Woodward 7
Woodward's Theory of Explanation

(pp. 187–204)

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Woodward's theory

Definitions

- An explanandum is what is to be explained.
- An explanans is what is claimed to explain the explanandum.

(EXP) (p. 203, simplified)

In a genuine explanation:

1. The explanandum is that a variable Y has the value y.
2. The explanans is:
   a. A variable X has the value x (initial or boundary conditions).
   b. A generalization G that relates X and Y.
3. G implies that when $X = x$ then $Y = y$.
4. There is an intervention on X with respect to Y that would change the value of Y, and G correctly describes the value Y would take under this intervention.

Explaining a pendulum's period by its length

1. Explanandum: Period T has value t.
2. Explanans:
   a. Length L has value l.
   b. $T = 2\pi\sqrt{L/g}$
3. Satisfied, provided $t = 2\pi\sqrt{l/g}$.
4. Satisfied. E.g., increasing the pendulum's length by stretching it is an intervention on L with respect to T that would change the value of T, and (b) correctly describes the value T would then have.

So (EXP) says this is a genuine explanation.

"Explaining" a pendulum's length by its period

1. Explanandum: Length L has value l.
2. Explanans:
   a. Period T has value t.
   b. $T = 2\pi\sqrt{L/g}$, or $L = gT^2/4\pi^2$.
3. Satisfied, provided $l = gt^2/4\pi^2$.
4. Not satisfied.
   - Changing T by changing L is not an intervention on T with respect to L.
   - There is an intervention on T with respect to L: Move the pendulum to somewhere g is different. This won't change L.

So (EXP) says this is not a genuine explanation.

Electric field example (pp. 187–188, 191–192)

Suppose a long straight wire has a positive charge uniformly distributed along it. Let λ be the charge per unit length on the wire. Then at a distance r from the wire, there is an electric field at right angles to the wire with intensity $\lambda/2\pi\epsilon_0 r$.

Explanation of this given in a physics textbook:

- Think of the wire as divided into segments so small that they may be regarded as point charges.
- The electric field at a point due to each of these small segments is calculated using Coulomb's law (a charge q creates an electric field at a distance s equal to $q/4\pi\epsilon_0 s^2$).
- The electric field due to the whole wire is calculated by integrating the contributions from all the segments. (This assumes the superposition principle: The total electric field is the sum of the fields due to the charges present.)
- This integration gives the result stated.

Application of (EXP)

1. Explanandum: Let E be the electric field intensity at point p; its value is $\lambda/2\pi\epsilon_0 r$.
2. Explanans:
   a. Let X specify the shape and position of the wire and the way electric charge is distributed on it. It has the value "Straight very long wire at a distance r from p with a uniformly distributed charge of λ per unit length."
   b. Coulomb's law and the superposition principle.
3. Satisfied (proved by integrating the contributions from all the small segments of the wire).
4. Satisfied. We can intervene on X with respect to E by changing the shape of the wire, the charge on it, and the distance of the wire from p; (b) correctly describes the value E would have in all these cases.

So (EXP) says this is a genuine explanation.

Raven example: DN argument (p. 187)

All ravens are black.
a is a raven.
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a is black.

1. Explanandum: Let C be *a*'s color. It has the value "black."
2. Explanans:
   a. Let S be *a*'s species; it has the value "raven."
   b. All ravens are black.
3. Satisfied.
4. Not satisfied. It is unclear what would count as intervening to make *a* not a raven. Furthermore, (b) does not say what the result of that would be.

So (EXP) says this isn't a genuine explanation.

Raven example: Genuine explanation (p. 204)

1. Explanandum: Let C be a's color. It has the value "black."
2. Explanans:
   a. Let B be the relevant biochemical reactions in a.
   b. Generalization about how the relevant biochemical reactions produce pigmentation.
3. Satisfied. The value of B together with the generalization will imply that a is black.
4. Satisfied. There will be interventions on B with respect to C that would change C, and the generalization will correctly describe the value C would then have.

Man taking the pill (p. 198)

No men who take birth control pills get pregnant.
Jones is a man who takes birth control pills.

Jones hasn't gotten pregnant

1. Explanandum: Let P be whether Jones has gotten pregnant. Its value is "hasn't gotten pregnant."
2. Explanans:
   a. Let X specify whether Jones is male and whether Jones takes birth control pills. Its value is "male and takes the pills."
   b. No men who take birth control pills get pregnant.
3. Satisfied.
4. Not satisfied. The generalization doesn't say what would happen if X were changed. Also, changing whether Jones takes the pill won't change P, and it is unclear what would count as changing whether Jones is male.

So (EXP) says this isn't a genuine explanation.

Objection (invented by me)

No men get pregnant.
Jones is a man.

Jones hasn't gotten pregnant

1. Explanandum: Let P be whether Jones has gotten pregnant. Its value is "hasn't gotten pregnant."
2. Explanans:
   a. Let M specify whether Jones is male. Its value is "male."
   b. No men get pregnant.
3. Satisfied.
4. Not satisfied. The generalization doesn't say what would happen if M were changed. Also, it is unclear what would count as changing whether Jones is male.

So (EXP) says this isn't a genuine explanation. But it seems that it is.

Questions

1. According to Woodward's (EXP), if we want to explain why a variable Y has the value y, what should the explanans say? What conditions must it satisfy to be a genuine explanation?
2. According to Woodward's (EXP), can the height of a flagpole be used to explain the length of its shadow? Can the length of its shadow be used to explain the height of the pole? Justify your answers.
3. The following are two statements made by Lange. For each, say whether Woodward would agree, and justify your answer.
   (a) *We might explain why a certain powder burns with green flames, rather than with flames of any other color, by noting that the powder is a copper salt and that it is a law of nature that all copper salts, when ignited, burn with green flames.*
   (b) *A given car's maximum speed on a dry, flat road could be explained by the distance of its gas pedal from the floor and the relation between this distance and the maximum speed. This relation is accidental (since it depends on how the car happens to be constructed.)*