

Sticky Content and the Structure of the Web

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Harvard University

Workshop on the Economics of Networks, Systems, and Computation
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What is “sticky content”?

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Sticky content is....

What is “sticky content”?

Sticky content is website content which induces return traffic.

What is “sticky content”?

Sticky content is website content which induces return traffic **and holds user attention**.

What is “sticky content”?

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- news/weather updates

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- news/weather updates
- horoscopes

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- webmail

What is “sticky content”?

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- online games

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Observation

Sticky content is prevalent on the internet.

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Observation

*Sticky content is prevalent on **commercial sites/portals**.*

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Sticky content is prevalent on commercial sites/portals.

Why study sticky content?

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Sticky content is prevalent on commercial sites/portals.

Moreover...

Why study sticky content?

Observation

Sticky content is prevalent on commercial sites/portals.

Moreover...

- Sticky content has received little attention

Why study sticky content?

The screenshot shows a web browser window with the address bar displaying 'http://en.wikipedia.org/wiki/Sticky_content'. The browser's toolbar includes navigation buttons (back, forward, reload, home, star) and a search bar. Below the toolbar, there are links to various services: Gmail, GCal, Email Login, my.h, scottkom.com, PeopleSoft, Paper Bunnies, and HG Scholar. The main content area features the Wikipedia logo (a globe made of puzzle pieces) and the text 'WIKIPEDIA The Free Encyclopedia'. To the right of the logo is a navigation menu with links: 'Main page', 'Contents', 'Featured content', 'Current events', and 'Random article'. Below the navigation menu is a search bar with a 'Go' button. The main article title is 'Sticky content', followed by the subtitle 'From Wikipedia, the free encyclopedia'. The article text explains that 'Sticky content' refers to content published on a website with the purpose of getting attention and getting users to spend longer periods of time at that site. It also mentions that 'Webmasters' use this term. Examples of sticky content include 'Chat room', 'Online forum', 'Webmail', and 'Internet'. The article concludes by stating that sticky content is also sometimes called 'sticky tools' or 'sticky gear'. At the bottom of the article, there is a note indicating that this is a 'stub' and that users can help Wikipedia by expanding it. The categories listed are 'World Wide Web stubs'.

Sticky content - Wikipedia, ...

http://en.wikipedia.org/wiki/Sticky_content

Gmail GCal Email Login my.h scottkom.com PeopleSoft Paper Bunnies HG Scholar

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Sticky content

From Wikipedia, the free encyclopedia

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Categories: [World Wide Web stubs](#)

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[Categories: World Wide Web stubs](#)

navigation

- [Main page](#)
- [Contents](#)
- [Featured content](#)
- [Current events](#)
- [Random article](#)

search

Go Search

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Moreover...

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Why study sticky content?

Observation

Sticky content is prevalent on commercial sites/portals.

Moreover...

- Sticky content has received **very** little attention

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Why study sticky content?

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Moreover...

- Sticky content has received very little attention
- Sticky content may be universally beneficial

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Moreover...

- Sticky content has received very little attention
- Sticky content may be universally beneficial
 - for content providers (marketers believe)
 - for consumers (conjectural)

Attracting vs. Entrapping

Attracting vs. Entrapping

Recall our examples of sticky content:

Attracting vs. Entrapping

Recall our examples of sticky content:

- news/weather updates
- horoscopes
- webmail
- online games

Attracting vs. Entrapping

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Question

*Which of these do you use **daily**?*

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*Which of these do you use **daily**? **Hourly**?*

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Which of these do you use [daily](#)? [Hourly](#)?

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Attracting sticky content – attracts

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Definitions

Attracting sticky content – attracts

Entrapping sticky content – attracts AND entraps

Road Map

We will...

Road Map

We will...

- Model sticky content

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 - Based upon Katona and Sarvary (2009)

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We will...

- Model sticky content
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 - Entrapping
- Conclude

The Internet

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Two parties of interest

The Internet

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- Content providers (“sites”)

The Internet

Two parties of interest

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- Consumers

The Internet

Two parties of interest

- Content providers (“sites”) – finitely many, n
- Consumers

The Internet

Two parties of interest

- Content providers (“sites”) – finitely many, n
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Sites

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Parameters...

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- commercial content parameter $c_i \in [0, 1]$

Sites

Parameters...

- commercial content parameter $c_i \in [0, 1]$ (sale value)

Sites

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- commercial content parameter $c_i \in [0, 1]$ (sale value)
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Sites

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- commercial content parameter $c_i \in [0, 1]$ (sale value)
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...and links

Sites

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- commercial content parameter $c_i \in [0, 1]$ (sale value)
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Sites

Parameters...

- commercial content parameter $c_i \in [0, 1]$ (sale value)
- sticky content parameter s_i

...and links

- sold in a market
 - $q_i :=$ per-click price of a link from site i ($\frac{\partial q_i}{\partial c_i} > 0$)

Consumers

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Measure 1 of consumers

Consumers

Measure 1 of consumers browse the web

Consumers

Measure 1 of consumers browse the web

Question

How can we track consumer traffic?

Consumers

Measure 1 of consumers browse the web

Question

How can we track consumer traffic?

Answer

PageRank!

Consumers

Measure 1 of consumers **browse the web**

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Consumers

Measure 1 of consumers **randomly walk the web**

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Consumers

Measure 1 of consumers randomly walk the web

Consumers

Measure 1 of consumers randomly walk the web,
buying content from the sites they visit

Consumers

Measure 1 of consumers randomly walk the web,
buying content from the sites they visit **with probability 1**

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Consumers (Attracting Sticky Content)

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$$M_{ij} = \begin{cases} \frac{1}{d_i^{\text{out}} + 1} & i = j, \\ \frac{1}{d_i^{\text{out}} + 1} & i \rightarrow j, \\ 0 & i \not\rightarrow j. \end{cases}$$

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- $r^{(t+1)} = \delta \cdot r^{(t)} \cdot M + (1 - \delta) \cdot r^{(0)}$

Remarks

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- In the case $s_i \equiv s$, $r^{(0)} = \left(\frac{1}{n}, \dots, \frac{1}{n}\right)$.
- We recover the model of Katona and Sarvary (*Marketing Science*, 2009).

Equilibrium Results

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Proposition

Set of network equilibria is independent of sticky content distribution.

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In equilibrium, in-degree and limit traffic increase in c_i .

Equilibrium Results

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And now for something...

Equilibrium Results

Corollary

Attracting sticky content is strictly beneficial for sites.

And now for something...

...surprisingly different.

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- We again recover the model of Katona and Sarvary (2009) as a special case.

Remarks

- In the case $s_i \equiv 1$, $r^{(0)} = (\frac{1}{n}, \dots, \frac{1}{n})$ and $M' = M$.
- We again recover the model of Katona and Sarvary (2009) as a special case.
- However, we do not recover any other cases of the attracting content model.

Key Result

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If s_i^* is site i 's optimal level of entrapping sticky content...

Key Result

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Proposition

We have $\frac{\partial s_i^}{\partial c_i} > 0$.*

Key Result

If s_i^* is site i 's optimal level of entrapping sticky content and $R_i := \sum_{j \rightarrow i} \frac{r_j}{s(d_j^{\text{out}} + s_j)}$

Key Result

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- 2 For any i such that $R_i \leq \frac{(d_i^{\text{out}})^2}{s}$, we have $\frac{\partial s_i^*}{\partial c_i} > 0$.

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- 2 For any i such that $R_i \leq \frac{(d_i^{\text{out}})^2}{s}$, we have $\frac{\partial s_i^*}{\partial c_i} > 0$.
- 3 As $R_i \rightarrow \frac{(d_i^{\text{out}})^2}{s}$, we have $\frac{\partial s_i^*}{\partial c_i} \rightarrow 0$.

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Proposition

For $R_i < \frac{(d_i^{\text{out}})^2}{s}$ sufficiently large, site i would prefer not to have entrapping sticky content.

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- This is different from the result for *attracting* content!
- But notice that this is an *ex post* comparative static....

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For $R_i < \frac{(d_i^{\text{out}})^2}{s}$ sufficiently large, site i would prefer not to have entrapping sticky content.

- This implies endogenous business model specialization

Key Result

If s_i^* is site i 's optimal level of entrapping sticky content and $R_i := \sum_{j \rightarrow i} \frac{r_j}{s(d_j^{\text{out}} + s_j)}$ ($r_j = \lim_{t \rightarrow \infty} r_j^{(t)}$)

Proposition

For $R_i < \frac{(d_i^{\text{out}})^2}{s}$ sufficiently large, site i would prefer not to have entrapping sticky content.

- This implies endogenous business model specialization
- Entrapping content \iff Little inlink traffic

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... by site owners

Possible Extensions

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 - Can we sign $\frac{\partial q_i}{\partial s_i}$?
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 - Addressed briefly by Katona and Sarvary (2009)
- Non-commercial sites?
- Update the Wikipedia page?

Questions?

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