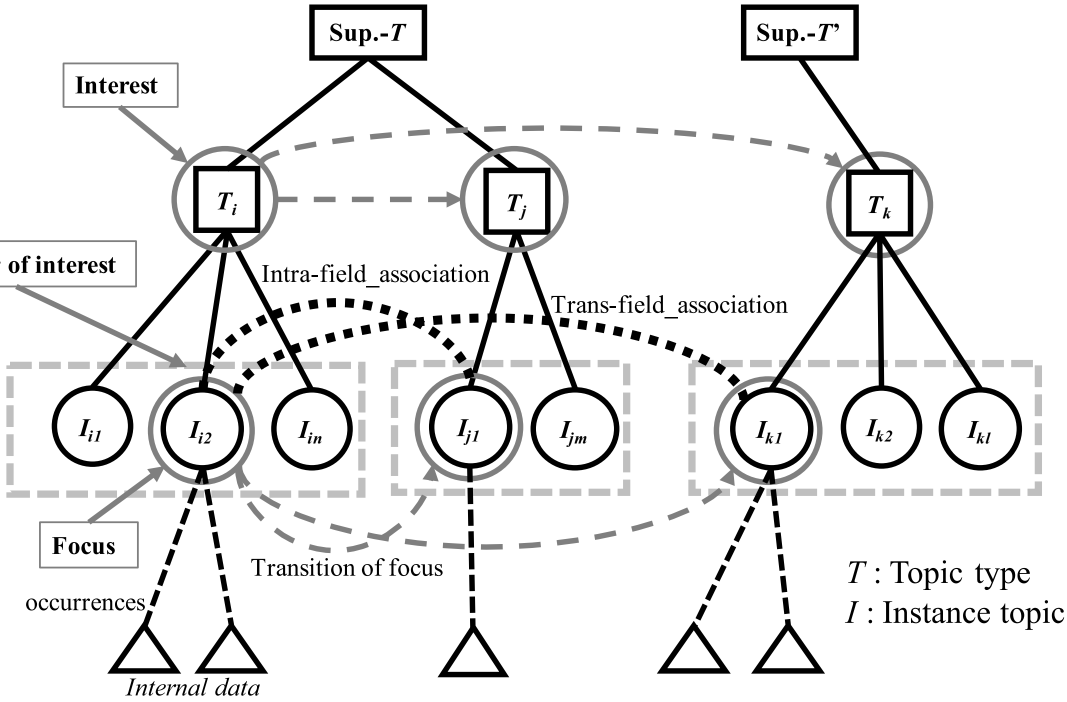

Fig. 3. Focus-interest model applied to a topic map. The letter "T" indicates the topic type, and the letter "I" indicates the instance topic. A solid straight line indicates a supertype_subtype association, and the dotted black curves indicate associations among instance topics. The black broken lines indicate occurrences that connect the instance topic with internal data.

which it can recognize and respond to. We now define the range of topics and data which are stored temporarily in the robot's memory. Here, we introduce a focus interest model as a representation of temporarily conscious words.

Figure 3 illustrates the focus interest set and its transition along an intra-field association and a trans-field association. In the figure, T_i indicates the ith topic type. If T_i and T_j have the same supertype, i.e., Sup.-T, they belong to a common field of knowledge. The topic instances of type T_i are written as I_{i1}, I_{i2}, ..., I_{in}. If the topic instance I_{i2} is retrieved, then we call I_{i2} the focus topic. The supertype topic T_i is the topic of interest. Further, the instance topics, I_{i1}, I_{i2},..., I_{in}, are the members of interest since they are instances of T_i. Thus, the temporary memory holds internal data for the focused topic I_{i2}, the topic of interest, and the members of interest. The dynamic concept is refreshed in preparation for recognizing words from it in the human utterance.

If the focus moves from I_{i2} to I_{j1} along with an intra-field association, the topic of interest changes to T_j with the members of interest I_{j1}, I_{j2},..., I_{jm}. In addition, if the topic of interest changes from T_i to T_k, the members of interest change to I_{k1}, I_{k2},... I_{kl}. Although the topic of interest can be chosen to be higher or lower in the category tree, the robot will prompt to narrow the scope of the field to the level at which the topic of interest directly has the instance topics as the member of interest.

3.4 Evaluation of dialog generation

Currently, the system has been tested only by a participant who has an expertise in the ontology of this learning system. First, the three-step model for dialog generation updated the robot's memory at every dialog and the list of recognizable words according to the human utterances. Second, the focus interest model ensured that both the topics within the field of interest and the topics directly associated with the focus topic were always recognizable during the dialog. Third, by changing the topic of interest, the user was able to change the entire topic at any time.

However, we have a major technical problem associated with language processing. Since many *kanji* have multiple pronunciations, the robot cannot identify a topic name unless the human pronunciation matches the robot's reading. The robot's *kanji* reading was in some cases inappropriate.

Furthermore, even though there is flexibility in selecting a topic, the user needs to have some knowledge of the members of interest topics under an interest topic type while talking. If the user is not accustomed to the ontology, the robot should be able to visualize or verbally navigate the theme. This kind of knowledge presentation or navigation is required as a future development.

4. Conclusions

We constructed a dialog generation system by linking a humanoid robot with an online learning system based on the topic map ontology. The dialog system developed in this study was intended for a dialog between a human lecturer and a humanoid, Nao. We proposed a three-step model to generate a dialog, which could update the terms recognizable by the robot during the dialog. Updating this term list in the robot's memory was also a transition in the collection of networked terms. To enable dialog content to be migrated, we proposed a focus interest model, which enabled the migration of a lineage of a set of recognizable topics.