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Risk and the Regulatory Challenges of Smart Consumer Products

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Osman's (2025) review depicts the formidable scale of the challenge faced by regulators in navigating the complexities of the risks and harms associated with consumer products with internet connectivity (CPIC). In our commentary, we consider: consumer perceptions of risks of CPIC; the difficulties in tracing accountability for harms arising in interconnected systems; potential harms arising from the informal use of the concept of psychological harm and the regulatory challenges posed by the novel risks arising from the easy availability and interconnected design of CPIC.

Osman's (2025) consideration of psychological harm and its applications to consumer products with internet connectivity (CPIC) convincingly emphasises the scale of the challenge faced by regulators in navigating the complex and ever-evolving landscape of connected products. The nature of the challenge is compounded not only by the pace of change, but also by the intricacies in defining what psychological harm means. In the following, we build on the themes presented by Osman (2025), considering characteristics of CPIC from the consumer's perspective, which further complicate the regulatory landscape. We reflect on issues of clarity over the concept of psychological harm and the evidence for its existence, suggesting that without conceptual clarity and a sound evidential foundation, we risk wasting resources on performative measures, which distract from real issues and may do more harm than good.

Psychological characteristics of CPIC

By their very nature, consumer products are ubiquitous everyday items and, as a result, their associated risks carry little weight in the public's minds, few of whom (8%) consider product safety a priority during their purchase (Office for Product Safety & Standards, 2024a). The majority of CPIC have existed in a non-smart form for decades and as such, individuals could be said to have a sense of familiarity around them. Although apparently people significantly over-estimate their understanding of how even non-smart and familiar household objects work (Sloman & Fernbach, 2017), with familiarity comes a sense of (perceived) control, both of which are linked to lower risk perceptions (Fox-Glassman & Weber, 2016; Jenkins et al., 2024; Slovic, 1987; Vaubel & Young, 1992). Plausibly the priors people have regarding the risk of connected products are low, and are not adjusted upwards, given the functionality and associated benefits that CPIC offer. Indeed, the enhanced quality of life that CPIC offer has been identified as a core motivation underlying adoption (Li et al., 2021). Increased benefit or utility perceptions are also associated with lower risk perceptions (Alhakami & Slovic, 1994; Finucane et al., 2000; Jenkins et al., 2024), which feed into an individual's risk tolerance – how individuals trade off benefits and risks. On this basis, the public might be said to be more tolerant of the risks posed by CPIC, given the benefits they confer, though this does differ according to precise product type (Hunte et al., 2024; Jenkins et al., 2024).

By definition, the level of interconnection inherent in CPIC is considerable (Verhoef et al., 2017). That such products extend beyond more than their physical form is potentially problematic for a consumer to frame, especially in order to weigh up the risks posed by such products. The abstract nature of the network is hard for a consumer to mentally model, which has consequences for how associated risks are perceived. Construal level theory (Trope & Liberman, 2010) suggests that psychological distance – "a subjective experience that something is close or far away from the self,

here, and now" (p.440) is linked to mental construal and the way these things are cognitively processed, with psychologically distant (close) targets or events are associated with more abstract (concrete) thinking. Research has indicated that an abstract mindset leads to lower risk perceptions compared to a concrete mindset (Lermer et al., 2016). As well as eliciting lower risk perceptions, the abstract nature of such products has implications for causal and responsibility attributions, if (and when) they go wrong and cause harm. We move on to consider these next.

When harm occurs – a normal accident?

Should harm occur with use of a CPIC, the complexity and interconnectedness of the network makes it especially difficult to identify how the harm occurred, how far the consequences can be attributed to the original product and whose responsibility it was. Yet identifying these three elements is crucial for the effectiveness of risk management and regulation. Take for instance, a physical teddy bear, which, owing to a manufacturing defect has loose button eyes, which, when unsupervised, a child pulls off, mouths and starts to choke on. It is (relatively) easy to identify what the harm was caused by and the associated counterfactual (if only the part had not been loose, the child would not have choked). Whilst there was a level of responsibility for the adult in leaving the child unsupervised; the ultimate responsibility was that of the manufacturer, who produced a non-compliant product. However, consider the example of a smart baby monitor, which was hacked by a malicious actor to talk to the child whilst the parents were downstairs. The product was used as intended – to monitor a baby in another room. The initial cause of the harm was the malicious actor, but the WiFi network used a default password, and the manufacturer did not provide adequate security infrastructure. How much of the harm could be fairly attributed to these elements, and whose responsibility are they?

More generally, as has been prompted by long established lines of investigation in human factors research (Bainbridge, 1983; Parasuraman & Riley, 1997), how much should we account for the potentially counterproductive ways humans interact with, and trust, automation? For example, one issue outlined by Endsley (2017) is that, as the development of autonomous and semiautonomous systems proceeds, the ability of humans to effectively oversee them diminishes. Endsley describes an "automation conundrum" whereby, as system autonomy and reliability increase, the lower the situation awareness of human operators becomes and the less able they will be to take over manual control when needed. In order to develop appropriate risk management responses, regulators face the difficult challenge of establishing standards for determining causality and assigning responsibility within complex networks.

Similar issues are reflected in Perrow's (1984) concept of 'normal accidents' – failures which are the inevitable consequences of increasingly prevalent complex and tightly coupled technologies,

and which could have catastrophic potential. According to Perrow, systems that are both complex (so interactions between their constituent components are unpredictable) and tightly coupled (so there is functional interdependence of the components) have a relatively higher rate of incidents causing harm than systems that are neither. Situated originally in the context of nuclear and chemical technologies, the concept has more recently been applied to artificial intelligence (AI) systems (Bianchi et al., 2023; Chan, 2021) with the suggestion that AI systems may create or exacerbate complexity and coupling as a result of two additional aspects: their easy availability and the incompleteness of their designs. The proliferation of CPIC underlines just how available AI models have become, but their incompleteness is manifest as they do not work across all contexts – an AI system that works in one setting may not work in another (Bianchi et al., 2023). According to this framework, safety can be improved if systems are designed to be less complex or tightly coupled, but by AI's very existence, the genie is somewhat out of the bottle**.** Bianchi et al. (2023) argue that while currently AI models are not tightly coupled – few AI systems link different models together – the potential for tighter coupling is high. Accordingly, whilst the consequences of AI failures are currently not what could be reasonably described as catastrophic, this will not always be the case. Echoing Bianchi et al. (2023), we have a window of opportunity to better understand the risks associated with such systems, including considering those that extend beyond physical consequences.

Psychological harm – an elusive concept

As Osman highlights, many terms have been used to refer to the psychological aspects of harm: emotional turmoil, psychological safety, distress, damage, injury, but most commonly 'psychological harm'. Despite the lack of any definition recognised by psychological science, this term has gained traction in recent years, being mentioned in the Online Safety Act (2023), the Product Security and Telecommunications Infrastructure Act (2022) as well as forming an element of product risk assessment methodology used in the United Kingdom (Office for Product Safety & Standards, 2024b). There is some risk of harms arising from the unregulated momentum that such undefined concepts can acquire; a parallel can be drawn with use of the term 'behavioural fatigue', the provenance of which is unknown, but was used as a justification for policy decisions taken during the Covid-19 pandemic. In a review of evidence for the term, Harvey (2020) notes that, despite its widespread use, there is little evidence for the existence of behavioural fatigue, calling it "either a naïve construct or policy contrivance" (p.5). Along similar lines, the origins of psychological harm are unclear and the term might be said to reflect a common sense - essentially lay - construct, rather than a specific psychological phenomenon identified in scientific evidence.

The common and (too) easy undisciplined invocation of the notion of 'psychological harm' could also promote an overly precautionary approach to regulation. In this regard, it is worth noting that one criticism of the precautionary principle made by a leading critic of this common approach to regulation (Sunstein, 2005) is that it is unduly sensitive to public *mis*perceptions. Because people use mental heuristics, which can produce severe and systematic errors, human beings are prone to what Sunstein (2006) described as "misfearing": people fear things that are not dangerous, and they do not fear things that present serious risks. Apropos of this possibility, Osman (2025) notes the lack of evidence indicating that consumers are concerned by psychological harm in CPIC, suggesting one reason for this lack could be that is not sufficiently measured in existing studies. Building on the research cited, Jenkins et al., (2025) participants were asked to rate the extent of concern regarding psychological risks (e.g., anxiety over product failure, stress) of ten CPIC, ranging from smart pet feeders, connected child's toy and smart door locks. Jenkins et al. (2025) found that perceptions of psychological risks were significantly lower than those relating to data security and equipment safety. One might hypothesise that such results could have been due to the way the question was phrased, or that individuals do not use such phrases to describe such intangible types of risks. However, even when (in free text), participants were asked to describe the biggest risk they perceived, psychological risks (or elements relating to these, as outlined in Osman [2025] such as stress, anxiety or psychological wellbeing) featured in only 0.49% of cases. It is hard to imagine a scenario in which consumers fear the adverse psychological effects associated with use of CPIC (or indeed have experienced them), but choose not to express such sentiments, even when prompted in a myriad of ways. Echoing Osman's (2025) conclusions then, consumers do not perceive psychological harm to be a primary concern with CPIC.

Summary and conclusion

One curious paradox of progress is that as new and initially unfamiliar technologies are developed and we implement new ways of controlling and improving our world, we find ourselves in situations of unfamiliarity and ignorance which, in turn, has the effect of increasing our perceptions of how risky our world is. Some forty years ago, the German sociologist Ulrich Beck (1986; 1992) argued that, rather than being tamed by scientific and technological progress, risk was increasing *because of* technology, science and modernization. Surveys confirm that, regardless of whether life actually is riskier, in several respects many people think their lives are riskier now than they were (e.g., Lloyd's Register Foundation, 2024). Indeed, in the context of CPIC, their abstract and complex nature, coupled with the increased benefits such products offer mean that consumers may not always fully account for the associated risks of such products. In addition, ambiguity in defining psychological harm makes

it difficult to evidence. Regulators must navigate this paradox carefully, in order to guard against both genuine risks and the unintended consequences of misplaced caution.

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