect, they are a duality rather than a dualism, they are interdependent, not separate, so one is not secondary to the other (Farjoun, 2010).

CONCLUSION

In their review Hillmann and Guenther (2021, p. 31) state: 'All other domains [other than stability] have added to our understanding of resilience but moved the concept farther away from its original idea'. As such, their quest for parsimony has been a reductionist one, leaning towards simplicity. In doing so, it has removed the richness associated with the phenomenon. While their review undoubtedly offers a thorough review of resilience, it would benefit from a more sophisticated and comprehensive appreciation of resilience. In particular, it could reflect its multifaceted nature, both in terms of outcomes and measurement. We argued that organizations can experience three different, distinct, and positive outcomes after facing adversity. Conceptualising robustness, resilience, and antifragility as discrete and observable outcomes means that they are not latent phenomena that can only be indirectly inferred. Causes and effects can be studied.

As mentioned in Hillmann and Guenter's (2021) review, resilience has become a buzzword. There has been a publication surge on resilience due to academics and practitioners reflecting on the COVID-19 pandemic, terrorist attacks, and natural disasters experienced in the past few decades. For these reasons, it is critical to understand the facets of the phenomenon to develop new knowledge (Lane et al., 2006). This publication surge, together with the range of definitions revealed in Hillmann and Guenther's (2021) review, combined with the conflation we have described, suggest that the concept of resilience is at risk of being reified. There is a lack of

cohesion in its use, and it is becoming taken for granted (Giudici & Reinmoeller, 2012). One major risk of reification is that 'scholars unknowingly integrate findings from studies with inconsistent construct definitions, which can create serious threats to validity' (Lane et al., 2006, p. 835). This is why construct clarity is critical. Construct clarity is also the first step to theorizing from a phenomenon (Fisher et al., 2021). Furthermore, by explicitly conceptualizing robustness, resilience, and antifragility as outcomes, we eschew the possible tautological definition that being resilient leads to resilience ('An organization's resilient behaviour, resilience resources and resilience capabilities enable and determine organizational resilience', Hillmann & Guenther, 2021, p. 25), which is problematic as they cannot be subject to disconfirmation (Bacharach, 1989).

The COVID-19 pandemic also exemplifies the need for such construct clarity. It typifies the sort of adversity that affects organizations and does so in a range of ways. An antifragile organization is enhanced by adversity, a robust organization is untouched, and a resilient organization is damaged, but recovers. These are very distinctive outcomes. Our composition argument (Davis, 1971) that resilience is not a single phenomenon and is in reality composed of various heterogeneous phenomena, adds to our understanding of organizational responses to adversity. Conceptualizing resilience as one element reduces our ability to understand differences in organizations' survival outcomes. This limits not only our theorization of resilience and its measurement, but also our ability to formulate meaningful practical guidance. The relevance of such guidance is particularly nascent in times such as the pandemic, when there is a greater need to strengthen the link between theory and relevance (Bailey & Breslin, 2021).

As mentioned in Hillmann and Guenther's (2021) review, resilience is best observed ex-post, with the main differences in outcomes being recovery, insensitivity, or a net gain. However, managers need ex-ante guidance, so any ex-post assessment needs to be evaluated to consider how useful it can be to address future adversities. This, in turn, will also allow us a more coherent understanding of the phenomenon (George, 2014). Following Mintzberg and Waters (1985), these reflections suggest a differentiation between realized outcomes (i.e. the current observable outcome) and intended outcomes (the planned, desired future). This differentiation corresponds to Milliken's (1987) response uncertainty argument. It allows us to recognize that there will be no ex-ante optimal range of actions, and given that organizations may wish to achieve a particular outcome, the nature of uncertainty is such that intended goals may not be realized. How events unfold could result in either business failure, resilience, robustness, or antifragility. It also suggests that without appreciating the range of post-adversity outcomes, organizations cannot start understanding how actions lead to preparedness.

For instance, as discussed earlier, if the intention is robustness, organizations need to build up slack resources to resist and avoid the negative impact on performance. Alternatively, organizations can embody alternative configurations to preserve service levels and continue operations without performance degradation. Similarly, if the goal is resilience, organizations need to be capable of acting towards recovery, either via transformation into an alternative configuration or seeking and procuring resources that will sustain the organization until the adversity subsides or recovery can be enacted. Finally, antifragility necessitates that organizations have the resources and abilities to exploit unexpected opportunities. Such exploitation could be achieved by strategically allocating investments to minimise downside risk while maximizing upside opportunity. Conceptualising resilience as both intended and realised is a conduit to inform managerial prescription. What the analysis of ex-post outcomes affords us is the unpacking of how organizations achieved a particular outcome when facing adversity, which may help understanding of how they could prepare for similar future situations.

In summary, while we concur with Hillmann and Guenther's (2021) premise for conducting the review and applaud their describing and categorising, we have argued that the umbrella concept of resilience is multifaceted and should include the distinct outcomes of resilience, robustness, and antifragility. Further, we suggest that an important next step towards developing such managerial guidance is an understanding of the heterogeneous nature of organizational actions associated with each outcome. We also argued that we should dichotomise these outcomes into intended and realised to increase its managerial relevance further. It is too restrictive to limit the boundary of resilience to stability and to treat growth as an issue that moves 'the concept farther away from its original idea' because that ignores the interdependence of stability and growth. Such a narrow focus compromises our ability to develop a complete account of organizational survival at times of adversity when failure is a potential outcome.

ACKNOWLEDGMENTS

Open access publishing facilitated by University of Wollongong, as part of the Wiley - University of Wollongong agreement via the Council of Australian University Librarians.

ORCID

Véronique Ambrosini https://orcid.org/0000-0002-7074-211X

REFERENCES

Amankwah-Amoah, J., Khan, Z. & Wood, G. (2021) COVID-19 and business failures: the paradoxes of experience, scale, and scope for theory and practice. *European Management Journal*. 39, pp. 179–184.

Bacharach, S. B. (1989) Organizational theories: some criteria for evaluation. *Academy of Management Review*, 14, pp. 496–515.

Bailey, K. & Breslin, D. (2021) The COVID-19 pandemic: what can we learn from past research in organizations and management? *International Journal of Management Reviews*, 23, pp. 3–6.

Breslin, D. & Bailey, K. (2020) Expanding the conversation through 'Debate Essays' and 'Review Methodology' papers. *International Journal of Management Reviews*, 22, pp. 219–221.

Breslin, D. & Gatrell, C. (2020) Theorizing through literature reviews: the miner-prospector continuum. *Organizational Research Methods*, 1094428120943288.

Burnard, K. & Bhamra, R. (2011) Organisational resilience: development of a conceptual framework for organisational responses. *International Journal of Production Research*, 49, pp. 5581–5599.

Carlson, J. M. & Doyle, J. (2002) Complexity and robustness. *Proceedings of the National Academy of Sciences*, 99, pp. 2538–2545.

Cavanagh, C. J. (2017) Resilience, class, and the antifragility of capital. *Resilience*, 5, pp. 110–128.

Coutu, D. L. (2002) How resilience works. *Harvard Business Review*, 80, pp. 46–56.

Cunliffe, A. L. (2018) Wayfaring: a scholarship of possibilities or let's not get drunk on abstraction. *M@n@gement*, 21, pp. 1429–1439.

Davis, M. S. (1971) That's interesting! Towards a phenomenology of sociology and a sociology of phenomenology. *Philosophy of the Social Sciences*, 1, pp. 309–344.

Derbyshire, J. & Wright, G. (2014) Preparing for the future: development of an 'antifragile' methodology that complements scenario planning by omitting causation. *Technological Forecasting and Social Change*, 82, pp. 215–225.

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Blome, C. & Luo, Z. (2017) Antecedents of resilient supply chains: an empirical study. *IEEE Transactions on Engineering Management*, 66, pp. 8–19.

Duchek, S. (2020) Organizational resilience: a capability-based conceptualization. *Business Research*, 13, pp. 215–246.

Durach, C. F., Wieland, A. & Jose, A. D. M. (2015) Antecedents and dimensions of supply chain robustness: a systematic literature review. *International Journal of Physical Distribution & Logistics Management*, 45, pp. 118–137.

Farjoun, M. (2010) Beyond dualism: stability and change as a duality. *Academy of Management Review*, 35, pp. 202–225.

Fiksel, J. (2006) Sustainability and resilience: toward a systems approach. *Sustainability: Science, Practice and Policy*, 2, pp. 14–21.

Fisher, G., Mayer, K. & Morris, S. (2021) Phenomenon-based theorizing. *Academy of Management Review*, 46, pp. 631–639.

Gallopín, G. C. (2006) Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*, 16, pp. 293–303.

George, G. (2014) Rethinking management scholarship. *Academy of Management Journal*, 57, pp. 1–6.

Gittell, J. H., Cameron, K., Lim, S. & Rivas, V. (2006) Relationships, layoffs, and organizational resilience: airline industry responses to September 11. *Journal of Applied Behavioral Science*, 42, pp. 300–329.

Größler, A. (2020) A managerial operationalization of antifragility and its consequences in supply chains. *Systems Research and Behavioral Science*, 37, pp. 896–905.

Giudici, A. & Reinmoeller, P. (2012) Dynamic capabilities in the dock: a case of reification? *Strategic Organization*, 10, pp. 436–449.

Haimes, Y. Y. (2009) On the definition of resilience in systems. *Risk Analysis: An International Journal*, 29, pp. 498–501.

Haimes, Y. Y. (2015) *Risk Modeling, Assessment, and Management*: Wiley.

Hillmann, J. & Guenther, E. (2021) Organizational resilience: a valuable construct for management research? *International Journal of Management Reviews*, 23, pp. 7–44.

Hohenstein, N.-O., Feisel, E., Hartmann, E. & Giunipero, L. (2015) Research on the phenomenon of supply chain resilience: a systematic review and paths for further investigation. *International Journal of Physical Distribution & Logistics Management*, 45, pp. 90–117.

Holling, C. S. (1973) Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4, pp. 1–23.

Hoss, T., Ancina, A. & Kaspar, K. (2021) Forced remote learning during the COVID-19 pandemic in Germany: a mixed-methods study on students' positive and negative expectations. *Frontiers in Psychology*, 12, pp. 1–9.

Jaaron, A. & Backhouse, C. J. (2014) Building antifragility in service organisations: going beyond resilience. *International Journal of Services and Operations Management*, 19, pp. 491–513.

Kahn, W. A., Barton, M. A., Fisher, C. M., Heaphy, E. D., Reid, E. M. & Rouse, E. D. (2018) The geography of strain: organizational resilience as a function of intergroup relations. *Academy of Management Review*, 43, pp. 509–529.

Kamalahmadi, M. & Parast, M. M. (2016) A review of the literature on the principles of enterprise and supply chain resilience: Major findings and directions for future research. *International Journal of Production Economics*, 171, pp. 116–133.

Kantur, D. & İşeri-Say, A. (2012) Organizational resilience: a conceptual integrative framework. *Journal of Management & Organization*, 18, pp. 762–773.

Khadem, N., Janda, M. & Chalmers, S. (2020) Qantas to cut at least 6,000 jobs as part of coronavirus recovery plans, Alan Joyce reveals. ABC News online. Assessed from, https://www.abc.net.au/news/2020-06-25/qantas-job-cuts-coronavirus-pandemic-covid-19-alan-joyce/12390802 on 9 November 2021.

Kitano, H. (2004) Biological robustness. *Nature Reviews Genetics*, 5, pp. 826–837.

Kobasa, S. C., Maddi, S. R. & Kahn, S. (1982) Hardiness and health: a prospective study. *Journal of Personality and Social Psychology*, 42, pp. 168–177.

Lane, P. J., Koka, B. R. & Pathak, S. (2006) The reification of absorptive capacity: a critical review and rejuvenation of the construct. *Academy of Management Review*, 31, pp. 833–863.

Lengnick-Hall, C. A. & Beck, T. E. (2005) Adaptive fit versus robust transformation: how organizations respond to environmental change. *Journal of Management*, 31, pp. 738–757.

Lengnick-Hall, C. A., Beck, T. E. & Lengnick-Hall, M. L. (2011) Developing a capacity for organizational resilience through strategic human resource management. *Human Resource Management Review*, 21, pp. 243–255.

Levitas, E. (2013) Demand-side research's role in macro-management: a commentary on Priem, Li, & Carr. *Journal of Management*, 39, pp. 1069–1084.

Linnenluecke, M. K. (2017) Resilience in business and management research: a review of influential publications and a research agenda. *International Journal of Management Reviews*, 19, pp. 4–30.

Linnenluecke, M. K., Griffiths, A. & Winn, M. (2012) Extreme weather events and the critical importance of anticipatory adaptation and organizational resilience in responding to impacts. *Business Strategy and the Environment*, 21, pp. 17–32.

Madni, A. M. & Jackson, S. (2009) Towards a conceptual framework for resilience engineering. *IEEE Systems Journal*, 3, pp. 181–191.

Mallak, L. A. (1998) Measuring resilience in health care provider organizations. *Health Manpower Management*, 24, pp. 148–152.

Markey-Towler, B. (2018) Antifragility, the Black Swan and psychology. *Evolutionary and Institutional Economics Review*, 15, pp. 367–384.

Meyer, A. D. (1982) Adapting to environmental jolts. *Administrative Science Quarterly*, 27, pp. 515–537.

Milliken, F. J. (1987) Three types of perceived uncertainty about the environment: state, effect, and response uncertainty. *Academy of Management Review*, 12, pp. 133–143.

Mintzberg, H. & Waters, J. A. (1985) Of strategies, deliberate and emergent. *Strategic Management Journal*, 6, pp. 257–272.

Poleg, D., (2021) How remote work's gains are captured by the superstar few. *New York Times*, 21 September.

Ramezani, J. & Camarinha-Matos, L. M. (2020) Approaches for resilience and antifragility in collaborative business ecosystems. *Technological Forecasting and Social Change*, 151, pp. 1–26.

Rudolph, J. W. & Repenning, N. P. (2002) Disaster dynamics: understanding the role of quantity in organizational collapse. *Administrative Science Quarterly*, 47, pp. 1–30.

Sheffi, Y. (2005) *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. Cambridge, MA: MIT Press.

Sutcliffe, K. M. & Vogus, T. J. (2003) Organizing for resilience. In (K. S. Cameron, J. E. Dutton, & R. E. Quinn Eds.), *Positive Organizational Scholarship: Foundations of a New Discipline*. San Francisco: Berrett-Koehler. pp. 94–110.

Taleb, N. (2012) *Antifragile: How to Live in a World we don't Understand*: London: Allen Lane.

Vogus, T. J. & Sutcliffe, K. M. (2007) *Organizational resilience: towards a theory and research agenda*. 2007 IEEE International Conference on Systems, Man and Cybernetics. IEEE. pp. 3418–3422

Walker, B., Holling, C. S., Carpenter, S. & Kinzig, A. (2004) Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, 9, pp. 1–10.

Weick, K. E. (1998) Introductory essay—Improvisation as a mindset for organizational analysis. *Organization Science*, 9, pp. 543–555.

Wied, M., Oehmen, J. & Welo, T. (2020) Conceptualizing resilience in engineering systems: an analysis of the literature. *Systems Engineering*, 23, pp. 3–13.

Williams, T. A. & Shepherd, D. A. (2016) Building resilience or providing sustenance: different paths of emergent ventures in the aftermath of the Haiti earthquake. *Academy of Management Journal*, 59, pp. 2069–2102.

Zhou, Y., Sheu, J. B. & Wang, J. (2017) Robustness assessment of urban road network with consideration of multiple hazard events. *Risk Analysis: An International Journal*, 37, pp. 1477–1494.

Žiha, K. (2000) Redundancy and robustness of systems of events. *Probabilistic Engineering Mechanics*, 15, pp. 347–357.

How to cite this article: Munoz, A., Billsberry, J. & Ambrosini, V. (2022) Resilience, robustness, and antifragility: Towards an appreciation of distinct organizational responses to adversity. *International Journal of Management Reviews*. 1–7.
https://doi.org/10.1111/ijmr.12289