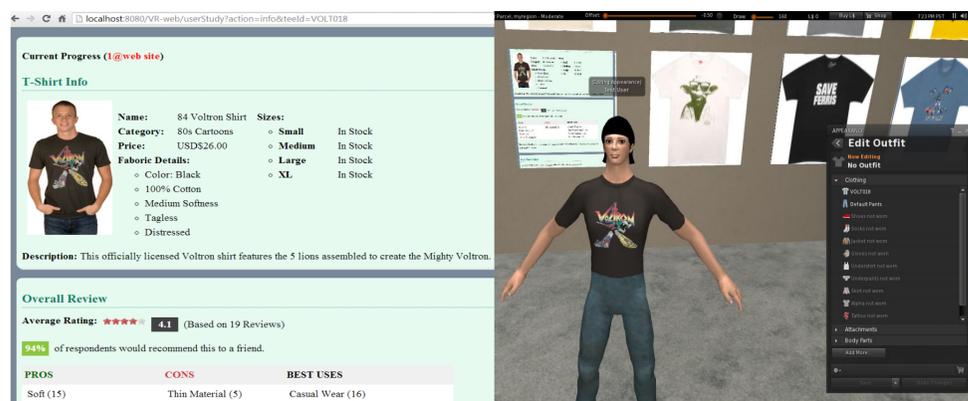


1. Motivation

The effectiveness of recommender systems is restricted due to users lack of motivation to provide ratings and eligibility to rate generally after purchase, leading to typical issues such as *data sparsity* and *cold start*.

Besides, 3D virtual reality (VR) environments offer more adequate information which can be used to model user preference. However, the research in VR recommenders is still in its infancy.

This paper propose a new information source, called “prior ratings” from the perspective of user interface, along with a conceptual model whose validity is verified by user studies in two different modalities as shown below.



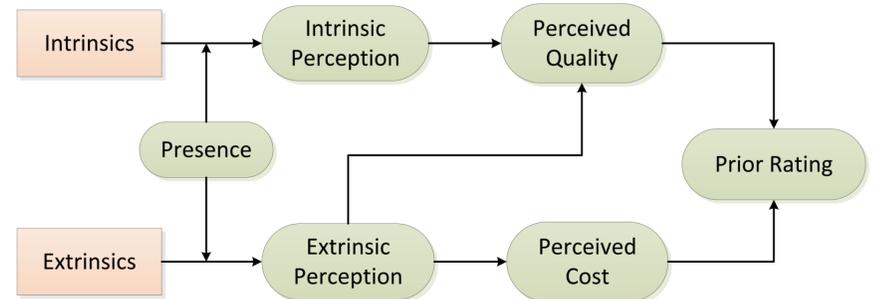
1. Website (WS)

2. Virtual Reality (VR)

2. Prior Ratings

We define *prior ratings* as users’ assessment of products in the light of their *virtual product experience*, referring to the psychological and emotional states that users undergo while interacting with virtual products in a mediated environment.

The conceptual model of prior ratings is shown as below:



Hypothesis 1: Users are more willing to provide prior ratings to the items (e.g., products) that they have interacted with in VR than in WS.

Hypothesis 2: (a) Users have more confidence in providing prior ratings in VR than in WS; (b) the average value of prior ratings in VR is closer to that of posterior ratings than that of prior ratings in WS.

Hypothesis 3: Presence has positive influence on the perceptions of both intrinsic and extrinsic attributes.

Hypothesis 4: Users depend more on extrinsic attributes than intrinsic attributes to evaluate the product quality in WS, whereas users depend more on intrinsic attributes than extrinsic attributes to evaluate the product quality in VR.

Hypothesis 5: Perceived quality has significantly positive influence on prior ratings, and perceived cost will also positively influence prior ratings, if the price is acceptable.

3. User Study

Both interfaces sell 50 t-shirts originated from 80stees.com from which we collect user posterior ratings and t-shirt information. 30 subjects (students) in our experiments (randomly in two groups) to experience two environments and give ratings to the questionnaire (shown in the right).

Hypothesis 1: of 19 users, 18 gave positive response, and only one negative response (“time-consuming”), but indicate the willingness if “benefits or luck draw” were offered.

Hypothesis 2: (a)

Table 1: The evaluations of the environmental factors

	Mean.ws	Mean.vr	Diff	p-value
confidence	3.296	3.778	0.482	3.300e-3
comfort	3.444	3.963	0.519	6.653e-3
presence	2.185	3.222	1.037	1.420e-4

(b)

In ratings: $corr(R.p, R.ws) = -0.42$, $corr(R.p, R.vr) = 0.23$

In opinions: $corr(R.p, R.ws) = -1.0$, $corr(R.p, R.vr) = 1.0$

Hypothesis 3: supported by Table 3.

Table 3: The influences of presence on attributes

Env.	Attributes	Estimate	T Value	Pr(> t)
WS	appearance	0.142	2.131	0.0342
	material	0.270	3.822	1.740e-4
	fit	0.187	2.452	0.0150
	category	0.130	1.880	0.0614
	price	0.0921	1.294	0.197
	store	0.269	3.216	1.500e-3
VR	appearance	0.0860	1.259	<2e-16
	material	0.244	3.388	8.370e-4
	fit	0.216	3.349	9.580e-4
	category	0.0698	1.092	0.276
	price	0.209	3.295	1.150e-3
	store	0.468	7.623	7.740e-13

Hypothesis 4: supported by Table 4.

Table 4: The evaluations of perceived quality

Env.	Attributes	Estimate	T Value	Pr(> t)
WS	appearance	-0.06649	-1.152	0.250485
	material	0.28331	5.729	3.52e-08
	fit	0.12482	2.130	0.034338
	category	0.31082	5.115	7.11e-07
	price	0.04622	0.975	0.330593
	store	0.21357	3.748	0.000231
VR	appearance	0.1958	3.217	0.00150
	material	0.1413	2.941	0.00363
	fit	0.2467	4.748	3.79e-06
	category	0.1081	2.044	0.04222
	price	0.1999	4.795	3.07e-06
	store	-0.0059	-0.126	0.89976

Hypothesis 5:

partially supported.

Price range [\$3.99, \$32.00]

	coefficient	p-value
Quality	>0.6	<0.001
Cost	0.14 (VR)	<0.05
	0.06 (WS)	>0.1

Questionnaire (in part): to what extent do you agree with statements:

For each t-shirt:

- The t-shirt has a good looking in terms of color, patterns, style, etc.
- The t-shirt is made of good material.
- The t-shirt fits you well.
- The category of this t-shirt is of your favor.
- The price of this t-shirt is acceptable, including shipping fees.
- The website is well-designed.
- In total the quality of this t-shirt is good.
- You need to spend a lot to obtain this t-shirt in price, efforts, etc.
- In total, this t-shirt is worthy purchasing.
- Overall, you like this t-shirt.

For each environment:

- You are confident about your ratings.
- It feels the same that inspecting the t-shirt is just as if in real world.
- You are comfortable to give ratings in the tested environment.
- You are (not) confident about your ratings because ...

4. Conclusion and Acknowledgement

We proposed a new information source called “prior ratings” that were potentially useful to resolve issues of traditional recommender systems. Its conceptual model is presented and demonstrated by user studies. This work is supported by the Institute for Media Innovation, NTU, Singapore.