File Cards, Discourse Referents and the Objects of Belief

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0. The file card metaphor starts with Karttunen (1976) and is taken up by Heim(1983) to motivate her update semantics, called File Change Semantics (FCS). The metaphor refers to a tool in historical research: the building of a set of file cards where each card serves to record results about a particular topic of investigation with cross references to other relevant cards. It is a method to store new data in a way that integrates these data with what is known already and makes it possible to find the data back from related file cards.

The metaphor is broken in both Discourse Representation Theory (DRT) and FCS to deal with logical complexity. This paper contends that this was not necessary and that file card systems are an improvement on DRT and FCS and have a better logical and psychological motivation. File card systems also seem to have good papers as a formalisation of the traditional perception-based view of mental representation that dominated philosophy from Aristotle to Husserl. Finally, it will be argued that file card systems give a natural non-modal account of belief attribution in natural language, in which the counterpart relation naturally emerges.

These three points derive from an old observation of Urs Egli (1985) about DRT: that everything done in DRT can be done with Skolem Normal Forms for first order logic, and moreover can be done better. The improvements lie in the extra anaphoric possibilities, as in the examples ruled out by DRT and FCS:

Every chess set comes with an extra pawn. It is taped to the box.
Bill does not have a car. He does not have a place for it.

Conjunctive Skolem Normal Forms (CSNF) are but two steps removed from file card systems (a file card system is a set of file cards with a dependence partial order and an inheritance partial order over the cards). Create a file card for each term in the CSNF. Write all the disjunctions about that term on the card. Create a dependence relation from the form of the terms: the card for $f(x_1 \dots x_n)$ depends on the cards for $x_1, \dots, x_n$. (The inheritance order is empty for FOL) Replace all terms by their card number.

1. More natural are file card systems based on event semantics and generalised quantifiers/plurals. File cards are now about non-empty sets of objects and events. Nouns and verbs have a single argument, theta functions θ connect those single arguments with other argument places. In this setup, positive generalised quantifiers are indefinites introducing non-empty sets where other terms can depend on those sets. Conjunction (in any type) is disjoint union and there are two ways in which a theta role can be filled by a properly plural set. A satisfies $\theta X = Y$ iff $A(Y) = \{\theta(x) : x \in A(X)\}$. Or the case where X also depends on Y. In that case $A(X) = f : A(Y) \to pow(D) \setminus \emptyset$ and for $y \in A(Y) \theta(f(y)) = x$. The last case reconstructs classical generalised quantifiers, the first leads to cumulative and branching quantification. This is not the place to develop this further, see e.g, Robaldo (2011) for this more subtle treatment of quantification. It is also natural to let the file cards inherit from file cards denoting larger sets and from the conceptual structure that gives rise to these sets. This is the second relation between file cards in a system and relates nouns and verbs to their projections.

2. Classical mental representations are about connecting action, perception and reasoning and assume a representation per object in which all information about the object can be stored. Frege argued against mental representations as a foundation for logic and it should

be admitted that they are not a good basis for motivating modern logical formalisms, lacking the algebraic structure that is characteristic for modern logical languages. Egli's observation however makes it possible to regard file card systems as a properly logical formalism: systems of mental representations would be similar to the CSNFs of a modern logical language, e.g. one adding plural and event semantics to first order logic. As CSNFs, they would have exactly the expressive power of the logical language they are the CSNFs of. The CSNFs would by their relation to resolution theorem proving be optimally suited for consistency checking both on the set as a whole and locally. By the file card structure, the cards can also be used to create integrated local structures for action planning and for representing perceived content in memory. The structure also fits well with associative memory and -in inheritance- has a model for the interface with semantic memory. All these seem to be properties that make mental representations more suitable for their tasks. Cognitive evolution would therefore tend to go in the direction of a file card system and not towards a language closed under logical operations.

Twardowski (1977) gives a fascinating account of the meaning of mental representations based on Brentano's principle. The account however breaks down on the negation. The search for external objects of negated representations forced Twardowski in the adventurous direction of negative facts. Egli's observation also seems to provide a way of escaping this argumentation. If mental representations are CSNFs, there are almost no negative CSNFs (the one exception being singleton disjuncts with a negative literal that are trivially realised.) CSNFs can be realised by an assignment of values from a model to their file cards: functions for the dependent cards, non-empty sets for the independent ones and so fulfill a version of Brentano's principle.

3. Belief complements can be realised by the file cards of the belief subject in the same way: the file card system of the subject is the information state on which the complement must hold.

This raises the question of anaphora across belief complements and into belief complements, as well as the de re constructions of referring expressions inside belief complements. These would involved different file card systems. File cards are however the kind of entity that can help here. File cards can however share parts of their information even if they belong to different systems.

If the speaker uses a referring expression, the hearer in figuring out what the speaker thinks must associate a speaker file card with the referring expression which licenses the chosen expression for the speaker: if it is a name, the name must be attributed in the file card, if it is a description, the description must be contained in the file card, if it is a deictic expression, the file card must instantiate the relevant deictic category.

For referring expressions in belief complements this is less straightforward, since there are two perspectives, the speaker's and the belief subject's. It would appear that the default is that both speaker and subject associate a file card that extends the public part, but that default can clearly be overridden. The extreme cases are proper de re and de dicto attributions. Schiffer noticed that belief complements are underspecified for the way in which the object is given to the subject and proposed that resolving this underspecification is part of the interpretation of belief complements. Without it, belief attributions do not have a truth value.

John believes that your brother is rich. [John does not even know you]

John believes that his brother is rich. [speaker has no clue about whether John has a brother]

In the first case, "your brother" picks out an individual and there needs to be a file card of John that picks out that individual and that has the property of being rich according to the file card (sometimes other file cards in John's information state would be involved).

But pure *de re* is not the general case. If the entailed sub-file-card can be part of the belief subject's file card, it would by default also be part of the subject's file card that is part of the file card in the subject's file card system that realises the complement. This mechanism resolves part of Schiffer's underspecification.

In contrast, the purely de dicto case is simple: it is ruled out that there is such a thing for the speaker. Let's look at some classical examples.

A, Pete believes he has seen Vulcan.
B. Pete believes the morning star is not visible in the morning. [he does not know that the morning star is the evening star]
C. The Babylonians did not believe that the morning star is the evening star.
D. Tom does not believe that Paderewski the prime minister is the same as Paderewski the pianist.
E. Tom is in Spain but Mary believes he is home.
F. Hob thinks there a witch poisoned his cow and Nob thinks she poisoned his well.
G. John thinks that somebody has an accident and Mary believes he is wounded.
. H. Arsky believes somebody killed Jones and Barsky believes he also killed Smith.

In A. one assigns a file card to Pete that includes the name Vulcan and is part of the larger Vulcan tradition. In B. the claim is problematic: it does not suffice that Pete believes the evening star is visible in the evening. (Maybe other explanations are possible.) In C. the two internal file cards are not merged and share a public part each with the one external file card. This is exactly the situation of in D. showing that it is pragmatic enrichment rather than the sense of names that matters. In E. Mary's file card should agree with the speaker's file card about the name and the referent. In F. many solutions have been been suggested that all come down to constructing a shared description of the witch contained in Hob's and Nob's witch files. Communication is but one possibility (the case Hob and Nob conversed with each other, or both read about about the witch in the local newspaper). Edelberg (1992) however also opens other scenarios: Hob and Nob both heard strange noises coming from Flob's stable and decided there was a witch at work there. G. from Edelberg is the scenario that somebody staged a fake accident: a car against a tree, a smashed wind shield, a bottle of ketchup emptied in the grass next to the driver's seat. John walks past first and leaves the scene. Then Mary comes by and notices the ketchup. H. is the Edelberg asymmetry. Arsky and Barsky are detectives investigating the murders of Smith and Jones (who both died by quaint accidents) and never talking to each other have concluded (Barsky) that the murderer is the same in both cases and (Arsky) that murderer of Smith has left town. H. is then true for the respective file cards for "the murderer of Jones". But one cannot invert the example to read: *H'. Barsky believes somebody killed Smith and Arsky believes he killed Jones.* This is what we predict: pragmatics identifies Barsky's file card as the murderer of Jones, who according to Barsky also killed Smith. This is the same in H': the file card is of the murderer of Smith who for Arsky is not the murderer of Jones. The pragmatically disallowed choice of "the murderer of Smith" in H' (and surely that should be someone for Barsky) would make H' true, but it is not the way in which the example would be enriched.

References

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