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Cynthia Lopez-Bagousse, Nathalie Bonnardel, Grégory Lo Monaco, Thomas
Arciszewski

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SCIENCE FICTION: CRITICAL AND CREATIVE COGNITION OF THE WORLD TO COME

CYNTHIA BAGOUSSE, NATHALIE BONNARDEL,
GRÉGORIO LO MONACO & THOMAS ARCISZEWSKI
AIX-MARSEILLE UNIVERSITY

WHEN SCIENCE FICTION TAKES UP THE CHALLENGE OF EDUCATION

Through the lens of cognitive psychology as well as education and training sciences, we present the pedagogical role that science fiction could have in the development of creative and critical future thinking. Science fiction seems to be able to contribute to take up the challenge of the many global educational reference systems. Especially, it can be useful to favor the development of skills to envision the future in its alternative forms and to adapt to the evolving environment of the 21st century. A consensus seems to define the “4Cs”, i.e. creativity, critical thinking, collaboration and communication, as the skills required for this adaptation (OECD, 2019; P21, 2019; UNESCO, 2015). In this chapter, we focus on creativity and critical thinking, which are crucial both in individual and collective situations. Creativity aims to propose ideas and productions that are innovative, unexpected, and appropriate to the considered context (Bonnardel, 2002; Lubart et al., 2015). Critical thinking allows individuals to carefully evaluate and judge information in order to reach an informed viewpoint for the purpose of a specific action (Ennis, 1993). Future thinking, on the other hand, allows for imagining and pre-experiencing futures situations (Atance & O’Neill, 2001). In this chapter, we explore how science fiction tools use three modes of thought to facilitate temporal travel, potentiate our imagination, and guide our mind towards reflexive paths. After defining

the notion of potential futures, we will describe how science fiction fosters creative thinking by acting as a constraint (Tromp & Baer, 2022; Bonnardel & Lellouche-Gounon, in press), and how it takes on the function of a thought experiment to foster critical thinking (Arcangeli, 2017; Rumpala, 2018). Finally, we will conclude by proposing to leverage the qualities of science fiction in an educational setting using the Design Fiction approach (Bleecker, 2010).

AN INFINITE VARIETY OF POTENTIAL FUTURES ACCESSIBLE THROUGH SCIENCE FICTION

Future thinking allows us to imagine, simulate, and experience future situations through our ability to predict consequences, both temporally and spatially. To envision the future, we produce mental simulations of futures that are likely to occur in the near future. We often face difficulties in envisioning the full range of potential futures, because our mental simulations are informed by our knowledge and experience. Indeed, individuals tend to remain fixed on unoriginal ideas, based on knowledge easily accessible in memory, without managing to overcome them to generate more creative idea (Camarda et al., 2018), which corresponds to a phenomenon of fixation (or “design fixation”). The way we think about the future leads us to three types of futures (Henchey, 1978): probable futures (what is likely to be), preferable futures (what should be), and plausible futures (what could be). Probable futures explore possible developments and consequences of current trends. Emphasizing the importance of emotions in our simulations, preferable futures are more normative, encouraging us to express our desires for the future in line with our individual values and socially shared values in search of conformity (Filion-Mallete, 2019), a kind of normative injunction. As probable and preferable futures become clearer, plausible futures become accessible. They reflect what we consider to be reasonable and are influenced by our current understanding of how the world works. These three types of futures are referred to as “conventional” futures (Voros, 2006) and, according to much research in cognitive psychology, are spontaneously influenced by biases toward positivity and optimism about the future (Taylor & Brown, 1988; Sjästad & Baumeister, 2020). Beyond these conventional futures are “potential futures”. The latter are conceivable by extending our reflective and imaginative exercise

to the limits of normality and normativity (Voros, 2006). They are cognitively costlier, and their access seems to be facilitated by science fiction imaginaries thanks to the particular cognitive value of this literature through its inscription in a time that does not (yet) exist (Stroud, 2008).

THE IMAGINARY OF SCIENCE FICTION, AGITATORS OF KNOWLEDGE

Science fiction offers a wide range of visualizations of unreal worlds that are difficult to represent or to access without its use. These worlds can be physically very different from the world we know, such as planetary systems for which the space opera, a sub-genre of science fiction, takes on an educational role by familiarizing “whole generations of readers with the fundamental cosmological notions of galaxies” (Bellagamba, 2009). These worlds may also be conceptually very different from our current world, such as Gibson’s (1984) *Neuromancer*, where nature and life are replaced by the Matrix. The use of these imaginaries is possible thanks to processes of meaning-making and integration of new concepts they involve. Bonoli’s (2004) work on fictional narratives emphasizes the formation of a mental representation based on our experience and knowledge (“constructive dimension”) following a “negotiation” between these and the fiction (“interpretative dimension”). This representation seeks to satisfy a partial truth by producing a possible and comprehensible image (dimensions of alethic partiality and imagination). On a cognitive level, this allows the resolution of a failure of referential representation through the search of an interpretative framework to conceiving a new mental representation based on the modification of existing concepts (Ward, 1994). This new construction is incorporated as an alternative within the existing information in our memory (Green & Brock, 2000). Suvin (1979, p.63-84) calls “novum” this cognitive construction intended to link the fictional world to the real world, which prompts one to imagine another way of seeing the world (Picholle, 2018). This strange newness leads to a feeling of *cognitive estrangement* or *distancing* (Suvin, 1979, p.4-15) allowing the “suspension of disbelief” to favor the projection in the science fictional universe. This cognitive displacement is not far from the one used by Montesquieu (1721) to set a distance to allow to see the French society

from another point of view, and it's not a surprise that his two main characters, *Usbek and Rica*, are now the name of a journal about societal future thinking (<https://usbeketrica.com/fr>). Let us emphasize that these cognitive mechanisms echo those of the learning process (i.e., general theory of schemas, Rumelhart & Norman, 1976), and of the adaptation process (Piaget, 1992), involving the formation of new schemas as soon as the existing ones are no longer sufficient for comprehension, in other words, new mental models (Nersessian, 2018). Then, these new schemas are added to our knowledge and adjusted to ensure assimilation and accommodation for cognitive balance.

SCIENCE FICTION TOOLS: CREATIVE THINKING, CRITICAL THINKING AND FUTURE THINKING

Science fiction allows one to project “into a future far enough away to allow for strategic inflections and close enough to mobilize individuals” (Saives et al., 2019, p.160). Literary narrative holds the power to move individuals to thought, reflection, action, and belief (Stroud, 2008). This power, accentuated by the literary genre of science fiction through the novum, reinforces this “literary acumen”. Picholle (2018, p.208) cites the example of the fictitious device, the ansible proposed by Le Guin in the *Dispossessed* solving the problem of interstellar distances and allowing galactic societies to communicate with each other. This device is then taken up by a number of science fiction universes. Thus, science fiction enables the elaboration and maintenance of a shared hypothetical representation, while allowing to go beyond the logics of normative constraints, which makes it an asset not only for future thinking but also for creativity and critical thinking. As a result, science fiction imaginaries provide a fertile ground for problem-solving activities in which our creative thinking is solicited, as well as for thought experiments in which our critical thinking is activated.

In cognitive psychology, creative thinking is often associated with the intellectual activity of problem solving, in which solutions are devised to allow the passage from an initial state to a final state involving the generation and introduction of new constraints (Chevalier & Bonnardel, 2003). According to Tromp and Baer (2022), constraints can have two functions. The first is the function of focusing by anchoring the search by providing specific concepts as the

starting point. The second is the exclusionary function, promoting a move away from known concepts to engage in a flexible search of the constraints' potential (Tromp, 2022). We argue that science fiction imaginaries will act as constraints that promote forward-looking creative cognition by simultaneously endorsing both functions of constraints. On the one hand, the function of exclusion can be fulfilled by the nature of science fiction described as a literature of distancing (Suvin, 1979). On the other hand, science fiction offers the possibility of several anchoring, either in a present starting situation leading to the examination of possible paths towards a future situation (i.e., forecasting scenario), which solicits our divergent thinking and mental flexibility. A future starting situation allows us to imagine the consequences and potential circumstances of a present situation that could have led to this future situation (i.e., backcasting scenarios), soliciting our counterfactual thinking. Let's take the example of the series *Black Mirror*, which invites us to question the circumstances that could have led to the considered situation. In the episode *Nosedive* (2016), where a mobile application makes every human interaction potentially risky since any interaction is noted, which can lead, as it does for the protagonist, to turn her life into hell. The viewer is invited to take an introspective look at his/her personal actions (i.e., personal use of social networks), and more globally to reflect on the social and societal significance of collective actions (i.e., the use of social networks by others). This is in line with Rumpala's (2018) idea that showing a common future engenders a transgenerational collective responsibility and encourages certain issues to become a collective and justiciable matter for discussion (see also Demarque & Suchier, 2022).

While science fiction was originally thought of as a literature of exploration (Convert & Demailly, 2012), it soon takes on a more experimental role, to extrapolate possible consequences or events through hypothesis testing in the form of "What if..." (Rumpala, 2018). This is particularly the case in uchronies, a popular genre in science fiction, such as in Philip K. Dick's *The Man in the High Castle* (1962), a fictional case in which the United States would have finally surrendered to the Japanese Empire and the Third Reich. Currie (2020) argues that the cognitive value of science fiction leads to "imaginative tests of values and ways of life". Science fiction, furthermore, promotes detachment from

our beliefs and value judgments to allow us to interrogate a kind of contesting counterculture (Convert & Demailly, 2012). Especially, Ursula K. Le Guin's *The Left Hand of Darkness* (1969) attacks a robust cognitive and social construct, the binary representation of gender (masculinity *vs.* femininity). The author not only disrupts the binary representation of gender but also our patriarchal values and sexual morals, by presenting Gethen, an Earth-like planet populated by most of the time asexual inhabitants, taking one or the other sex once a month to reproduce before becoming asexual again. This is like thought experiments, which are considered reasoning about an imaginary case for the purpose of increasing our knowledge or understanding of the world (Arcangeli, 2017) and serve as a basis for exploring the possible (Murzilli, 2022; Rumpala, 2018). The science fiction imaginary can be used as a pedagogical basis, as Bellagamba, (2022) points out citing the example of the fictional trial of *The Ring of Ritornel* of Harness (1968) used to observe the mechanisms of justice, or the famous laws of robotics enacted by Asimov in *Robot Series* used as a reference model to think the regulation of artificial intelligence.

ALTERNATIVE KNOWLEDGE TO PROMOTE A REFLECTIVE OR CREATIVE PROCESS IN EDUCATIONAL CONTEXTS

Given the heuristic power of science fiction on creative and critical thinking, the use of science fiction in an educational setting could be used to favour the macro-processes common to creative and critical thinking modes, i.e., seeking, imagining, doing and reflecting (Vincent-Lancrin et al., 2020). To enable and facilitate the use of science fiction in educational contexts, we propose the Design Fiction approach, which seems to require the qualities of a constructivist learning environment that promotes experimentation, conceptualization, analysis, and application of knowledge (Cope & Kalantzis, 2015) while fostering a proximal zone of development as defined by Vygotski (2014). Design Fiction is a prospective method that wields science fiction imaginaries and uses a diegetic object to explore alternative futures (Bleecker, 2010; Kirby, 2010).

Like prospective methods using narrative and fiction, such as *future literacy* (Miller, 2007), the Design Fiction method is a means of apprehending the future both individually and collectively. The role of science fiction goes well

beyond the development of prospective skills. For example, it allows the teaching of science through a process of investigation and questioning of concepts by the learners. Blanquet and Picholle (2011, p.131-133) point out that these approaches give teachers a way to assess understanding of a problem and allow for formative assessment of students on the conceptual tools abused by the story. Furthermore, Pardede (2019, p.172) advocates that the use of fiction allows for the practice of critical thinking skills, since “the reader must reflect, infer, analyze, and synthesize the information presented” in order to make sense of the story. Thus, the impact of science fiction is far more important than just anticipating the future; it can be considered as a tool for creation and reflection.

The specificity of the Design Fiction approach is that it proposes to the novum to materialize into a diegetic and fictional artifact. The fictional artifact, as defined by Renauld (2013), is a shift “from an ontological (it doesn’t exist) or semantic (it isn’t true) qualification, to a more psychological specificity [...], ‘pretending to believe’ that this proposition is true...” (Renauld, 2013, p.18). It favors a kind of voluntary belief that deliberately suspends disbelief: “*one accepts, so to speak, that one is willing to believe*” (*ibid.*, p. 162). Thus, artifacts are objects from the world of fiction that take the form of real, manipulable objects, which are intended to resonate with the fiction to enhance the fictional immersion and stimulate inferential activity (Bréan, 2020; Kirby, 2010). The materialization of the artifact returns the dual nature to the latter, namely a physical object and a functional object (Kroes & Meijers, 2006) thus justifying an ontological and/or semantic nature. Studies on the use of artifacts in co-design sessions have shown that the artifact does not only stimulate the imagination and support the narrative form of the scenario, but also favors the creation of a shared language between the future users and the designers (Dindler, 2010).

Science fiction imaginaries, and more specifically the method of Design fiction, through the resolutely concrete, visual, and physical anchoring, offer “a neutral and sanitized space, a veritable virtual laboratory that allows experimentation to fully unfold” (Armand, 2018). Within this virtual laboratory, empirical studies seem to be able to address the interpretative plurality, the mechanisms of complexification and understanding of action, or even the effects of our knowledge and moral judgments on the scenarios of potential

futures. Indeed, decontextualization in a science fiction universe seems to allow the engagement of our creative and critical capacities and to favor reflection, in particular on the uncertainties of action and the heterogeneity of initial knowledge. This engagement, in turn, fosters our socialization, in line with Petitat's (2012, p.8) idea that the most important aspect of our socialization is "the gradual entry into the complexification of understanding and action and into the concomitant plurality of worlds."

Thus, the Design fiction method can be both a pedagogical and experimental tool for stimulating the heterogeneity, variety, and complexity of ideas and reasoning, by allowing us to mobilize our creative and reflective capacities. It then has a positive effect on our motivations and transformative efforts, by allowing us to "use futures" (Jonassen et al., 1993) and "play with futures" (Minvielle et al., 2016) to shape a vision of the world to come and question its boundaries (Petitat, 2012).

To conclude this chapter, let's use a literary analogy to more precisely explain the concept of diegetic elements. In *His Dark Material trilogy* (Pullman, 1995-2000), Pullman uses the alethiometer as a symbol of the ability to travel between possible worlds. The alethiometer corresponds to the diegetic element : an opening towards possibilities, towards different worlds which offers to mind an exploration of all their variations and richness. This is exactly the purpose of the literature of the imaginary, and its perfect incarnation in the Design fiction, which suggests that we now build these alethiometers to imagine the *world to come*.

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