

Linkability across different contexts due to the use of these pseudonyms can be represented as the lattice that is illustrated in the following diagram, cf. Fig. 8. The arrows point in direction of increasing unlinkability, i.e.,  $A \rightarrow B$  stands for “B enables stronger unlinkability than A”.<sup>79</sup>

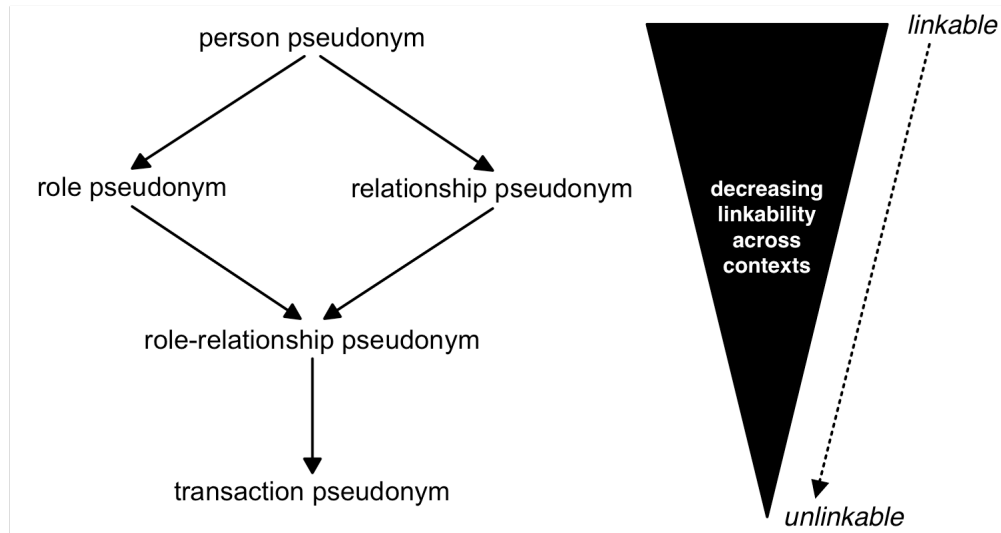


Fig. 8: Lattice of pseudonyms according to their use across different contexts

In general, unlinkability of both role pseudonyms and relationship pseudonyms is stronger than unlinkability of person pseudonyms. The strength of unlinkability increases with the application of role-relationship pseudonyms, the use of which is restricted to both the same role and the same relationship.<sup>80</sup> Ultimate strength of unlinkability is obtained with transaction pseudonyms, provided that no other information, e.g., from the context or from the pseudonym itself (cf. footnote 57), enabling linking is available.

Anonymity is the stronger, ...

- ... the less personal data of the pseudonym holder can be linked to the pseudonym;
- ... the less often and the less context-spanning pseudonyms are used and therefore the less data about the holder can be linked;
- ... the more often independently chosen, i.e., from an observer's perspective unlinkable, pseudonyms are used for new actions.

The amount of information of linked data can be reduced by different subjects using the same pseudonym (e.g., one after the other when pseudonyms are transferred or simultaneously with specifically created group pseudonyms<sup>81</sup>) or by misinformation or disinformation, cf. footnote 34.

<sup>79</sup> “ $\rightarrow$ ” is not the same as “ $\Rightarrow$ ” of Section 7, which stands for the implication concerning anonymity and unobservability.

<sup>80</sup> If a role-relationship pseudonym is used for roles comprising many kinds of activities, the danger arises that after a while, it becomes a person pseudonym in the sense of: “A person pseudonym is a substitute for the holder's name which is regarded as representation for the holder's civil identity.” This is even more true both for role pseudonyms and relationship pseudonyms.

<sup>81</sup> The group of pseudonym holders acts as an inner anonymity set within a, depending on context information, potentially even larger outer anonymity set.