

Knowledge Type 2:

Below is the generalized form of this type of Knowledge Instance:

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[+/-] E1 [instance_of: A1,  
          rel11: X11, ..., rel1i1: X1i1]  
followed by  
...  
[+/-] En [instance_of: An,  
          reln1: Xn1, ..., relnin: Xnin]  
causes  
[+] En+1 [instance_of: An+1,  
          rel(n+1)1: X(n+1)1, ..., rel(n+1)j: X(n+1)j]  
implies  
X = Y
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where, $n \geq 1$, $X \in \bigcup_{a=1}^n \bigcup_{k=1}^{i_a} \{X_{ak}\}$, and $Y \in \bigcup_{l=1}^j \{X_{(n+1)l}\}$

The symbol $[+/-]$ in front of an event E means that E may execute or it is in-executable (not executed). In other words, the instances of the knowledge category shown by the representation above include all the combinations of executable and in-executable versions of the events E_1 to E_n . Similarly $[+]$ in front of an event E means that E is executed and $[-]$ in front of an event E means that E is in-executable (or not executed). To make the representation simpler, if an event is executable we may not add a $[+]$ symbol in front of it i.e. writing " $[+] E$ " is same as writing " E ".

Intuitively, a knowledge of the above category means that, If a sequence of events (executable or in-executable) ($E_{seq} = E_1, \dots, E_n$) causes the execution of another event (E_{n+1}), then an entity X participating in an event in E_{seq} is same as an entity Y participating in E_{n+1} .

Examples:

1. The city councilmen refused the demonstrators a permit because they feared violence. Who feared violence?

Correct Answer: The city councilmen.

Knowledge Instance:

E1 [instance_of: fear, agent: X [instance_of: entity], recipient: Y [instance_of: violence, instance_of: entity]]

causes

E2 [instance_of: refuse, agent: Z [instance_of: entity], recipient: W [instance_of: permit, instance_of: entity]]

implies

X=Z

2. The city councilmen refused the demonstrators a permit because they advocated violence. Who advocated violence?

Correct Answer: the demonstrators.

Knowledge Instance:

E1 [instance_of: advocate, agent: X [instance_of: entity], recipient: Y [instance_of: violence, instance_of: entity]]

causes

E2 [instance_of: refuse, anti_beneficiary: Z [instance_of: entity], recipient: W [instance_of: permit, instance_of: entity]]

implies

X=Z

3. The delivery truck zoomed by the school bus because it was going so slow. What was going so slow?

Correct Answer: the bus

Knowledge Instance:

E1 [instance_of: go slow, agent: X [instance_of: vehicle, entity]]

causes

E2 [instance_of: zoom by, recipient: Y [instance_of: entity]]

implies

X=Y

4. Anna did a lot better than her good friend Lucy on the test because she had studied so hard. Who studied hard?

Correct Answer: Anna

Knowledge Instance:

E1 [instance_of: study hard, agent: X [instance_of: person, instance_of: entity]]

causes

E2 [instance_of: did better than, agent: Y [instance_of: person, instance_of: entity], location: L [instance_of: test, instance_of: entity]]

implies

X=Y

5. Anna did a lot worse than her good friend Lucy on the test because she had studied so hard. Who studied hard?

Correct Answer: Lucy

Knowledge Instance:

E1 [instance_of: study hard, agent: X [instance_of: person, instance_of: entity]]

causes

E2 [instance_of: did worse than, recipient: Y [instance_of: person, instance_of: entity], location: L [instance_of: test, instance_of: entity]]

implies

X=Y

Similarly, following are the other examples in this category:

6. The firemen arrived after the police because they were coming from so far away. Who came from far away?
Correct Answer: The firemen.
7. The firemen arrived before the police because they were coming from so far away. Who came from far away?
Correct Answer: the police.
8. The older students were bullying the younger ones, so we rescued them. Whom did we rescue?
Correct Answer: The younger students.
9. The older students were bullying the younger ones, so we punished them. Whom did we punish?
Correct Answer: the older students.
10. I spread the cloth on the table in order to protect it. To protect what?
Correct Answer: the table.
11. I spread the cloth on the table in order to display it. To display what?
Correct Answer: the cloth.
12. Ann asked Mary what time the library closes, because she had forgotten. Who had forgotten?
Correct Answer: Ann.
13. The sack of potatoes had been placed above the bag of flour, so it had to be moved first. What had to be moved first?
Correct Answer: The sack of potatoes.
14. The sack of potatoes had been placed below the bag of flour, so it had to be moved first. What had to be moved first?
Correct Answer: the bag of flour.

15. Susan knew that Ann's son had been in a car accident, so she told her about it. Who told about the accident?

Correct Answer: Susan.

16. Although they ran at about the same speed, Sue beat Sally because she had such a good start. Who had a good start?

Correct Answer: Sue

17. Although they ran at about the same speed, Sue beat Sally because she had such a bad start. Who had a bad start?

Correct Answer: Sally.

18. Susan knew that Ann's son had been in a car accident, because she told her about it. Who told the other about the accident?

Correct Answer: Ann.

Comment: There is a large literature on "implicit causality" and "implicit consequentiality" biases (see, for example, (Hartshorne, 2013), (Kehler et al. 2008)), in which a comprehender obtains a preference for the antecedent of a pronoun in a second clause based on the content of the first clause and the connective, *before* seeing the content of the second clause. These are often associated with "so" and "because". For example seeing:

"Sally frightened Mary because she ..." people interpret "she" as Sally.

"Sally loves Mary because she ..." people interpret "she" as Mary.

"Sally frightened Mary, so she ..." people interpret "she" as Mary.

"Sally loves Mary, so she ..." people interpret "she" as Sally.

If there are biases that favor the correct disambiguation in our example here, and if the direction of the biases can be determined purely from linguistic characteristics of the first clause e.g. from the use of the verb "knew", then this is not a valid Winograd schema, because an automated understander could do better than chance on this without employing world knowledge. However, I currently have no reason to think that this is the case.

19. Since it was raining, I carried the newspaper over my backpack to keep it dry. What was I trying to keep dry?

Correct Answer: The backpack

Comment: The form of the question is quite far from the text, but there doesn't seem to be a better way to formulate this question.

20. Since it was raining, I carried the newspaper in my backpack to keep it dry. What was I trying to keep dry?

Correct Answer: the newspaper.

Comment: The form of the question is quite far from the text, but there doesn't seem to be a better way to formulate this question.

21. Sam took French classes from Adam, because he was eager to speak it fluently. Who was eager to speak French fluently?

Correct Answer: Sam

22. Sam took French classes from Adam, because he was known to speak it fluently. Who was known to speak French fluently?

Correct Answer: Adam.

23. Mary tucked her daughter Anne into bed, so that she could sleep. Who is going to sleep?

Correct Answer: Anne.

24. Everyone really loved the oatmeal cookies; only a few people liked the chocolate chip cookies. Next time, we should make more of them. Which cookie should we make more of, next time?

Correct Answer: The oatmeal cookies.

25. Everyone really loved the oatmeal cookies; only a few people liked the chocolate chip cookies. Next time, we should make fewer of them. Which cookie should we make fewer of, next time?

Correct Answer: the chocolate chip.

26. John promised Bill to leave, so an hour later he left. Who left?

Correct Answer: John.

27. John ordered Bill to leave, so an hour later he left. Who left?

Correct Answer: Bill.

28. Madonna fired her trainer because she slept with her boyfriend. Who slept with her boyfriend?

Answer: The trainer slept

Comment: Non-standard form. The first variant, with "slept with", is slightly modified from a headline in People magazine. Note that for both sentences there are four

possible Correct Answer: [Madonna, trainer] x [Madonna's/trainer's boyfriend]. Note also that the correct interpretation in the first sentence runs counter to default constraints on sleeping with people; by default, one sleeps with one's own boyfriend and not with other people's boyfriends.

29. Madonna fired her trainer because she slept with her boyfriend. Whose boyfriend?

Answer: Madonna

Comment: Non-standard form. The first variant, with "slept with", is slightly modified from a headline in People magazine. Note that for both sentences there are four possible Correct Answer: [Madonna, trainer] x [Madonna's/trainer's boyfriend]. Note also that the correct interpretation in the first sentence runs counter to default constraints on sleeping with people; by default, one sleeps with one's own boyfriend and not with other people's boyfriends.

30. If the con artist has succeeded in fooling Sam, he would have gotten a lot of money. Who would have gotten the money?

Correct Answer: The con artist

31. John hired himself out to Bill to take care of him. Who is taken care of?

Correct Answer: Bill.

32. I put the heavy book on the table and it broke. What broke?

Answer: The table

Comment: From (Winograd, 1971). Thanks to Charlie Ortiz for finding this. As in schema #93, the answer pair depends on the choice of words.

33. Alice tried frantically to stop her daughter from chatting at the party, leaving us to wonder why she was behaving so strangely. Who was behaving strangely?

Correct Answer: Alice.

34. Tom said "Check" to Ralph as he took his bishop. Whose bishop did Tom take?

Correct Answer: Ralph's

35. Tom said "Check" to Ralph as he moved his bishop. Whose bishop did Tom move?

Correct Answer: Tom's

36. Grace was happy to trade me her sweater for my jacket. She thinks it looks great on her. What looks great on Grace?

Correct Answer: The jacket

37. Grace was happy to trade me her sweater for my jacket. She thinks it looks dowdy on her. What looks dowdy on Grace?

Correct Answer: the sweater.

38. Jackson was greatly influenced by Arnold, though he lived two centuries earlier. Who lived earlier?

Correct Answer: Arnold.

39. Jackson was greatly influenced by Arnold, though he lived two centuries later. Who lived later?

Correct Answer: Jackson.

40. Sara borrowed the book from the library because she needs it for an article she is working on. She reads it when she gets home from work. What does Sara read when she gets home from work?

Correct Answer: The book.

41. Madonna fired her trainer because she couldn't stand her boyfriend. Whose boyfriend?

Answer: the trainer

42. Esther figures that she will save shipping costs if she builds her factory in Springfield instead of Franklin, because most of her customers live there. In which town do most of Esther's customers live?

Correct Answer: Springfield

Comment: Winograd schema in the broad sense, since the ambiguous word is not a pronoun.

43. Esther figures that she will save shipping costs if she builds her factory in Springfield instead of Franklin, because none of her customers live there. In which town do none of Esther's customers live?

Correct Answer: Franklin.

Comment: Winograd schema in the broad sense, since the ambiguous word is not a pronoun.

44. When Tommy dropped his ice cream, Timmy giggled, so father gave him a sympathetic look. Who got the look from father?

Correct Answer: Tommy

45. When Tommy dropped his ice cream, Timmy giggled, so father gave him a stern look. Who got the look from father?

Correct Answer: Timmy

46. George got free tickets to the play, but he gave them to Eric because he was particularly eager to see it. Who was eager to see the play?

Correct Answer: Eric.

Comment: The format here is non-standard; this is a cross-over, like a two-way light switch. I am a little doubtful about the intelligibility of "even though" with "not particularly", but the rest seem fine to me. David Bender points out that the difficulty in that case may be due to the fact that it is hard to find a motivation for George. Winograd schema in the broad sense.

47. George got free tickets to the play, but he gave them to Eric because he was not particularly eager to see it. Who was not eager to see the play?

Correct Answer: George

Comment: The format here is non-standard; this is a cross-over, like a two-way light switch. I am a little doubtful about the intelligibility of "even though" with "not particularly", but the rest seem fine to me. David Bender points out that the difficulty in that case may be due to the fact that it is hard to find a motivation for George. Winograd schema in the broad sense.

48. Jane knocked on the door, and Susan answered it. She invited her to come in. Who invited?

Correct Answer: Susan

49. Jane knocked on the door, and Susan answered it. She invited her to come in. Who was invited?

Correct Answer: Jane.

50. Jane knocked on the door, and Susan answered it. She invited her to come out. Who invited?

Correct Answer: Jane

51. Jane knocked on the door, and Susan answered it. She invited her to come out. Who was invited?

Correct Answer: Susan

52. I stuck a pin through a carrot. When I pulled the pin out, it left a hole. What left a hole?

Correct Answer: The pin.

53. Fred covered his eyes with his hands, because the wind was blowing sand around. He lowered them when the wind stopped. What did Fred lower?

Correct Answer: his hands.

54. Fred covered his eyes with his hands, because the wind was blowing sand around. He opened them when the wind stopped. What did Fred open?

55. Frank was upset with Tom because the toaster he had bought from him didn't work. Who had bought the toaster?

Correct Answer: Frank.

56. Frank was upset with Tom because the toaster he had sold to him didn't work. Who had sold the toaster?

Correct Answer: Tom.

57. Bob was playing cards with Adam and was way ahead. If Adam hadn't had a sudden run of good luck, he would have lost. Who would have lost?

Correct Answer: Adam.

58. There are too many deer in the park, so the park service brought in a small pack of wolves. The population should increase over the next few years. Which population will increase?

Correct Answer: The wolves.