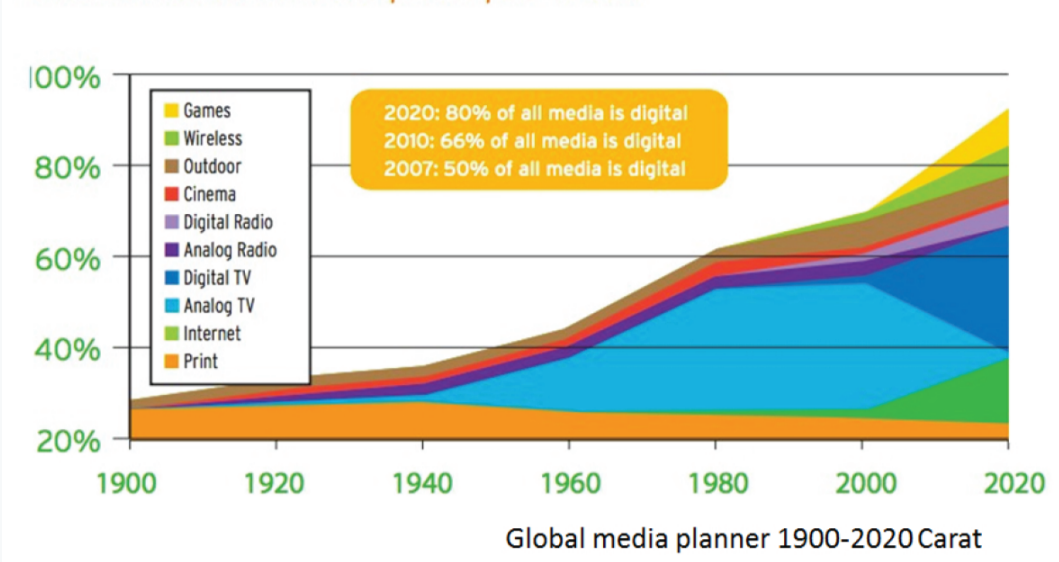# Introduction

Context

- Tremendous changes in media communications, and the printing and publishing industries
- rapid digital technology developments

Global Media Consumption per Week

2020: 80% of all media is digital
2010: 66% of all media is digital
2007: 50% of all media is digital

Global media planner 1900-2020 Carat

Our Media Consumption & Mix have Changed

Augmented Reality (AR) – a New Medium

- Combines advantages of print with advantages of digital media
- Allows to utilize value of print as a tangible object   gital world and the real world
- Enables creation of completely new products with novel and original features.
- The world is happening in real time - fusion of current, historical and imaginative information
- Dynamic – reflects geo-location and user interest
- Main emphases are on user experience, expanded content and interactivity.

Unknowns

- AR is new enough to masses that people are interested in it just because it is augmented reality. This could wear off very quickly (Craig, 2013).
- Challenges
    - Cumbersome user experience
    - Fragmented ownership of AR platforms
    - A lack of value-added content
    - Limited research on the applicability and effectivenss of AR in publishing

Research Questions

- How do users evaluate their experience with different publishing methods, including AR?
- Which method do they prefer?
- Does print matter in novel publishing platforms?

Methodology

Study design

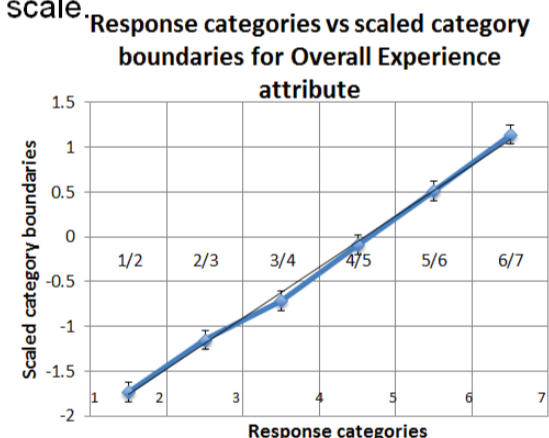A 2×2 within-subject experimental design with two independent variables and two levels for each variable:

- Medium: print vs. electronic medium (webpage) (AR+/AR-).
- Augmentation with the smartphone using video clips: the presence vs. absence of AR (AR+/AR-).
- A second version for the electronic medium: webpage with video, was added.

Participants

- 32 student participants from different RIT colleges: 16 female and 16 male participants
- Average age – 23 years old, range -18-29 years old.
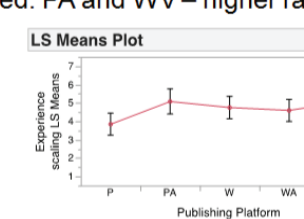- Normal visual acuity and color vision. No reading difficulties.

Procedure

Each participant:
- viewed five different stories produced using five different publishing methods. The story order and story/publishing method combination were randomized.
- rated understanding of the content; readability; interestingness; overall story liking and publishing method liking using 7-point scales.

Example of a story page

Lost and Found
Oliver Jeffers

Once there was a boy, and one day he found a penguin at his door. The boy didn't know where it had come from, but it began to follow him every-where. The penguin looked sad and the boy thought it must be lost. So the boy decided to help the penguin find his way home.

He checked in the lost and found office. But no one was missing a penguin. He asked some birds if they knew where the penguin came from, but they ignored him. Some birds are like that.

The boy asked his duck. But the duck floated away. He did not know.

That night, the boy couldn't sleep for disappointment. He wanted to help the penguin, but he didn't know how. The next morning, he discovered that penguins come from the South Pole. But how could he get there?

Independent Variables	Medium				
	Print		Electronic		
Subjects	Augmentation				
	Yes (AR+)	No (AR-)	Yes (AR+)	No (AR-)	
Gender — Female 16 participants	Print /AR	Print	Web/AR	Web	Web Video
Gender — Male 16 participants	Print /AR	Print	Web/AR	Web	Web Video
Dependent Variables	Ratings: Understanding, Ease of reading (readability), Interestingness, Liking story content, Liking the method of publishing, Overall experience				

Story #	Story Name
1	Lost and Found
2	The Incredible Boy Eating Books
3	The Heart and The Bottle
4	The Way Back Home
5	How to Catch a Star

Stories (#1-5) were pseudo-randomly combined with publishing methods for every participant to equalize number of combinations across participants and gender. Presentation order was randomized.

Results

- We used Thurstone law of categorical judgment (condition D) (Torgerson, 1958) to rescale our data from ordinal scale to interval scale.

Response categories vs scaled category boundaries for Overall Experience attribute

- Applied ANOVA and multiple regression analysis techniques to scaling data.

Platform liking

- *Significant main effect of AR* ($F = 13.15, p < 0.000$)

LS Means Plot — Augmented Reality Y/N

Significant interaction effect of Medium × AR ($F = 4.41, p < 0.037$)

LS Means Plot — Paper Y/N
Augmented Reality / No Augmented Reality

- *No significant effect of Paper*
- *Similar results for each story and post test questionnaires*
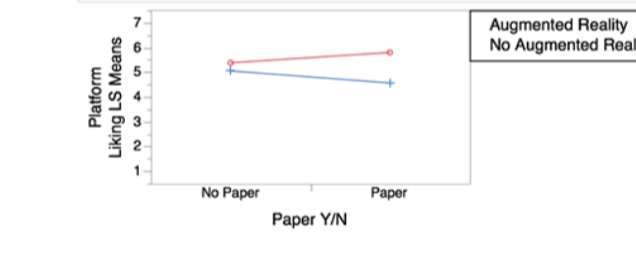
Platform liking

One way *Anova*. Significant effect of Publishing platform with 5 levels: $F = 5.42, p < 0.000$

Paper/AR condition – the highest score. significantly different from the *Web* ($p < 0.004$) and *Paper* ($p < 0.000$) conditions, Paper only –the lowest score.
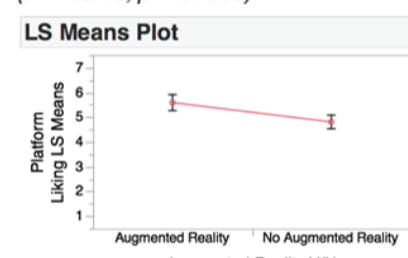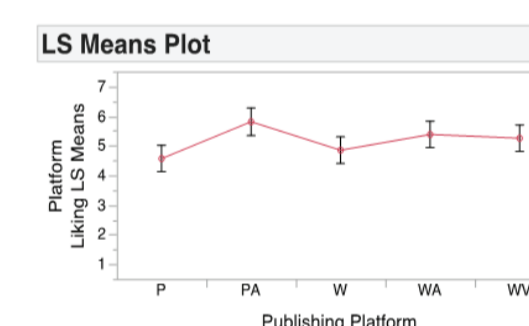

LS Means Plot — Publishing Platform (P, PA, W, WA, WV)

Overall experience

- No significant main effects
- Statistically significant interaction effect of *Medium × AR* ($F = 6.93, p < 0.009$), similar to the platform liking attribute
- One-way ANOVA showed a significant effect for the *Publishing Method* variable ($F = 2.68, p < 0.034$), with the *Paper* condition being substantially lower rated. PA and WV – higher ratings.

LS Means Plot — Publishing Platform

No significant effects of AR, Medium, or Platform on interestingness, readability, understanding and story liking.

Multiple regression analysis has shown significant contributions of user preferences for publishing platform and content-related attributes (interestingness, readability, understanding and story liking) to the overall experience ratings ($p < 0.04$; $R2 = 0.62$).

Conclusions

Conclusions

- AR factor was significant when judging preferences for publishing method

- The simple paper version was least preferred and rated consistently lower by our participants than other methods

- AR enhanced preference and overall experience particularly when combined with the stories printed on paper, which was revealed by significant interaction effects

- Content–related attributes are highly important for the overall experience with the published material

- Augmentation of print with electronic information can make it one of the most preferred publishing mediums

Future research

- More difficult reading material

- Look at specific elements where AR can be beneficial

Acknowledgements

Reference

Craig, A. B., 2013. Understanding augmented reality: Concepts and applications. Burlington: Morgan Kaufmann.