**Information**

An important aspect of communication relates to the transfer of information, but the treatment of information as a sociological phenomenon cannot be limited to its associations with communication alone: of equal importance are questions of creation, access, accumulation, transformation, function, social effect, etc. To address such issues, we will need to begin with an appropriate understanding of what ‘information’ means in the sociological context. Unfortunately, ‘information’ in that context (or in most others for that matter) is a term that is more widely used than analysed; and we do not get much relevant enlightenment from the few fields of study where it has been treated rigorously such as Computer Science and Communication Studies. The definitions and investigations of information and its characteristics appropriate to those fields are those inspired by the work of Shannon and Weaver ((1949) *The Mathematical Theory of Communication*, Urbana, IL: University of Illinois Press) and are concerned with quantitative aspects of ‘information’ such as the amount of uncertainty in a variable or the ability to reconstruct messages sent over noisy channels rather than anything relevant to the questions mentioned above.

The (non-quantitative) understanding of information that is intuitively appealed to in most other fields is rather that identified by Dretske (1981/1999, *Knowledge and the Flow of Information*, CSLI:LSJU) as the *nuclear* sense of the term. There (p 44) he argues that “Roughly speaking, information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it” and (p. 45) “A state of affairs contains information about X to just that extent to which a suitably placed observer could learn something about X by consulting it.” As Dretske acknowledges, information is supposed to yield true beliefs, and so we can loosely say that information has to be true: although we may speak colloquially of ‘false’ information or of ‘misinformation,’ the nuclear sense rejects that possibility. On this view then, a state of affairs could be said to contain information when a true proposition which is apt for belief could be derived from that state of affairs.

This, though better, is still not an appropriate approach to information as a sociological phenomenon. The truth of a claim that is current in society is of no particular interest to the sociologist, and the effect that that claim has on society is only indirectly (and often very weakly) related to its truth or falsity. The sociologically important characteristic of such a claim – which is apt for belief on the part of some agent(s) – is the degree to which and the manner in which it affects the actions of those in the society associated with that claim in the relevant way. The relationship between this and the nuclear view of information is that the effect of the claim can be related to the belief on the part of the relevant agents that the claim is a true (or false) one and therefore a good (or bad) guide to actions, where good and bad can be understood as meaning likely to lead to good or bad results for the relevant agents. That something like this is involved in the non-specialist use of the term ‘information’ is suggested by, for example, the use of the term ‘information society’ when the subject of discussion ranges over all forms of production, consumption, and exchange of claims regardless of their relationship to truth. (Further considerations on the characteristics that should be considered in the formulation of a definition of ‘information’ for sociological purposes may be found in H. Garfinkel (ed. A. Rawls) (2008) *Toward a Sociological Theory of Information*, Boulder CO: Paradigm, pp.110 ff.)

***Adduction and Information***

The nature of the processes by which information in this relevant general sense is derived from a state of affairs is both uncertain and to a certain degree beyond the scope of our interest. The discussion will therefore be conducted at a level of abstraction that does not prejudge that nature. It will be assumed that the only relevant criteria here are that the processes are systematic and that they are dependent upon the contents of the state of affairs in question

1. *Propositional Function: Adduction*

A possible way that the world is may be represented as a set of propositions describing the world, Define **

a State of Affairs, as:

** = {*si*: *i* *ℕ*, *si* *ℙ*, *si* is a partial description of the way the world is} where

1. ** is a consistent set

* A state of affairs is a subset of a complete description of the world.
* ** = **: ** is a state of affairs} is the Possible States of Affairs

Let *h* be a function such that

*h*:**  *ℙ*

*h* is an Adduction from a state of affairs ** iff

(*p* *ℙ*) [*h*(**)  *p* (*S***) [*h*(**\*S*)  *p*]]

» *An adduction is the production of a proposition apt for belief from a description of a state of affairs. It is sensitive to the contents of . This is a non-triviality condition.*

* Write *H*(*h*,**)
* In this case *p* is an Adduct of ** by *h*, and we say *p* is Adduced from ** by *h*.
* Not every adduction will be well-defined for every state of affairs.
* An adduction is not guaranteed to yield a true proposition, nor is it even guaranteed to yield a result that is consistent with **.
* The set of possible adductions is barely constrained by the condition given, and we can be sure that the set of adductions that the agents of a population are actually capable of performing is a much more limited set. The discovery of which possible adductions are actually applied by agents is a matter for empirical (psychological) enquiry and will form part of the agent theory.
* The work of Sperber and Wilson (e.g. (1986) *Relevance*) would suggest that the actually applied adductions will turn out to be more context sensitive or otherwise complex than a mere propositional function. Nevertheless, for the simplicity of this initial development we shall maintain that assumption.

Above, *h* is defined as a function on the propositions of**. However, it need not be supposed implausibly that only the complete set of propositions in ** should be necessary and sufficient for any particular *h*. We suppose instead that there will be a subset *h* (proper or otherwise) for which:

1. *h*(*h*) = *h*(**)

» *The propositions of h are collectively sufficient for the adduction to yield the same result*.

1. (*s**h*) [*h*(*h*\*s*)  *h*(**)], or

» *The propositions of h are collectively necessary for the adduction to yield the same result*.

* Call *h* so characterized, the Adduction-Relevant State of Affairs for *h* on **.
* Write *ARSA*(**, *h*)
* We will assume in what follows that where appropriate the state of affairs in question is the adduction-relevant one. Including the restriction in each definition, though strictly required, would add clutter to definitions which are already cluttered enough.

1. *Action: Adducement*

An agent is able to access the results of an adduction on a state of affairs, **, when it is able to perform an action by which it applies some adduction *h* to that state of affairs and the result of that adduction is added to **B***x*. Such an action we shall call an Adducement for *h* from **. Thus; when an agent *x* performs the adducement, *x**x*, for the adduction *h* from **:

*Q*(*x,i*, *qx,i*)  *Bx,i+1*[ *h*(**) ]

* All the normal indices are applicable in the obvious way.
* Write *Add*(**, *h*, **) – though it may not be necessary to include ** in the arguments.
* We may write *h* to acknowledge that the adducement applies the adduction *h*

1. *Motivation: Interrogation*

Agent *x* performs an adducement (*quâ* adducement) when he has a question that he needs answered (or is in a situation that is effectively identical to this) and which he knows or suspects can be answered by an application of an adduction on the facts presented in the current state of affairs.

We will adapt an approach to the semantics of questions by Groenendijk & Stokhof (1984, *Studies in the Semantics of Questions and the Pragmatics of Answers*, PhD Thesis, U. Amsterdam,) by which a question may be treated as a partition of the set of all propositions (van Rooy, R. (2003) ‘Quality and Quantity of Information Exchange’ in *Journal of Logic, Language, and Information*, 12.4 pp. 423-451) where the members of that partition are the correct answers to that question in declarative form.

Let ** = {*i* }  2*ℙ* be a question,

((*p*)[~*Bx*[ *p*** ]] &   
*Bx*[ (*p***)[ *qx*’ = *qx*  *Bx*[ *p*** ]  *T*(*C*(*Ax*(*qx’*, *cx*), *cx*), *Ix*) > *T*(*C*(*Ax*(*qx*, *cx*), *cx*), *Ix*)

 *Dx*[ (*p***)*Bx*[ *p*** ]

» *If x believes that knowing an answer to the question  will enable an improvement in that agent’s total satisfaction then x will desire to know that answer*

* Under some fairly plausible assumptions for the logic of the *Bx* operator

*Bx*[ *p*** ]  *Bx*[ *p* ]

But, given opacity in the *Dx* operator, it does not necessarily follow that

*Dx*[ (*p***)*Bx*[ *p*** ] *Dx*[ (*p***)*Bx*[ *p* ] ]

Let ** = {*i* }  2*ℙ* be a question, ** a state of affairs, *h* an adduction on**; then

( *Dx*[ (*p***)*Bx*[ *p*** ] ] *qx,i*

» *If x wants to know an answer to the question *

& *Bx*[ (*p*)[*p***](*p*)[*h*(**)*p**p***] ] *qx,i*

» *and believes that if there is an answer to  that it would be found by the adduction h on *

& (***x*)[*Bx*[***x* & *Add*(**, *h*, **) ] *qx,i*])

» *and believes that an action  which x can perform is an adducement for h from *

*Ax*(*qx,i*, *cx,i*) = **

» *then x does *

* A more complete description of this condition would include reference to expected outcomes, weighted interests, alternative actions, and so on, but they can be ignored here for the sake of simplicity.
* Let the antecedent of that conditional be abbreviated as *Mot*(**, *x*, *h*, **, **) and read it as ** motivates *x* to apply *h* on ** using **.

*Mot*(**, *x*, *h*, **, **) *Ax*(*qx,i*, *cx,i*) = **

* Again, note that this assumes success in adductions

1. *Information*

Define the (Total) Information contained in **, as

**It**** = {*p* *ℙ*: (*x*)(**)(*h*)[*H*(*h*,**) & *h*(**)*p* & *Bx* [(*p*)[*h*(**)*p**p***]]]}

» *The (total) information in a state of affairs is all the statements that are adducible from it by some adduction which some agent believes would thereby answer some question.*

* Note that if no agent believes the adduced statement answers a relevant question, then that statement will not thereby count as information (even if it *does* answer the question.)
* We also say of any *p* **It**** that it is information in **.

Define the Information Relative to *x* contained in **, as

**Ir***x,* = {*p* *ℙ*: (**)(*h*)(***x*) [*H*(*h*,**) & *h*(**)*p* & *Add*(**, *h*, **) &   
 *Bx*[(*p*)[*h*(**)*p**p***]]]}

» *The information relative to an agent in a state of affairs is all the statements that may be adduced from it by the agent which he believes may answer some question.*

* **Ir***x,* may be an inconsistent set
* The information relative to a population *X* in ** is given in the obvious way

**Ir***X,* = *x**X* **Ir***x,*

* Define the Population Informationally Related to **i**  **It**** as

**Xri***,* = {*x*  *X*: **i**  **Ir***x,* }

Define the Information Available to *x* contained in **, as

**Iv***x,* = {*p* *ℙ*: (**)(*h*)(***x*) [*H*(*h*,**) & *h*(**)  *p* & *Add*(**, *h*, **) &   
 *Bx* [(*p*)[*h*(**)*p**p***] & *Add*(**, *h*, **) & ***x*]]}

» *The information available to an agent in a state of affairs is all the statements that may be adduced from it by the agent which he believes may answer some question using adductions that he can perform.*

* **Iv***x,* may be an inconsistent set
* The information available to a population *X* in ** is given in the obvious way

**Iv***X,* = *x**X* **Iv***x,*

* Define the Population Informationally Availed of **i**  **It**** as

**Xvi***,* = {*x*  *X*: **i**  **Iv***x,* }

***Conditions on Availability***

We have defined availability for information considered as a set of propositions, **Iv***x,*, in terms of the ability of an agent to apply the adduction *h* by an adducement ** to adduce that set of propositions. It may be useful to extend the use of the term availability to refer also to this ability. It is not likely that the two uses, even though related, will be confused.

Thus, for ** a state of affairs, *h* such that *H*(*h*, **), we say that *h* is Available To *x* In **Through **and write **(*h*, *x*, **, **) when

1. *Add*(**, *h*, **), and
2. ***x*

* Where *x*, **, and **are understood we may speak simply of the Availability of *h*
* The notion of the availability of functions from states of affairs to propositions to an agent could be naturally extended beyond adducement, which would then be just a particular instance of a more general notion, but that does not concern us here

We shall now consider several conditions on availability.

1. *A Quality Condition on Availability*

One of the most significant of these for our purposes relates to the requirements placed upon the quality of the agent by the adduction in question. If we assume, as seems reasonable, that the adduction, *h*, may at least to *some* degree be stated in algorithmic form, then we can say that *h* determines a set of questions, *h1*, *h2*, …, to which an agent must have the answers in order to complete *h*. We may say that:

*h*  *Qh* = {*h1*, *h2*, …}

* Call *Qh* the Queryset of *h*.
* The cardinality of the queryset is finite.

In that case the performance of an action ** which applies some adduction *h* includes providing – at least implicitly – a correct response to all elements of the queryset that arise.

On the understanding of the semantics of questions that we have adopted above, for *x* to be capable of the adduction *h* a necessary condition is that

(*hi**Qh*)(*p**hi*)[ *Bx*[ *p**hi* ]]

» *The agent has to correctly believe he has an answer for each question posed by the adduction.*

* Say that *x* isResponse Competent in *h* and write *RC*(*x*, *h*)

We may also distinguish a class of elements of the available information by the nature of their availability. Thus, for an agent *x*, a state of affairs **, and *p*  **Iv***x,*, we say that *p* is R(Response)-Available from **to the agent if:

(*h*)[ *H*(*h*,**) & *h*(**)*p* &*RC*(*x*, *h*) ]

» *There is an adduction to that proposition in which the agent is responsive*.

* Write *R*(*p*, **, *x*)

Let *h* = *ARSA*(*h*,**, *h*) be the Adduction-Relevant State of Affairs for *h* on **. We define the Response-Relevant State of Affairs for *h* on ** to be *h’*  *h*

1. (*s**h’*) (*hi**Qh*)[~*Bx*[ *s* ] ~(*p***B**x)[*p*  *hi*]]

» *The propositions of h’ are collectively necessary for the adduction to proceed at all*.

* Write *RRSA*(*h’*,**, *h*)

Note that the quality conditions determined above followed from the assumption of the algorithmic nature of the adduction. It is not assumed that the algorithm involved is applied consciously or known explicitly. In the case of adductions which are not at least implicitly algorithmic, there may well be other qualities of the agent that are necessary for it to have the capability of performing the adducement. This is unlikely to be a significant constraint on the functions that would be of most interest to us.

1. *An Instrumentality Condition on Availability*

It is natural to consider that another condition on the capacity of an agent to perform an adducement relates to the requirements that the adduction places upon the physical instrumentality of the agent – the means by which the agent may interact with a state of affairs. Normal usage suggests that a state of affairs can be thought of as containing information even when the necessary instrumentality is not available. This is consistent with the definition of (total) information given above, since the instrumentality is merely the means whereby the elements of the state of affairs that are relevant to an adduction (that constitute the Adduction-Relevant State of Affairs for the adduction) are made accessible to the agent and thus to the adducement. The adduction, defined as a function operating on the propositions that constitute a state of affairs is of course independent of the means by which the function is realised; and so the information in the state of affairs, defined in terms of possible functions, is for the same reason independent of the instrumentality.

The same cannot be said with respect to the relative or available information in the state of affairs since they are dependent upon the capability of the agent – i.e. whether the adducement is or is not one of its the possible actions – and this capability is constrained by the availability of the necessary instrumentality.

*Observations*

The means by which the relevant part of the state of affairs becomes usable by the agent is debatable, but we shall take it to be effectively equivalent to making the relevant statements of the state of affairs elements of the agent’s beliefs, **B***x*. This is achieved by some action on the part of the agent in the context of the state of affairs in question. Such an action may be termed an observation.

Let ** be a state of affairs; we say that an action *x**x* is an Observation by *x* in ** when:

(*s***) (*p* *ℙ*) [(*Q*(*x,i*, *qx,i*)  *Bx,i+1*[ *p* ]) & (*Bx,i+1*[ *p* ]  *Bx,i+1*[ *s* ])]

» *An observation is an action by which the agent comes to believe one of the propositions that describes the state of affairs*.

* Write *Obn*(*x*, *x*, **)
* All the normal indices are applicable in the obvious way.
* The condition *Bx,i+1*[ *p* ]  *Bx,i+1*[ *s* ] may be understood as either a semantic equivalence/implication condition or a condition of basic cognitive competence – as for example believing that something is blue is believing it is coloured or believing it is azure is believing it is blue or similar. It is not to be read as assuming that *x* believes all the logical consequences of *x*’s beliefs – for example, that (*B*[ *p* ] & *B*[ *p**q* ])  *B*[ *q* ].
* We might prefer to make the condition *Bx*[ *s*** ]

Let ** be a state of affairs, *x* an observation in ** by *x*; we say that *s*** is Observed by *x* in ** by *x* where:

(*p* *ℙ*)[ *Q*(*x,i*, *qx,i*)  *Bx,i+1*[ *p* ] & (*Bx,i+1*[ *p* ]  *Bx,i+1*[ *s* ]) ]

» *An element of the state of affairs is observed when the agent makes an observation that results in his coming to believe a proposition that describes that element*.

* Write *Obd*(*s*, *x*, * x*, **)
* All the normal indices are applicable in the obvious way.
* The previous comment on the condition *Bx,i+1*[ *p* ]  *Bx,i+1*[ *s* ] applies here
* *s* is an Observed Status. (To call it an observation would risk confusing it with the action. It is an ‘observation’ of a condition of the state of affairs. The term is intended to be reminiscent of the ‘observation statements’ of some empiricist schools.)
* Again, we might rephrase using *Bx*[ *s*** ]

*Observational Availability*

A condition for the adducement *h,x* is that observations to make the adduction-relevant state of affairs for *h* on ** available to *x* are associated with*h,x*. That is, for *h* such that *ARSA*(*h*,**, *h*):

(*s**h*) (*x**x*) [*Obd*(*s*, *x*, * x*) & *x*  *h,x*]

» *h,x contains a sequence of observations sufficient to make the elements of the adduction-relevant state of affairs for h on  available to the adduction h,x.*

* Call these *x* the Pro-Adductive Observations for the adducement *hx,i* from ** by *x*.
* Write *ProAddObn*(*x*, *h,x*, *x*, **)
* Define *h,x* = {*x*: *ProAddObn*(*x*, *h,x*, *x*, **)}

The condition written above as *x*  *h,x* assumes that some actions are ‘compound’ in the sense of being a collection of actions that might be taken separately, or that might be considered as a sequence, and that *h,x* is a compound action of which the indicated *x* are constituents. On the face of it this seems unexceptionable, but should the notion of such compound actions be considered unacceptable for some reason then we may replace that condition for *h,x,I* (note that it is time indexed) with

(*s**h*)(*j<i*)(*x,j**x*) [*Obd*(*s*, *x*, * x,j*, *h*) & *Bx,i*[ *s* ]]

» *A sequence of observations occur prior to h,x making the elements of the adduction-relevant state of affairs for h on  available to the adduction h,x.*

For *x* an agent, *h* on ** an adduction, *h* such that *ARSA*(*h*,**, *h*) and

(*s**h*) (*x**x*) [*Obd*(*s*, *x*, * x*)

* Say that *x*is Observationally Competent for *h*
* Write *OC*(*x*, *h*)

As before, we will find it convenient to distinguish a class of elements of the available information by the nature of their availability. Thus, for an agent *x*, a state of affairs **, and *p*  **Iv***x,*, we say that *p* is O(Observationally)-Available from **to the agent if:

(*h*)[ *H*(*h*,**) & *h*(**)*p* &(*h*) [*Add*(*h*, *h*, **) & (*h***) [*ARSA*(*h*,**, *h*,) &

(***h,x*) [(*s**h*) (*i,x***) [*Obd*(*s*, *x*, * i,x*)] & (*i,x***)[*i,x**x* ] ] ] ] ]

» *There is an adducement which can adduce p from  and for which there is a set of observations possible to x that can access the adduction-relevant state of affairs.*

* Write *O*(*p*, **, *x*)

1. *A Norm Condition on Availability*

Another possible significant condition on availability relates to the norm formations that govern the agent in the context in which it confronts a relevant state of affairs. Where the relevant adducements are themselves contrary to the norms accepted by the agent, the information that they might yield is inaccessible to the agent.

For *x* an agent in the context *cx*, *h* on ** an adduction, and

(*h**x*)[*Add*(*h*, *h*, **) & ~(*n*)[*k*(*x*, *n*) & *g*(*n*, *cx*) & ~*n,cx*(*h*)]

* Say that *x*is Normatively Competent for *h*
* Write *NC*(*x*, *h*)

As before, we find it convenient to distinguish a class of elements of the available information by the nature of their availability. Thus, for an agent *x* in the context *cx*,, a state of affairs **, and *p*  **Iv***x,*, we say that *p* is N(Norm)-Availability from **to the agent if:

(*h*)[ *H*(*h*,**) & *h*(**)*p* &(*h**x*)[*Add*(*h*, *h*, **) & ~(*n*)[*k*(*x*, *n*) & *g*(*n*, *cx*) & ~*n,cx*(*h*)] ] ]

» *There is an adducement which is a possible action of the agent which can adduce p from  and for which no norm accepted by x which governs that context forbids the action.*

* Note the distinction between the state of affairs and the context. It is not even generally the case that a defined state of affairs confronting an agent will include or entail the context of that agent.
* Write *N*(*p*, **, *x*)

***Information and State Transformations***

Define a State Transformation to be a function:

**:**  **

* All actions may be considered as state transformations though not all state transformations are necessarily the result of actions. The latter is obvious; the former follows because for *ax* *x*, and all *cx* *x* we have defined a context consequence function *C*: *x**y*  *y*. For each *ax* therefore we have *C*(*ax*): *y*  *y*, Furthermore, each context *cx* *x* is itself a particular kind of state of affairs, so that (**)[*cx*  **], and so that therefore *C*(*ax*):**  **. Given the invariance of *C*, this allows us to treat each action as equivalent to a transformation of states of affairs.
* It is convenient to adopt that way of talking about actions when we are dealing with more generally defined states of affairs rather than with sociologically relevant contexts.
* Talking in terms of state transformations allows us to avoid commitment to any limiting or confusing claims concerning agents.

1. *Information Generation*

The state transformation **is said to Generate (Total) Information when

(*1*, *2***)[**(*1*) = *2* & **It****\**It****]

* Given that no standardized system of description for a state of affairs has been given, it is possible to see this characterization as insufficiently well-defined. For example, if **It**** and every statement “*s”* in *1* were replaced with “*s* & 1+1=2” in *1* then this would be a state transformation that generated total information – contrary to our intentions and our strong intuitions. I think, however, that we may assume that this is not a difficult problem in practice, though it may be theoretically tricky.
* We can also similarly say that an action generates information
* The obvious analogous definitions are available for the generators of relative and available information.

For ** a state transformation where **(*1*) = *2* and *p* **It***2*\**It***1* we say that ** Generates *p* As (Total) Information from *1*.

* We write *GenIt*(**, *1*, *p*)
* For *p* **Ir***x,2*\ **Ir***x,1* we say that ** Generates *p* As Information Relative to *x* from *1* and we write *GenIr*(**, *1*, *p, x*)
* For *p* **Iv***x,2*\ **Iv***x,1* we say that ** Generates *p* As Information Available to *x* from *1* and we write *GenIv*(**, *1*, *p, x*)
* For all the above we may generalise to generation of a set of information elements with the obvious notational modifications

For ** a state transformation where **(*1*) = *2*, **genIt**(**, *1*) = **It***2*\**It***1* is the (Total) Information Generated by ** from *1*.

* **genIt**(**, *1*) = {*p*: *GenIt*(**, *1*, *p*)}
* **genIr**(**, *1*, *x*) = {*p*: *p* **Ir***x,2*\ **Ir***x,1*} is the Information Relative to *x* Generated by ** from *1*
* **genIv**(**, *1*, *x*) = {*p*: *p* **Iv***x,2*\ **Iv***x,1*} is the Information Available to *x* Generated by ** from *1*

1. *Information Preservation*

The state transformation **is said to Reproduce (Total) Information when

(*1*, *2***)[**(*1*) = *2* & **It****  **It****

* *MM* as above for actions and for relative and available information.

This, however, is unlikely to be a useful category of non-trivial transformations (but not as limiting as the condition (*1*, *2***)[**(*1*) = *2* & **It****  **It****.] We shall prefer to use a version relativized to some subset of the total information.

The state transformation **is said to Reproduce A (Total) Information Set when

(*1*, *2***)[**(*1*) = *2* & (**i** **It**** **i** **It****

* *MM* as above for relative and available information.

For ** a state transformation where **(*1*) = *2* and *p* **It***1***It***2* we say that ** Reproduce *p* As (Total) Information from *1*.

* We write *ReproIt*(**, *1*, *p*)
* *MM* as above for relative and available information.
* *MM* as above for reference to sets of information elements

For ** a state transformation where **(*1*) = *2*, **reproIt**(**, *1*) = **It***1***It***2* is the (Total) Information Reproduced by ** from *1*.

* **reproIt**(**, *1*) = {*p*: *ReproIt*(**, *1*, *p*)}
* *MM* as above for relative and available information.

1. *Information Destruction*

The complementary process to generation is easily defined. The state transformation **is said to Destroy (Total) Information when

(*1*, *2***)[**(*1*) = *2* & **It****\**It**** ]

* *MM* as above for actions and for relative and available information.

For ** a state transformation where **(*1*) = *2* and *p* **It***1*\**It***2* we say that ** Destroys *p* As (Total) Information from *1*.

* We write *DestIt*(**, *1*, *p*)
* *MM* as above for relative and available information.
* *MM* as above for sets of information elements

For ** a state transformation where **(*1*) = *2*, **destIt**(**, *1*) = **It***1*\**It***2* is the (Total) Information Destroyed by ** from *1*.

* **destIt**(**, *1*) = {*p*: *DestIt*(**, *1*, *p*)}
* *MM* as above for relative and available information.

1. *Information Conversion*

For ** a state transformation where **(*1*) = *2* and *p* **It***1*\**Ir***x,1* **Ir***x,2* we say that ** Relates *p* to *x*.

* We write *Rel*(**, *1*, *p, x*)
* **rel**(**, *1*, *x*) = {*p*: *Rel*(**, *1*, *p, x*)}
* Distinguish this from generation in that here the information is assumed to already exist as total information in the initial state
* *MM* as above for sets of information elements

For **(*1*) = *2* and *p* **It***2*\**Ir***x,2* **Ir***x,1* we say that ** Unrelates *p* from *x*.

* We write *UnRel*(**, *1*, *p, x*)
* **unrel**(**, *1*, *x*) = {*p*: *UnRel*(**, *1*, *p, x*)}
* Distinguish this from destruction in that here the information is assumed to continue to exist as total information in the final state
* *MM* as above for sets of information elements

For **(*1*) = *2* and *p* **It***1*\**Iv***x,1* **Iv***x,2* we say that ** Avails *p* to *x*.

* We write *Avl*(**, *1*, *p, x*)
* **avl**(**, *1*, *x*) = {*p*: *Avl*(**, *1*, *p, x*)}
* Distinguish availing from generation as for relating
* Note that an availing is also a relating
* *MM* as above for sets of information elements

For **(*1*) = *2* and *p* **It***2*\**Iv***x,2* **Iv***x,1* we say that ** Unavails *p* from *x*.

* We write *UnAvl*(**, *1*, *p, x*)
* **unavl**(**, *1*, *x*) = {*p*: *UnAvl*(**, *1*, *p, x*)}
* Distinguish unavailing from destruction as for unrelating
* Note that an unrelating is also an unavailing
* *MM* as above for sets of information elements

***Information and Time***

Not all changes in states of affairs are best thought of as resulting from distinct processes identifiable as state transformations defined as functions upon states of affairs; many changes, for example, are the result of a number of natural processes operating within the state of affairs and acting in concert which we would not wish to consider as an individual ‘transformation.’ Nothing would be gained theoretically by the reification of such a purely notional function. On the other hand such changes are certainly going to be an important aspect of the informational environment for agents and we are therefore required to have some tools for dealing with the more significant effects on information content caused by changes in states of affairs over time without committing ourselves to any claims whatever concerning state transformations. Here we will consider just those effects which are generalisations or analogues of the effects noted above for information under state transformations.

A possible way that the world is at time *t* may be represented as a set of propositions describing the world at time *t*, Define ***t*

a State of Affairs at Time *t*, as:

***t* = {*si*: *i* *ℕ*, *si* *ℙ*, *si* is a partial description of the way the world is at time *t*} where

1. ** is a consistent set

* A state of affairs at time *t* is a subset of a complete description of the world.at time *t*
* ***t* = ***t*: ***t* is a state of affairs at time *t*} is the Possible States of Affairs at Time *t*

Define a State Development, **, to be an ordered pair of states of affairs. ** = (***t1*, ***t2*) where:

1. *t1* < *t2*
2. ***t1****t1*, ***t2****t2*
3. (*s****t1*)[(*s****t2*⊬)  *s****t2*]
4. (*s****t2*)[(*s****t1*⊬)  *s****t1*]

» *A development of a state is one of its successor states. The differences between a state and its development are statements which may not be truly asserted for both the state and its development.*

* The conditions iii and iv are required here but not in the definition for state transformations because of the functional nature of the latter. The contents of the argument and output states there are therefore already appropriately related.
* Write **(*t1**t2*) and say that **[*t2*] is a Development of **[*t1*]
* As mentioned in the introductory material, all state transformations will result in state developments though not all state developments are the result of state transformations that may be defined in a non-*ad hoc* fashion. In particular, they are not necessarily or even usually the results of actions.
* It is convenient to adopt this way of talking about changes in states of affairs over time when we are not principally concerned with the causes of such changes but rather with their sociologically significant informational effects.
* Talking in terms of state developments allows us to avoid commitment to any limiting or confusing claims concerning causes.

Despite the distinction so emphatically drawn above between developments and transformations, it is appropriate to adopt much of the apparatus and vocabulary of generation, preservation, destruction, and conversion previously defined for the case of transformation to the case of development. The adaptation is straightforward: consider the development ** = (***t1*, ***t2*) as equivalent to the pair (***t1*, **(***t1*) for some notional transformation **.

* For convenience we may write **(***t1*) = **[*t2*] where confusion is unlikely
* Recall that for ** ***t1* and ***t2*are givens, so they may be omitted from the definitions given above for concepts applying to transformations.
* To maintain the distinction between transformations and developments, we may choose when speaking specifically of developments to make the following replacements:

Generate  Introduce,

Reproduce Preserve,

Destroy  Eliminate,

Convert  Drift.

***Information Flow***

A fundamental sociological interest in information is in how it is distributed in society.