

**Uses and functions
of a formal symbolic
language for codifying
behavioral contingencies**

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Characteristics of most formal symbolic languages

The symbols represent the discipline's basic units and concepts.

The grammar describes their relationships.

The vocabulary typically uses discrete units to codify continuous dimensions.

Examples of formal symbolic languages

- **The language of chemistry codifies atoms of elements and the bonds that connect and configure them;**
- **The language of music codifies notes and their pitch and duration;**
- **The language of mathematics codifies numbers and operations.**

Roles of formal symbolic languages

**The functions they perform
often accelerate progress
in their disciplines.**

**Some of these functions
include...**

The visualization function

The key function is making the discipline's basic units and their parameters *visually accessible.*

Examples of the visualization function

**In the symbolic language of music,
notes are basic units, and their
parameters include pitch and duration.**

**By making the parameters visually
accessible, the symbolic language makes
it possible to read and write music.**

Visualization of parameters in chemistry

The formal symbolic language of chemistry codifies the main parameters of atoms—like types of bonds that link and configure them.

By making these parameters visually evident, the language provides graphic representations of molecular structures and chemical reactions.

Visualization of behavioral contingencies

The simplest operant contingency,
“If **A** then **C**,” is codified as **A**→**C**

A is any act, response, or behavior.

C is a consequence, situation,
circumstance, or event.

Identification of parameters

The contingency language identifies, in a graphic and visually accessible way, the parameters of the contingency that can be manipulated and adjusted with a view to producing desired behavioral effects.

Some parameters of A and C in behavioral contingencies

Possible parameters of consequences:

**probability, magnitude, valence
(positive, negative, or neutral).**

Possible parameters of acts or responses:

rate, duration, magnitude.

How these parameters are codified

When applicable and relevant, a C's

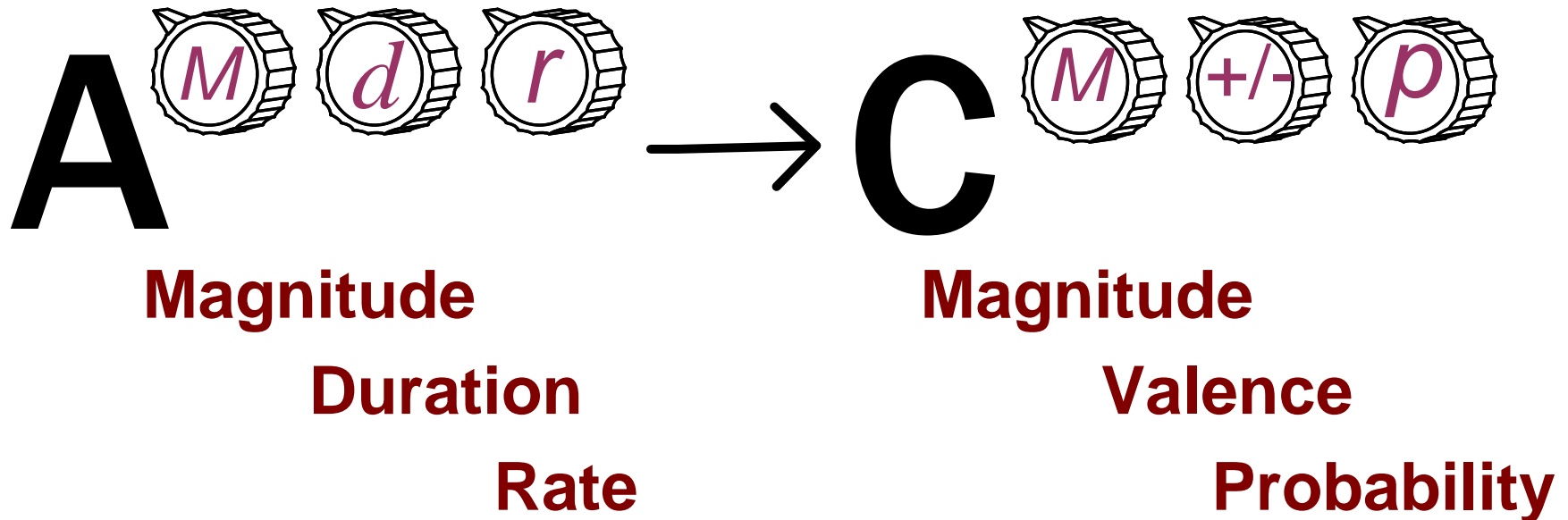
- probability is shown as C^p ,
- magnitude as C^M ,
- valence as C^+ or C^- ,

When applicable and relevant, an act A's

- magnitude is shown as A^M ,
- duration as A^d ,
- rate as A^r

The contingency diagram as a control panel

The parameters are shown here as knobs for setting or adjusting the parameters to produce the desired behavioral effects.



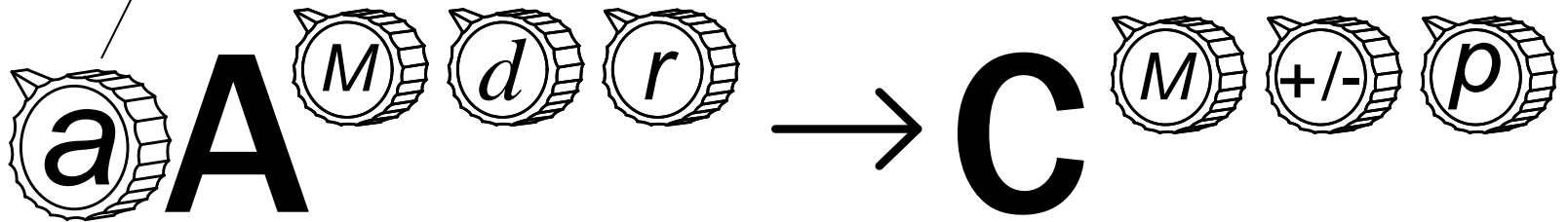
Why the knobs?

To emphasize the fact that adjusting the parameters and setting their values does not change the structure of the contingency.

The agent of act A

If relevant, the agent of an act can be designated by an arbitrary lower case letter, such as **a**, placed in front of the **A**. (Note that the agent is a parameter only when there are multiple parties.)

Party(ies)
that would
perform A



Time delays

The language also prompts consideration of the potential *delay* of the consequence **C**, codified as

$$\mathbf{T} \rightarrow \mathbf{C},$$

which means

“if and when time period **T** elapses, then **C** would occur upon its termination.”

Perception of consequences

For an operant contingency to have an effect on an organism, the organism must *perceive* the consequence of its behavior, **with or without “awareness” or “consciousness.”**

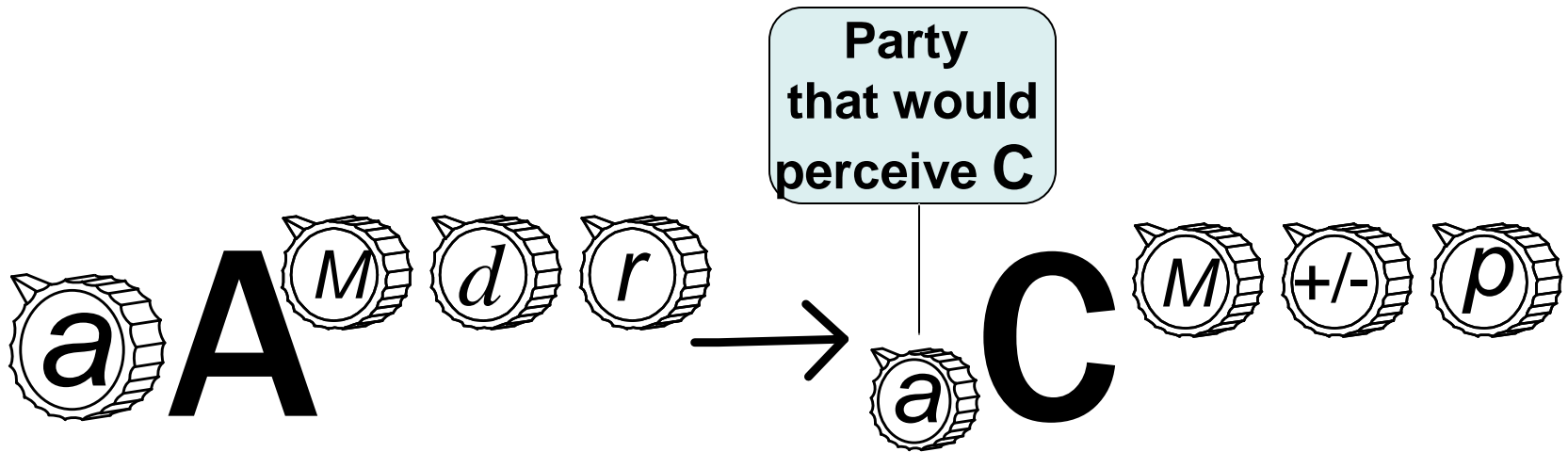
The “*would perceive*” modifier is therefore an implied parameter of any consequence C.

Notation of “would perceive”

To state explicitly that the agent of the behavior

would perceive a consequence,
the agent’s designation, *a*, is shown

in the C’s lower left quadrant: aC



Operant contingencies and prior history of exposures

The effects of an operant contingency on a subject can depend on:

- **the subject's prior history of exposure to the contingency and consequence.**
- **a prior verbal or non-verbal cue regarding the contingency and consequence.**

Prediction of consequences

The “*would predict*” modifier embodies all of the behavioral effects of these history variables, and is therefore another implied parameter of the consequence in operant contingencies.

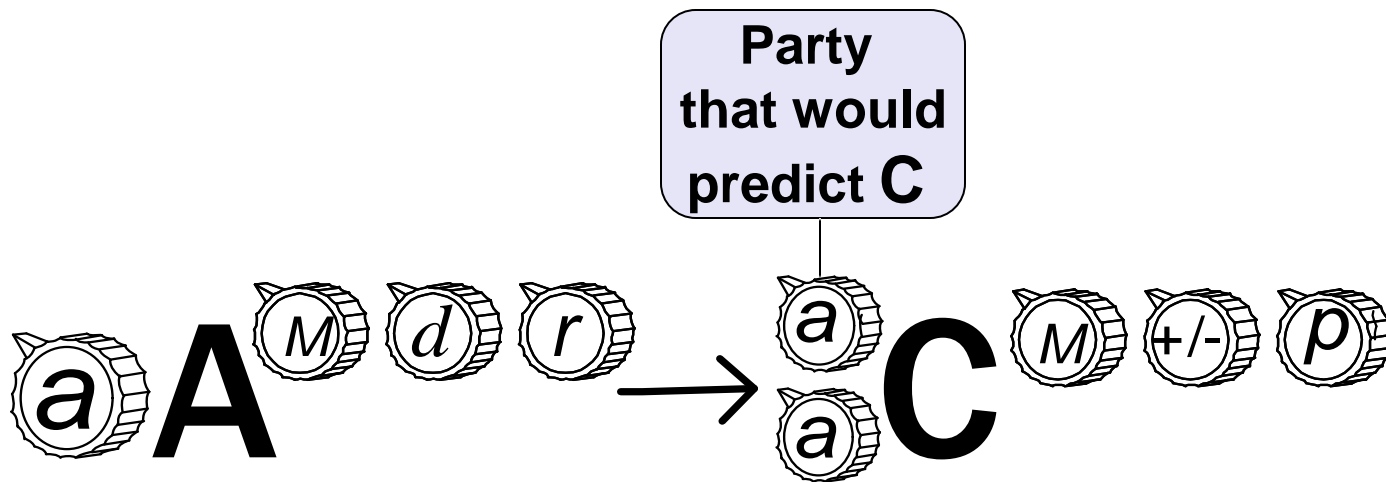
Behavioral meaning of “Predict”

By indicating that ***a*** “***would predict***” consequence **C**, the analyst states, in effect, that ***a*** would behave as if the consequence **C** would occur in these circumstances.

The possible behavioral effects may include stimulus control and reinforcing effects.

Notation of “would predict”

To state that the agent of the behavior *would predict* a consequence, the agent’s designation, **a**, is shown in the C’s upper left quadrant: **^aC**



Importance of the “would perceive” and “would predict” modifiers

In operant contingencies, “*would perceive*” and “*would predict*” are important parameters of consequences.

When the analyst shows a consequence without these parameters, its perception and history of exposures are usually assumed.

Behavioral effects of behavioral contingencies

In the behavioral contingency **A→C**

“If you pay \$2, you get a loaf of bread,”

A is paying \$2, and **C** is getting the loaf.

The contingency’s potential effects:

For the customer:

Buying or not buying the loaf.

For the store owner and baker:

Increasing or lowering its price

A contingency has effects even if the act never occurs

- **The price of the product (the contingency) often affects sales, buying patterns, and manufacturing practices (effects).**
- **The threat of getting a ticket (the contingency) often affects driving behavior and accident rates (effects).**

Independent variables versus their effects

**Most formal symbolic languages
codify only events and parameters
that can be controlled directly,
i.e., the independent variable.**

**Behavioral contingencies therefore
have more generality than their
myriad potential behavioral effects
(the dependent variables).**

Familiar examples

- ***If a musical score is played, music will result, but the actual sounds are not codified;***
- **The diagram of a chemical formula or reaction does not codify the behavior of resulting substances.**

Why focus on behavioral contingencies rather than on behavioral effects?

Because behavioral contingencies are independent variables that can be controlled.

The relationships of the units and their parameters can often be manipulated and adjusted to produce desired behavioral effects.

But these potential behavioral effects are not codified. Rather, they remain the subject of scientific research.

Behavioral contingencies versus empirical statements

An implied “*if*” precedes every act or response, because the language codifies only behavior that *can* occur, and its consequence *if it does* occur—

not behavior that *actually would* occur, or other effects of the contingency’s existence, as these would constitute dependent variables.

Value of the distinction

**The distinction is vital when
the goal is to analyze, explain,
or to influence results.**

**The usefulness of behavioral contingency
statements resides in their status as
the causal side of behavioral paradigms.**

Feedback from a contingency's effects to its definition

Organisms have evolved to be responsive to the consequences of their behavior.

Behavioral contingency statements, therefore reflect the organism's history, biological characteristics, capabilities, and present state.

Thus there is inevitable feedback from a contingency's effects to the history of the organism whose behavior is codified.

The distinction applied to the three-term contingency

$$\mathbf{S^D: R \rightarrow S^R}$$

This paradigm is not a pure contingency statement.

Its S^D and S^R terms both represent behavioral effects (i.e., the stimuli's discriminative and reinforcing effects).

Two ways to read the paradigm

“If response R occurs in the presence of an “S^D,” the result will be a behavioral effect called “reinforcement.”

or

“If response R is followed by stimulus S^R in the presence of a certain other stimulus, the behavioral effect will be that this other stimulus acquires a “discriminative” function.

Both are empirical statements.

Identifying the three-term contingency's parameters

To identify some of the three-term contingency's parameters, it must first be translated into the contingency language.

Why? Because the language makes the parameters visually evident, and separates these from the effects of the contingency's existence.

Translation of the three-term contingency

$S^D: R \rightarrow S^R$ becomes $\left[\begin{array}{l} C_D \\ A \rightarrow C^{+/-} \end{array} \right.$

This contingency statement is read as:

**“If act A occurs in the presence of C_D ,
the consequence would depend
on the definition of the Cs and
their histories for the parties.**

The valence of a consequence

$$\left[\begin{array}{l} \mathbf{C}_D \\ \mathbf{A} \rightarrow \mathbf{C} \text{ +/-} \end{array} \right.$$

The \mathbf{S}^D becomes \mathbf{C}_D .

The \mathbf{D} is now a subscript of the \mathbf{C} .

A legend would explain that \mathbf{C}_D is a prevailing stimulus, situation, or circumstance that was previously associated with act \mathbf{A} and its consequence. It is a statement about the \mathbf{C} 's history rather than about its behavioral effect, such as its “discriminative” effect.

The status of “reinforcement” in the behavioral contingency language

The concept of “reinforcement” cannot be part of the independent variable represented by a behavioral contingency because it refers to a particular behavioral effect of the contingency.

The act’s consequence S^R is shown simply as C with a valence (+ or -) —the analyst’s (optional) conjecture as to likely effects of the C, given the C’s definition in the legend.

The “valence” concept

A rigorous behavioral contingency statement would limit itself to an objective description of the C (like “food delivery” or “amount of money received (or lost’’)).

The term “valence” is not a technical term. Indicated valences do not represent clear behavioral effects of a C. The actual effects would remain empirical issues not addressed by the contingency statement.

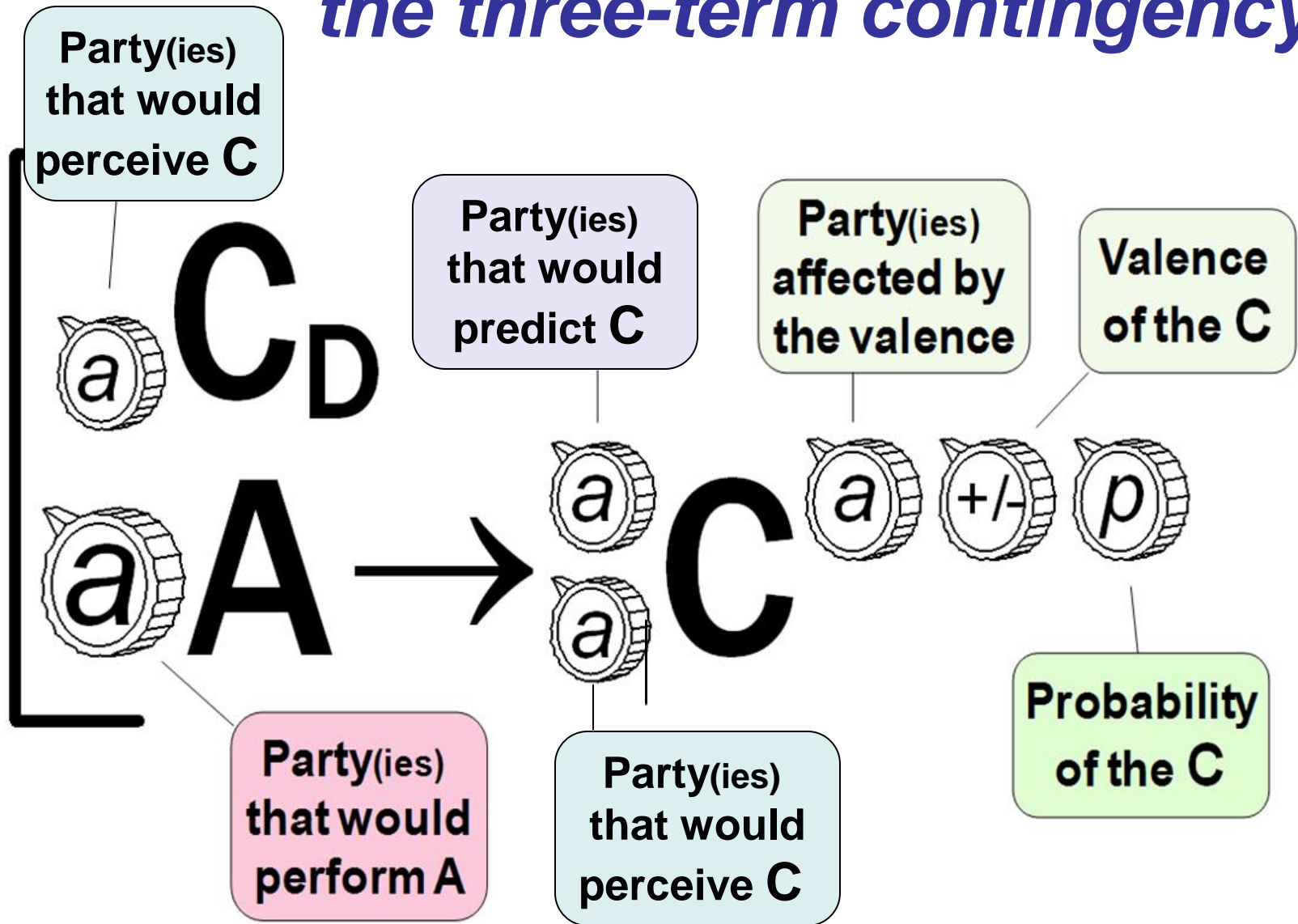
Notation of valence when there are multiple parties

The party or parties to which the valence would apply is shown in front of the + or - sign.

C^{a+} positive for **a**

C^{b-} negative for **b**

Some common parameters of the three-term contingency



The diagram defines a class

It shows the three-term contingency as *the general case* of many and varied particular contingencies that would be defined and distinguished by different values and combinations of parameters and by the many ways the particular acts and consequences can be described.

Example of a particular three-term contingency

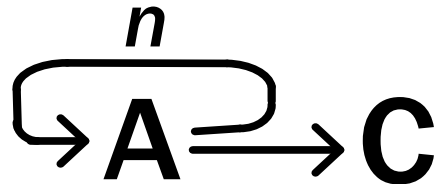
- **the act A is described as smoking**
- **the consequence C: getting lung cancer**
- **the valence for the act's agent: negative**
- **the probability: low**
- **the time interval: long**

Language features used

- The symbol \cap shows that both of two events would need to occur.

Thus $(A \cap T) \rightarrow$ means that both **A** and **T** are necessary.

- **Recycling:** Act **A** can occur n times.



An expression that combines these features

$$\left(\overbrace{\rightarrow aA_{\text{smoke}}}^n \cap T \right) \rightarrow$$

It is read as “If party **a** smokes **n** times,
and an amount of time **T** passes,
at the end of that time the
consequence would be...”

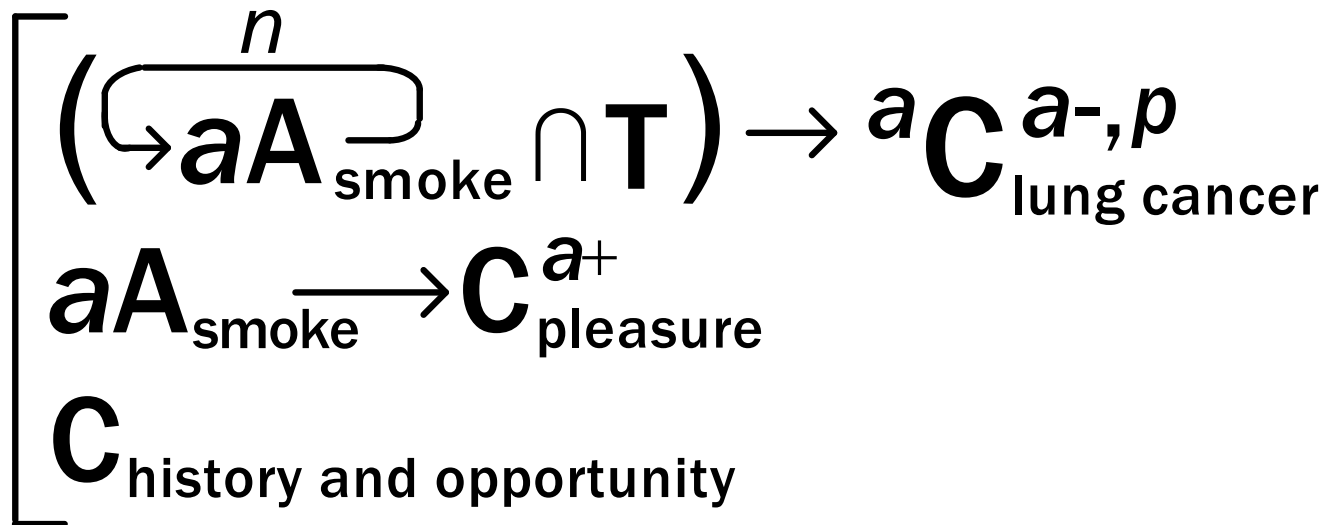
Additional specifications

Possible definitions of **T** may be elaborated in a legend to specify such details as exactly when **T** starts (e.g., with the first cigarette, with the last one, or after a certain number?) and/or how **T** may be a function of *n*, or how *p* may be a function of **T**.

The diagram and legend could also specify **A's** rate of occurrence or duration, if relevant.

Diagram of the smoking contingency

- The long-term consequence shown is getting lung cancer with probability p after time T .
- a would predict this consequence.
- The short-term consequence has a + valence.



Diagrams provide prompts for identifying parameters

Prompts can help analyze:

- **independent variables in experiments by identifying parameters that could function as uncontrolled variables.**
- **contingencies that occur outside the laboratory.**

Examples of prompts regarding the C

- Would the **C** be perceived and/or predicted by the agent of the behavior that produced the consequence? By another party?
- Would the **C** be delayed?
- What would be the **C**'s valence for each party involved in the contingency?
- What would be the probability of the **C**?

Another important function of formal symbolic languages

Recording, communicating, and memorializing a discipline's subject matter in terms that cut across all natural languages, with concise codifications that avoid the inevitable ambiguities and undesired connotations of verbal descriptions.

Pedagogic functions

**Formal symbolic languages
are important in pedagogy.**

**It would be inconceivable to teach
music without its symbolic language,
chemistry without chemical notation,
or mathematics without numerals.**

**In 1960, Jack Michael used an earlier
version of the present symbolic language
to teach introductory behavior analysis.**

***A third function:
Conceptualizing knowledge by
categorizing and grouping it.***

**The progress of disciplines is
often marked by the appearance
of new conceptual frameworks,
like the periodic table of elements.**

The conceptualization function of the contingency language

Behavioral contingency analysis can reveal structural parallels among seemingly diverse contingencies.

Behavioral contingencies can be grouped, categorized, and conceptualized on the basis of such structural similarities, as illustrated in the slides that follow.

Prevention contingencies

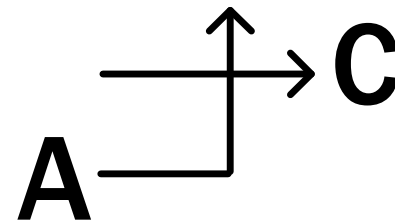
When the valence of the consequence would be negative:

escape, avoidance, averting, warning

When the valence of the consequence would be positive:

foiling, forfeiting, depriving, blocking

The diagrams for all of these include a vertical arrow cutting a horizontal arrow:



Recursive properties of quadrants

All modifiers also apply to the modifiers themselves, in recursive fashion, as a potentially infinite regress.

This recursive feature permits codification of the subtlest nuances of contingencies.

It is needed in the codification of ...

Deception contingencies

These are pervasive in the animal kingdom and include camouflage, disguise, impersonation, lying, stealing, tricking, seduction, lulling, stalking, obfuscation, pretense, entrapment, etc.

**They all involve
*misperception or misprediction.***

Misperception and misprediction

“*Would mispredict*” or “*would misperceive C*”

means “*would perceive or predict some consequence other than C,*” (as in an optical illusion, a history effect that overrides the contemporaneous reality, or a response to misleading cues.)

Codification of deception contingencies

a would *misperceive* C. $a^x C$

a would *mispredict* C. $a^x C$

The deceiving party *b* would *predict*
that the deceived party *a* would
mispredict C. $ba^x C$

A deception contingency

b would *predict* that *a* would
mispredict that it would get hurt.

$bA \rightarrow {}^b a^x C^{a-}$

Contingency created by deceptive advertising

The **b** in **bA** denotes the tobacco companies.

The **b** in ${}^b a^x$ indicates that **b** would predict that **a** would mispredict **C**_{lung cancer} along with its probability **p**.

$$\left[\begin{array}{l} \left(\overset{n}{\curvearrowright} \rightarrow aA_{\text{smoke}} \cap T \cap bA_{\text{advertise}} \right) \rightarrow {}^b a^x C_{\text{lung cancer}}^{a-,p} \\ C_{\text{history and opportunity}} \end{array} \right.$$

Theory of mind contingencies

**This category shares the feature of
a party perceiving or predicting
a perception or prediction,
(its own or that of another party),
in a recursive hierarchy.**

**Included in these contingencies are
the prisoner's dilemma, "false belief"
contingencies, and analyses of autism.**

Temporal and probability discounting contingencies

These include:

- **Addictions**
- **Degradation of the environment**
- **Costly borrowing.**
- **The smoking contingency described earlier falls into this category.**

Certain economic and financial contingencies

These contingencies have similar structures:

- **Pyramid (Ponzi) schemes**
- **Currency creation**
- **Creation of derivatives**
- **Securitization**
- **Formation and bursting of bubbles**

Contingencies that change

All contingencies change if and when the initiating act and its consequences occur.

When contingency changes are the intended focus, the formal symbolic language is able to codify how a contingency's parameters and consequences can change.

Conceptualization of contingencies that change

(either as a function of the passage of time, acts, or events)

Familiar examples:

- **The longer you wait, the worse it gets**
- **Windows of opportunity**
- **Running up debts**
- **Depletion of a resource**
- **Saving money**
- **Effects of smoking**

Cycling contingencies in which behavior lags behind perception

Locomotion (perception of upcoming terrain)

Reading (perception of upcoming words)

Listening (recall of recent sounds)

Copying text (recall of just-read text)

Some other conceptualizations based on shared behavioral structures

- **Zero-sum games**
- **Racing**
- **Cooperation contingencies**
- **Competition contingencies**
- **Contracts, agreements, promises**
- **Standoffs, deadlocks, mutual deterrence**
- **Choice situations**
- **Blackmail and kidnapping**
- **Feuds**

The value of categorization

Regardless of which, if any, of these particular categorizations and conceptualizations will prove useful, *it is clear that the behavioral sciences will always need to conceptualize the behavioral contingencies that lie at their core.*

Creation of linkages to other disciplines by conceptualizing some of their contingencies

- **Economics and finance**
- **Education**
- **Business management**
- **Government and public affairs**
- **Preservation of environment**

Summary of functions performed by formal symbolic languages

- **Visualization of parameters and relationships**
- **Identification of parameters**
- **Prompts for analyzing independent variables**
- **Recording and communicating subject matter**
- **Categorization and conceptualization**
- **Pedagogy**

The contingency language and the behavioral sciences

**It is likely that economics, education,
political science, management, and
other behavior-based disciplines
will eventually need the functions
of a formal symbolic language
to further their advancement.**