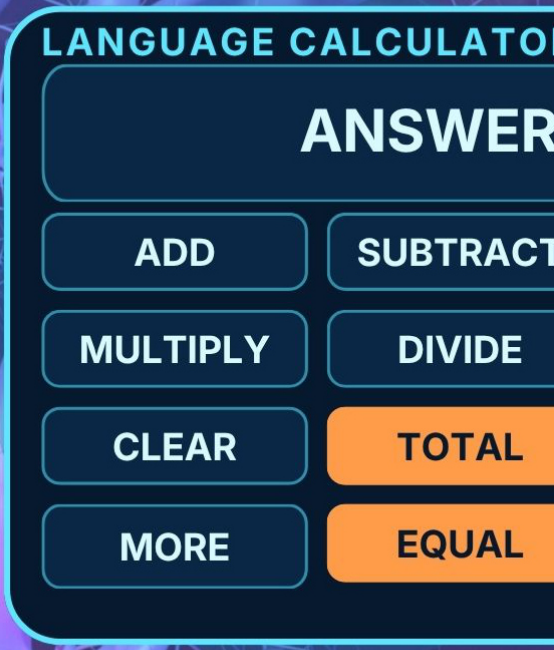
Exploring the *Language Calculator*



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Exploring the Language Calculator

By John Ball

A Pat Labs Publication

Pat Labs: Making AI Tools with Patom Brain Theory

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Who this book is for

The **Language Calculator** is a tool that demonstrates *Natural Language Understanding* or NLU. NLU converts text to its meaning, uses it, and facilitates conversation between humans and machines as a consequence. This is the companion guide to the tool, introducing the sections and content.

This book covers what is currently included in the Language Calculator tool, and some of the reasons for including it to illustrate how English works, since this book covers the English version only. Other books will cover their respective languages.

One of the goals of the tool is to help grow the capabilities through user feedback. Over time, we plan to extend the capabilities and demonstrations to align with the range of interactions people have with a machine that understands out language, so please provide feedback if you want to (**info@pat.ai** is a good email address for general comments).

Organization

The **Language Calculator** is divided up into 3 parts - ***semantics*** or the meanings of words and sentences, ***grammar*** or the use of sequences of word patterns to communicate meaning efficiently and effectively and ***discourse*** or pragmatics that interacts between language speakers to achieve our goals.

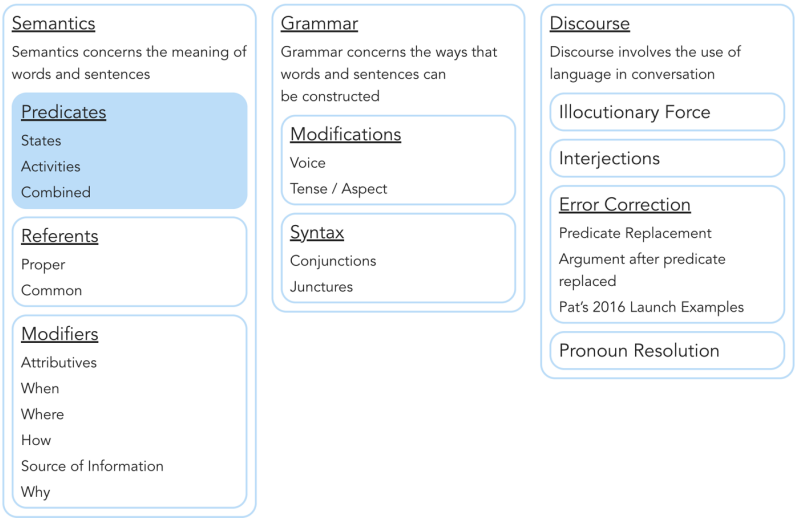

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Diagram 1 (above) shows the grouping of these elements with the categories that compose them immediately below.

By seeing the breakdown of sentences, you can see what is going on, rather than having it described to you. Our brains are excellent at recognizing patterns - a useful tool when learning how language works as in an NLU system! See if it makes language understanding easier than reading complex books in which theories are proposed that don't work in practice.

Background Discussion

Natural Language Understanding is a science whose role is to explain how language works so we can emulate it. Perhaps the most amazing capability in the universe is human language because it is so effective at describing *anything*, at least as far as our other sciences can tell us.

Science is written in human language to explain to others what it has discovered. Amazingly, it is like a time travel device in that we can read the words recorded thousands of years ago by the people at the time.

Linguistics is the science of how humans recognize and generate human languages, with specialties involving the sounds of speech (phonetics), the use of phrases to accurately group words (**syntax**) and the recognition of the meaning of those words in the phrases selected (**semantics**). All linguistics relies on **pragmatics**, the science of how context works - the use of the order of conveyed meaning in language to effectively communicate.

NLU relies on linguistics to explain how the world's languages interact and therefore what our brain is doing in general to use a language.

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SECTION 1:

SEMANTICS

Semantics concerns the meaning of words and sentences.

What makes up semantics? The building blocks I like to use, which reflect the meaning of the words, not the words themselves, are:

- **predicates** - these *relate* parts of a sentence and when verbs make up clauses and sentences most typically. In RRG these are built using the universal model, the layered structure of the clause (LSC). A sample LSC is "The girl saw the car."

- **referents** - these are *things* in the world. They are typically made from the RRG reference phrase (RP), that can also be used to build a clause by using nominal forms of predicates (nouns). A sample referent in an RP is: "The very tall woman."

- **modifiers** - these are adjectives and adverbs that extend the meaning of phrases including predicates (LSC) and referents (RP). Examples include time and space. A sample modifier in adverb (how) form is "evidently," and in adjective form is "evident."

- This section considers some of these elements in detail and, in particular, outlines many of the additional categories involved. Observations about how we can use these elements differs, further enabling accurate communications. The concept of an Aktionsart class, how a predicate performs in a language and what is and isn't possible, was the original driver behind these classes.

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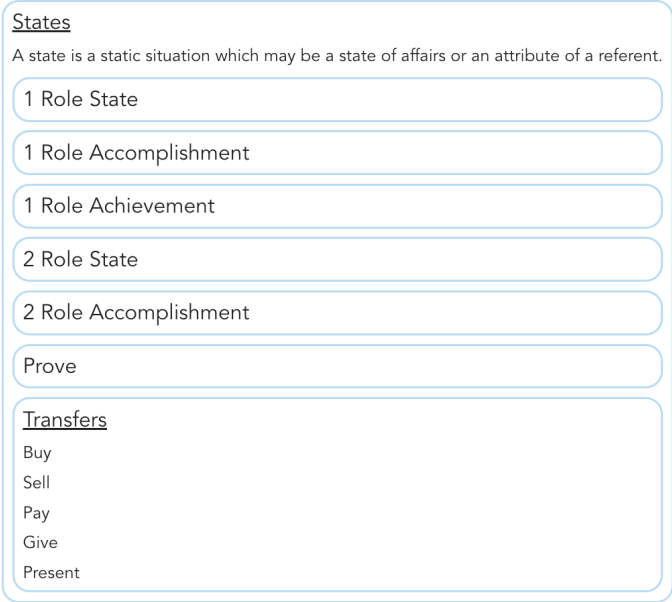
Predicates

Predicates relate their meaning with their arguments. For example, the predicate meaning 'black' can be associated with its argument, a tree in 'The fire made the tree **black**.'
Predicates limit the meaning of their arguments, provide a way to disambiguate the meanings of all the parts of the related elements.

The representation of the black tree is: **black'**(the tree).

States

States are comprised of a few classes that extend it and have a common range of properties. 1, 2 or more **arguments**? Changes of states that are instantaneous (**achievements**) or take some time (**accomplishments**). Each case is shown with a range of permutations in both conversational use and just as meaning representations.



1 Role State

The 1 role states shown below are 'annoy' and 'upset'.

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There are many different ways to package these up in a clause, such as in an LSC statement, question or command, an RP that includes gerund and infinitive forms that act like verbs and derived nominal and action nominal forms that behave like nouns. The RP can also be used in a cleft construction that adds a narrow focus item, something that can function as the answer to a question that is also extended by additional context.

Conversation

The dog upset the cat
Did the dog upset the cat
Was the cat upset by the dog
Is the cat upset
What is upset
What upset the cat

Meaning

Annoy
For the dog to annoy the cat was amusing
The dog annoyed the cat
It is the woman that the cat was annoyed by
It is the cat that the dog annoyed
To annoy the cat was inappropriate
It is the dog that annoyed the cat
The annoying of the cat by the dog was amusing
The cat is annoyed
It was the cat that was annoyed by the woman
The cat was annoyed by the woman
The dog's annoying the cat was amusing

Upset
The cat is upset
It is the woman that the cat was upset by
For the dog to upset the cat was surprising
It was the cat that was upset by the woman
The dog upset the cat
To upset the cat was clever
The cat was upset by the woman
It is the cat that the dog upset
It is the dog that upset the cat

1 Role Accomplishment

The 1 role accomplishment shown below is 'melt'. As melt can take a long time to complete to a new state, that temporal duration is a feature of an accomplishment.

Conversation:

The melting of the snow by the man was clever

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Did the man melt the snow
What was melted
Who melted the snow
Was the snow melted by the man

Meaning:
The man melted the snow
It is the snow that the man melted
For the snow to be melted by the man was clever
It was the snow that was melted by the man
The snow was melted by the man
It is the man that the snow was melted by
The man's melting of the snow was clever
For the man to melt the snow was clever
It is the man that melted the snow
To melt the snow was clever
The melting of the snow by the man was clever
The snow melted

1 Role Achievement

The 1 role achievement shown below is 'pop'. As pop takes no time to complete a transition to a new state, that temporal duration is a feature of an accomplishment. This time duration is cognitive, in that we know a balloon can pop slowly in some cases, such as when using a very high speed camera, but our language seems to represent it as an instantaneous change of state.

Conversation:
The balloon was popped by the cat
Was the balloon popped by the cat
What popped the balloon
What was popped
What did the cat pop
Did the cat pop the balloon
Did the balloon get popped

Meaning:
To be popped by the cat is unexpected
The balloon was popped by the cat
It is the cat that popped the balloon
What did the cat pop
It was the balloon that was popped by the cat
The balloon popped
It is the balloon that the cat popped
The cat popped the balloon
What popped
It is the cat that the balloon was popped by
To pop the balloon was amusing
The popping of the balloon by the cat was amusing

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The cat's popping the balloon was amusing
What popped the balloon
For the balloon to be popped by the cat was amusing
For the cat to pop the balloon was amusing
What was popped by the cat

2 Role State

The 2 role state shown below is 'see'. Both arguments of these predicates are presumed in a sentence made from them. "The man saw" alone begs the question of *what he saw!*

Conversation

The man saw the light
Who was the light seen by
What was seen
What did the man see
Was the light seen
Who saw the light

Meaning
The man saw the light
It was the light that was seen by the man
The light was seen by the man
It is the light that the man saw
It is the man that the light was seen by
It is the man that saw the light

2 Role Accomplishment

The 2 role accomplishment shown below is 'kill'. Both arguments of these predicates are presumed in a sentence made from them. "The man killed" alone begs the question of *what he killed*!

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Conversation

It is the octopus that the man killed
Who killed the octopus
Did the man kill the octopus
Who was the octopus killed by
Was the octopus killed by the man
What was killed

Meaning

It was the octopus that was killed by the man
It is the man that killed the octopus
It is the octopus that the man killed
The man killed the octopus
The octopus was killed by the man
It is the man that the octopus was killed by

Prove

The predicate 'prove' has some well known papers written about it and the range of ways it can be used. At one end is the word *proof*, a noun that refers to the written evidence that proves something, but it also means the activity of creating the evidence. At the other end of the spectrum is the verb *prove.* Modifiers can be seen to behave differently with similar variations. We can have 'a quick proof' but when a clause, we have, instead, 'something proved quickly.'

The number of examples for this showcases the range of variation possible.

Conversation

The savant proving the theorem astonished the professors
Who was astonished
What was proved
Who was the theorem proved by
Who proved the theorem

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Meaning

The quick proof was surprising
The quick proof by the savant was surprising
For the savant to prove the theorem was difficult
The theorem was proved by the savant
To prove the theorem was difficult
The quick proof of the theorem by the savant was surprising
It is the theorem that the savant quickly proved
The savant's proving the theorem was difficult
The theorem's quickly being proved by the savant was difficult
By who was the theorem proved
The savant quickly proved the theorem
Proving the theorem by the savant is difficult
It is the savant that quickly proved the theorem
The proof of the theorem by the savant was difficult
The quick proof of the theorem was surprising
Who was the theorem proved by
The savant proving the theorem astonished the professors
It was the theorem that was proved by the savant
What was proved by the savant
The savant's quick proof of the theorem was difficult
The savant quickly proved the theorem to the professors
That the savant quickly proved the theorem astonished the professors
To who did the savant quickly prove the theorem
Who did the savant quickly prove the theorem to
The savant's quick proof was surprising
The proving of the theorem by the savant was difficult
What did the savant quickly prove to the professors
The theorem having quickly been proved by the savant astonished the professors
Who quickly proved the theorem to the professors
It is the savant that the theorem was proved by
It is by the savant that the theorem was proved
The quick proving of the theorem by the savant was difficult
For the theorem to be proved by the savant was surprising

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BUY

The predicate 'buy' is one of the transfer verbs, including 'pay for', 'sell', 'give/take' and even 'present with'. These examples are probably the best examples of the accuracy possible in dealing with a large number of very precise differences in meaning used in language.

Conversation

The man bought the car from the dealer for one dollar for Beth.
Who bought the car from the dealer for one dollar for Beth.
What did the man buy from the dealer for one dollar for Beth.
Who did the man buy the car from for one dollar for Beth.
Was the car bought by the woman?
Did the man buy the car?
Who did the man buy the car from the dealer for one dollar for.
Was the car bought by the man?

Meaning

It is for one dollar that the man bought the car from the dealer for Beth
Buying the car by the man was silly
Who bought Beth the car from the dealer for one dollar
Beth was bought the car by the man from the dealer for one dollar
Who was bought the car by the man from the dealer for one dollar
Who bought the car from the dealer for one dollar for Beth
To buy the car was stupid
It is the man who bought Beth the car from the dealer for one dollar
It is Beth that the man bought the car from the dealer for one dollar for
Who was Beth bought the car by the man from for one dollar
What was bought from the dealer by the man for one dollar for Beth
It is the car that the man bought from the dealer for one dollar for Beth
What did the man buy Beth from the dealer for one dollar

SELL

Conversation

The man sold the car to the dealer
Who did the man sell the car to
Was the car sold
Who sold the car
Did the man sell the car to the dealer
Did the man sell the car
What did the man sell to the dealer

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Meaning
It is the car that the man sold to the dealer for one dollar
It was the car that was sold by the man to the dealer for one dollar
It is the man that the car was sold by to the dealer for one dollar
It is for one dollar that the man sold the car to the dealer
The car was sold to the dealer by the man for one dollar
The dealer was sold the car by the man for one dollar
It is by the man that the dealer was sold the car for one dollar
It is the dealer that the car was sold by the man to for one dollar
It is the car that the dealer was sold by the man for one dollar
It is the dealer that the man sold the car to for one dollar
The man sold the car to the dealer for one dollar
The man sold the car to the dealer for one dollar
It is to the dealer that the car was sold by the man for one dollar
It is to the dealer that the man sold the car for one dollar
It is the man who sold the car to the dealer for one dollar
It was the dealer that was sold the car by the man for one dollar
It is the man that sold the car to the dealer for one dollar
It is the man that the dealer was sold the car by for one dollar

PAY

Conversation
The man paid one hundred dollars to the dealer for the car
Who did the man pay one hundred dollars to for the car
Who was the dealer paid one hundred dollars by for the car
What was paid by the man to the dealer for the car
Who did the man pay
Who paid for the car
What did the man pay the dealer for
What was the dealer paid one hundred dollars by the man for
Who was the dealer paid by

Meaning
It is the man who the dealer was paid one hundred dollars by for the car
What was the dealer paid one hundred dollars by the man for
What was paid by the man to the dealer for the car
It is for the car that one hundred dollars were paid by the man to the dealer
It was the dealer that was paid one hundred dollars by the man for the car
It is for the car that the man paid the dealer one hundred dollars
It is one hundred dollars that the man paid to the dealer for the car
Who was paid one hundred dollars by the man for the car
It is the man that one hundred dollars were paid to the dealer by for

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the car
It is to the dealer that one hundred dollars were paid by the man for the car
The man paid the dealer one hundred dollars for the car
Who were one hundred dollars paid by the man to for the car
It is the car that the man paid one hundred dollars to the dealer for
One hundred dollars were paid by the man to the dealer for the car
It is the man that paid one hundred dollars to the dealer for the car
Who did the man pay one hundred dollars to the dealer for
Who did the man pay the dealer one hundred dollars for
It is the car that one hundred dollars were paid by the man to the dealer for
It is the car that the man paid the dealer one hundred dollars for
It is the car that the dealer was paid one hundred dollars by the man for
The man paid one hundred dollars to the dealer for the car
It is for the car that the man paid one hundred dollars to the dealer
Who did the man pay one hundred dollars to for the car
It was one hundred dollars that were paid by the man to the dealer for the car
It is to the dealer that the man paid one hundred dollars for the car
Who was the dealer paid one hundred dollars by for the car
Who paid the dealer one hundred dollars for the car
It is the dealer that one hundred dollars were paid by the man to for the car
It is the dealer that the man paid one hundred dollars to for the car
It is the man that paid the dealer one hundred dollars for the car
It is for the car that the dealer was paid one hundred dollars by the man
The dealer was paid one hundred dollars by the man for the car
Who were one hundred dollars paid to the dealer by for the car
It is one hundred dollars that the dealer was paid by the man for the car

GIVE

Conversation

The man gave the car to the dealer
Did the man give the car to the dealer
Is it the man who gave the car to the dealer
To whom did the man give the car
What did the man give to the dealer
Who did the man give the car to
Was it the car that the man gave to the dealer
Who gave the car to the dealer
Was it the dealer the man gave the car to

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Meaning
It is the car that the dealer was given by the man
It is to the dealer that the man gave the car
It is the man that the dealer was given the car by
The car was given by the man to the dealer
It is to the dealer that the car was given by the man
It is the car that the man gave to the dealer
It is the man that gave the car to the dealer
It is the man who gave the dealer the car
It was the car that was given by the man to the dealer
It is the dealer that the man gave the car to
The man gave the car to the dealer
It was the dealer that was given the car by the man
The man gave the dealer the car
The dealer was given the car by the man

Present

Conversation
The man presented the winner with the award
What did the man present the winner with
Is it the man who presented the winner with the award
Who did the man present with the award
Was it the winner the man presented the award to
Did the man present the winner with the award
Who presented the winner with the award
With what did the man present the winner

Meaning
It is the man that the winner was presented with the award by
It was the winner that was presented with the award by the man
It is by the man that the winner was presented with the award
The man presented the award to the winner
The award was presented to the winner by the man
The man presented the winner with the award
It is the man that presented the winner with the award
It is the award that the man presented to the winner
It is the man that the award was presented by to the winner
It is the award that the winner was presented with by the man
It is the winner that the award was presented to by the man
It is the winner that the man presented with the award
It is to the winner that the award was presented by the man
It is to the winner that the man presented the award
It is the winner that the man presented the award to
It is the man that presented the award to the winner
It was the award that was presented by the man to the winner
It is the award that the man presented the winner with

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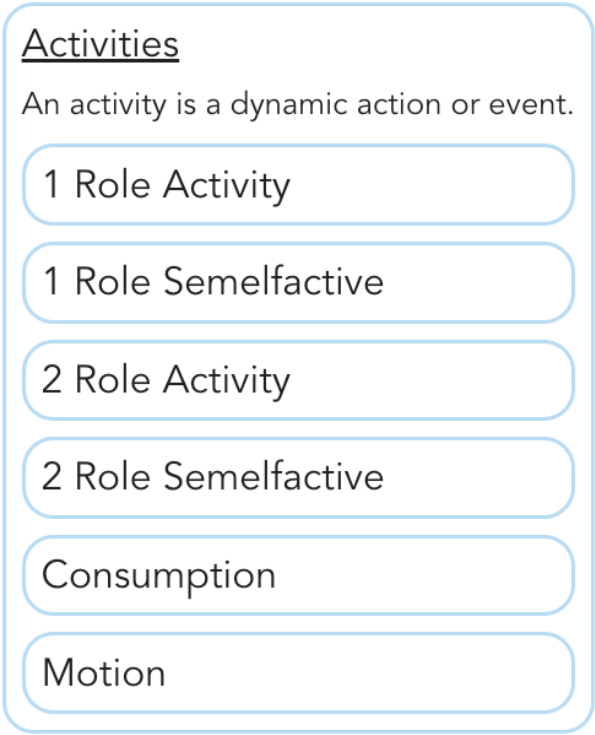
The winner was presented with the award by the man

Activities

Activities are another basic building block. As predicators (such as the verbs in a clause), these differ from the other basic building block, states, because the types of modifiers is quite different. They have a common range of properties. 0, 1, 2 or more arguments?

Classes of activities include semelfactives and active accomplishments. Semelfactives are instantaneous and can repeat. Active Accomplishments end with a result - a change of state. Each case is shown with a range of permutations in both conversational use and just as meaning representations.



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1 Role Activity

Classes of activities with a single role are shown below in the 'bathe' and 'cry' examples. Unlike states that don't have a progressive for 'The cat is being tall,' activities do: "The cat is running quickly."

Conversation

Bath

Mary gave the baby a bath
Did Mary bathe the baby
Who bathed
Who bathed it
Did the baby bathe

Cry

The soldiers cried
Who cried
Did the soldiers cry

Meaning

Bath

The baby took a bath
The baby had a bath
Mary bathed the baby
The baby bathed
Mary gave the baby a bath

Cry

The soldiers cried

1 Role Semelfactive

Classes of one role activities with no change of state are semelfactives as seen below in the verbs 'cough' and 'sneeze'. Semelfactives are an instantaneous activity that has no change of state. You do the activity and then things are as they were before.

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Conversation
The girl coughed
Did the girl sneeze
Did the girl cough
What did the girl do
Was it the girl who coughed
Who was it who coughed

Meaning
The girl coughed

2 Role Activity

Classes of activities with a two roles are shown below in the 'bite' examples. In this sample conversation, you can see the range of elements in a simple sentence like 'the shark bit the surfer.' While there are only 3 elements (a predicate and two arguments) we can ask questions about any of those elements in the order to place the relevant item in narrow focus.

If you are concerned with the original actor, 'the shark', you would ask "what bit the surfer" or "the surfer was bitten by what." or even "It was what that bit the surfer."

Conversation
The shark bit the surfer
Did the shark bite the surfer
Was it the shark that the surfer was bitten by
Who did the shark bite
Did the shark bite John
What bit the surfer
Who was bitten by the shark
Was it the surfer that was bitten by the shark
What did the shark bite
Who bit the surfer
Who was it that the shark bit

Meaning
The surfer was bitten by the shark
The shark bit the surfer
It is the shark that the surfer was bitten by
It is the shark that bit the surfer
It was the surfer that was bitten by the shark
It is the surfer that the shark bit

2 Role Semelfactive

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Classes of two-role semelfactives are shown below in the 'glimpse' examples. Here there are two arguments (man and light) with some activity that leaves no trace afterwards. What's the difference between a glimpsed light and one that wasn't?

Conversation

The man glimpsed the light
Whom was the light glimpsed by
What did the man glimpse
Was the light glimpsed
Was the sandwich glimpsed
Who glimpsed the light
Did the man glimpse the light
By whom was the light glimpsed

Meaning

The man glimpsed the light
It is the man that the light was glimpsed by
It was the light that was glimpsed by the man
The light was glimpsed by the man
It is the light that the man glimpsed
It is the man who glimpsed the light

Consumption

The consumption activity classes illustrate the change of state activities like 'drinking a large glass of beer' from those without an endpoint like 'dancing'. When you drink that large glass, the resulting state is an empty glass with the beer being consumed.

The 2 role example is 'eat' and its causative 3-role version is 'feed' (i.e. cause to eat).

Conversation

Eat

It is the food that the man ate
Was the food eaten by the girl
What was eaten
Was the surfer eaten by the man
Did the man eat the food
Who ate the food

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Feed

The man fed the children the food
Did the man feed the food to the children
The man fed who
Did the man feed the children
Who was the food eaten by
Who ate the food
Who did the man feed
Who were the children fed by

Meaning

Feed

It was the girl who the food was fed to the children by
It is the children that the girl fed the food to
It is the food that the girl fed to the children
It is the girl who fed the children the food
It was the children who were fed the food by the girl
The girl fed the children the food
It is the children that the food was fed to by the girl
It is to the children that the food was fed by the girl
It is the food that the children were fed by the girl
The food was fed to the children by the girl
It was the food that was fed to the children by the girl
The girl fed the food to the children
The children were fed the food by the girl
It is the girl who fed the food to the children
It is to the children that the girl fed the food

Eat

The girl ate the food
It is the food that the girl ate
It is the girl that the food was eaten by
It is the girl who ate the food
It was the food that was eaten by the girl
The food was eaten by the girl

Motions

The motion class is perhaps the most comprehensive one-role activity class, as it enables a wide range of distinctions to be made. There are the active accomplishment goals (source, destination, path, distance and so on) and a range of manners of motion with similar properties.

We start with the motion, 'march' and its causative form.

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Conversation
The soldiers were marched by the sergeant
Were the soldiers marched by the sergeant
Did the sergeant march the soldiers
Who was marched

Meaning
It is the sergeant who the soldier was marched by
The soldier was marched by the sergeant
It is the sergeant who marched the soldiers
It was the soldier who was marched by the sergeant
The sergeant marched the soldiers
It is the soldiers that the sergeant marched
The soldiers marched

Other (motion) Predicates

Each of these examples can be seen to share the range of sentences , but where was word form shows the manner of motion in its semantic representation (the Logical Structure or LS).

John tiptoed into the garden
John staggered into the garden
John limped into the water
John hiked into the garden
John jogged to the garden
John rushed into the garden
John sprinted into the garden
John ran into the garden

Climb

'Climb' is an activity that takes a defaul direction. You climb in the direction 'up'. But you can also climb 'down from a roof' or 'across a rockface'.

This combination of direction is worth further exploration.

The bear climbed past the barn
The bear climbed through the hole
The bear climbed around the house
The bear climbed over the car
The bear climbed the tree
The bear climbed down the tree
The bear climbed by the window
The tree was climbed by the bear

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Enter / Exit

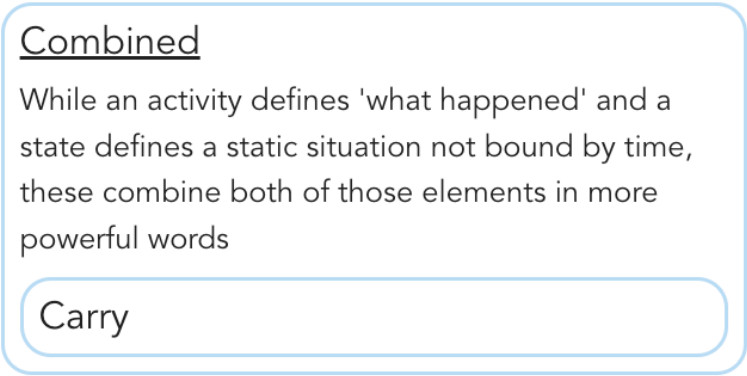
'Enter' and 'exit' are satellite verbs in contrast to motion verbs that incorporate manner. Languages use different interpretations, such as in Japanese when you enter a room it is an achievement (instantaneous) while in English it is an accomplishment, taking time. In English we can say "he entered the room slowly!"

The cave was entered by the bear
The bear exited the cave
The bear entered the cave through the hole
The cave was exited by the bear

Combined State and Activity

Some predicates seem to have a more complex interpretation as seen when talking to people and seeing what they understand by a statement in conversation. Perhaps this is inference or some kind of recognition of the possibilities of the real world.

This example combines the motion of the actor with the motion of the undergoers under the control of the actor!



Conversation
The girls were carried by the sergeant to the kitchen today in New York
Did the sergeant carry the girls to the kitchen yesterday
Did the sergeant carry the girls

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Did the sergeant carry the girls to the kitchen
Who was carried
Did the sergeant carry the girls to the kitchen today in London
Did the sergeant move to the kitchen
Did the girls move to the kitchen

Meaning

The girls were carried by the sergeant to the kitchen today in New York
The sergeant carried the girl
The girls were carried by the sergeant to the kitchen today
The girls were carried by the sergeant
The girls were carried by the sergeant to the kitchen

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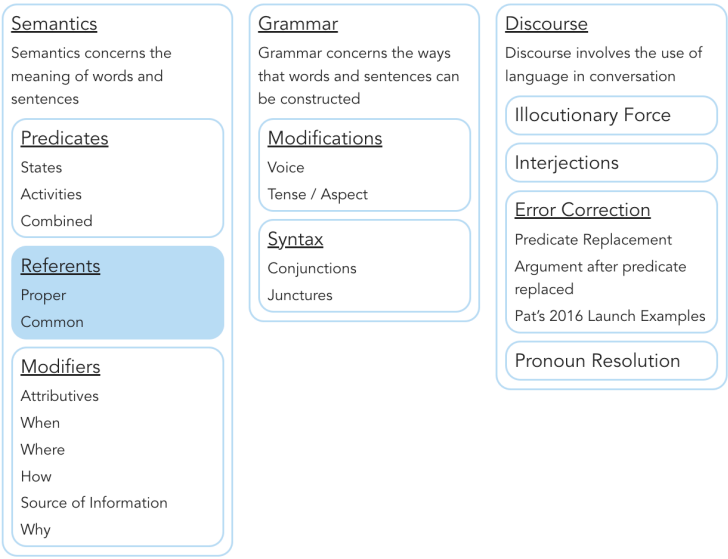
Referents

Referents are things like people, places and objects. They are often arguments as in the tree example: in 'The fire made the ***tree*** black.' The representation of the black tree is: **black'**(the tree). A key distinction is between categories of things (common) and specific individuals (proper).



Proper Names

Proper names label things with labels to help identify the **unique** things being referred to.

In human interactions, we distinguish between **specific** examples and **general** examples. When you meet your mother, her features are irrelevant to your knowledge of her. When you meet a new animal that is a dog, all of the characteristics of dogs is assumed.

In human brains, the specific examples help us determine the general.

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Proper

These are the specific objects we want to identify to talk about in context

- Names
- Places
- Companies
- Streets
- Cities
- Countries

Names

Names put an arbitrary connection between a word and its meaning, the thing it refers to. These categories work in combination of other naming conventions. In our discourse, one key system enables labelling of people, places and things in great detail (I call it the naming system) and another system enables their manipulation in highly accurate ways (I call this language).

Both systems, naming and language, share common features, but differ in key ways

Conversation

Roger, Stuart, Brad and James are working
Is Roger eating
Who is working
Is Charles working
Is Roger working

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Meaning

First Names

Connor is a person
Claire is a person
Michael is a person
Brad is a person
Charlie is a person
Ben is a person
Thomas is a person
Robert is a person
William is a person

Jennifer is a person
Roger is a person
Charles is a person
James is a person
Richard is a person
David is a person
Bryan is a person
Stuart is a person
Jesse is a person
Joel is a person
Van is a person
Joseph is a person

Full Names

Ms. Beth Carey is in the Big Apple
John Ball eats pizza

Places

Conversation

John went to SFO yesterday because he was tired
Did John go to SFO
Did John go to the Hilton
Did Beth go to SFO
When did John go to SFO
Why did John go to SFO
Where did John go
Who went to SFO

Meaning

The luggage is at The Hilton
Beth is going to Walmart
John is at Pat Inc
The woman is at Bondi Beach
John went to SFO

Companies

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Conversation
oneworld sold John a ticket
What company sold John a ticket
Is oneworld a company
Who sold John a ticket
Did oneworld sell John a ticket

Meaning
Pat Labs is a company
Qantas Airways is a company
oneworld is a company
Japan Airlines is a company
Alaska Airlines is a company
Sri Lankan Airlines is a company
Malaysia Airlines is a company
Cathay Pacific is a company
American Airlines is a company
Royal Jordanian is a company
S7 Airlines is a company
Royal Air Maroc is a company
Elemental Cognition is a company
British Airways is a company

Streets

Meaning
The office is on El Camino Real
The office is on California Street
The office is on Market Street
The office is on University Avenue
The office is on Mission Street
The office is on Sand Hill Road
The office is on Hacker Way

Cities

Conversation
John went to the Big Apple yesterday because he wanted to see the gardens
Where did John go
Where was John
Is John in NYC
When did John go to New York
Where is John

Meaning
Can you march the soldiers to the Windy City
The woman is in the Big Apple
I ate the fish in Los Angeles

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I want to go to New York

Countries

Meaning
Japan is a country
England is a country
Spain is a country
The United States is a country
China is a country
The United Kingdom is a country
Italy is a country
Australia is a country
Germany is a country

Common Names

Common names label things with labels to help identify the unique things being referred to by referring to its class or category. That ‘dog’ assumes a particular example of a dog is being referred to, for example.

We categorize the level above these common names (naming, not language) as similar to language, but with simple conventions that support the immediate recognition of new examples. by combining sequences of well-known phrases in which each element are similar.

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Common

These are categories of objects that enable us to quickly understand what unknown objects are so we can talk about them

- Animals
- People
- Artifacts
- Entities
- Pronouns
- Possessives

Animals

Meaning

The invertebrate is an animal
The mouse is an animal
The parrot is an animal
The amphibian is an animal
The fish is an animal
The dog is an animal
The reptile is an animal
The cat is an animal
The horse is an animal
The bird is an animal
The mammal is an animal
The monkey is an animal

People

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Meaning
A brother is a person
An uncle is a person
A mother is a person
A manager is a person
A sister is a person
An employee is a person
A parent is a person
An aunt is a person
A father is a person
A child is a person
An administrator is a person

Artifacts

Meaning
The axe is an artifact
The jewelry is an artifact
The artwork is an artifact
The ring is an artifact
The mummy is an artifact
The flute is an artifact
The instrument is an artifact
The tool is an artifact
The vase is an artifact
The relic is an artifact
The painting is an artifact
Pottery is an artifact

Entities

Meaning
The company is successful
The bus is late
The traffic is bad
The customer is buying a ticket
The idea is new
The person is happy

Pronouns

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Conversation

The flight is expensive because it is direct
Is it direct
What is expensive
Is the flight expensive
Why is the flight expensive
What is direct
Is it expensive
Is the flight direct

Meaning

Our flight is leaving tomorrow
My luggage is missing
The flight is expensive because it is direct
I need to book a flight

Possessives

Conversation

John's luggage is at the hotel
Where is John's luggage
Is John's luggage at the hotel
Does John have his luggage
Does John have luggage
What is at the hotel
Is John's luggage at the airport

Meaning

The passenger's luggage is on the plane
John and Beth's luggage is on the plane
John's luggage is at the hotel

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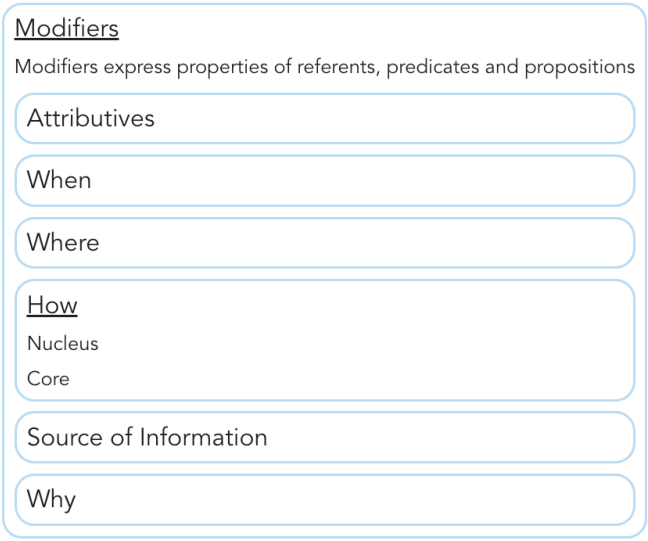
Modifiers

Modifiers express properties of referents, predicates and propositions. In reference phrases (RPs) the typical modifier is an adjective in English. In clauses, the typical modifier is an adverb or prepositional phrase, both of which are predicates.



Attributives

Conversation
Beth is happy
Beth is unhappy
Is John happy
Sue is not sad at the beach today because John is eating fish
Is Sue sad
Is Beth happy
Beth is happy
Who is happy
Beth is not happy
Who is eating fish

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Meaning
Is Beth hungry
Beth is not sad
Beth isn't happy
Beth is not sad at the beach today because she is eating fish
Beth is happy

When (temporals)

Conversation
The girls were eating when the soldiers were marched by the sergeant
Were the girls eating
When were the girls eating
Did the girls eat

Meaning
The sergeant moved today
The girl called while you were away
The girl called while you were gone
The girls were eating when the soldiers were marched by the sergeant
Did anyone call while you were gone
The girl called while you were absent

Where (locatives)

Conversation
A complex (subordinate) location
The girls were eating where the soldiers were marched by the sergeant
Where were the girls eating
Were the girls eating
Static and Resulting
The sergeant moved to the kitchen
Who moved to the kitchen
Where is the sergeant
Did the sergeant move to the garden
Is the sergeant in the kitchen

The infinite selection of a location based on another event
Beth moved where the man is happy
Where did Beth move

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How/Adverb

Nuclear

Meaning
The man continuously marches
The man continuously marches slowly evidently
The man slowly marches continuously
The soldiers were continuously marched slowly by the sergeant evidently
The man slowly marches continuously evidently
The man marches continuously

Core

Conversation
The man marches slowly
Who is it that marches slowly
Is it the man who marches slowly
Who marches slowly
Does the man march slowly

Meaning
The man quickly marches
The man ate the hamburger savagely
The man slowly marches

Source of Information

Conversation
Plainly, John is happy in the kitchen
Where is John happy
Is John happy in the kitchen
Is it John that is happy in the kitchen
Who is happy in the kitchen
Meaning
John is happy in the kitchen plainly
Beth is obviously not marching to the kitchen
Beth is continuously moving to the kitchen slowly apparently

Reason (Why)

Conversation
Plainly, John is happy in the kitchen
Where is John happy

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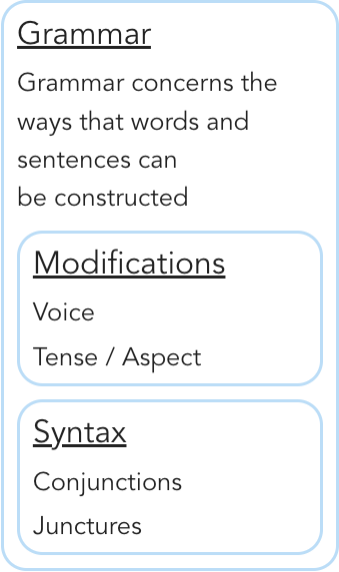
SECTION 2:

GRAMMAR

Grammar allows word sequence to provide useful generalizations of words to create far more accurate communications. The constraints of which words to use to compose a sentence starts the process of understanding language.



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Modifications

Voice

Conversation

The apples will have gotten eaten by the policemen
Who ate apples
Will the policemen eat apples

Meaning

Get

The apples have been getting eaten by the officers
The apples have gotten eaten by the policemen
The apples had been getting eaten by the officers
The apples get eaten by policemen
The apples had gotten eaten by the policemen
The apples got eaten by the officers
The apples have not gotten eaten by the policemen
The apples had not gotten eaten by the policemen
The apples will have been getting eaten by the officers
The apples will have gotten eaten by the policemen
The apples will not have gotten eaten by the policemen
The apples got eaten by the policemen

Be

The woman had eaten the sandwich
The woman ate the sandwich
The sandwich is being eaten by the woman
The sandwich isn't being eaten by the woman
The sandwich has been eaten by the woman
The woman is eating the sandwich
The sandwich is eaten by the woman
The woman eats the sandwich
The sandwich was eaten by the woman
The sandwich had been eaten by the woman

Tense/Aspect

Conversation

The woman eats the sandwich
Does the woman eat the sandwich
Is the woman eating the sandwich
Will the woman have been eating the sandwich
Did the woman eat the sandwich
Will the woman eat the sandwich
Has the woman been eating the sandwich
Had the woman eaten the sandwich
Will the woman have eaten the sandwich

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Has the woman eaten the sandwich
Will the woman be eating the sandwich
Was the woman eating the sandwich

Meaning
Beth hasn't been making the children eat sandwiches
The woman is eating the sandwich
Beth didn't promise the girl to buy a car from the dealer
Beth hasn't been persuading the girl to buy a car from the dealer
Beth has been making the girl happy
The woman had eaten the sandwich
The woman ate the sandwich
The woman eats the sandwich
The woman has eaten the sandwich
The woman has been eating the sandwich

Syntax

Conjunctions

Conjunctions allow the language to combine multiples in a word category to be used. In attributive sentences "The girl is tall, happy and sad.", in reference phrases "The moved, melted and popped moving, melting and popping balloon is carried." and many others, even whole sentences: "John is tall, Sue is fat and Beth is thin". The categories below allow you to see some of the range.

- Attributives
- Reference Phrases
- Conjoined Clauses

Junctures

These allow arguments to be shared between predicates

- Introduction
- Actor / Undergoer Sharing Example

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Conjunctions

Attributives

Conversation
The girl is tall, happy and sad
How is the girl

Meaning
The girl is tall, happy and sad
The girl is tall and happy

Reference Phrases

Conversation

Present Participle

The moving, melting and popping balloon is carried
What is carried

Past Participle

The moved, melted and popped balloon is carried
What is carried

Combined Past and Present Participle

The moved, melted and popped moving, melting and popping balloon is carried
What is carried

Combination of Modifiers

The cat, the dog and the boy ate the hamburger on the mat. They are tall. Where did they eat
Who is tall
Did the boy eat the hamburger
Did the dog eat the hamburger
Are they tall

Conjoined Clauses

Conversation
The man is happy, the woman is tall and John is unhappy
Who is happy
Who is tall
Who is sad
Is the woman happy
Is John happy

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Is the woman tall
Is the man happy

Junctures

Introduction

Meaning
Beth wants John to eat the fish
Beth is happy to see John
Beth is eager to buy a car from the dealer for John
Beth promised the girl to eat the sandwich
Beth is eager to see the car
Beth is eager to eat the sandwich
Beth wants to eat the fish
Beth made the girl buy a car from the dealer
Beth is easy to see
Beth made the children eat sandwiches
Beth is easy for John to see
Beth made the girl happy
Beth wants to be eager to have been seen by the man
Beth persuaded the girls to be happy

Actor/Undergoer Sharing Example

Meaning
Beth was promised by the girl to buy a car from the dealer
Beth promised the girl to buy a car from the dealer
Beth persuaded the girl to buy a car from the dealer
Beth was persuaded by the girl to buy a car from the dealer

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SECTION 3:

DISCOURSE

Discourse

Discourse involves the use of language in conversation

Illocutionary Force

Interjections

Error Correction

Predicate Replacement

Argument after predicate replaced

Pat's 2016 Launch Examples

Pronoun Resolution

Discourse involves the use of language in conversation.

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Illocutionary Force

Conversation
The woman eats the sandwich
Who ate the sandwich
What did the woman eat
Who was the sandwich eaten by
Did the woman eat the sandwich

Meaning
Please eat the sandwich
Will you eat the sandwich
The sandwich is eaten by the woman
The woman eats the sandwich
Does the woman eat a sandwich
Eat the sandwich
Is the sandwich eaten by the woman

Interjections

Conversation
John does mmm see the um savage dog
Does John see the dog
Did John see the dog
What does John see

Meaning
Can you mmm see the um savage dog
Can you um glimpse the dog
Oh can you see the dog
Can you see mmm the dog
Can you glimpse er the dog

Error Correction

Predicate Replacement

Conversation
John has, no is being glimpsed, no seen by the dog
Who is seen
Who was seen
Who did the dog see
Who is glimpsed

Meaning
Can you have, no be being glimpsed, no seen by the dog
Can you have been being glimpsed, no seen by the dog
Can you have, no be being glimpsed by the dog

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Can you be glimpsing, no seeing the dog
Can you glimpse, no see the dog

Argument after predicate replacement

Conversation
Beth was glimpsing the dog, no the cat the dog bit
was the cat bitten by the dog
who glimpsed the cat
who did the dog bite
who glimpsed the dog

Meaning
Can you glimpse the dog, no the cat
Can you be glimpsing the dog, no the cat the dog bit

Pat's 2016 Launch Examples

Conversation
Call Beth, no Samantha, no John, no text
Who is called
Was John called
Who is texted
Was John texted
Was Beth called

Meaning
Call Beth, no John
Call Beth, no text
Call Beth, no Samantha, no John, no text

Pronoun Resolution

Conversation
Beth arrived. She saw Sam. He kissed her
Who arrived
Who was Beth seen by
Who saw Sam
Who kissed Beth
Who was she kissed by
Was Beth kissed by him
Did Sam kiss Beth
Did Beth see him

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SECTION 4:

GDC*

Goal directed conversation (GDC) is an approach to the human-machine interface that emulates today's traditional graphical user intetface or GUI.

The purpose of a GUI is to enable most people to work their way through the requirements set by a programmer to solve a problem. We use a GUI to order airline tickets on the internet from an airline. The GUI uses a number of tools to signal what is needed. Sometimes a text box is shown with a label like "First name". The user normally takes the hint and types their first name in the box.

Sometimes there is a box, but when you click on it, a list of choices are seen. A user is invited to select one of the fields to complete that requested input, such as your age range: 0-12, 13-21, 21-65 and 65+. The mechanics behind a GUI is behind the world's online systems from banks to shops to games.

To make the transition to the next generation of AI as simple as possible, GDC exploits the existing, working and tested applications to quickly enable language and speech-based interactions, with integrated trust.

How can you trust a machine? GUI is already trusted as the result of the vast numbers of them, and the ability for payments and errors to be corrected by helpdesk staff as needed. In the same was a GUI shows your input for validation, so too is the GDC design using combinations ot text, speech and device monitors.

If GDC asks "what's your name" and you enter "I call myself John Samuel Ball" there is an obvious lack of trust without better feedback! But if the question also includes a visual display of TITLE, FIRST NAME, MIDDLE NAME and LAST NAME, for example, I am visually prompted to enter that meaningful data. But trust is aligned with the GUI model when the screen shows my name's elements in the displayed text boxes.

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I can then validate trust by fixing any errors, such as by saying, not 'Jon', but 'John, J-O-H-N.' If the display refreshes correctly, my trust is up to the current GUI trust of an application such as used by a bank.

Following on closely is the next level of trust that speeds up such interactions dramatically. It uses the concepts of the 'semantic web' or Web 3.0 as proposed by the English computer scientist, Tim Berners-Lee. By using the meaning representation of language to reference the fields, the system functionality becomes language independent and allows prompting of fields to rely on the user's native language without localization (in which a company adds different words depending on the language specified).

By using the meaning of fields, the user's system can store their personal data on their own device for use at their chosing. If they wish, they can permit their data to populate fields automatically to sped through a use case requesting data like personal details - name, address, phone number and so on. But with the full control of the user for privacy reasons, the system's trust is under the control of the user.

GDC Samples .

A number of GDC samples are available in the language calculator.

As the system is based on language, interactions focus on the use of language with the understanding that an existing application sits behind it. The goal of GDC is to prompt the user for what is needed using the best human interface - written or spoken language.

Each GDC is intended to be customized to an existing business' web site, but the principles can be explored here.

Templates emulate a physical store

A template is intended to perform a specific function in the same way a depertment stored used to position staff with specific skills around a department store. At the front door is a friendly greeter, who says hello and knows how to get to particular departments. Don't ask the greeter how long the warranty is on sock, because that's a different skill. In GDC, that's a different template!

When you go to a cashier, they can handle a number of payment methods, but they won't know the particulars of socks, either. The hosiery department will know all about socks, but perhaps not much else. That's the principle.

What does GDC do?

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In each of the GDC examples, the user is given two options

- enter their **request or information** with language or
- request a **prompt**, by entering nothing

Prompt or provide information. Don't expect a useful response to whether the current president likes ice cream or science, because that's not related to most goals.

But if you say, "My name is Mister John Samuel Ball" you should expect that the name is correctly recorded in the system for any uses needed, and formatted according to the developer's wishes with austomatic prompts for missing information.

Start a set of demonstration templates

To start a set of templates, enter 'start NAME' where NAME is the name of the collection. Examples are:

- **help** (e.g. start help)
- **sequence** (e.g. start sequence)
- **joke** (e.g. start joke)

in which there will typically be a greeting, some content in the middle, and an ending to close it. That's how people tend to structure their conversations as an expected use of context (also known roughly as pragmatics).

By starting with help, the template will provide some guidance.

Navigating a set of templates

To understand how a set of templates is setup, when looking at the Goal-directed Conversation page, after starting them, you can view their status with the 'TEMPLATES' button. This shows the default flow of each template amd the completion status.

If there is data to be gathered, the 'DATA VIEW' button will display the current status of data.

To request a prompt, press the 'SUBMIT' button without any text. To answer a prompt, you can type the content in any supported language. The interaction is intended to be natural, so complete sentences should maximise the interaction's speed. If sentences aren't fully recognized, the templates are typically designed to prompt for missing detail, as required.

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More Information

For more information on the Language Calculator, you can refer to the scientific elements that enable it.

Theoretical Brain Theory (Patom Theory / PT)

John Ball developed Patom theory until the late 1990s with the analysis of what we see brains do.

Rather than the commonly accepted computational model that drives digital computers, PT evolved to a model in which all that a brain needs to do is "store, match and use hierarchical, bidirectional linked sets of patterns made of just sets and lists."

To read more, you can check out :

- John's substack at https://johnsball.substack.com/ (John Ball inside AI) and
- Medium at https://medium.com/@john-at-pat.
- Videos and demonstrations are available on YouTube at
- https://www.youtube.com/@JohnBallAI and
- https://www.youtube.com/@patinc8841 and
- https://www.youtube.com/@patinc.

Linguistics (Role and Reference Grammar / RRG)

Robert D. Van Valin, Jr. is the primary developer of the linguistics framework known today as Role and Reference Grammar. RRG developed from a very scientific approach to language by starting with a clean slate and determining how languages work by studying the diverse range of languages available for study, rather than focusing on only one or two.

There are many (thick) textbooks on how RRG has evolved to date. Learning RRG is both challenging and rewarding, with a great introduction by Emma L. Pavey "**The Structure of Language**" (2010) and a recent 1000-page overview edited by Robert Van Valin in the "**Cambridge Handbook of Role and Reference Grammar**" (2023).

Readings on RRG can be found online at https://rrg.caset.buffalo.edu/ including introductions and a vast bibliography of research papers across a range of languages.

-- END --

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