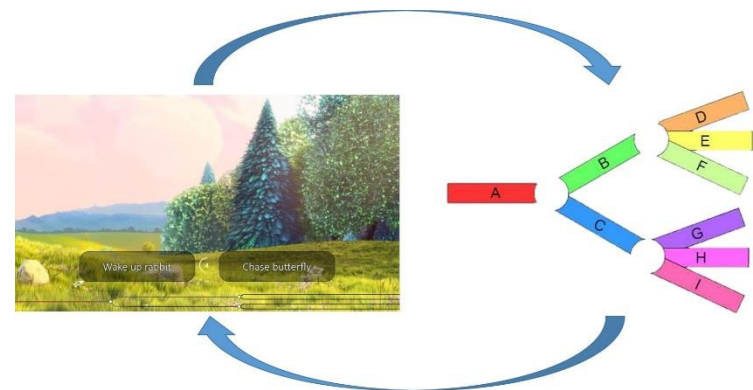




# Generalized Playback Bar for Interactive Branched Video

Eric Lindskog, Jesper Wrang, Madeleine Bäckström, Linn Hallonqvist, **Niklas Carlsson**

*Proc. ACM Multimedia, Nice, France, Oct. 2019.*



We have all seen a movie where we may have wanted our favorite character to make a different choice...

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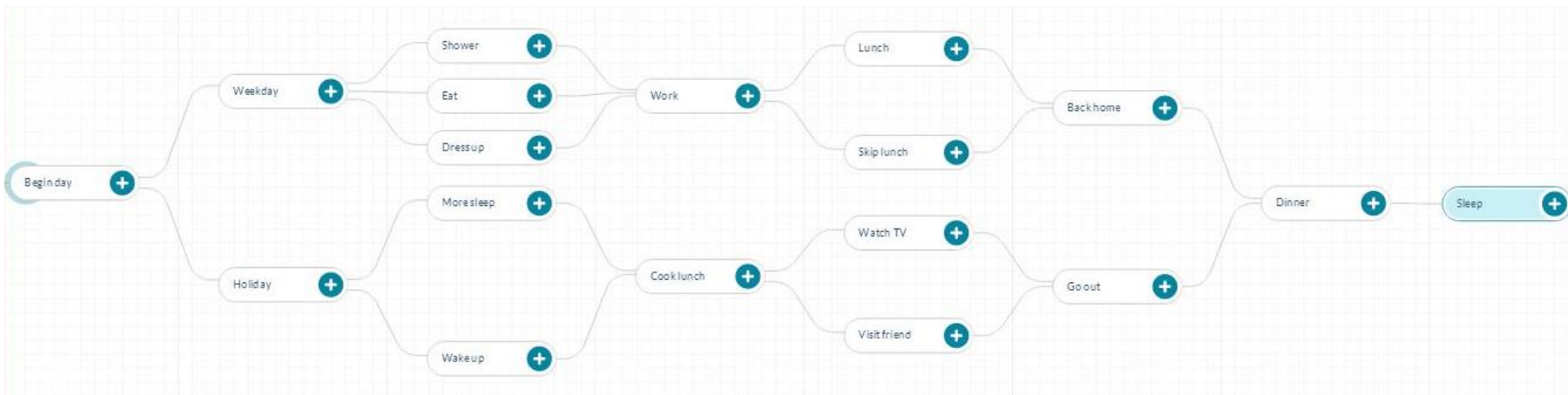


We have all seen a movie where we may have wanted our favorite character to make a different choice...



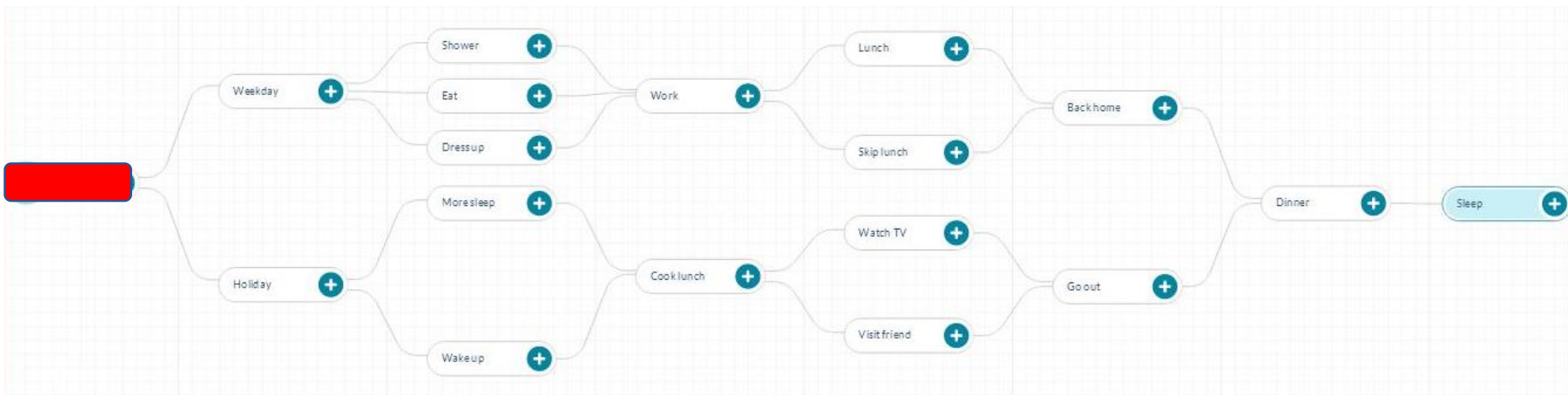
... or that we would be more in control of their choices.

# Interactive branched streaming



- Clickable objects allow the user to make viewing choices that impact the storyline
- 
-

# Interactive branched streaming

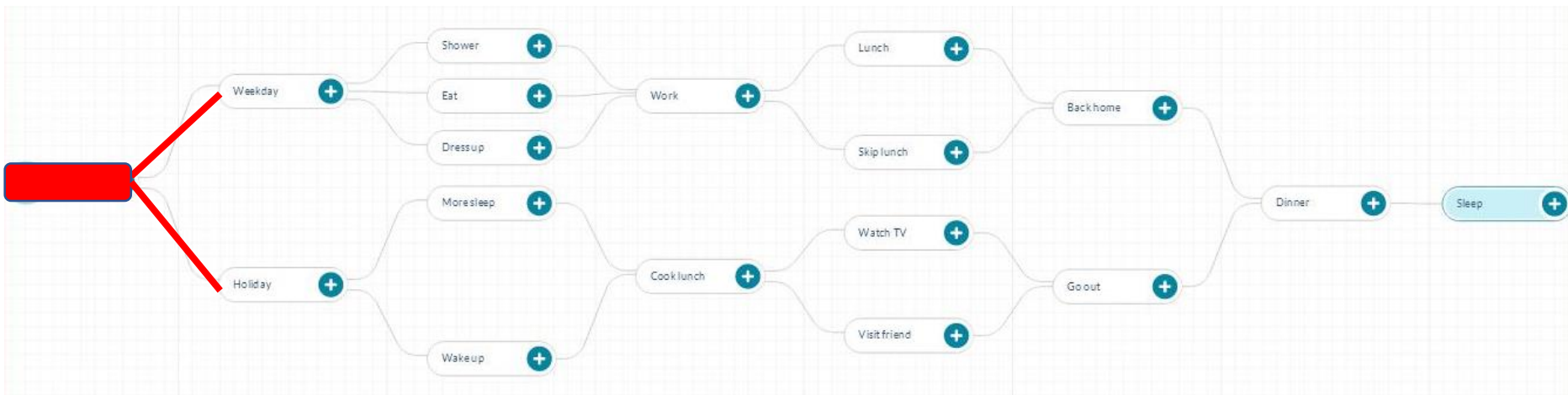


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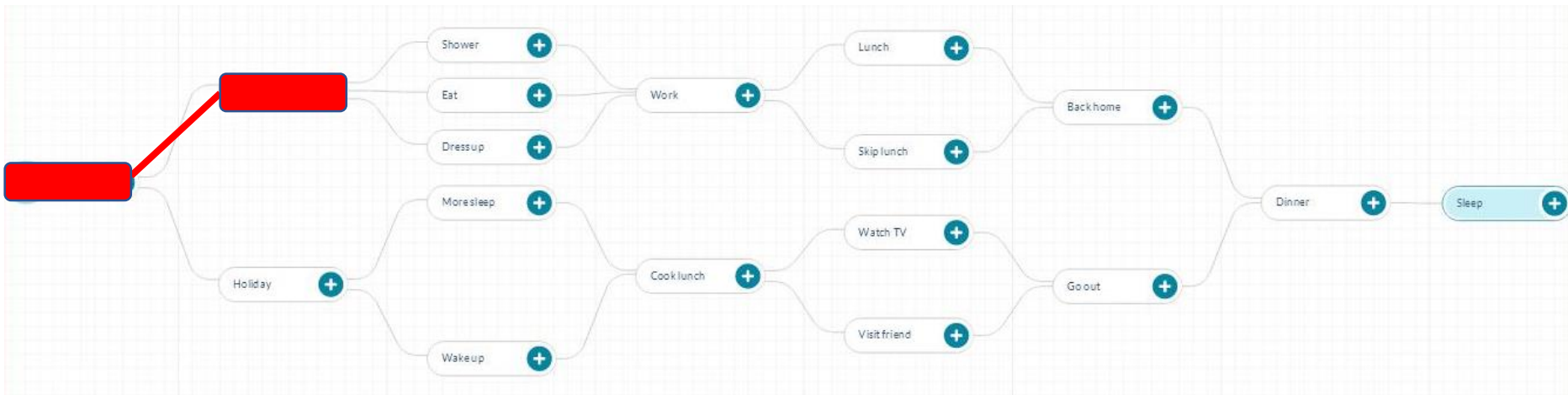
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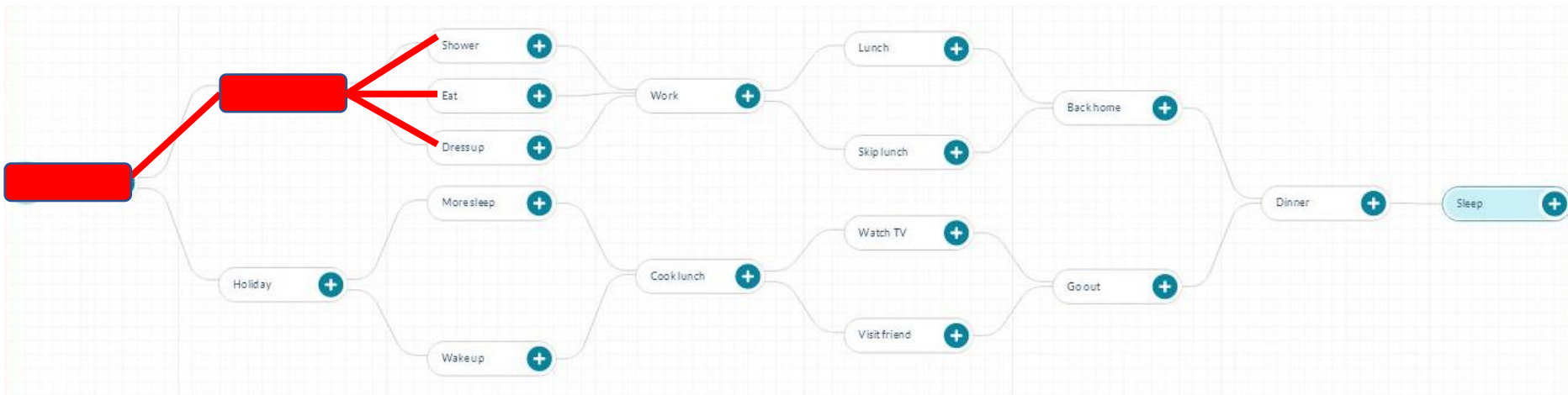


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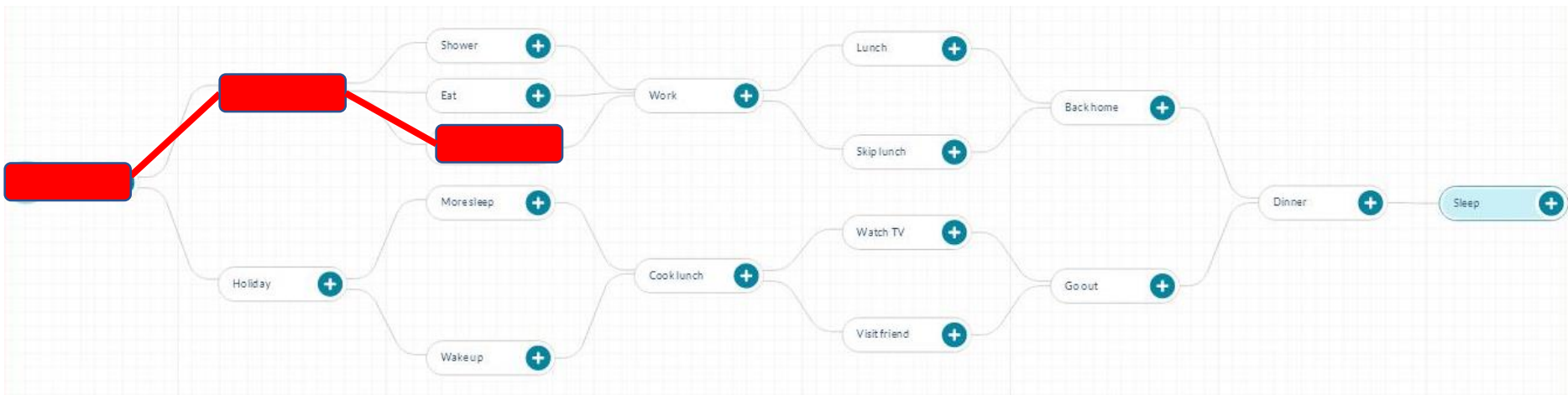
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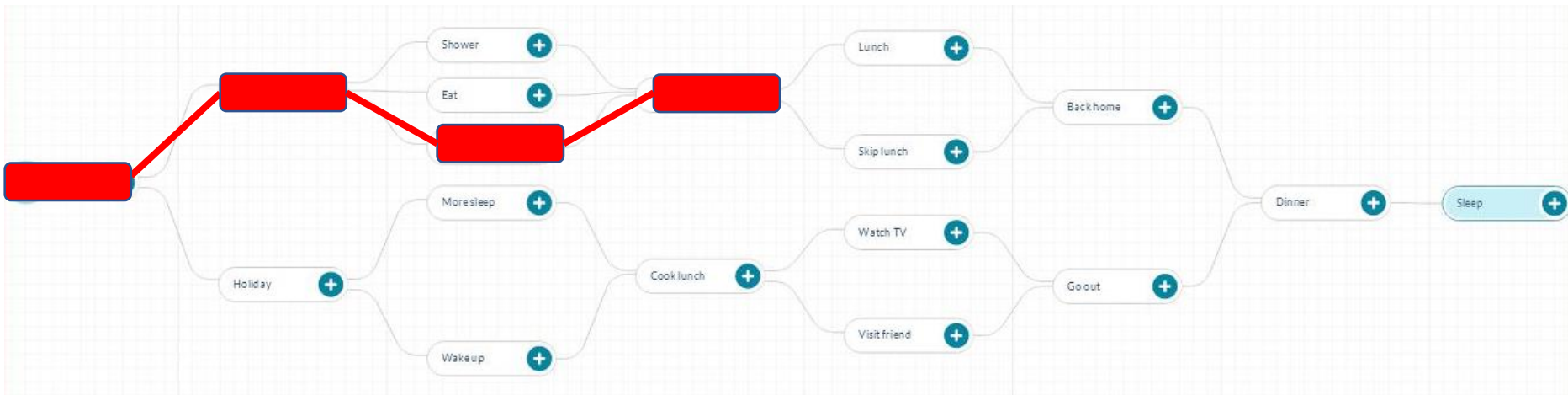
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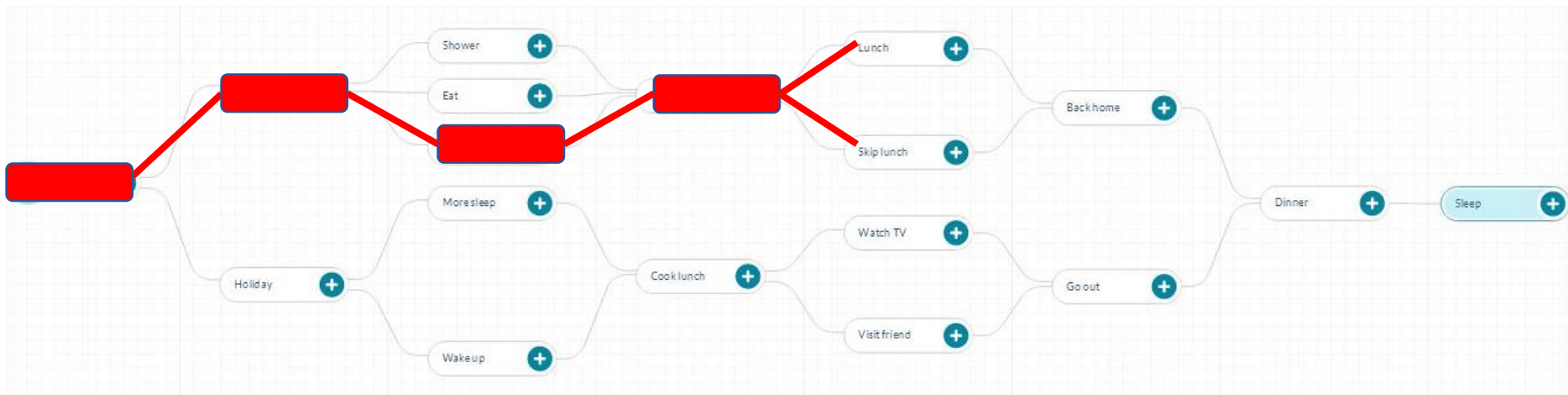
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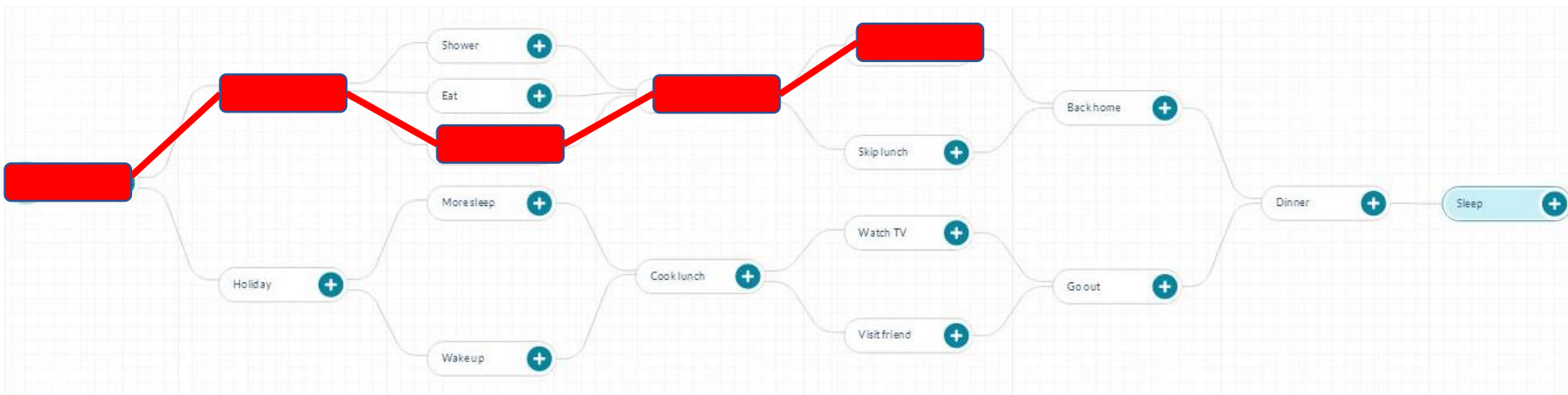
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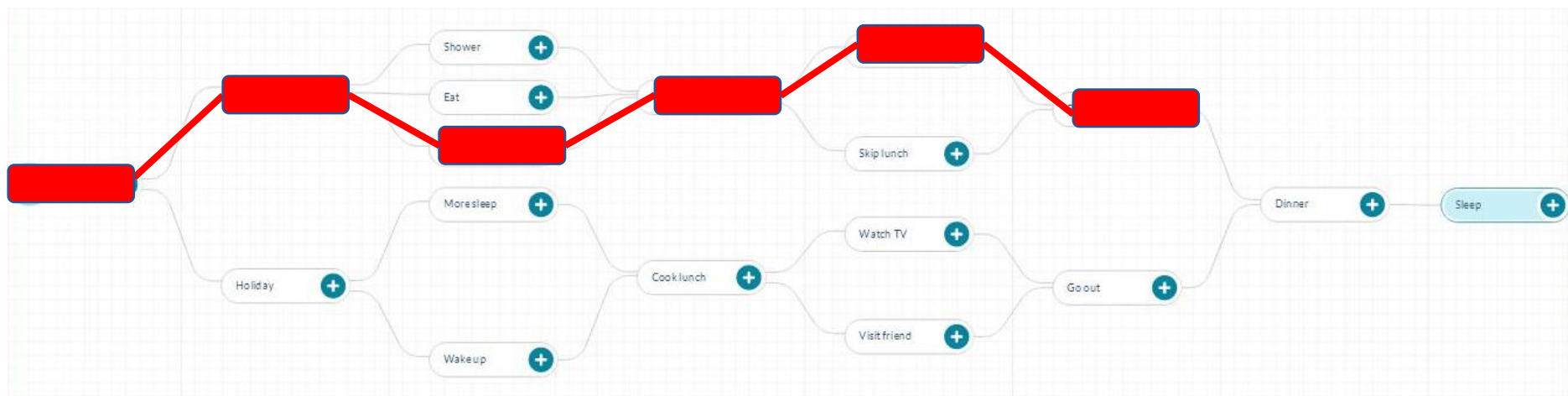
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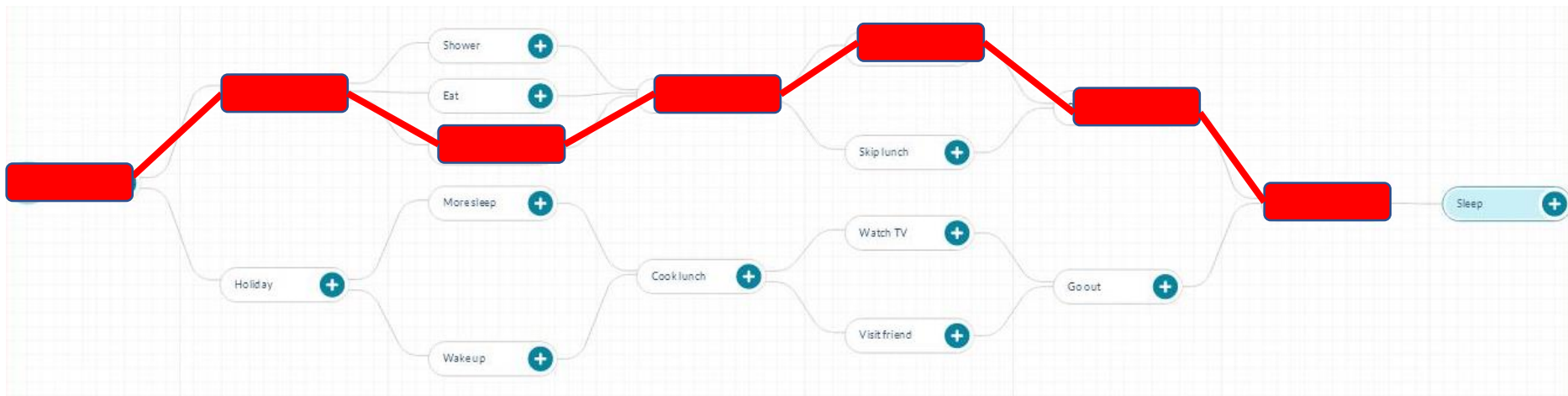
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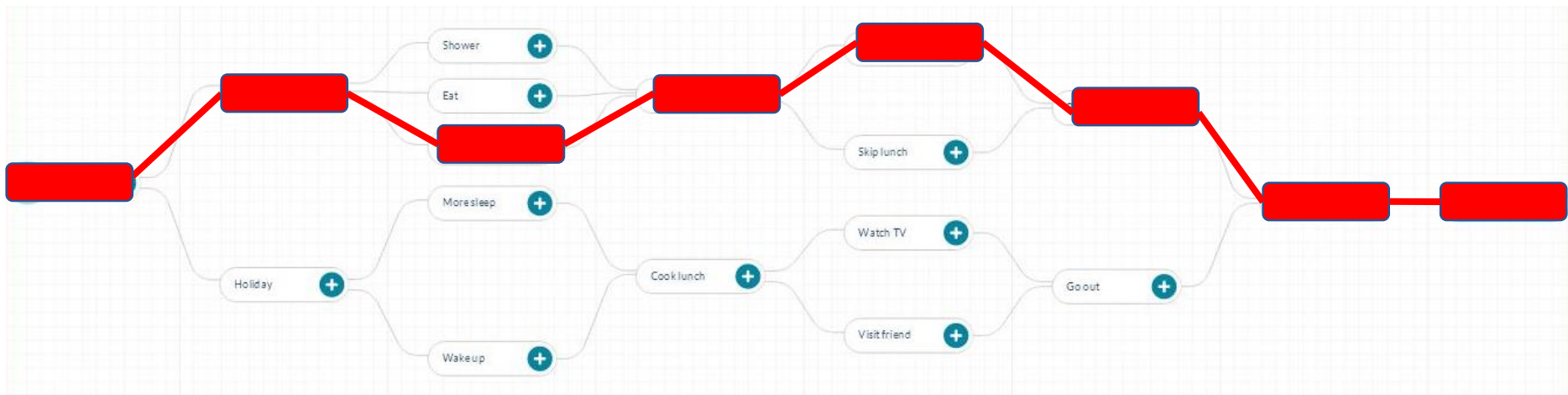
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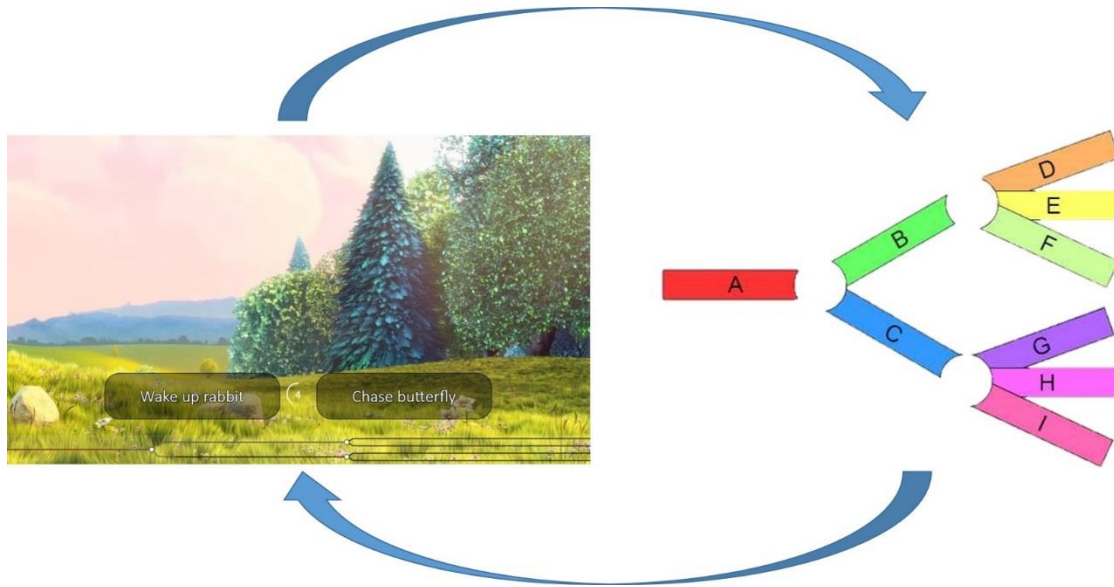


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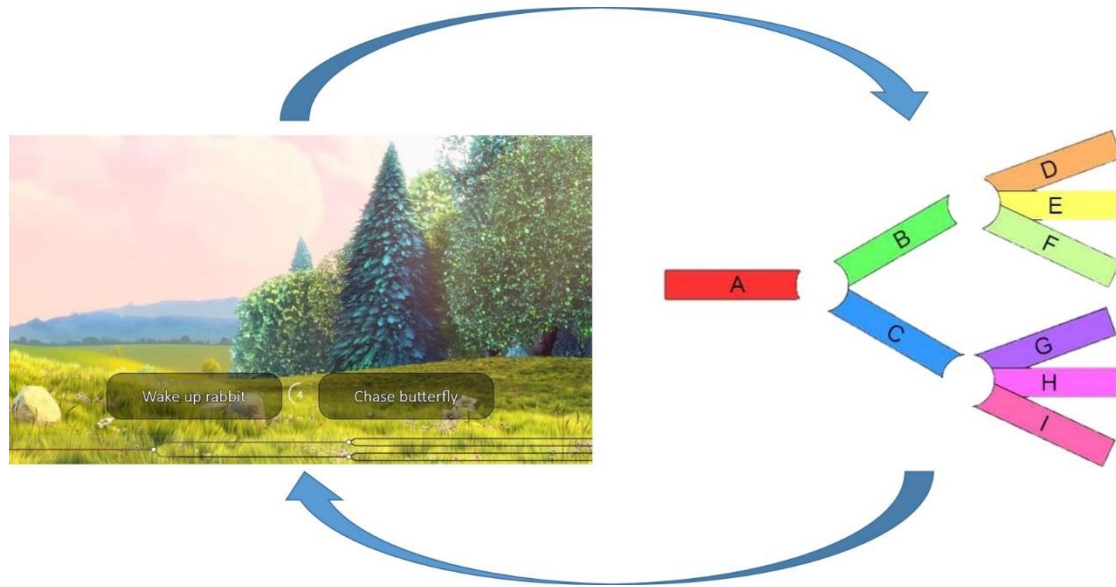
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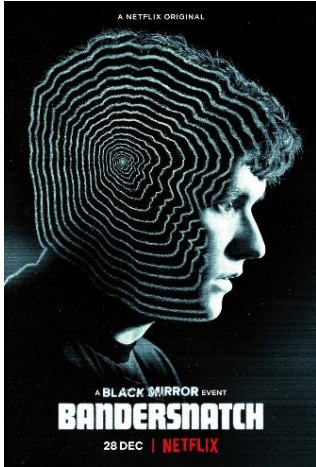
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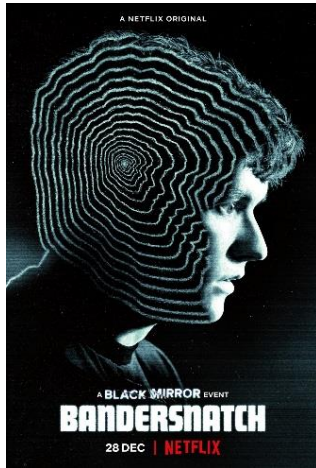
- Clickable objects allow the user to make viewing choices that impact the storyline
- Puts user in control of viewing experience
- Content creators have great flexibility how to personalize viewing experience of users

# Examples and some prior work

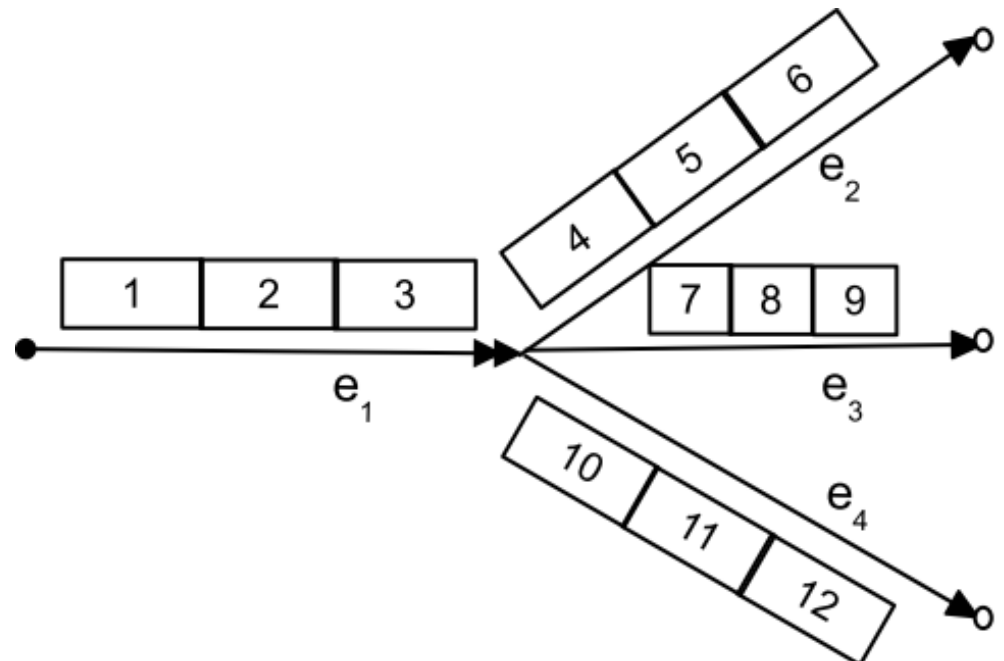
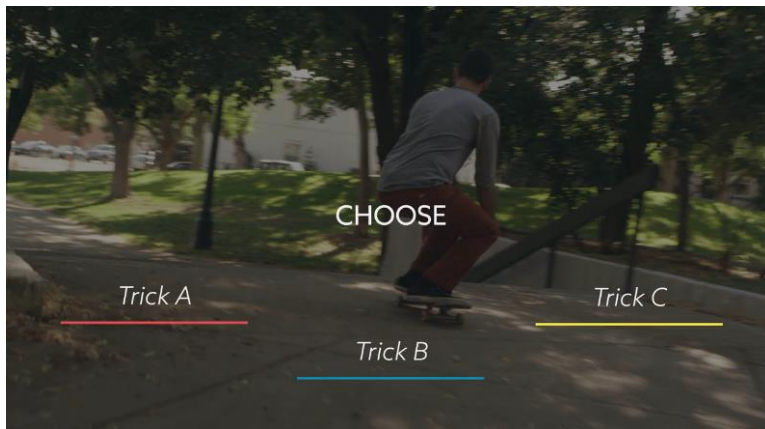


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- However, Bandersnatch: Black mirror (Dec. 2018) won many prizes and seen by many

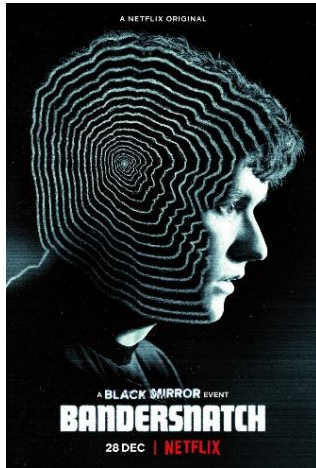
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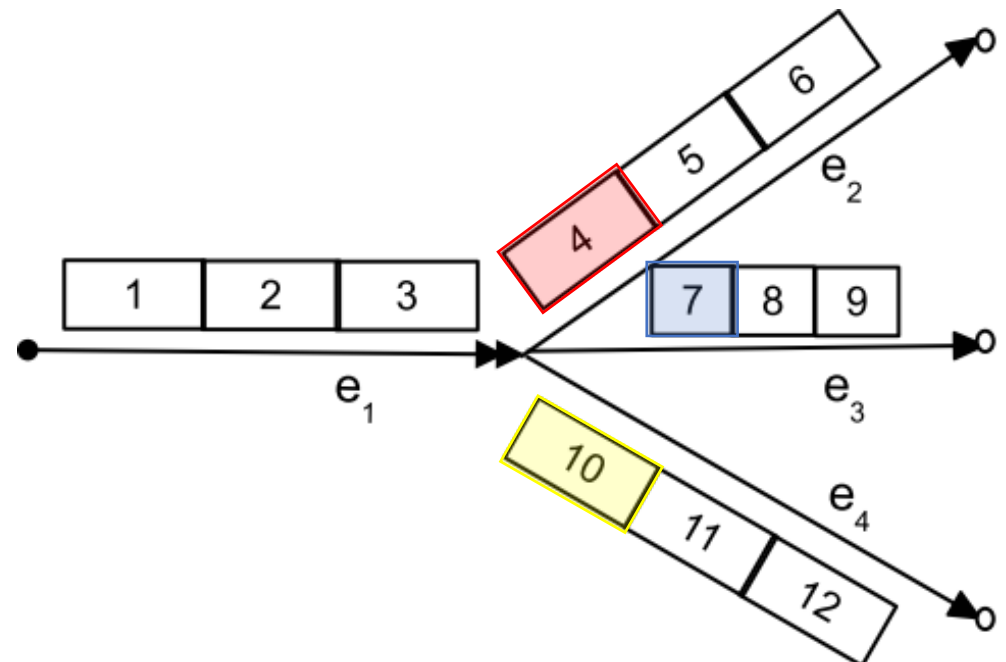
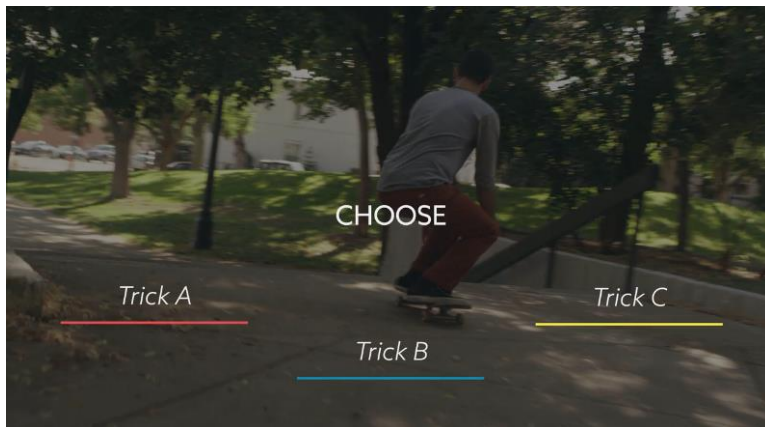
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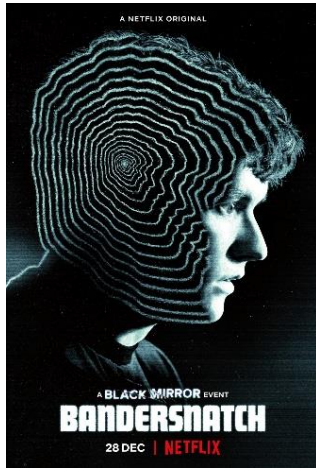
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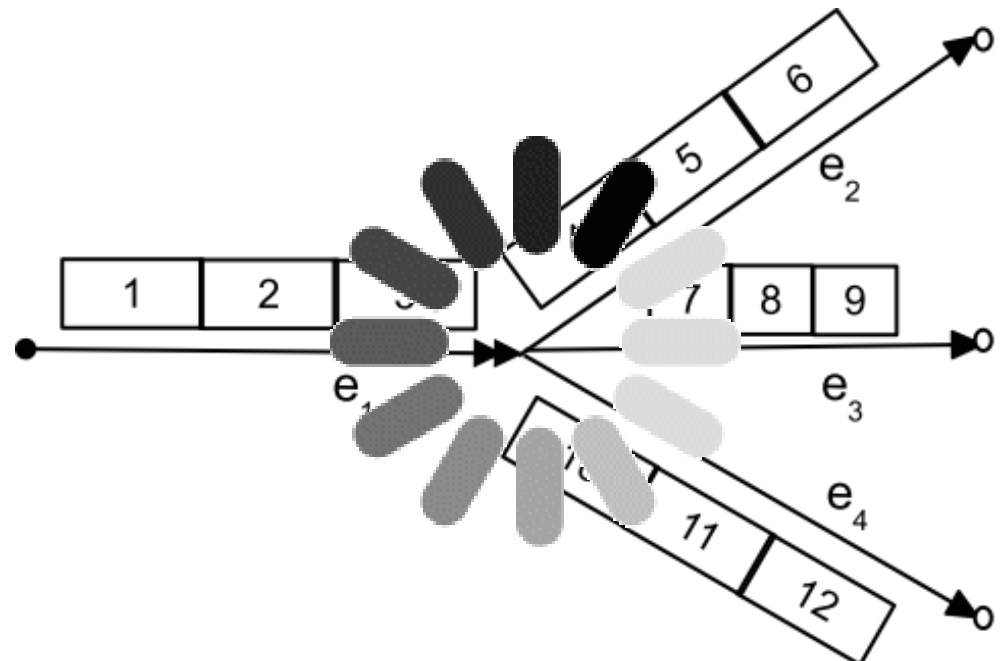
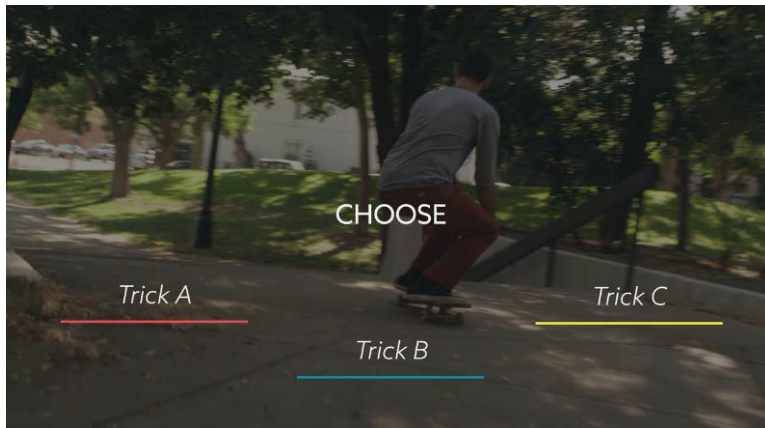
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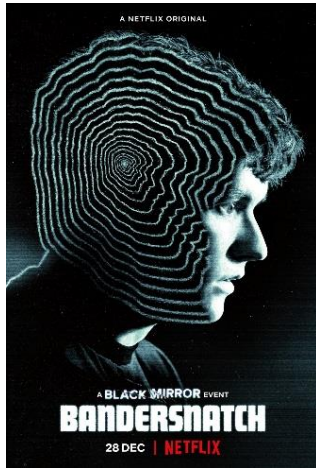
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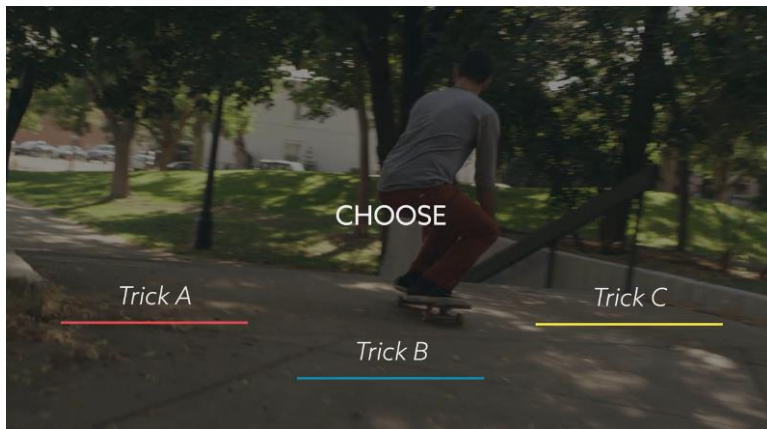
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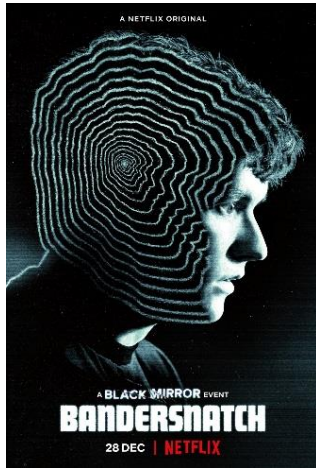


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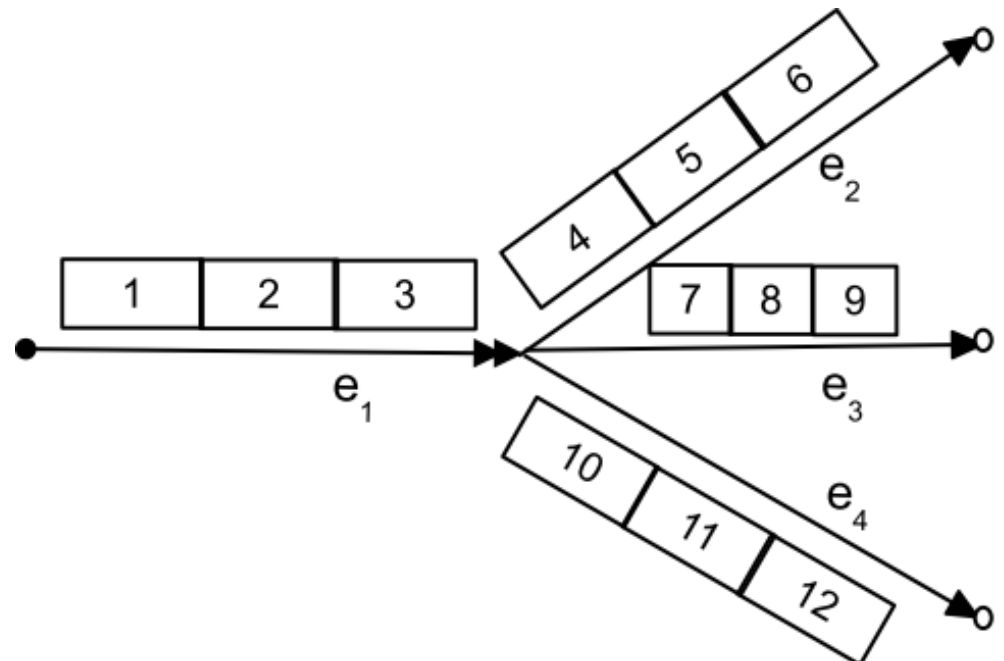
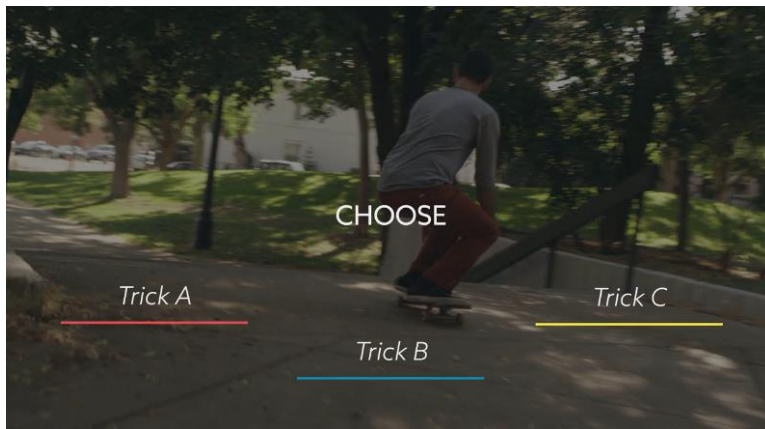




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# Problem: Generalized playback bar



(a) YouTube (linear) example

- Traditional video players use general playback bar (e.g., shows progress and buffer levels)
- There currently does not exist any generic playback bar for branched video that helps visualize the upcoming branch choices

# Problem: Generalized playback bar



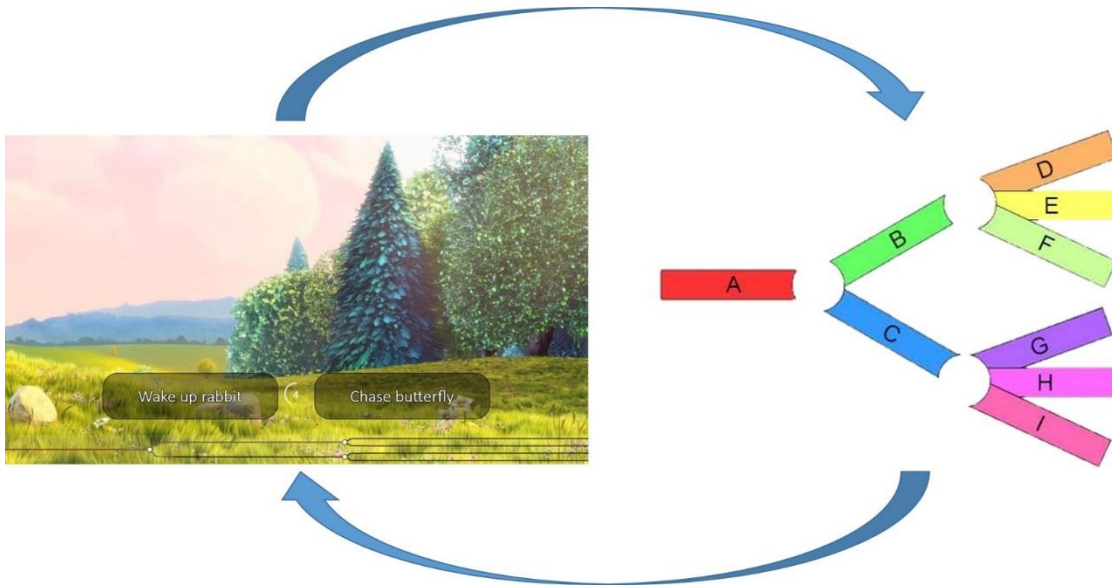
(a) YouTube (linear) example



(b) Netflix's "Pussy in Boots"

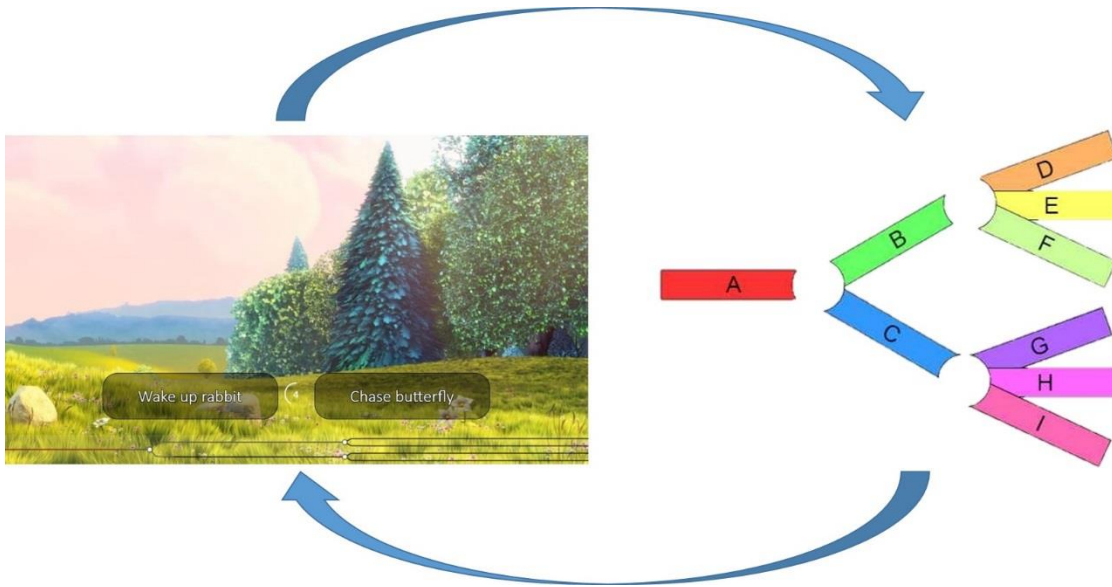
- Traditional video players use general playback bar (e.g., shows progress and buffer levels)
- There currently does not exist any generic playback bar for branched video that helps visualize the upcoming branch choices
- Most branched videos use per-video custom-made user interfaces

# Problem: Generalized playback bar



- Need for a generalized interface that easily can be reused for many videos and that provides clear visual information about
  - upcoming branch choices,
  - playback progress, and
  - buffer levels.

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- Need for a generalized interface that easily can be reused for many videos and that provides clear visual information about
  - upcoming branch choices,
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  - buffer levels.
- Again, these aspects are expected by traditional video players, but not yet available for branched players

# Contributions at a glance

- 1) Design and implementation of a novel branched video player
- 2) Results and insights from a three-step user study

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- 1) Design and implementation of a novel branched video player
  - includes a generalized playback bar and other branch features
  - open source: `dash.js`
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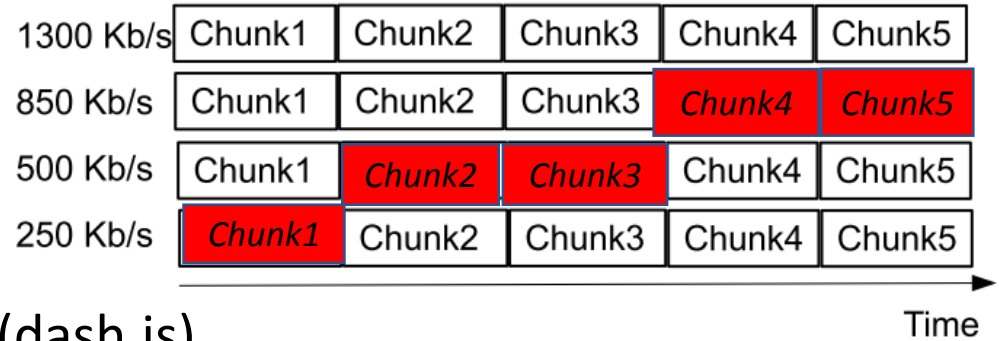
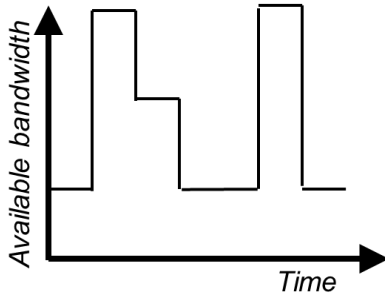
- includes a generalized playback bar and other branch features
- open source: [dash.js](#)

## 2) Results and insights from a three-step user study

- evaluate the user perceived effort and the added value of the use of such a playback bar,
- compare alternative designs, and
- evaluate the integration of the playback bar and other branch-related features

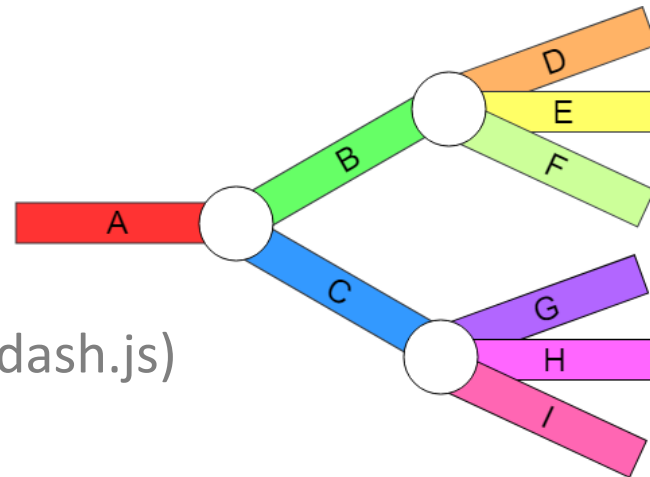


# System design



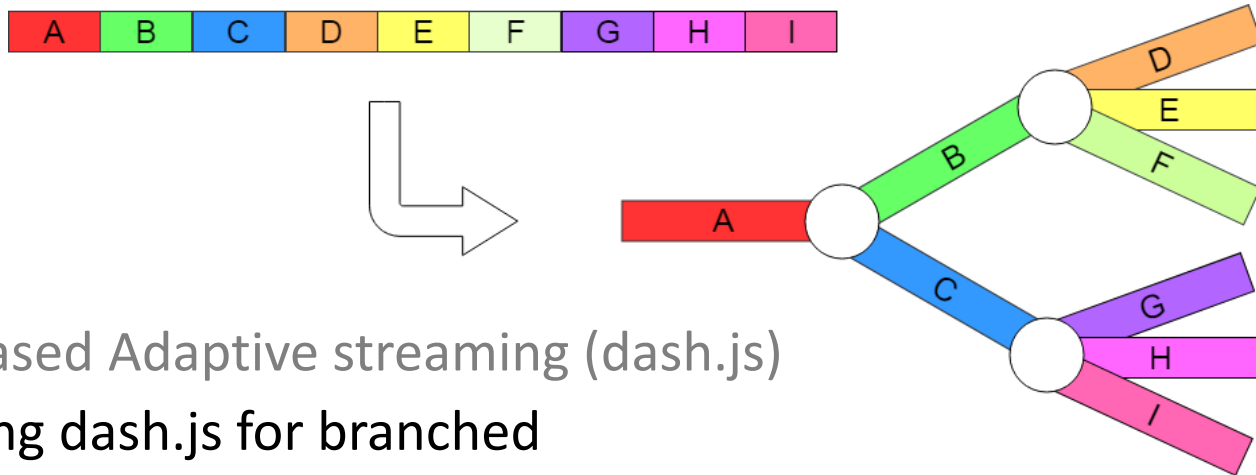
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  - Meta file format (in JSON) based on Krishnamoorthi *et al.* [MM 2014]: (i) branch points, and (ii) segments

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  - Segments defined by (i) unique identifier, (ii) start/end times, (iii) branch options, and (iv) a descriptive name
  - Player keeps track of playpoint, determines the next branch point, presents branch options, prefetches data for upcoming segments

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  - Player keeps track of playpoint, determines the next branch point, presents branch options, prefetches data for upcoming segments
- A novel customized playback bar
  - Javascript using canvas elements for drawing the graphics
  - Playback bar consists of multiple segments. Each segment shows what has been played (if any) and what has been buffered (if any)

# Example player



# Playback bar features (designed/evaluated)

- How much of the tree to show?
  - Compared alternatives; e.g., “full structure”, “simple zoom-and-follow”, and “prune non-selected paths”
- Position, visibility, and timing?
  - Placement and size of branch choice buttons?
  - How far in advance?
  - When to show (or not to show) the playback bar?
- Visual appearance of branches?
  - Generalized shape of branches (e.g., arctan, log, step function, ...)?
  - Focus-based visual distortion (e.g., fish-eye effects)?
- Integration and branch-choice labeling
  - Matching branch labeling?
  - Highlight path when hovering?
  - Clickable playback bar?
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# User study

- 32 participants
  - University students from mix of programs
  - Ages 20-30 (mean = 22.7)
  - 10 female; 22 male
  - Half never seen a branched video before; rest 1-5 times
  - Bandersnatch dominated among first such video seen



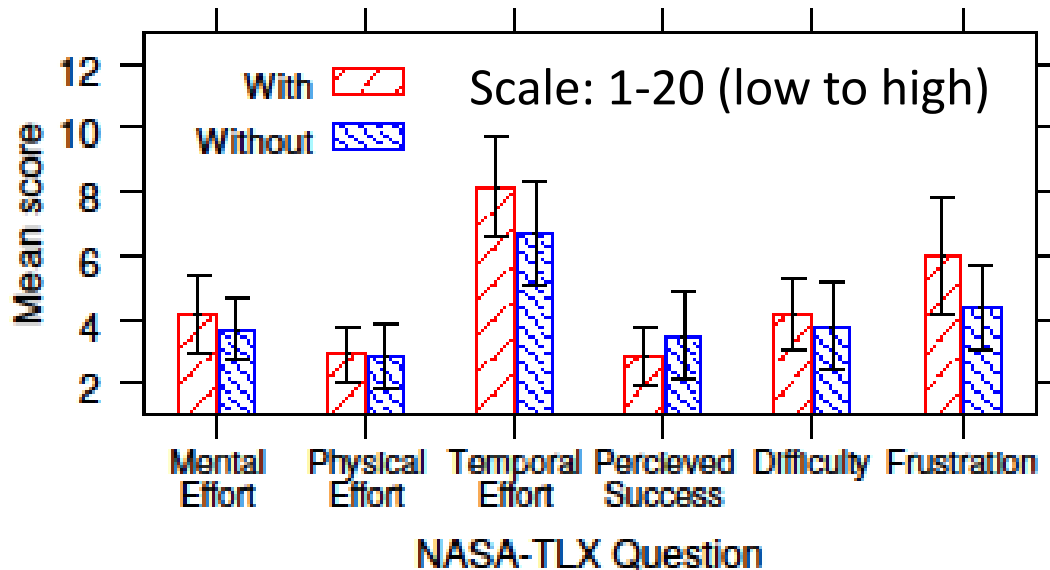
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  1. With vs without [default]: User perceived effort (NASA-TLX), complexity (SEQ), and measured response time
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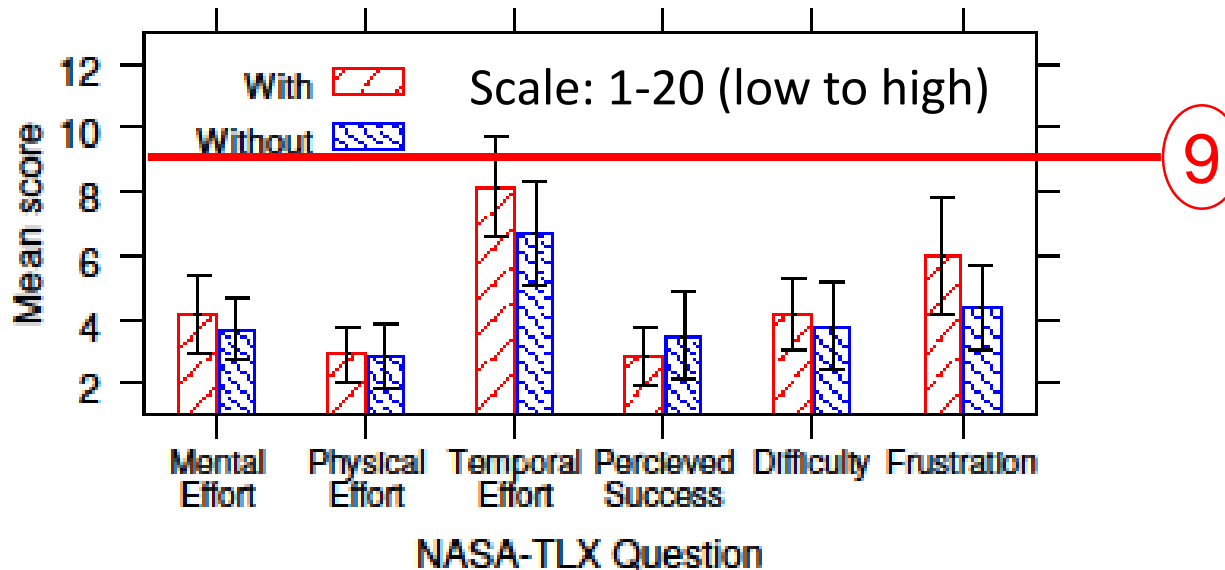
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  3. List of feature comparisons [one-by-one vs default]: Demonstrate, express like/dislike, and motivate/explain answer
- Tried to reduce potential influence
  - E.g., avoid leading questions

## Example results [step 1/3]: Perceived effort (with “default” version and in first step of study)



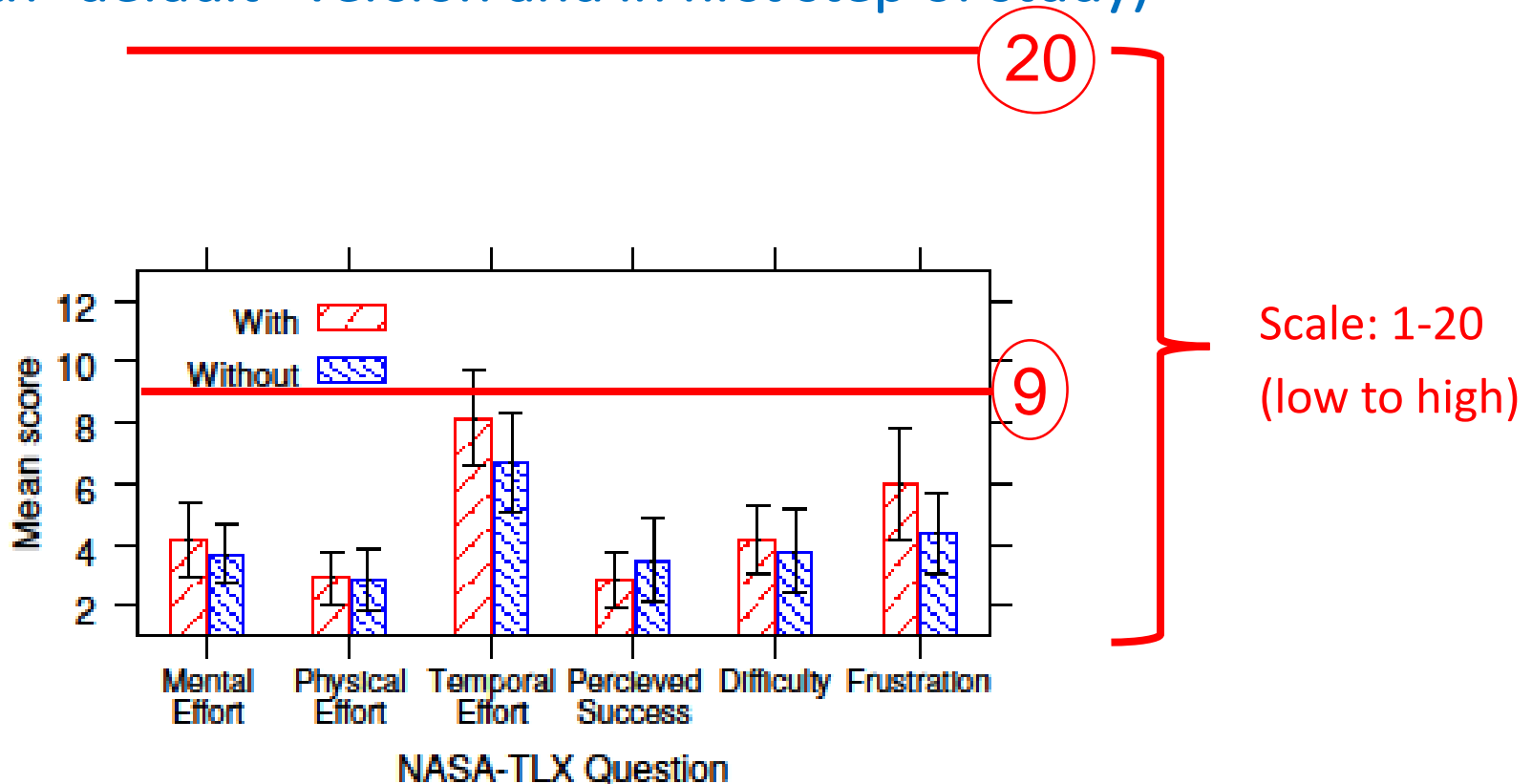
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In paper also other effort and complexity measures

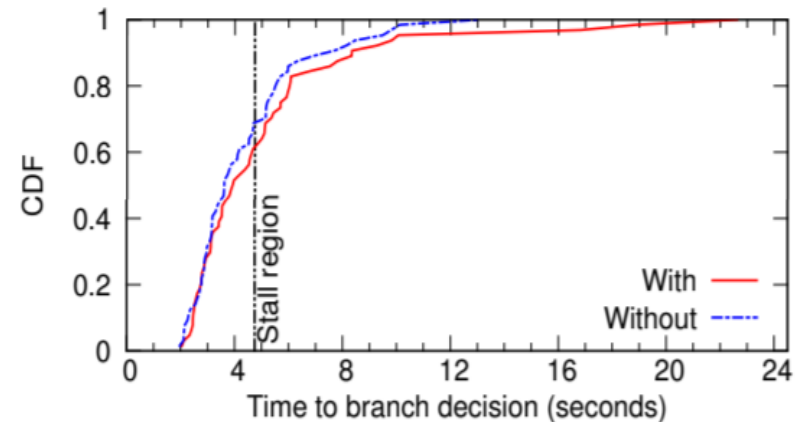


Figure 7: CDFs of the branch selection times.

Table 1: Summary of SEQ (scale 1-7; low-to-high).

Implementation	Mean ( $\mu \pm \sigma$ )	95% interval
With PBB	6.63 $\pm$ 0.83	(6.33,6.92)
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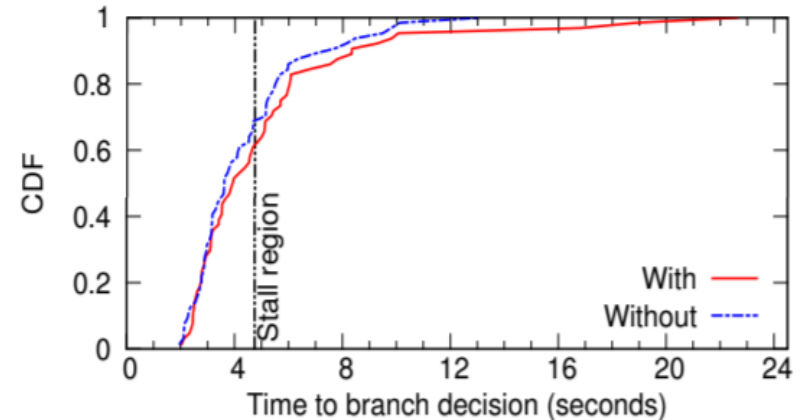


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## Example results [step 2/3]: Added value (with “default” version and in first step of study)

<b>Aspect of consideration</b>	<b>Score (<math>\mu \pm \sigma</math>)</b>
The branched video concept	13.6 $\pm$ 5.2
The video structure and choices at hand	14.0 $\pm$ 4.7
Whether there will be upcoming branches	18.3 $\pm$ 2.7
Remaining playback time	16.8 $\pm$ 4.3
Amount data buffered	13.3 $\pm$ 6.9

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**Branched playback bar can add value at the cost of very limited perceived client effort**

# Example results [step 3/3]: Like/dislikes

**Table 3: Summary of like/dislike evaluation results. Here, we use (\*\*) to indicate when a result is significant.**

Feature	Like	Dislike	Don't know
Simple zoom-and-follow	13	13	6
Prune non-selected paths	26 **	4	2
Fish-eye	1	28 **	3
Mouse-eye	3	26 **	3
Matching branch labeling	8	21 **	3
Highlight path when hovering over button	18 **	8	6
Clickable playback bar, without any buttons	0	28 **	4
Explicitly place buttons in tree	16	14	2

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Simple zoom-and-follow	13	13	6
Prune non-selected paths	26 **	4	2
Fish-eye	1	28 **	3
Mouse-eye	3	26 **	3
Matching branch labeling	8	21 **	3
Highlight path when hovering over button	18 **	8	6
Clickable playback bar, without any buttons	0	28 **	4
Explicitly place buttons in tree	16	14	2



# Example results [step 3/3]: Like/dislikes

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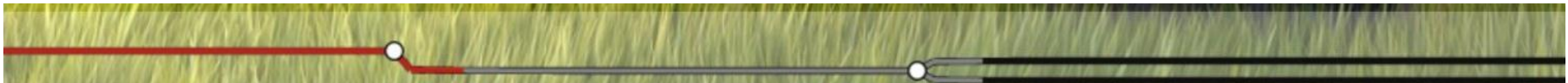
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- No silver bullet, but some features provided significant differences (\*\*)

# Example results [step 3/3]: Like/dislikes

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Feature: Prune non-selected paths

Example comments(+): “removes unnecessary information”, “focus on the part of interest”, “reduces the chance regretting past choices”, and “feels more realistic”

# Example results [step 3/3]: Like/dislikes

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Feature: Highlight path when hovering over button

Example comments (+): “simple”, “made it clear what path you consider choosing”, “feels more in control”, and “connects playback bar to the buttons”

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2. Three-step user study in which we evaluated the playback bar and compared with alternative designs and branch-related features

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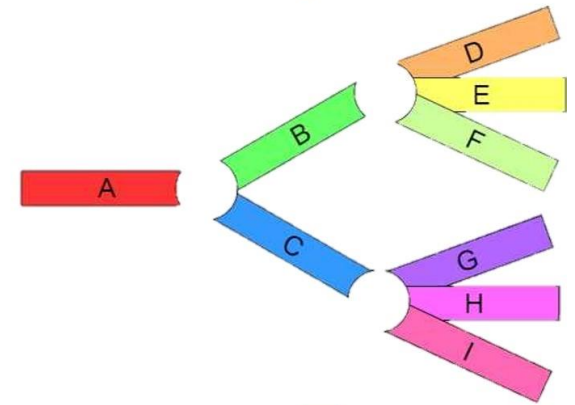
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  - Visualizes the tree-like branched video structure and the buffer levels of the different branches
  - Playback bar and presentation of branch choices easily customized
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2. Three-step user study in which we evaluated the playback bar and compared with alternative designs and branch-related features
  - Highlights that the branched playback bar can add value at the cost of very limited perceived client effort
  - Further improvements by hiding the playback bar between branch points and enhance the playback bar with high-scoring features such as pruning non-selected paths and highlighting path when hovering over button
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Thanks for listening!



# Generalized Playback Bar for Interactive Branched Video

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