

**Multimodal Interaction  
Multimedia and Multimodality  
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Modality Relations**

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Multimedia & multimodality

**Outline:**

- Medium vs. modality
- Multimedia systems vs. multimodal systems
- *Modality relations*
- Characteristics of multimodal systems



The third topic of this week are Modality Relations.

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Modality relations

**General:**

- temporal (parallel vs. sequential)
- amount of information conveyed (complementary vs. redundant)

**CARE properties** (Coutaz et al., 1995):

- *Complementarity*: Different modalities have to be used in order to reach the goal.
- *Assignment*: Only one modality is selected, either by the system or the user.
- *Redundancy*: Different modalities are used, bearing comparable information, either in parallel or sequentially.
- *Equivalence*: Any available modality can be used. There are no restrictions on the temporal order.



There are two general dimensions concerning the different relations of modalities and please keep in mind that in this case we are talking about modalities in the frame of human-computer interaction which means that we are referring to modes of interaction by the users.

So, these two general dimensions are the temporal domain and the amount of information conveyed. With temporal domain, I am speaking of the possibility of presenting information or using different modalities one after another in a sequential way or in parallel, during the same time.

The amount of information conveyed is referring to the information which may be redundant on different or repeated on different modalities or separated and therefore, not redundant but complementary. We are referring here to different information that are used for the same task. But this may change in the next slides.

So, based on these two principal dimensions, these two principal relations, actually, there is a nice approach –a systematic to, which leads to or results in four different so-called properties. These CARE properties I would present now in the following-

These are Complementarity;

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this means that the different modalities are used all in order to reach a certain goal.

That means in this case the amount of information conveyed is triggered. That means that different information are used on different modalities and they all have to be used in order to reach a goal.

The typical example is the one you saw was in the video from the 1980 or 1979, from MIT, the so-called put-that-there scenario.

For example, if you would sit in this nice chair and point to the screen and say-‘put this angle in this cycle’ you are referring to the yellow one and the red cycle for example, you need both information-the acoustic information and the pointing gesture in order to interpret the user input. This would be complementarity.

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The next one is Assignment. Assignment means that only one modality is selected for a certain piece of information, either for the user or by the system. The typical example would be a push-to-talk button, where the button press disables all other modalities and only the microphone is on in order to perceive and process information from the user voice.

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The third one is Redundancy and this means that the information or parts of the information are used or spread over different modalities.

Coming back to the put-that-there scenario, an example would be put the yellow triangle into the red cycle. So in fact we don't need any of the pointing gestures any more, at least if there is only one red cycle and one yellow triangle. But nevertheless the information provided by voice are still redundant in the pointing gestures.

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The last one is Equivalence.

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Equivalence means that actually at any given time any kind of modality can be used.

These CARE properties are particularly useful to analyse individual human-computer interactions -so which kind of behaviour do the users show and so on-this could be nice for annotation.

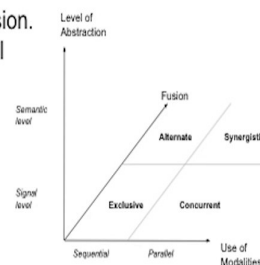
The next one –

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### Modality relations

#### CASE properties / multimodal design space (Nigay & Coutaz, 1993):

- *Exclusive*: No fusion possible, only one modality at a time.
- *Alternate*: Modalities are fused sequentially.
- *Concurrent*: Different modalities are used in parallel, but are interpreted independently.
- *Synergistic*: Modalities are used in parallel with fusion.
- *Levels of abstraction*: signal level or semantic level



the so-called CASE properties, are actually used to classify different systems. This means does the whole system provide different functionalities, it can be placed in a so-called design space.

This is actually a 3-dimensional space but I will start with four CASE properties which are only referring to a two dimensional space. And this space can be seen in the figure down on the right side of the slide.

The one dimension is the fusion. So is there fusion or is there no fusion? So this means are the information or modalities provided separate or not? Do they have to be analysed combinedly by the system? This means we need a fusion module.

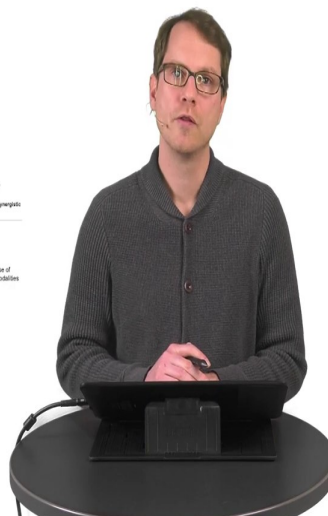
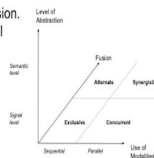
The second dimension is the temporal domain. This means simply, the old general domain which we know, is it a sequential pattern or does the system allow for a parallel or a combined way of presenting information? This leads to four different CASE properties. I reordered them a little bit to present them more clearly.

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The first one is called Exclusive. This just means there is no fusion possible and only one modality that can be processed by the system at a time.

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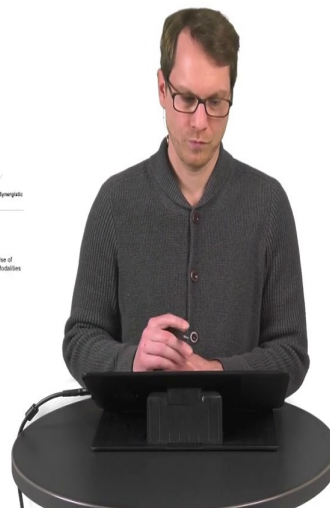
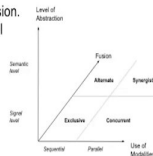


The second one is Alternate. This is actually the most wide spread system design that we have in nowadays. This means there is some kind of multimodal input possible by the system, but each information, each modality can only be used in a sequential way.

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- Levels of abstraction: signal level or semantic level



The third one is Concurrent-and this means, we can, the system can process actually information from different modalities but they are mutually exclusive which means that they are used for different tasks.

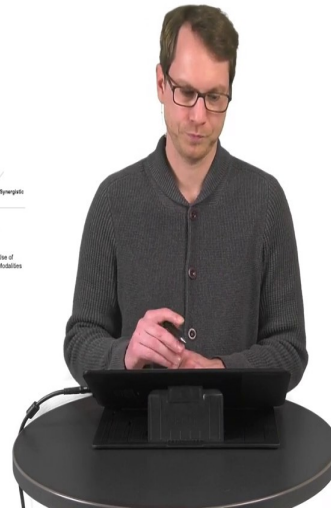
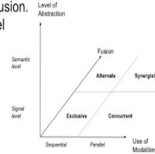
This is a rare system but actually there have been built such systems. For example, you can dictate via voice text and use a command or buttons or something else in order to delete a file

or to do a different task like starting a different program. So, this information on different modalities are not used in a combined way.

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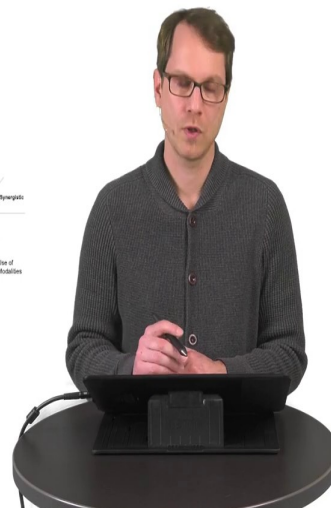
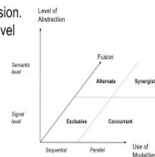


The last one is a system which we would call actually a truly multimodal system. This means on the different modalities, different information for the same task for the same intention can be used either in parallel, or sequentially and be evaluated and processed from the system together.

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The third dimension of the so-called design space is actually the representation level of the information provided by the users. So either we have a signal based representation or a symbolic processing which is again referring or quite similar to the definition of multimodality by Benoit et al.