

Technological futures in semiotics: The year 2024 in review

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Introduction

Our reading of the 2024 *Semiotica* and *Sign Systems Studies* (henceforth SSS) volumes identifies six overarching topics, which suggest an alignment of semiotic theory with the greater transition in the humanities and social sciences towards new materialism and situated cognition. This has to do with the reforming of academic discourses within the current technological revolution – an orientation that we identify in scholarship, but which we also choose as the optics for this overview. We emphasize that the effort we try to make in this review consists in looking at contemporary semiotic research in awareness of not merely scholarly trends and whims, but also of a profound and unfolding technological revolution. Of course, we do not claim to see very far ahead. Nobody can tell where still emerging computational media technologies are taking society and academia, nor which recent scholarly inquiries are but passing trends and which will endure as disciplines. We are inspired by John Deely's (2001: xxx) discussion in the opening of his monumental treatise on the history of semiotics in which he writes that “the interval between past and future, the present, is long enough for us to work some matters out and perhaps even contribute together to what will be the heritage of the past for those future inquirers who are not yet part of our present”. We suggest that understanding contemporary research in this manner implies paying attention to situating it in the current context of ongoing change. We can notice this concern also in the volumes discussed here, and we divide the articles

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published in these into the following groups according to their topic: (1) material and embodied trends; (2) discourse-analytical perspectives; (3) human–machine interaction; (4) transdisciplinary potential of the *umwelt* framework; (5) cognitive semiotics of the lifeworld and the relevance of relevance; (6) evolving concepts and frameworks stemming from Tartu semiotics.

Our classification is one possible interpretation of these studies, and we do not mean it to be rigid or exclusive. Actually we rather consider the above topics as overlapping and interconnected. A guiding consideration for our perspectives is that the two journals observed are classic, and leading, platforms for general semiotic theory, as contrasted to journals that focus on more specialized theoretical sub-branches of semiotics, and applied journals that are dedicated to empirical analysis. As such, the two journals serve to advance cutting-edge semiotic theory, the strength and weakness of which is often its conceptual hermetism. With this review we hope both to offer to scholars in semiotics an overview of the state-of-the-art, helping to reveal opportunities for semiotics to address currently salient issues and contribute to other scholarly fields, as well as to inform scholars from other fields about how semiotics literature can be of use for them.

We recognize that by providing our own perspectives and opinions, we may simultaneously impact the epistemic potential of semiotics and its applicability. We hope that our acknowledged bias, as active (and *present*, in Deely's sense) scholars in the field, is justified and helpful. We observe a tendency of semiotic theories to move towards inter- and even trans-disciplinarity, which we are optimistic about. Many of the reviewed papers either boldly venture in transdisciplinary epistemic spaces or provide pathways for further cross-disciplinary applications of semiotic theories. We exemplify our overview by briefly discussing many of the papers included in these 2024 volumes, but cannot cover every study published in these. As such, we admit that relevant points may also stem from articles which we had to bracket in order to keep our argument focused.

Material and embodied trends in contemporary semiotics

The cross-disciplinary tendencies we observe are underpinned by an increasing interest in the material and embodied turns, challenging long-enduring structuralist and disembodied conceptions of meaning-making. This theoretical preference foregrounds the affective and sensory dimensions of semiosis, affirming that signs are not abstract ideations, either cognitive or sociocultural phenomena, but deeply rooted in their perceptual, material, and ecological

contexts. As such, we observe a tendency in semiotics to keep up the pace with the general reorientations in the humanities and social sciences (e.g. Martinelli 2016; Cobley 2017; O'Halloran 2017), challenging classical humanism and the main tenets of modern philosophy. The (re)considering of humanism through the prism of contemporary semiotic frameworks remains an important debate, as noticeable in Klyukanov 2024 and Machtyl 2024 in these *Semiotica* and SSS volumes. Historically, as well as from our perspective, the study of language and literary concepts is related to interrogations of the '*human*'. Importantly, language and literature have been and remain central concerns in semiotics. Many papers from the two volumes address language (Chávez Barreto 2024; Betancourt 2024; Konyratbayeva *et al.* 2024), literature (Dairbekova, Mekebayeva 2024; Hopkins 2024) and interlinguistic translation (Kasar, Didem 2024; Hill-Madsen 2024) as specific areas of research and a laboratory for semiotic theory. While we acknowledge these as necessary concerns and important contributions in their own right, we shall not treat them as overarching themes here. Rather, we want to share with the reader our interrogation of how such studies are best appreciated as situated in emerging academic and social contexts.

Instead of treating materiality as a passive property of signs, the 2024 studies published in *Semiotica* and SSS overall display a commitment towards the assumption that matter participates in signification processes by guiding, channeling, affording, and/or constraining. Materiality is a prerequisite of semiotic agency, as semiotic resources which semiotic agents use, discover and/or construct are material. These perspectives contribute to the increasing interdisciplinary interest in how meaning emerges from the lived experiences of organisms situated in specific environments. In this regard, we highlight the outstanding contributions to the journal volumes in question by Sergio Torres-Martínez (2024), Jaime F. Cárdenas-García (2024), as well as Simon Levesque and Pascale Bédard (2024).

Our own work is also aligned with this direction, and we are not surprised that semiotic theory is increasingly critical of classical humanism and embracing new materialism, in a loose sense. Of course, for a long while, semiotic theory has been concerned with collapsing modern dualisms through the optics enabled by concepts of the sign (Deely 2001; 2009). This avant-gardism may be one of the reasons for which the academic popularity of semiotics had been declining in recent decades – some anti-dualist claims may have appeared too radical for the philosophy of language and linguistics in the past couple of decades. The *status quo* has changed by now, due to explorations in a variety of directions, such as cognitive and applied linguistics (see O'Grady, Bartlett 2023), the ushering in of *science and technology studies* through an increasing focus on relationality and

networks in sociology (e.g. Bijker, Law 1992), philosophy of mind and philosophy of technology (see Clowes *et al.* 2021). Most importantly, the reconsideration of humanism is motivated by the current technological (digital) revolution (see O'Halloran 2017, 2022). This transformation particularly inspires and challenges (theoretical) semiotics: what can semiotic concepts reveal about human–machine interaction and integration? Only very recently, but convincingly, semiotic interrogations started to guide discussions on the relation between organic minds and their non-organic extensions (Hayles 2025). In this direction, the two journal volumes display recurring themes such as information, technology, and artificial intelligence. Perhaps more tellingly, even when topics other than the technological revolution are addressed, semiotic studies tend to factor in its characteristics, such as multimodality, intermediality and algorithmic computation (see Zeng, Zhu 2024). In the sociocultural sphere, semiotic theories have always lent themselves effectively to political analyses, particularly in their capacity to provide insights on the deep structural workings of political and media discourses. Such analyses are now carried out in consideration of emerging media technologies.

An important question we want to raise for colleagues in semiotics is whether semiotics research will lead or follow the new scholarly directions of the (post)digital age. We do not have an answer to such a question, but we see the potential of semiotic theories, as reflected in these two volumes, to eschew modern ideologies, false dualisms and falsified hypotheses that still endure in academic discourse.

Discourse-analytical perspectives: from textual to multimodal focus

Global political developments of the past years have triggered a range of critical perspectives on various discourses. In this regard, social and political semiotic frameworks provide useful tools to complement discourse-analytical approaches. Aitken 2024 is one remarkable example of bringing semiotic analysis into a sociological consideration on perceptions of safety. The growing popularity of the multimodality perspective in discourse analysis (Machin 2016; O'Halloran 2022) endures, fuelling a broader recognition of the necessity of understanding how environments are mediated. Semiotics offers a rich selection of options for shedding light on the complexity of mediated communication. Coupled with the embodied turn, multimodal frameworks enable more nuanced understandings of how meaning is experienced and enacted through the body.

Rahat Bashir and Musarat Yasmin (2024) conduct a multimodal analysis, complemented by post-colonial framing, of the antithetical depiction of the Global South and the Global North in the COVID-related discourse in Pakistani English-speaking media. Yunling Zhu (2024) highlights the aspects of populist rhetoric in the latest presidential speeches in the US through systemic-functional linguistic analysis. In the same vein, Heidi Campana Piva (2024: 279) scrutinizes the dangerous impact of disinformation and deproblematisierung, which underlie climate change denial discourse.

Andreas Ventsel (2024) augments the micro-level analysis of discursive rhetoric by employing Umberto Eco's (1979) notions of 'Model Reader' and 'Model Author' as a framework in dialogue with strategic narrative theory (Miskimmon *et al.* 2017). This tactic helps reveal the formation of an interpretative horizon in Russia's news narratives, as well as "demonstrate which cultural-ideological values are being appealed to in targeting the audience" (Ventsel 2024: 98). Ventsel provides not only a thorough analysis but also an excellent elaboration on the methodological foundations and concrete analytical steps of his inquiry.

Relying on the critical multimodal discourse framework, Rauha Salam-Salmaoui *et al.* (2024) investigate the strategic symbolism appropriation practices employed by a Pakistani Muslim cleric to appeal to younger audiences and disrupt traditional stereotypes of Islamic scholars. This study focuses on the attire of Pakistani *ulama* (religious scholars) as material signifier of their power and a form of enacted socio-cultural capital (Salam-Salmaoui *et al.* 2024: 116). Similarly, Dorota Wójciak (2024) highlights the particular performativity of religious culture in Podhale, Poland.

Continuing the multimodal track, Nana Zhou (2024) explores how different communicative modalities – visual, verbal, and auditory – interact and compete in the meaning-making processes of modern TV series.

Multimodality is a concern not only of critical discourse analysis. For example, through a study on iconicity in Nigerian poetry, Amaka Grace Nwuche *et al.* (2024) consider multimodality as a cognitive concern, contributing to the conceptualization of language and literature as multimodal. Another contribution in the cognitive interrogation of iconicity and, hence, multimodality is Anne Bonifazi's (2024) study on songs about weeping. The concept of iconicity and, more specifically, diagrammaticity, and its implications for perception, has metasemiotic uses, as displayed in Thierry Mortier's (2024) important theoretical discussion on Peirce's notion of 'sign'. Yet another common concern in the interrogation of multimodality is education. In this regard, we observe Zhigang Yu and Yaegan Doran's (2024) pioneering study on chemistry education, reflecting on literacy and scientific representations such as chemical formulas and equations,

and Ibrahim Halil Topal's (2024) contribution to edusemiotics that discusses intonation.

Semiotic perspectives on human–machine interaction

Not overlooking the cross-disciplinary contribution of multimodal analysis, we find that there is a research gap in social robotics and interaction design that merits attention. Current approaches often miss the symbolic, cultural, and semiotic dimensions of human interaction with non-organic artefacts. The epistemological contribution that semiotics can bring along here is noted also in regard to science: the studies by Carola Manolino (2024) as well as Ahti-Veikko Pietarinen and Lauri Snellman (2024) reveal that scientific inquiry is historically and culturally situated, arguably a blind spot in analytical approaches in philosophy of science. Semiotic perspectives can provide theoretical depth and applicable insights on interfacing, as well as design automation tools suitable for multimodal, multisensory, and materially grounded, as well as meaningful, human–machine interaction.

The study of media has always been a main interest and area of application for semiotics as we can see, for example, in Helio Rebello Cardoso Jr's (2024) revisiting of Deleuze's uptake of Peirce to reflect on cinema. More than contributing to the study of media, semiotics is also useful in making sense of changing human interaction in digitally mediated environments. While adding layers of representation in human societies, multimodal social media platforms (e.g. Instagram, TikTok) evoke greater awareness of embodied, enacted, and performed practices of communication where language-based messaging is more clearly accompanied by, and actually situated in, non-linguistic meaning (e.g. consider the inclusion of dance moves in conveying a message). In a comparative analysis, Daria Arkhipova and Marijn Janssen (2024) discuss the reception and impact of AI recommendation systems (AiRS) on the social media practices and decision-making processes of Dutch, Estonian, and Italian young adults. They find that young people tend to accept AiRS as part of their digital environment, but experience stress from social pressure and feel detached from their digital representations. Even so, youth appear to comply with the perceived standardization of online representations. Arkhipova and Janssen (2024: 82) insist on the necessity of further studies on the cognitive and bodily changes of social media users. Nevertheless, young adults should not be viewed as a powerless, vulnerable and susceptible group in the clutches of tech giants, as often depicted in media discourse (Liang, Lim 2024).

The question of human–machine interaction concerns semiotic theory on a theoretical level. The Cartesian framing of human–machine interaction or of the interfacing between human cognition and computational systems can be reframed non-dualistically as a question of meaning-making. The interpellation of semiotic agency by abiotic, automated processes suggests a semiotic-material entanglement (see Suchman 2012; Hayles 2025), inviting us to reconsider how meaning is constituted in such configurations. Mind extension processes can be construed as semiosic, possibly enabling a conceptualization of human-machine *integration*, where agency is not clearly localized and bounded, instead of human-machine *interaction*.

Some of the studies we are looking at offer first steps in this regard. Cárdenas-García (2024) approaches the old and difficult issue of the relation between information and meaning, in a study of impressive scholarly breadth and depth. He informatively and critically explores the intricate relation between meaning and cybernetic perspectives on information. Filippo Silvestri (2024) adopts a discursive and poststructuralist approach to conceptualize the difference between the meaningful world of humans and machine computations. He describes the web-machine configuration not only as a non-person but also as a non-thing (Silvestri 2024: 252).

Evolving concepts and frameworks from Tartu semiotics

The theoretical thinking of the Tartu school proves to be remarkably flexible in handling contemporary sociocultural, technological, and transdisciplinary challenges. Ventsel's (2024) work on political semiotics discussed above is one prominent example, while Martin Oja (2024) employs Lotman's idea of space as a primary modelling system, proposing that in cinematic modality conflicts, the representation of spatial distance simultaneously represents semantic distance.

A couple of papers directly tackle Tartu-specific theoretical concepts (Kim 2024; Blaim, Gruszewska-Blaim 2024), yet most additions to “Tartu conceptology” come from the field of biosemiotics. This is the case, arguably, because of the current relevance of the concept of ‘the *umwelt*’, stemming from Tartu biology, around which Thomas Sebeok developed his biosemiotics. *Umwelt* theory enjoys a whole double SSS issue on which we will expand below. However, one of the most remarkable trends of 2024 is the rediscovery of Ivar Puura's (2013[2002]) concept of ‘semiocide’; (Alnıaçık Özyer Çavuş Peksöz 2024; Hendlin 2024; see also Uslu 2020). Semiocide, defined as the destruction of the meaningful, e.g. of signs, objects, stories, cultural symbols (Puura 2013; Fatehi 2024), addresses a gap

in semiotic theory regarding the role of signs in cultural violence and systemic oppression. Erfan Fatehi (2024) recalls the concept in a poignant analysis of the practices of epistemic violence against the Bahá'í community in Iran, arguing that the concept affords insights into identity politics, cultural marginalization or symbolic violence and can successfully fill a gap for cultural analysis in conflict, genocide and peace studies. Integrating perspectives from Juri Lotman, Gayatri Spivak, Ernesto Laclau, Giorgio Agamben, and Johan Galtung, Fatehi convincingly shows how the framework of semiocide can explain the mechanisms of cultural hegemony and empower marginalized communities.

The transdisciplinary potential of *umwelt* as a heuristic framework

A double issue of *SSS* (3/4 of vol. 52) explores Jakob von Uexküll's legacy, emphasizing the contemporary and interdisciplinary relevance of *umwelt* theory across many fields of research. Developed by Uexküll as a concept in experimental biology, '*umwelt*' has become the cornerstone of a widely used heuristic framework with the potential of functioning "as a bridge between the humanities, natural sciences, and applied disciplines" (Magnus, Mäekivi 2024: 313). The editors highlight three as yet insufficiently studied research areas where the framework could prove highly beneficial. The *umwelt* theory is relevant to understanding the temporal perception of different species, as well as the cognitive and emotional capacities of animals in the context of animal welfare and training. Most importantly, certain concepts further derived from it – *umwelt* transition, *umwelt* collapse, and *umwelt* reversions – can help explicate how species cope with environmental change and provide critical understandings for species protection (Magnus, Mäekivi 2024: 311–312).

Drawing on *umwelt* theory, Morten Tønnessen (2024) takes new steps towards a more-than-human descriptive phenomenology. The value of his contribution as an integral and transdisciplinary framework cannot be overestimated. Tønnessen also indicates potential further applicability of the applied *umwelt* theory across 17 fields of research that study the perception and behaviour of humans and/or animals. To name a few less common perspectives, this framework could help in behavioural reframing of human ecology, address Anthropocene discourses in environmental humanities, model potential lifeworlds for astrobiology, or enrich psychological lifeworld studies, especially in "socio-ecological contexts and settings that involve human–animal interaction" (Tønnessen 2024: 334). The theory is also relevant for well-established epistemic communities such as

the fields of sociology, political science, anthropology, (behavioural) economics, speculative and futures studies, and many others (Tønnessen 2024). In similar lines, we note Anton Markoš and Jana Švorcová's (2024) theoretical development of the *umwelt* theory in regard to symbiosis.

As a step toward more-than-human lifeworlds, Pauline Delahaye (2024) ponders on the possibility of a shared urban semiosphere, considering the *umwelts* of several species. Jana Tajchmanová and Nelly Mäekivi (2024) apply *umwelt* theory and critical anthropomorphism, supported by qualitative interviews with Czech behaviourists, better to understand the complexity of domestic cat welfare.

Nicola Zengiaro (2024) takes significant steps towards integrating *ecosemiotics* with new materialist and posthumanist perspectives by decentring the semiotic subject and emphasizing material-semiotic entanglements. He introduces the concept of 'umwelt diffraction', designating situations where organisms encounter materials novel to their life experience. This conceptual coupling lays foundations to a material semiotics that challenges the traditional models of *biosemiosis*, highlighting the embedded materiality of signs and the possibility of matter itself as a semiotic agent.

Umwelt is also considered in papers outside the special issue. Bridging sociologist George Ritzer's framework of 'the simulated animal' with Uexküll's *umwelt*, Andrew Mark Creighton (2024) criticizes the idealization and anthropomorphism of nonhuman animals under rationalized sociocultural structures and media enchantment. He proposes the concept of 'simulated *umwelt*' to draw attention to the ways that human imaginary ('simulation') of non-human animals "changes nonhuman subjective reality by changing the way they perceive, interact, and make meaning of their world" (Creighton 2024: 220). By attributing agency to the animal, a simulated *umwelt* analysis helps counter the distorted conception of the animal's subjective experience in terms of anthropocentric systems of control and representation. At the same time, the non-human animal is recognized as a sentient being, instead of being treated as a product of human consumer culture or an enchanted object (Creighton 2024).

Cognitive semiotics of the lifeworld and the relevance of relevance

From a semiotic perspective, cognition is both a hard nut to crack as well as a long-standing interest that keeps growing. Recently, attempts to explain the relation between cognition and meaning have consolidated cognitive semiotics as a theory in its own right. We welcome efforts, which we have observed, of

bridging (post)structuralist perspectives with embodied cognition approaches. For example, consider Mohamed Bernoussi (2024) reflecting on the semiotics of the body through the representations of the afterlife in Arab-Muslim scriptures, Filomena Diodato (2024) unearthing compatibilities between Tullio de Mauro's lexical semantics and Göran Sonesson's phenomenological semiotics, and Bogdana Paskaleva (2024) asserting the material dimension of language in Saussure.

A special issue of *Semiotica* dedicated to the memory of Göran Sonesson explores the common ground between relevance theory and the phenomenology of the lifeworld (Strassheim 2024a, 2024b). Celebrating the impressive work and intellectual legacy left behind by this late colleague who has nurtured generations of semioticians at Lund University and beyond, the issue displays the important contingencies of semiotics with phenomenology and cognitive sciences.

Alice Orrù (2024) employs Eco's concept of the 'encyclopedia' as a powerful tool for investigating boundary words like 'race' and explaining how it came to connote sociocultural lifeworlds. Orrù demonstrates that only a rhizomatic, interpretive, context-sensitive and historicizing approach provides an adequate understanding of the term's complexity.

Diodato (2024) scrutinizes lexical field theory. Relying particularly on the works of Sonesson and Tullio de Mauro, she proposes a dialogue between the structural and cognitive-phenomenological traditions. We find that such efforts to bridge competing schools of semiotics are likely to keep the discipline relevant and progressive.

Rafael G. Lenzi (2024) radically shifts the focus from abstract semantic structures to the semiotics of real-world, tactical survival. Demonstrating excellent use of applied semiotic analysis, he dissects the semiotic dynamics of overt and covert deception.

Overall, the collection introduces several themes that significantly advance cognitive semiotic theory. We can observe a considerable transition from structuralist and static models of meaning-making toward a more dynamic conceptualization of meaning as emergent and embodied, both an evolving as well as contextually and historically grounded process. Conceptual dialogues with the sociology of knowledge confirm that meaning is also performed, constructed and selected from what is relevant for the organism. Employing the concepts of 'semiotic assemblages' and 'semiotic creativity', Gabriel Simungala and Deborah Ndalamu-Mtawali (2024) provide a framework to conceive meaning as fluid, finding that "the system of signage transcends the limitations of the material conditions as memory, objects, artifacts, and cultural materialities can potentially be redeployed in place to new uses, and for extended meaning potentials"

(Simungala, Ndalamu-Mtawali 2024: 149). In a typical phenomenological key, Benjamin Stuck (2024: 51) argues that “not all lived experiences are meaningful”.

This is where relevance theory (Wilson, Sperber 2012) helps counter the naive optimism of discourse analysis on rushed conclusions about interpretation in studies on representation. The claim eventually suggested is that meaning, which semiotic actors attribute to various signs, is more complex and less controllable than much semiotic theory, especially that focused on representation, has supposed. This is consistent with the developments in media studies, which has moved on from top-down notions of meaning as mass broadcasting, especially in conditions of global, digitally mediated communication streams, to multi-directional notions.

Edna Andrews *et al.* (2024) highlight the irreducible multimodality of language and cognition. They also argue for the embodied and interactive nature of signification, where meaning is constructed through sensory experiences in cultural-physical spaces, even on the most symbolic level.

Some well-established authors in the discipline have published in a focused way to develop theory under this label, e.g. Amir Biglari and Marcel Danesi (2024) offer an outlook in which Greimassian structural semiotics can complement cognitive science, while Todd Oakley and Jordan Zlatev (2024) employ cognitive semiotics to understand the history of money. Another subcategory of contributions to cognitive semiotic theory through applied, targeted analysis, regards iconicity. On this, see the discussion above on Nwuche *et al.* 2024 and Bonifazi 2024.

We note that Charles S. Peirce’s pragmatism has recently become a pillar in most attempts at developing cognitive semiotic theory. Consider, as salient examples, Douglas Niño’s (2024) study, which displays the avenues that Peircean semiotics opens for contemporary concerns on agency and habit, and Ramona Pistol’s (2024) Peircean contribution to cognitive theories of metaphor. We trace these developments back to earlier work that has explored the linkages between Peirce’s logic and phenomenology, for example Short 2006, Pietarinen 2006, Stjernfelt 2007, 2014 and 2022, and Bellucci 2018. Peirce’s semiotics was explicitly proposed as a cognitive semiotic theory, as such, in conjunction with externalist perspectives on mind, by Claudio Paolucci (2021).

We see some of these authors pursuing their Peircean projects further. Paolucci (2024) expands his cognitive-semiotic Peircean theory; Pietarinen and Snellman (2024) draw on Peirce’s pragmaticism to complement theories of knowledge in philosophy of science. In this regard, we also highlight Nöth’s (2024) review of Stjernfelt’s recent book on Peirce (Stjernfelt 2022).

Also in this line of thinking, Timothy Rogers (2024) develops the theoretical linkages between Peirce's semiotics and current biosemiotic concerns, particularly, but not only, in regard to learning. In this way, he demonstrates the applicability of relational biosemiotics to informational processes at various scales. We observe here the possibility of a biosemiotic discourse on other-than-human conditions. In this momentum, we are not surprised to see explorations of Peircean semiotics *vis-à-vis* embodied cognition by authors established in other theoretical branches, such as Andrews *et al.* (2024).

Conclusion

What do we, at present, see in the future of semiotics? Without claiming to have a satisfying answer, we consider that semiotics research has to gain from such a future-orientation, which arguably fuelled John Deely's (2001) proposal of semiotics serving as postmodern philosophy. Reading between the lines and connecting dots (as semioticians do), we identify such a future-orientation as an undercurrent of the *Semiotica* and SSS volumes in 2024. Classic themes for semiotic research echo here in new keys, as driven by the current technological revolution and its reshaping of human societies, including academia. We find the potential of semiotics to stir inter- and trans-disciplinary research to be of particular importance. Also, our conviction is that semiotic theories have a responsibility to integrate into their own epistemology and discourse the concepts that are driving the reshaping of humanistic academia. By understanding and, as such, following the major scholarly trends, semiotics itself should be able to propose ways forward, and thus also lead, in some regards, the current transformation of academia. For example, in light of the volumes we looked at, we have in mind such fields and themes as social robotics; the convergence of media, cognition and communication; the interfacing of (human) sense perception and language with computational artefacts; climate issues and environmental humanities.

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