Understanding Cool: An Analytic Exploration of Contributing Factors for Teens

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ABSTRACT

This paper explores the way that young people view the notion of cool, and how designers can leverage that notion in their design activities. To complement the many user studies about cool, this paper presents an analytic evaluation of categories of cool, leveraging information from multiple expert review sessions with a total of 38 participants. All of the participants, who were in their late teens or twenties, were asked to reflect on aspects of cool for young teens and tweens. The participants took part in our analysis because of their knowledge of technology and their understanding of people in our target teen demographic. Results of a Qualitative Comparative Analysis (QCA) of data from the sessions suggest that innovation is a driving factor attributed to coolness for our target population, older males view monetary wealth and authenticity as important for coolness among our target population, and younger males view rebellious and anti-social technology as not cool for our target population. These findings suggest the need for different user models focused on demographics to capture the aspects of cool that are important in technology design.

1. Introduction

The notion of "cool" as a goal for the design of user interfaces is important challenge—particularly for certain segments of the population. Many studies focus on issues of performance or error rates, but to draw appeal and drive usage it is vital to consider whether a user interface is considered to be cool by the target population. Prior work has explored the teenage population, for whom cool is particularly important and is influential in making purchasing and usage decisions (Read et al., 2011). This

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paper extends that work through an analytic study of the teen population, seeking to highlight relative levels of concern among the key categories of cool.

The categories of cool as a design metric were adopted from the definition that emerged from the work of Read et al. (2011). A series of metrics for cool emerged from literature in the fields of marketing, consumer research, and culture (Nancarrow, Nancarrow and Page, 2002; O'Donnell and Wardlow, 2000; Pountain and Robins, 2000). Despite these investigations and other reflections about cool, there are numerous ideas but there is not yet consensus on definitions or design methods for cool (Agosto and Abbas, 2010; Holtzblatt, 2011; Douglas, Tremaine, Leventhal, Wills and Manaris, 2002; Read, Fitton, Little and Horton 2012).

To explore the dimensions for cool proposed by Read et al. (2011), this paper provides data from three interventions: all classroom discussions with domain experts with technology experience and with personal familiarity with the desires of teens. In each instance, we first presented initial information about our goals in understanding cool and the metrics to be explored. We then asked the research participants to rate facets of cool on a Likert scale, then we encouraged speculation and follow-up thoughts regarding what's cool and who's cool in computing and technology.

To build on the findings from our expert review, the final section of this paper speculates on how "cool" could be used as a critical parameter in user interface design processes. Building on the notion of critical parameter as introduced by William Newman (1997) and explored by our prior work (McCrickard and Chewar, 2003; McCrickard, Chewar, Somervell and Ndiwalana, 2003; McCrickard, Wahid, Branham and Harrison, 2011; McCrickard, 2012; Wahid, Allgood, Chewar and McCrickard, 2004), we examine how the establishment of critical parameters for cool could influence design and enable comparison and evaluation.

2. Approach

Read et al. (2011) identified six categories of cool, summarized here: rebellious (REB, socially or morally unacceptable), anti-social (AS, encouraging anti-social behavior), retro (RET, clearly from a previous era), authentic (AUT, brands/trends), monetarily expensive (RIC, reflecting the owner has money), innovative (INN, original and unusual). Each of these categories emerged from the literature and was exercised

in activities with youth (teens and pre-teens ages 11-15), as reported in (Read et al., 2011).

In our own investigation, we wanted to complement the empirical field studies with analytical expert reviews, toward understanding how designers could better approach creating cool interfaces. We approached three groups of computer science students (n=38) to seek to understand how teens view "cool". Most of the students were Black and/or African-American, attendees of a Historically Black Colleges and Universities (HBCU) institution. We chose to focus on computer science students for two reasons: because they have expertise in technology, and because they have recent understanding of our teen demographic (as they have recently exited the demographic and likely still have friends and relatives in the demographic). We told them that this was an expert review and not a user study—we wanted them to reflect on the feelings regarding "cool" from others' perspectives and not their own, and we wanted to engage them as fellow researchers and not as test participants. As such, we did not pursue informed consent. We explained to the participants the purpose of the study and how the data would be used. Participation by the experts was purely voluntary, with no expectation for participation in any of the review sessions.

Initially, we presented the six Read cool categories to the students, explaining what each was seeking to capture. We asked the students to rate the importance of each on a Likert scale ranging from 1 (not important) to 5 (very important). After rating the categories, the students were given the opportunity to provide free-form elaborations about their ratings selections. Finally, we engaged with the students in an open discussion, leveraging their responses to broaden our understanding of their answers.

The data were processed using Qualitative Comparative Analysis (QCA), a method that employs Boolean algebra and set theory to provide an analytic technique that does not require as many samples to make causal inferences (Rihoux and Ragin, 2008; Ragin, 2008). Boolean algebraic approaches to evaluation—commonly used in electronic circuit design—affords identifying causality through performing Boolean operations on data and establishing necessity and sufficiency when paired with set theory. Because statistical methods are based in linear algebra and correlational connections, hundreds of cases (e.g., participants) can be required to fully leverage the power of these approaches. In many situations, QCA can allow interface designers to draw more meaningful conclusions with limited samples. QCA seemed like a good match, given our small number of participants in our expert reviews and the possible categorizations in our data.

Three variants of QCA provide flexibility in identifying deterministic sets for continuous variables: crisp-set (csQCA), multi-value (mvQCA), and fuzzy-set (fsQCA). These methods balance the strengths of case-oriented (viz., qualitative) and variable-oriented (viz., quantitative). In csQCA, values are dichotomized—phenomena are deemed either present or absent. In mvQCA, values are categorical—a variable can have many levels. In fsQCA, values are represented in decimal form between 0 and 1—allowing researchers greater precision in their explanation.

In statistics, significance and strength play a critical role in interpreting the meaningfulness of results. Consistency and coverage, respectively, play a similar role in QCA (Ragin, 2008). Consistency measures how similar the data is for each configuration, and it is used to determine which configurations deserve further attention. It denotes to what extent a configuration—a combination of conditions and an outcome—is (in)consistent with the other configurations. As a heuristic, 85% consistency is a reasonably high enough threshold to indicate that further analysis is warranted. Coverage measures the extent to which a solution explains the data. For example, one solution might account for 80% of the cases. Coverage is calculated if consistency is above the researcher's threshold. When multiple configurations lead to the same outcome (known as equifinality), coverage can indicate which path is more important.

Conclusions are expressed in terms of whether conditions are necessary and/or sufficient to cause the outcome (Rihoux and Ragin, 2008). A condition is necessary to cause the outcome if the outcome consistency score is less than or equal to the consistency score of the condition(s). A necessary condition must be present for the outcome to occur. A condition is sufficient to cause the outcome if the condition consistency score is less than or equal to the consistency score of the outcome. A sufficient condition can, alone, cause the outcome.

3. Analysis

The data were analyzed using fsQCA. The 5-point Likert response scale for each variable were calibrated—assigned a fuzzy value equally distributed between 0 and 1—as prescribed by Ragin (2008). Calibration thresholds were set in alignment with what was considered high and low ratings. In essence, .75 represents that the participant either indicated that a category was moderately or very important to

"coolness" of the design. Conversely, .25 represents that the participant either indicated that a category was somewhat not important or not important to "coolness" of the design. Hence, responses greater than or equal to .75 were categorized as high, responses less than or equal to .25 were categorized as low, and responses at .5 were not considered as high or low.

After calibration, standard analyses were performed using the fsQCA software tool, which executes the truth table algorithm (Ragin, 2008). In the resulting truth table (Table 1), rows without cases were removed. Outcome variables were then coded as 1 if their consistency score was above the recommended threshold of 0.75, and 0 otherwise. The final truth table was then used as the basis for the remainder of the

Gender	age	Expertise	#	Aut	raw consist.
0	1	1	4	1	.904663
0	0	0	3	0	.721362
1	1	0	3	1	.787594

standard analyses.

Table 1. Truth table for authentic configurations

Following is a summary of the steps taken to perform the standard analyses:

- Each variable was assigned a fuzzy value equally distributed along the scale between 0 and 1.

- The conditions and outcomes values were calibrated in alignment with the response scales to denote the desired level of acceptability for each condition or outcome.

- The truth table was generated from the raw data table. Configurations with less than one case were removed. Those with a consistency score less than 0.75 were coded as 0. The remaining configurations were coded as 1.

- The standard analyses algorithm was executed on the refined truth table as input.

- Further analyses were performed to determine whether any conditions were necessary and/or sufficient for inverse outcomes

4. Results

Data from 38 participants were used for analysis (35% female). The demographics were age, technology expertise (measured via a 5-point novice to expert Likert scale),

and gender. A 5-point level of importance Likert-scale was used to measure how important each category was on perceived "coolness." The average age of participants was 22.97 (SD = 5.38) and the average level of expertise was 3.05 (SD = .93).

The results summary table (Table 2) shows that three configurations imply innovation as a key factor of whether technology is perceived as cool: older males who have greater experience with technology implies that technology is perceived as cool if it is innovative, but also that younger males who have lesser experience with technology and older females who have lesser experience with technology could also imply (albeit, to a lesser extent because it covered less of the solution formula) that technology is perceived as cool if it is innovative. These multiple configurations illustrate equifinality in QCA--in essence, that multiple paths (or configurations) can lead to the same outcome. The configuration with the larger X indicates the formula that covered the most observed cases. Hence, although there are three configurations, the second configuration is considered more important since it covered more observed cases for innovation (viz., 33% coverage). The same holds true for the richness (45% coverage), authenticity (36% coverage), and not anti-social (33% coverage) factors. The last column shows that younger males who have lesser experience with technology implies not rebellious (26% coverage) as a key factor of whether technology is perceived as cool.

Demographics	Outcomes (Configurations for key factors of what determines whether teens consider technology cool)				
	Innovation	Richness	Authenticity	(NOT) Anti-social	(NOT) Rebellious
Younger males who have lesser experience with technology	x			x	X
Older males who have greater experience with technology	X	X	X	X	
Older females who have lesser experience with technology	x		x	x	
Solution Consistency	0.91	0.88	0.86	0.9	0.82
Solution Coverage	0.63	0.45	0.53	0.54	0.26

Note: Large bold X's indicate which configurations had the largest unique coverage of all configurations in a solution.

Table 2. Summary of results.

Key findings from the results include:

- Younger males who have lesser experience with technology, older males who have greater experience with technology, and older females who have lesser experience with technology perceive **innovation** as an important factor of "cool" technology (consistency = 0.91, coverage = 0.63).

- Older males who have greater experience with technology perceive **richness** as an important factor of "cool" technology (consistency = 0.88, coverage = 0.45).

- Older males who have greater experience with technology and older females who have lesser experience with technology perceive **authenticity** as an important factor of "cool" technology (consistency = 0.86, coverage = 0.53).

- Younger males who have lesser experience with technology, older males who have greater experience with technology, and older females who have lesser experience with technology perceive technology that is not **anti-social** as "cool" (consistency = 0.90, coverage = 0.54).

Younger males who have lesser experience with technology perceive technology that is not rebellious as "cool" (consistency = 0.82, coverage = 0.26).

5. Discussion, Conclusions, and Future Directions

Results from our study suggest that many of the Read cool factors elicit reactions among people with expertise in technology and expertise in different target demographics (i.e., gender, age). A key element of our findings is that there is not consistency across all demographics—people in different demographics view the importance of the factors differently. This finding suggests that there are different user models that vary based on user demographics (and perhaps other factors as well). To appropriately leverage this finding, we propose to parameterize elements of cool to support the creation, comparison, and evaluation of models for "cool" people and technologies. This approach would draw from and contribute to the approaches found in user modeling, a sub-discipline to human-computer interaction that has long explored differences in user models for design and testing (Johnson and Taatgen, 2005).

This consideration for "cool" as a factor in design harkens to the Newman (1997) proposal regarding the use of critical parameters, figures of merit that transcend specific applications to focus on the broader purpose of technology. Newman implies that well-selected critical parameters can function as benchmarks—"providing a direct and manageable measure of the design's ability to serve its purpose"—to indicate the units of measure for analytic methods that predict design success.

Building on Newman's work, our own efforts undertook the challenge of identifying critical parameters that would be measurable and manageable during the design process (McCrickard, Wahid, Branham and Harrison, 2011). Specifically, we identified interruption (I), reaction (R), and comprehension (C), as important for systems used in dual-task situations where human attention is at a premium. The definition of these IRC parameters and their ratings on a 0 (not supported) to 1 (well-supported) scale enabled us to categorize design knowledge—thus enabling future design and evaluation.

One challenge to our creation of critical parameters emerged as we were developing a Communications of the ACM article, when it was noted that the IRC categorization did not account for the inherent feelings of the user with regard to the design of notification systems (McCrickard and Chewar, 2003). In response, we introduced a "satisfaction" critical parameter to capture the overall enhancement and approval of the general computing experience. To measure the parameter, we suggested metrics related to reducing stress, emoting humor, cultivating enjoyment, augmenting meaning or presence, and increasing feelings of security—all of which fall outside of the original IRC parameters but are essential to the view of utility for certain user populations.

We envision "cool" as a logical next step from our proposed "satisfaction" critical parameter—capturing not only the core human emotions of satisfaction but looking at even more visceral reactions that are common to the important user group of teens. The cool categorizations provided in (Read et al., 2011) highlight important and potentially measurable aspects of cool—ones which could be posited by experts or measured through usability studies. Collecting a "cool" rating (or a collection of ratings) would allow systems or interface techniques to be tabulated, plotted on a graph, or positioned in a figure, thus enabling design activities like understanding how target users think (McCrickard et al., 2003), identifying relationships among pieces of design knowledge (Wahid et al., 2004), evaluating existing designs (McCrickard et al., 2003), and establishing avenues for creative idea sharing (McCrickard et al., 2011). Further exploration of these ideas—toward establishing a "cool engineering" approach to technology creation—will encourage a focus on an oft-ignored aspect of design.

6. Acknowledgments

7. References

Agosto, D. E., & Abbas, J. (2010). High school seniors' social network and other ICT use preferences and concerns. In Proceedings of the *73rd ASIS&T Annual Meeting* (pp. 65-1—65-10), Pittsburgh, PA, USA. Silver Springs, MD: American Society for Information Science.

Douglas, S. A., Tremaine, M., Leventhal, L. M., Wills, C. E., & Manaris (2002). Incorporating human-computer interaction into the undergraduate computer science curriculum. In Proceedings of the *SIGCSE Technical Symposium on Computer Science Education* (pp. 211-212), New York, NY: ACM.

Holtzblatt, K. (2011). What makes things cool? *Intentional design for innovation. Interactions*, *18* (6), 40-47.

Johnson, A. & Taatgen, N. (2005). User modeling. In K-P. L. Vu and R. W. Proctor (Eds.) *Handbook of Human Factors in Web Design* (pp. 424-439). Mahwah, NJ: Lawrence Erlbaum Associates.

McCrickard, D. S. (2012). *Making Claims: Knowledge Design, Capture, and Sharing in HCI.* San Francisco, CA: Morgan and Claypool.

McCrickard, D. S. & Chewar, C. M. (2003). Attuning notification design to user goals and attention costs. *Communications of the ACM 46*(3), 67-72.

McCrickard, D. S., Chewar, C. M., Somervell, J. P., & Ndiwalana, A. (2003). A model for notification systems evaluation—Assessing user goals for multitasking activity. *ACM Transactions on Computer-Human Interaction (TOCHI). 10*(4), 312-338.

McCrickard, D. S., Wahid, S., Branham, S. B., & Harrison, S. (2011). Achieving both creativity and rationale: Reuse in design with images and claims. *Human Technology 7*(2). 109-122.

Nancarrow, C., Nancarrow, R., & Page, J. (2002). An analysis of the concept of cool and its marketing implications. *Journal of Consumer Research 1*(4), 311-322.

Newman, W. M. (1997). Better or just different? On the benefits of designing interactive systems in terms of critical parameters. In Proceedings of the *Conference on*

Designing Interactive Systems (DIS 1997) (pp. 239-245), Amsterdam, the Netherlands: ACM.

O'Donnell, K. A. & Wardlow, D. L. (2000). A theory of the origins of coolness. *Advances in Consumer Research, 27,* 13-18.

Pountain, D. & Robins, D. (2000). Cool rules: Anatomy of an attitude*. New Formations 39,* 7-14.

Ragin, C. C. (2008)*. Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago IL: University of Chicago Press.

Read, J. C., Fitton, D., Cowan, B. R., Beale, R., Guo, Y., & Horton, M. (2011). Understanding and designing cool technologies for teenagers. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems* (pp. 1567-1572.). New York, NY: ACM.

Read, J. C., Fitton, D., Little, L., & Horton, M. (2012). Cool across continents, cultures, and communities. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems* (pp. 2791-2794). New York, NY: ACM.

Rihoux, B. & Ragin, C. C. (2008). *Configurational Comparative Methods: Qualitative Comparative Analysis (ACA) and Related Techniques*. London: Sage.

Wahid, S., Allgood, C. F., Chewar, C. M., & McCrickard, D. S. (2004). Entering the heart of design: Relationships for tracing claim evolution. In Proceedings of the *16th International Conference on Software Engineering and Knowledge Engineering (SEKE 2004)* (pp. 167-172). Banff, AB: Knowledge Systems Institute.