Preface

This special issue contains some selected papers from the workshop Semantic Spaces at the Intersection of NLP, Physics, and Cognitive Science, held on the 6th-7th August 2020, in an online format. The workshop attracted a number of high-quality submissions, of which 7 in total were accepted for extension and publication in a special issue of the Journal of Cognitive Science. This issue contains 4 of these submissions.

Vector embeddings of word meanings have become a mainstream tool in large scale natural language processing tools. The use of vectors to represent meanings in semantic spaces or feature spaces is also employed in cognitive science. Unrelated to natural language and cognitive science, vectors and vector spaces have been extensively used as models of physical theories and especially the theory of quantum mechanics. Crucial similarities between the vector representations of quantum mechanics and those of natural language are exhibited via bicompact linear logic and compact closed categorical structures in natural language.

Exploiting the common ground provided by vector spaces, the workshop brought together researchers working at the intersection of NLP, cognitive science, and physics, offering to them an appropriate forum for presenting their uniquely motivated work and ideas. The aim of the workshop was to use the interplay between the three disciplines to foster theoretically motivated approaches to understanding how meanings of words interact with each other in sentences and discourse via grammatical types, how they are determined by input from the world, and how word and sentence meanings interact logically.

In this issue, some of the invited papers cover the interplay between grammar and meaning. McPheat et al provide a novel vector space semantics for Lambek calculus with a relevant modality, showing how anaphora and ellipsis can be represented, and deriving sloppy vs. strict reading of ambiguous anaphora with ellipsis. Tabor provides a formalisation of a syntactic-semantic space as a stable and countably infinite attractor of a dynamical system, that supports a unified treatment of grammatical processing.

In a more syntactic vein, Slavnov proposes a concrete surface representation of

Abstract Categorial Grammars in terms of *word cobordisms*; based on cobordisms, he then introduces a formalism of Linear Logic Grammars and studies their relation to multiple contextfree grammars. Within the area of formalizations of cognitive scientific theories, Tull and Kleiner give a formalization of integrated information theory, a mathematical formalism for describing consciousness.

We thank the authors, participants, and reviewers for the workshop, and hope that the collected papers provoke interest in the audience.

Programme Chairs
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