The “semantic gap” between the low-level features of sensorimotor data and their meaning as expressed through language is one of the fundamental challenges in developing intelligent systems. In this demonstration, we will present the very first release of the PRAXICON [1], a grounded conceptual knowledge base tightly coupled with programs that perform a generative analysis of sensorimotor and language representations. This is the first grounding resource that is coupled with compositional and generative modules for visual, motoric and language representation analysis and the first one that integrates the output of such modules within and across concepts, formulating a rich semantic network of multi-representational concepts. We will focus the demonstration on the PRAXICON database, its visualisation and four of its language-related tools: (a) FreeText2PRAXICON: a first version of the language-based PRAXICON reasoner; (b) WordNet2PRAXICON: a module that converts WordNet [2] into a reference-based resource, for enriching the PRAXICON; (c) COSMOROE2PRAXICON: a module that extracts and infers conceptual information from the annotated COSMOROE corpus of TV travel series [3, 4], and (d) Cognitive2PRAXICON: a module that extracts and infers conceptual information from the POETICON cognitive Corpus (cf. more details in http://www.poeticon.eu).

1 The conceptual knowledge base and its visualisation interfaces

The PRAXICON conceptual knowledge base has been realised in the form of a database (MySQL server) developed using the Java Persistence API (JPA). Thus, it is not bound to any operation system or database server. A graphical user interface (GUI) has also been developed, which allows for text-based search of the concepts in the resource (cf. Figure 1) and subsequent exploration of all available concept-information in a visualisation environment (cf. Figure 2). PRAXICON’s GUI has been developed in JavaFX, a new language that enables the PRAXICON to run in any operating system, either as applet or stand alone application. The interface serves for exploration of the PRAXICON conceptual knowledge base. One may type a word denoting a concept of interest, in Greek or English and explore its multiple representations and network of relations. For example, Figure 1 shows the list of results of a query with the word “hammer” and the detailed results for the selection of the “hammer#entity” concept. Figure 2 shows the visualisation interface for exploring such concept where information on
the language representation(s) (LR) of the concept, its visual representation(s) (VR) and network of relations to other concepts is presented.
2 FreeText2PRAXICON

We have integrated the PRAXICON conceptual knowledge base with the ILSP text processing pipeline for Greek and English and with a very first version of the PRAXICON’s language-based reasoner. The ILSP text processor extracts information about some sentence, by performing tokenization,lemmatization,stemming,part of speech tagging and syntactic parsing. This info is crucial for the development of an interface for the PRAXICON that uses free natural language. The reasoner in its current, simple form, takes as input the processed text and matches the language representation of concepts in PRAXICON. Then it finds the optimal path than links the textually-expressed concepts, as shown in Figure 3.

![Fig. 3. This screenshot displays the optimal path that associates the concepts that are participating in the sentence “cut the pizza”. The path starts from the Language Representation “cut” which is linked to the abstract concept “cut”. The relations of the concept “cut” are expanded and the relation with the movement “cut_with_pizza_cutter” is selected. The path continues to the inherent intersection of the relations between the movement “cut_with_pizza_cutter” and the entity “pizza_cutter” and the abstract concept “cut”. The relations of the entity “pizza_cutter” are being expanded and the chain of relations with the movement “cut_with_pizza_cutter” and the entity “pizza” is selected. The path ends at the Language Representation of the entity “pizza” (Pizza). The reasoner favors the paths that invoke inherent relations between concepts. (Faded nodes and edges are (some) of the “roads not taken”).](image-url)
3 WordNet2PRAXICON

We have developed a module that uses the WordNet 3.0 dictionary and the WordNet 3.0 semantically annotated gloss files as an input resource and produces xml files based on the PRAXICON Concept schema. The module, which is implemented in Java and makes use of the MIT Java WordNet Interface traverses the WordNet entries and performs the following challenging, but essential, tasks: (a) it distinguishes between literal and figurative senses of synsets, and (b) clusters synsets that have the same reference. Thus, we turn WordNet from a sense-based lexical resource into a reference-based one, for the needs of the PRAXICON. For example, WordNet considers knife as a “cutting instrument”

a different concept from knife as a “weapon”, and a different concept from knife - any long thin projection that is transient (the tongue of flame). However, in the first two cases, it is the same reference object that is denoted. The different senses reflect different uses. For similar cases, we have developed a mechanism that merges the synsets to the same PRAXICON concept (cf. Figure 4). The third sense is a figurative one, the word is used metaphorically to denote a different concept (cf. Figure 5); our module distinguishes such figurative senses from the literal ones.

4 COSMOROE2PRAXICON

This is a rule-based Perl module that takes as input a COSMOROE xml annotation file; its xml output includes information per concept extracted from the corpus. Visual object representations, visual action representations (video segments) and textual representations, as well as relations with other concepts are extracted. The main task of the module is (a) concept-type categorization; the module classifies the annotation elements into “movements”, “entities”, “features” and “abstract concepts” and (b) clustering of information per “unique concept”; each concept has a unique id that consists of the lemma of the word
or visual label that expresses its LR, its concept type, and whenever applicable a further clarification of the lemma sense. Figure 6 provides an example of information extracted by the module for the PRAXICON.

5 Cognitive2PRAXICON

Another source of information for the PRAXICON is the POETICON Cognitive experiments. We have carried out experiments that employ the “think aloud” protocol to elicit verbal descriptions of everyday objects and actions using lithic tools as a stimulus for the description. The corresponding video recordings capture verbal reports of 120 participants and amount to approximately 110 hours. The verbal reports have been transcribed and annotated in terms of the semantic type denoted through specific words in the verbal reports. Cognitive2PRAXICON is a rule-based Perl module that runs over the semantically annotated verbal reports, and (a) extracts unique concepts with automatically attributed concept type, (b) infers a wealth of implied concepts from what is literally expressed in the verbal reports, (c) extracts and infers a wealth of conceptual relations that are expressed in the reports in the form of verbal justifications, conditionals, analogies, and clarifications. Figure 7 provides an example of information inferred from the reports.
Fig. 7. Extraction and inference of information from the POETICON Cognitive Experiment Verbal Reports

Acknowledgements The research reported in the paper is funded by the European Commission in the frame of the POETICON project (Grant:FP7-ICT-215843). We thank all POETICON partners for their feedback on developing the PRAXICON. Also, special thanks to our colleague Argyro Vatakis who designed and run the POETICON cognitive experiments and to the team of annotators of the COSMOROE and the Cognitive data corpora.

References