

## Pattern of Next-Step Hint

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This document summarize pattern of hinting found in the next-step hint sequences from 1999 Jan. experiment. There are 10 next-step hint sequences as shown in Table 1. The 6 out of 10 hint sequences consists of only a single hint. Even though 207-P2-01 holds two hints, it is counted as a single hint sequence, because the first hint (PP-E(A)) seemed not play a significant role in the sequence, but rather the tutor apparently just repeated what the student had already asserted (and what is only asserted). Remaining 4 hint sequences were the subject of analysis below.

**Table 1: Sequence of Next-Step hints**

205-P2-04	AW-P( $Y \rightarrow X$ )	PP-R( $X'$ )	AC-W( $((X' \rightarrow)X)$	PP-R(X)	PP-R(A)	AC-R( $((A, X \rightarrow)B)$
208-P2-03	AW-P( $Y \rightarrow X$ )	PP-R( $X'$ )	PP-R(Y)	PP-R(Z)		
207-P1-01	AW-P( $DE \rightarrow B$ )	AW-P( $DE \rightarrow B$ )				
209-P4-03	AC-W( $((F \rightarrow)D)$	PP-R(B)				
207-P2-01	PP-E(A)	AW-P( $Y \rightarrow X$ )				
202-P1-01	AW-P( $DE \rightarrow B$ )					
202-P2-02	AW-P( $Y \rightarrow X$ )					
203-P1-02	AW-P( $DE \rightarrow B$ )					
208-P1-04	PP-P(E)					
208-P2-02	PP-E(M)					

### 1. How did a hint sequence get started?

Only one hint sequence (209-P4-03) started at a fringe of student's assertions. The tutor seemed to apply some kind of selection mechanism for the target of hint sequence to start other 3 hint sequences, but the criterion for such decision making is not clear.

### 2. Did a hint sequence go from general to specific?

It's not such a simple matter.

First of all, a hint sequence in our analysis corresponds to a sequence of hints provided *spontaneously* by the tutor. Namely, when a student asked a hint on next-step, the tutor provided a series of hints that did not stop

even when the tutor heard a correctly response. In other words, the hints might be put in a row not only due to a failure, but also based on a plan of hinting for multiple steps.

*I do not think that model tracing tutor provides a sequence of next-step hints for multiple steps spontaneously.*

*On the other hand, human tutor may have a plan for hints over several consecutive steps, and provide a sequence of hints spontaneously.*

What happened when a hint failed?

The hint is considered to be failed when the student's response is either wrong, long pause, or to request further help.

When a hint failed, the tutor took one of the following strategies:

To increase directness by change the focus of hint from whole to specific (i.e., either premise or conclusion). (205-P2-04 x2, 208-P2-03)

To change the target of hint by proceeding a step *backward*. (208-P2-03 x2)

To repeat the same hint (in a case that the student seemed to misinterpret the hint). (207-P1-01)

What happened when a hint succeeded in a planed hint sequence?

When a hint succeeded, the tutor always proceeded a step *forward*. (205-P2-04 x2, 209-P4-03)

### 3. Summary

Human tutor might be capable of providing a sophisticated hint that is not only to change the level of abstraction but also to change

We need more cases. Hint for justification must be analyzed, too. To some extent, next-step hint and justification hint are similar; they are both a hint provided when a student couldn't make a necessary assertion.