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The Topic is *Open*

Libby Levison
University of Pennsylvania

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The Topic is *Open*

Abstract

We can **open a door**, **open an umbrella**, or **open a jar**; we **open the safe** (open the door of the safe), **open the cookies** (open the box and plastic pouch) and **open a valve** (turn the knob and open the pipe). I take *open* to mean CAUSE X TO BE OPEN and to describe the process of opening. given the diversity that occurs, is it possible to characterize the objects of a verb like *open*? In this paper I argue that there are similarities among the possible physical objects of the verb *open*, based on the objects; underlying geometric structure. This regularity, derived from an analysis of tokens extracted from the Brown corpus, is used in the remainder of the paper to analyze similarities amongst abstract use of *open*: (**open a meeting**, **open a gulf**). The proposed analysis also explain limits in usage: **#open the chair**; **#open the question**.

Comments

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THE TOPIC IS *OPEN*

Libby Levison
Department of Computer and Information Science
University of Pennsylvania
libby@linc.cis.upenn.edu

Abstract

We can **open a door**, **open an umbrella**, or **open a jar**; we **open the safe** (open the door of the safe), **open the cookies** (open the box and any plastic pouch) and **open a valve** (turn the knob and open the pipe). I take *open* to mean CAUSE X TO BE OPEN and to describe the process of opening. Given the diversity that occurs, is it possible to characterize the objects of a verb like *open*?

In this paper I argue that there are similarities among the possible physical objects of the verb *open*, based on the objects' underlying geometric structure. This regularity, derived from an analysis of tokens extracted from the Brown corpus, is used in the remainder of the paper to analyze similarities amongst abstract uses of *open*: (**open a meeting**, **open a gulf**). The proposed analysis also explains limits in usage: **#open the chair**; **#open the question**.

1 Introduction

We can:¹

- (1) a. Open a door.
- b. Open a jar.
- c. Open an umbrella.

which requires (1a) pulling or sliding the door; (1b) twisting off a lid; (1c) pushing a ring up a shaft.
We:

- (2) a. Open the safe.
- b. Open the cookies.
- c. Open a valve.

which requires (2a) turning a combination lock and a door handle; (2b) undoing both the cardboard box and any cellophane wrapping; (2c) turning a knob counter-clockwise. In addition, we:

- (3) a. Open a meeting.
- b. Open a discussion.
- c. Open a path through a forest.

The American Heritage Dictionary lists eleven definitions for the transitive use of *open*. WordNet [2], an on-line lexical database, identifies six separate senses of the verb (see Section 2.2). I am not interested in defining the verb myself, and have adopted Jackendoff's [5] definition of *open*: CAUSE X TO BE OPEN. Note that this definition is underspecified in that the action to be performed varies

¹Examples in Section 1–4 are simplified to illustrate the discussion. “Real” examples are examined in Section 5.

with different objects. I am interested in examining the permissible objects of *open*, and identifying what that set of objects tells us about the verb, as is relevant for a computational model.

In this paper I will ask two questions. First, is it possible to characterize the acceptable objects of a verb like *open*? Do doors, umbrellas, jars, *etc.* have something in common? Second, if it is possible to characterize the objects, what does the characterization tell us about the verb? Would it allow us to predict that *open* could be used with a novel object for which we had a geometric description?

My claim is that it is possible to characterize, in a computational model, the objects of the verb *open*. The paper proceeds as follows. I begin with a discussion of the physical objects of the verb *open*, and attempt to characterize what makes their usage acceptable. Using this characterization I examine some of the abstract objects that appear with *open* and describe some of the restrictions *open* imposes on its objects. In addition, I examine nouns which appear after the adjective *open*, but which can not appear as the object of the verb *open*. Examples extracted from an online corpus illustrate borderline cases, and I end the paper by noting a few exceptions to my analysis.

2 Framework

In this section I discuss issues of object reference, to avoid later confusion as to what the object of the verb is. I also present some initial definitions for *open*.

2.1 Object Reference

When we refer to an entity in the world, we can refer either to the entire object (the whole) or else a salient subpart of the object. *I.e.*, the lexical item which serves as the verb's object can mention either the whole or the part. If there is a jewelry box present, both (4a) and (4b) are acceptable: ²

- (4) a. Open the box.
- b. Open the top.
- c. #Open the hinge.

Note, however, that not all parts can be referred to, even parts associated in the action; (4c) is not acceptable.

In addition, at least with boxes, the verb's object can refer to the *contents* of the physical object (the box), as in (5).

- (5) a. Open the peanut butter.
- b. Open the milk.

The object often appears to be the *goal* of *open*. Intervening "layers" – both internal to the box (in the case where there is a interior cellophane wrapper) and external (wrapping paper around a box) – are handled automatically:

- (6) a. Open the cookies.
- b. Open your birthday present.

But with some restrictions:

- (7) a. Open the safe.
- b. Open the safe door.
- c. #Open the bars of gold.

In the following analysis, I will exclude certain objects of *open* from the study because they are licensed as objects through this inference process.

²The symbol # signifies that a sentence is semantically unacceptable. A ? signifies that a usage is questionable.

2.2 Six senses of *open*

The focus of this paper is not to define the verb *open*, but its objects. Therefore, I have adopted work by Beckwith *et. al.* in the WordNet system [2], an on-line, lexical database. Their definition of *open* identifies six separate senses:

6 senses of open

Sense 1: open, open up -- (start to operate; start to function; as of a business)

Sense 2: open, set in action -- (of meetings, speeches, etc.)

=> start, start up, begin, commence -- (as of an enterprise)

Also See-> open up

Sense 3: unfold, spread, open

=> undo, cause to become undone

Sense 4: open, become open, open up

=> change state, turn, fall

-- (undergo a transformation or a change of position)

Sense 5: open, open up, cause to open

Sense 6: open, make the opening move -- (in chess)

=> move, go -- (have a turn; make one's move in a game)

3 Physical *Openable* Objects

In this section I will discuss what types of *physical* objects appear with the verb *open*. By physical object I mean to differentiate between the more metaphorical uses of the verb, which will be addressed in Section 4.

3.1 Containers

The objects in (3) and (6) (boxes and safes) of Section 2.1 share the characteristic that they function to hold or contain something; these objects are of type CONTAINER. Other CONTAINERS include:

- (8) a. Open the can/bottle/soda.
- b. Open the crate/envelope.
- c. Open the paint can.
- d. Open the book.
- e. Open the house.

Regardless of the different physical movements a person must perform to *open* one of these items, all these nouns can occur as the object of the verb. Even a *book* can be seen as a CONTAINER, in the sense that it 'contains knowledge'. Therefore the first of *open*'s object types is CONTAINER.

3.2 Conduits: channels and paths

The category CONTAINERS however, does not explain all the objects of *open*, for example:

- (9) a. Open the door.
- b. Open the gate [in a fence].

While we might be able to construe the door as part of the room or building (so that we are, in effect, saying *open the house*), *open the gate* is more problematic. A gate in a fence does not imply a CONTAINER; instead, doors and gates fall into the categories of PORTALS (a passage between two spaces) and BARRIERS (an obstruction to a passage between two spaces). These two functional types

are inverses of each other; a closed door provides a BARRIER, while an open door provides a PORTAL. Consider:

- (10) a. Open the spigot.
- b. Open the valve.
- c. The Suez canal was opened in 1869.
- d. The mayor opened the Vine Street Expressway.
- e. The mine sweeper cleared the area and opened the channel for commerce.

While objects such as the spigot and the valve can be explained as BARRIER/PORTALS, the analogy does not quite extend through to the canal and highway cases. To handle these, I suggest instead viewing both valves and canals as types of CONDUITS, specifically, CHANNELS. A CONDUIT is something that leads an object from a particular starting point elsewhere. A CONDUIT has two options: either 1) it specifies the end point to which the object is being led, or 2) a directional component initiating at the starting point is specified. In both cases, the ‘sides’ of the CONDUIT restrict the lateral movement of the object. The spatial or geometric situation I am trying to evoke with this image is that a CHANNEL connect two points in space (the points may be areas or volumes), and a PATH takes data from a starting point in a specified direction. Then BARRIERS and PORTALS are variations of CHANNELS, i.e., where the distance between the endpoints is negligible.

The difference between CHANNELS and PATHS can be seen in (11) and (12).

- (11) a. The forester opened a path through the forest.
- b. The forester opened a path in/through the woods.
- (12) a. The ice breaker USS Alaska opened a passage to Antarctica.
- b. The ice breaker USS Alaska opened a passage through the ice.

The intended reading of (11b), ‘through the woods,’ is ‘among the trees’. Notice the similarities between the (a) sentences, and between the (b) examples. All four cases are CONDUITS; (11a) and (12a) are CHANNELS between two points in space; (11b) and (12b) are directed PATHS with a given direction. The second type of object that *open* can take is a CONDUIT.

There is a third type of objects which the verb *open* takes – TOOLS, or objects with a designed function. Examples are jack knives, crescent wrenches and umbrellas. This type will not be considered in this paper due to lack of space.

3.3 Restrictions – Delimitedness

Is it possible to *open* any CONTAINER or CONDUIT? Examples to the contrary are:

- (13) a. #Open a hole.
- b. #Open a gulf.
- c. #Open the sea.
- d. #Open a field/Plains.
- e. #Open a floor.

These objects do not lend themselves to *opening*. One problem is that we cannot envision what shape the resulting opening would have, since it does not have a fixed shape. This is to say that the ‘hole’ is not well-defined; it is ‘raggedy-edged’. This leads to a failure in predicting the size of the resulting opening; the opening is not well-delimited. (Well-delimited is distinct from well-defined; the first requires that the object be spatially bounded; the latter requires that the resulting object be pre-defined.) A CONTAINER itself restricts the size of a possible opening; the ‘walls’ of a CONDUIT limit the size of the BARRIER/PORTAL. Delimitedness is an important consideration in selecting the objects of *open*.

The reason that the examples in (13) are unacceptable can now be explained. *#Open a hole* describes beginning to carve an amorphous indent in the ground and is unacceptable due to the requirement for delimitedness. The same is true of *#open a gulf* which defines an indent in a shoreline (if, however, the meaning is to open a shipping channel across a gulf then the reading is fine). *#Open a field* not in the sense of allow people onto the field, but rather, begin clearing trees to create a field (perhaps ‘make a field’ describes it best), or *#open a floor*, are both unacceptable for the same reason – there is no default opening, the size and shape of the created opening are unpredictable. (Note that all of these are valid in adjective-noun form, eg, ‘an open field’.)

The issue of delimitedness carries over to CONDUITS:

- (14) a. #Open the wall.
 b. #Open the line/edge.
 c. ?Open the front lines.
 d. The Red Army broke through the front lines.

A CONDUIT must also be well-delimited to be *opened*; otherwise the resulting PORTAL is ‘raggedy-edged.’ Lines do not lend themselves to opening perpendicular to their length. *Break* does not enforce the same restriction; it can create an undelimited opening (if the front lines completely fall apart).

There is a difference when the object of *open* is a specific usage. The following definite uses of the same objects are noticeably better:

- (15) a. ?Open the hole.
 b. ?Open the gulf.
 c. ?Open the field/Plains.
 d. ?Open the floor.

These are specific objects, and the definite licenses their use as the object of *open*: as well as being definite objects, they have definite resulting openings.

With a well-delimited area, the following items can be opened:

- (16) a. The government opened Nebraska for settlers.
 b. Perry opened Japan in 1859.
 c. Open China for trade.
 d. He opened a wound in his leg.

Here (16a) has two senses, a permission sense (‘allow someone to *open*’), as well as the ‘provide access to’ interpretation. (16b) and (16c) also take the ‘provide access to’ reading, while (16d) indicates that it is possible to open unspecified, but well-delimited, volumes as well as areas.

3.4 Summary

In defining the physical objects of *open* for a computational model, we discovered two type categories: CONTAINERS and CONDUITS. CONDUITS have two subcategories: CHANNELS between two points and directed PATHS. Those objects which can not be *opened* are often undelimited spatially, or lack a directional component. In addition, objects referred to with a specific article, *i.e.*, which are delimited within their discourse segment, qualify as objects of *open*.

4 Extensions

In this section I consider more abstract objects for *open*. I begin by looking at extensions of CONDUITS and continue with temporal usages.

4.1 Abstract Usages

Most of the CONTAINER examples were presented in Section 3.3 in identifying the specificity and delimitedness factors. In this section I argue for the CONDUIT cases.

4.1.1 Channels

The simplest example of *open* licensing abstract objects are CHANNELS:

- (17) a. Open lines of communication.
b. Open the seas for trade.
c. Open the lights.

(17a) are whatever is aurally connecting the two speakers. (17b) implies not the vast area of the seas, but rather the shipping channels. (17c) is derived from the valve concept: opening the circuit allows the electricity to reach the lights, and is acceptable in certain American dialects, Modern Greek and Turkish.

The *lines of communication* usage is continued in:

- (18) a. Open a discussion/debate/exchange/discourse/negotiation.
b. Open the floor (for discussion).

In these usages, the communication is viewed as a CHANNEL between two (or more) discourse participants. Example (18b) is parallel to the ‘open the seas’ case; the floor here indicates an area which can be used as the object of *open* just in the case that it is traversed by a superimposed channel. In example (13e), the unspecific case, it was semantically unacceptable.

The examples in (17) differ crucially from the ‘negative’ examples below.

- (19) a. #Open a disagreement/argument/dispute.
b. #Open a war.
c. #Open a conspiracy.

In (19a) the connection between the two sides does not function as a CONDUIT (this malfunction alone could be the cause of the argument!). (19b) appears both undelimited and undirected; (19c) is undelimited. None of these examples are better if the object is specific: and these objects do have starting points, as can be seen when they appear with other verbs:

- (20) a. *Open the disagreement.
b. *Open the conspiracy.
c. Begin a war/argument.
d. Start a conspiracy/war.

But they lack either an endpoint or a directional component. This fact eliminates them as objects of *open*.

4.1.2 Paths

Examples of abstract objects of type PATH are in (21):

- (21) a. Open an inquiry/investigation.
b. Beryl Markham opened the way for women to become pilots.

Here the starting point is known, but the end point is not. However a specific direction is given which the event will follow. With a path directed towards a goal, the object is acceptable; the goal need not be known. Contrast this with (18a), in which there are two points between which the communication moves.

Removing the PATH component leaves the examples in (22) semantically unacceptable:

(22) a. #Open a question/consideration.

Questions, like inquiries, have starting points. But questions do not entail the concept of ‘progression forward’ that inquiries do.

In this section I have argued that the spatial requirements of delimitedness and directedness which were uncovered in examining CONTAINERS and CONDUITS carry over from physical to abstract objects. In the next section, I will look at temporal objects of *open*.

4.2 Temporal

The temporal objects behave differently than the CONTAINER and CONDUIT types. The delimitedness and directedness requirements, however, remain.

Periods of time that are delimited can be opened:

- (23) a. Clinton opened his day by jogging around Little Rock.
b. ...opened a month of negotiations.
c. Stores opened the 1991 Christmas season with massive sales.

Examples (23a and b) are unspecific temporal periods, which are delimited by the fact that the activity is in the past. In other words, the past tense usage serves to delimit the extent of the event. Unspecific, temporally undelimited extents are not *openable*:

- (24) a. #Open a day.
b. #Open a period.
c. #Open a project.
d. #Open a match.

But with a specific reading, or when the temporal object is defined by the discourse, the acceptability is improved:

- (25) a. ?Smith will open the period of ...
b. Open the project.
c. Brown will open the match with ...

This requirement is not enforced by all verbs; *begin*, for instance, allows:

- (26) a. Begin a period of regrowth.
b. Begin a project of urban renewal.

What licenses the temporal objects of *open*? First, they do not behave as CONDUITS: if they did, then *#open a period* should be acceptable in the same way that *open a path* is – being a directed path forward from a specific starting point (now). Nor are the temporal objects CONTAINERS, except in the abstract sense of being contained units of time. However, all temporal objects share, with the physical objects, the features of being both well-delimited and directed.

5 Real Data and Discussion

In the place of a formal discussion, the following examples from various newspaper texts with explication, will be used to summarize and illustrate my conclusions.

I examined tokens of *open* extracted from 400 million words of on-line text. The tokens broke down into 2497 adjective-noun occurrences, and 2655 verb-noun occurrences. Examining the nouns which appeared in one set and not the other (ie, when $\langle (det) open\ noun \rangle$ is acceptable but $\langle open (det) noun \rangle$ is not) provided the interesting cases considered below. The examples are presented grouped around certain objects which were initially tagged as possibly causing problems for the analysis.

1. Lines:

In the corpus, did the pair <*open*, line(s)> occur with a meaning other than “line of communication”?

Of the 43 cases of <*open*,line(s)>, 35 were lines of communication. The remaining examples are similar to:

- (27) a. He described a limited mission : “to open supply lines, get food moving and prepare way...
b. Against management’s advice, he opened breakfast lines at 20 cafeterias...

(27a) and (27b) carry readings of “begin to operate”.

2. Borders and Boundaries:

Following earlier discussion, we would expect that *open the border* would occur in the corpus, since the border encloses an area. *Open a boundary* is unlikely, and marks an extent rather than delimits an area. The corpus supported this hypothesis: *open a border* occurred frequently, but there were no occurrences of *open a boundary*.

3. Court:

Can ‘court’ be the object of *open*? ‘Open courts’ exist, but this implies an undelimited usage. The few cases that occurred in the corpus are similar to:

- (28) a. A judge who opened his court with a prayer...
b. The justices opened the court’s 1990-91 term with a flurry of activity.

In (28a) ‘court’ refers to the room or building; (28b) is a temporal usage where ‘court’ is not the object of *open*.

4. Gulf, Bay:

I argued that *opening a gulf* makes sense when the open describes establishing lines of trade across the gulf. Of course the other possible reading, as seen in (29a) is the ‘allow access.’

- (29) a. He promised to open the eastern gulf to oil and gas exploration.
b. NASA planned to open the payload bay Saturday.

(29b) illustrates the problem of polysemous words; ‘bay’ is ambiguous between CONTAINERS and bodies of water.

5. Position:

A position is another spatial entity which can not be *opened* because it is 1-dimensional. The only example which occurred in the corpus was a highly specialized (business) usage:

- (30) a. Nobody wants to open a large position around Christmas.

Open a position where position is a physical location did not occur.

6. Decision:

While discussions can be *opened*, decisions can not be. Decisions are the endpoint of a PATH, and objects which occupy a single point do not open. In (31b), the use of the discourse specific *that*, and the *for consultation* clause, which converts the decision from a point into a process, make this usage acceptable.

- (31) a. #Open a decision
b. They pray that the House open that decision for consultation with citizens who are ...

7. Issue:

Issues also can not be opened; there is no PATH leading to their description, they are, in ways, the starting point alone. The tokens in the corpus had a past, specific reading that possibly evokes a previous long PATH:

- (32) a. But now Intel has opened the issue again...

8. Conflict:

Conflicts fall into the same category as ‘arguments’. In the corpus, there were zero *open a conflict* tokens; the past, specific reading, however occurred frequently:

- (33) a. Tomahawk cruise missiles opened the Persian Gulf conflict in 1990.

9. Battle:

The expression *#Open a battle* is awkward; battles are undirected, as well as undelimited, events. Nor are they CONDUITS. However, in the past, when the result of the specific battle is known (*i.e.*, both end points are known):

- (34) a. Darman opened the annual budget battle by proposing a truce.
b. Top RJR Nabisco managers opened the takeover battle for the company...

10. Process:

I argued that *#opening a process* is unacceptable as it is an undirected, undelimited PATH. The corpus provided the following examples:

- (35) a. The appeal board was preparing to open a two-week process during which arguments...
b. ...inquiry into the future of nuclear power and open the nuclear power approval process to the public.

(35a) is a temporally delimited process; (35b) is delimited by virtue of being specific.

11. Race:

A race, like a process, is a PATH whose outcome is not known (neither direction, nor endpoint). Past usages, and specific readings, are acceptable:

- (36) a. The scheduling of debate opens a race to ratify the pact before Reagan meets with Gorbachev.
b. Gouws was attacked while helping to open a multiracial marathon race for handicapped people.

12. Opportunity:

As a final example: opportunities are like holes, undelimited, ‘raggedy-edged’ shapes which can not be opened. In the corpus, however, 13 tokens of *opportunity* were found – all tokens were past tense or very specific usages:

- (37) a. The Persian Gulf War opened a unique opportunity that the administration...
b. Research on oligomers and polymers 1-1-1-propellane that we have been engaged in for the past four years opened an interesting opportunity in the area of surface science: generation of an imaged organic thin film of a tough and extremely insoluble transparent polymeric coating of controlled thickness ...

6 *Open Problems*

Which is not to say that this explanation has not left a few questions unanswered. I have not discussed the `TOOL` category, umbrellas, for example, which *open* much the same as a flower does, which is perhaps the analogy.

And just in case this explanation makes sense, note that in the `FOOD` category, nothing is predictable. Few foods are openable:

- (38) a. #Open an egg.
b. Crack open an egg.
c. #Open a banana.
d. #Open an orange.

While most nuts are not acceptable, pistachios are an exception:

- (39) a. #Open a walnut.
b. Open a coconut.
c. Open a pistachio.

Nor can a characterization of openable objects be complete without *some* real-world knowledge. How else explain:

- (40) a. Open the oysters/clams.
b. #Open the mussels.
c. Steam the mussels open.

without pointing out that while oysters and clams can be eaten raw, mussels are always cooked. *Cooked-ness of shellfish* is a rather strange restriction for a verb to use when selecting its object.

7 *Conclusions*

In trying to describe a computational model for the objects of the verb *open*, I have argued for two of the three major `TYPES` into which the physical objects of *open* can be classed – `CONTAINERS` and `CONDUITS`. Factors of delimitedness and directionality derived from the physical objects limit the acceptability for abstract objects. Being able to describe both the physical and the abstract objects of *open* using the same set of criteria begs the question: Is this a single geometric specification for the objects of the verb *open*?

If it is, then the next question we must ask is: Can the approach be extended to other verbs? Is there a restricted set of possible objects for a verb? Is this form of analysis a valid method to explain the correlation between that set and the verb? Will this approach apply cross-linguistically?

Finally, if we can characterize the set of objects that occur with a verb, as I have for *open*, can that characterization predict whether a novel object can occur as the verb's object? In other words, given a geometric description of a new object, can we predict whether a native speaker will or will not use a specific verb to describe an action involving the object? This would imply that one factor in selecting the objects of a verb like *open* is the underlying geometric structure of the object. The use of a geometric description would have great influence on how, for example, children learn which verb to use in describing actions on certain objects.

I believe that there is a geometric preference influencing the selection of the objects of the verb *open*. As I have argued here, the objects are required to be of type `CONTAINER` or `CONDUIT`. Future work will investigate collapsing these two categories together: while there is good reason to do so for the physical objects, the justifications and feasibility is not as clear for the abstract cases. In addition, I hope to extend this method of analysis to other verbs.

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