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Capturing "cool": Measures for assessing coolness of technological products ☆

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ABSTRACT

These days, when we float an idea for an interface or demo a prototype, the compliment that we crave for is "This is Cool!" Coolness has become a major design goal for HCI professionals. If we are serious about building Cool into our products, we should also be serious about measuring it. With this in mind, we performed a scientific explication of the concept in order to capture the psychological essence of "coolness," covering a number of characteristics such as trendiness, uniqueness, rebelliousness, genuineness and utility. Based on the discourse in the literature, we arrived at a series of questionnaire measures, which we subjected to an exploratory factor analysis in Study 1 ($N=315$). The factor structure that emerged was tested through a confirmatory factor analysis in Study 2 ($N=835$), in which American and Korean respondents rated their perceptions of a variety of old and new technologies. Converging evidence suggests that in order for an interface to be rated as cool, it should not only be attractive and original, but also help the user assert his/her uniqueness or subcultural identity. Study 3 ($N=317$) tested the content validity of our factors by comparing them with a holistic evaluation of coolness and arrived at a parsimonious three-factor solution for conceptualizing it in terms of originality, attractiveness and subcultural appeal. Together, these constitute tangible user criteria that designers can strategically address and researchers can systematically measure.

1. Introduction

"Cool!" has become a common expression of approval and appreciation. We use the word to describe almost all entities, be they objects, people or phenomena. In recent years, the term is frequently used to signal user approbation of digital products, especially those that are developed by Apple, Inc., and associated with their success in the marketplace. As a result, "coolness" has become an important psychological criterion, much sought after by designers, developers and marketers of new applications, interfaces and devices.

While researchers in marketing have been trying to understand the concept of "coolness" for some time now (e.g., Nancarrow et al., 2002; O'Donnell and Wardlow, 2000), its emergence in the HCI community is relatively recent. HCI designer Holtzblatt (2010) organized and led a SIG (special interest group) meeting dedicated to "understanding cool" in CHI 2010. Based on attendees' personal experiences with—rather than professional opinions about—things that are cool, she concluded that coolness can be narrowed down to three domains—Sensation and Aesthetics (immersive, empowering, and delightful/surprising), Fit to the Life tasks (saves time and effort, adapts and enhances your life), and Device itself (invisible, engaging, effortless, reinvents the familiar, and fits the hand)—each carrying implications for interaction design (Holtzblatt, 2010). In CHI 2011, she offered a course entitled "What Makes Things Cool? Principles for Design," in which she concluded that "cool experience of game-changing technology (like the iPhone) goes well beyond aesthetic uniqueness or even bits of fun and surprise…[it] has a profound impact on…the way we live our life." (Holtzblatt, 2011a). This calls for reconceptualizing design in terms of the product's place in the user's life, especially his/her daily routines. Holtzblatt (2011b) opines that a cool product is one that provides "joy in life" by making users feel like that they accomplished something by using it, improved their connection with others, shaped their identity and underwent delightful sensations. In addition, the product itself should be a joy to use by being immediately deployable without too much of a learning curve and provide instant interaction gratification without too many demands on user input. Finally, she claims that cool

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products are transformative, creating a "can't go back" experience, in that the "users can't imagine going back to what they had before" (p. 47).

While coolness is often attributed to products, designers have also attempted to conceptualize it at the level of an environmental context within which certain products appear cool. For example, HCI 2011, the 25th British Computer Society (BCS) conference on Human–Computer Interaction, held a workshop on designing products for appropriation into a "cool lifestyle," which consists of "being cool, doing cool, and having cool stuff." Some products are inherently cool whereas others are cool in a certain context or when adopted by a cool person. A team of UK researchers applied these principles of cool to examine how teenagers designed their environments, and found age-based and gender differences in their emphasis on innovation and rebellion (Read et al., 2011). A cool product could be one that has both aspirational and anti-social connotations, but for different classes of users.

Coolness as a concept is used differently depending on the situation at hand and the uses to which users put it. It can mean different things to different people (Kerner et al., 2007). A scientific understanding of the various strands of meanings associated with this concept is necessary before we can objectively characterize its manifestation, both for design purposes and for user testing. The current investigation is an effort in this direction. The objective is to arrive at tangible perceptual requirements for coolness, i.e., what ingredients are necessary for a user to perceive coolness in an interface? These requirements can then be used as specifications by designers and as self-report measures by user experience (UX) researchers.

With this in mind, we performed a "concept explication" (Chaffee, 1991) of coolness, followed by a series of surveys in the United States and South Korea, eliciting users' perceptual responses to everyday technologies. These responses were then factor-analyzed to arrive at essential components of coolness, providing implications for design, communication and marketing of interfaces. We report these activities, in order, below.

2. Literature review – explicating "cool"

"Cool" is generally conceptualized as a positive, desirable attribute. The word has been used to describe a number of opinion objects. While some researchers approach it as a personality trait possessed by individuals (Dar-Nimrod et al., 2012), others see it as a cultural phenomenon (Frank, 1997; Zimmer, 2010). Some others see "cool" as a stage in life (Danesi, 1994), an attitude (Pountain and Robins, 2000), and even as a cognitive heuristic (or mental shortcut) used for making snap decisions (Sundar, 2008).

The flexibility of cool within American English means that the word or expression "cool" can be used for just about any purpose and to describe just about anything in regular conversation (Moore, 2004). It can be used as an adjective, an endearment, and a proxy for a host of other words or phrases in everyday conversation (Kerner et al., 2007). Cool has become so overused that some analysis suggests that it is now watered down, no longer conveying the same strength of approval or style that it once did in the past (Bauer and Bauer, 2002).

The overarching concept to which the word "cool" once referred is no longer what the colloquial usage of the word "cool" now refers. The word cool in everyday usage may not adequately connote the same strength of meaning as it once has, but for the purposes of this explication we are ignoring the watered down version of cool present in the American-English vernacular as it has become a ubiquitous "counterword of choice" (Petrucci and Head, 2006, p. 332). Rather, the "cool" for designers and academics is mostly concerned with the strongest expressions and perceptions of the idea. It may be more helpful to think of cool as a perceived state of being, one where the term used to describe this state is inconsequential. Whether the state of being is described as cool, hot, off the chain, or sweet (Petrucci and Head, 2006), the idea behind the phrase is the same in this explication: a positive and desirable quality used to describe innovations, be they ideas, technologies or products.

2.1. Defining cool

Most writers tend to define cool by showing how it is used in language (Moore, 2004; Petrucci and Head, 2006; Zimmer, 2010), pointing out products or people that are cool (Kerner et al., 2007), its effects (Kerner et al., 2007; Sundar, 2008) and conceptual makeup (Levy, 2006) without actually defining or quantifying coolness itself (e.g., Norman, 2004). Random House's dictionary.com defines cool as a slang term to mean "great; fine; excellent," something that is "characterized by great facility; highly skilled or clever," or "socially adept" (Cool ⟨http://dictionary.reference.com/browse/cool⟩). From this simple definition, we know that something that is cool is perceived as high quality and may accomplish a user's goals in a more creative manner.

These implicit conceptions imply that coolness is a perception that has an evaluative component. In fact, psychologists focus on individual perceptions of coolness when they ask study participants to rate their friends (Dar-Nimrod et al., 2012) and online interfaces (Oh et al., 2013). However, the general academic discourse on coolness, especially in marketing, suggests that these individual perceptions are reflective of culturally agreed-upon norms of coolness (Frank, 1997), implying that cool is socially constructed. This appears to be true especially at the high end of coolness. Recently, Fitton et al. (2012) found greater agreement among study participants on perceived coolness of entities that were clearly on the higher end and greater disagreement on the perceived coolness of less cool objects and brands. In other words, what one person thinks is cool is at least in part based on what other people think is cool (Gerber and Geiman, 2012). However, this correlation may not always be positive, especially if the former belongs to a subculture and perceives the latter as being part of mainstream culture (Goodman, 2001). Individuals tend to perceive others of their own social group as being more cool than those of other groups and that some groups are generally more cool than others (Rodkin et al., 2006). Thus, if an individual identifies himself or herself as belonging to mainstream culture, then that person may perceive digital devices within the mainstream realm as more cool than if the individual identified with a subculture.

Perceptions of self and others are not necessarily stable, and as social contexts vary, so do conceptions of coolness. This is illustrated by the failed attempts of marketers to make their products fit into the current social perceptions of cool (see Bulik, 2007; Creamer and Cuneo, 2008; Friedman and Cuneo, 1999; Garfield, 1999; Grossman, 2007; Madden, 2007; Pollack, 1997; Smith and Wylie, 2004; Wheaton et al., 2007). Within everyday use, cool is an evolving idea that changes from day to day (Grossman, 2007; Petrucci and Head, 2006). From this, we can conclude that the perception of cool is temporally unstable due to its socially constructed nature. Otherwise, uncool products could never become cool and cool products could never become uncool. Despite the changing perceptions of what is or is not cool at any given time, it is important to remember that cool itself does not change. A device that we consider cool today may not be as cool tomorrow, but this does not change the conceptualization of cool. Coolness as a concept is stable, but the perception of coolness in a given object is not.

The socially situated nature and temporal instability of cool are best illustrated by the very existence of so-called "cool hunters." These are professionals paid by marketers to discover the newest trends in fashion, electronics, art, music, athletics, etc. They know that some groups are better at creating and spreading cool trends than other groups (Goodman, 2001). This highlights the propensity for mass culture to absorb the cool trends of a subculture, but as Fiske (2003) points out, taking a counter-culture trend and repurposing it for a mass culture effectively kills its utility for the subculture; so too may the coolness of a trend die when it becomes mainstream (Goodman, 2001). Aside from co-opting a cool trend from a subculture, marketers and producers can take an existing product and, through association, alter its perceptions of coolness. The repackaging of a product or the creation of a new product to fit within the current perceptions of cool for whomever the product is intended is one means of achieving this less genuine and original cool, but such products may at least temporarily be perceived as cool nonetheless (Goodman, 2001; Kerner et al., 2007).

The success or failure of many products is often attributed and misattributed to the product's "cool factor" (Levy, 2006). The industries that have tried to carve out a piece of cool culture for their own products run the gamut, from clothing (Friedman and Cuneo, 1999) to copy machines (Bulik, 2007). Even cosmetics and sports drinks have made attempts to cash in on cool (Pollack, 1997).

Unfortunately, knowing how marketers develop cool products is not as good as knowing what coolness itself is, i.e., what we fundamentally mean by it. Furthermore, claims of its obviousness ("I know when I see it") do not help reify the concept; nor are they helpful to designers and researchers. Scholars like Norman (2004) have provided rich descriptions of well-designed products but stop short of providing a versatile, parsimonious scale. Researchers interested in examining various aspects of coolness have sought to investigate coolness and its relationship with either brands (Smith and Wylie, 2004), trends (Goodman, 2001) or specific products (Kerner et al., 2007). Even though such individual forays did not specifically conceptualize coolness, when taken together, they do offer insight into the components of coolness: Some products that help consumers express their individuality and stand apart from the crowd, as well as those described as innovative and unique, are more likely to be described as cool by users (Levy, 2006; Smith and Wylie, 2004). Other products or devices that have elements of authenticity and innocence are also sometimes described as cool (Conan, 2008). Still other efforts have described cool as something unexpected, a genuine natural expression, lucky, intelligent, sincere, and distinctly counter-culture (Kerner et al., 2007; Levy, 2006). Each of these potential subconcepts will be explored in detail below in the specific context of digital devices and interfaces.

2.1.1. Uniqueness

As a first step toward identifying the key sub-concepts of coolness, it may be helpful to examine the essential characteristics of products that have remained cool despite the ravages of time and the transition from obscurity to popularity. One such characteristic is the uniqueness of a digital device. Uniqueness can best be thought of as the degree to which users perceive that the digital device is substantively or cosmetically different from similar devices.

Kerner et al. (2007) provide two distinct examples where two separate producers have set their products apart from others in the same market. He examines Grey Goose Vodka, which is notable for several reasons. Unlike many top shelf liquors or expensive bottles of French wine, vodka, at its best, is a tasteless beverage. According to connoisseurs, the more tasteless the vodka, the higher its quality. Grey Goose then presents a unique case in that once it is poured into a glass, it is virtually indistinguishable from most other vodkas. Before it is poured into a glass, however, the coolness of Grey Goose can be seen. When Grey Goose was introduced to the market, it was shipped in wooden crates instead of cardboard boxes and in a frosted bottle instead of a clear one. Kerner attributes the coolness of Grey Goose to these two factors. The second case Kerner examines is that of Apple, which has had several wildly successful products. Most notable for our purposes though is the success of Apple's iPod. Typically, personal music players do not play songs better than any other music player. One may be able to hold more music, another might have a color screen instead of grayscale. Apple, through both its branding and packaging, had accomplished a similar type of coolness to Grey Goose simply by making its product different than comparable products on the market. These two examples illustrate that perceived coolness of a product can be due, in part, to the uniqueness of its packaging and branding.

The uniqueness aspect of cool can also be achieved through more substantive means than packaging. The unique performance of a digital device may be one mechanism for establishing coolness (Levy, 2006). Levy (2006) claims that many Apple products are perceived as cool because the incredible utility of the products sets them apart from others. As is the case with the iPod, Apple seamlessly integrated its music device with the ability to purchase music and organize playlists. This functional aspect of cool devices may be another aspect of coolness. From this example, we can also conclude that branding may not be sufficient to create "cool." Apple products, such as the iPod and iPhone, also follow through with a unique user experience (Holtzblatt, 2011b).

We can draw one very important conclusion about the nature of cool from both Grey Goose and the iPod: in a world of otherwise indistinguishable products, cool products are somehow unique, i.e., different from the rest, a conclusion that is very similar to the one found in a simple dictionary definition of cool. Cool then contains elements of uniqueness, both in terms of appearance and utility. Some producers of consumer goods have the ability to alter perceptions of cool itself simply by placing their product on the market in different packaging, whether that be the box in which alcohol is shipped or the case in which the workings of a personal music player are housed (Kerner et al., 2007).[1] Others are capable of designing a cool product that is substantively different than other products of a similar type, potentially changing perceptions of coolness of the entire product. Both of these processes are not simple and may involve the use of innovative marketing strategies and/or extensive design efforts to make the product look different and do something different, better, faster, or easier than others (Kerner et al., 2007; Levy, 2006).

Therefore, uniqueness, or some variation of it (originality, distinctiveness, novelty, freshness) appears to be associated quite strongly with the notion of coolness. When applied to the context of evaluating coolness of devices, this notion, along with the temporal instability aspect of coolness discussed earlier, yields the following items as potential measures of coolness: This device is original (1), fresh (2), unique (3), distinct (4), out of the ordinary (5), I never would have thought of the idea for this product (6), this product solves a problem I did not know existed (7), someone will soon try to copy this device (8), this device will not always be

[1] Note that there may be multiple perceptions within a culture for what is or is not cool. Cool is a user/consumer perception that may vary depending on a host of factors. Thus, while the idea of cool itself is held constant within temporal or social variation, the products or behaviors that fall under the umbrella of cool will vary across time, individuals and cultures.

as unique as it is today (9), and devices like this have been around for a long time (10), with the last mentioned suggesting uniqueness in the reverse.

2.1.2. Attractiveness

Undeniably, products such as the iPod, Grey Goose vodka, and Mercedes vehicles are attractive products, at least on the surface. In his detailed analysis of Apple products, Levy (2006) focuses on the attractiveness aspect, which is partly rooted in aesthetics. In human–computer interaction, Tractinsky (1997) has pointed out that the esthetic nature of an object plays a major role in how it is perceived. Interestingly, he found that this has implications for perceptions of utility as well, and is also culturally dependent. Levy (2006) maintains that the aesthetic design of both the utility and cosmetic aspects of the iPod contribute to its perceived attractiveness.

Aesthetic judgments are of course quite subjective, but can arise from both how the individual alone perceives the object and how the individual sees others within his or her particular subculture perceiving the object as well (Levy, 2006). This suggests that coolness perceptions are communal, requiring a quick assessment of its apparent cosmetic or functional appeal to both oneself and others. That is why coolness is often equated with trendiness (e.g., Oh et al., 2013), i.e., the degree to which a given object is in vogue at a given time.

In sum, the attractiveness aspect of coolness encompasses both the aesthetic appeal and a socially accepted notion of style. Therefore, measures tapping into this dimension should ask respondents to not only evaluate whether a given product looks great (11), accomplishes its purpose creatively (12) and helps them do a previously mundane task in a new and exciting manner (13), but also evaluate the degree to which they consider it to be hip (14), stylish (15) and makes them look great (16).

2.1.3. Subculture/counter-culture

The subcultural nature of cool can best be thought of as the degree to which users perceive that the digital device is either absent in mainstream culture, present in a subculture, or provides utility to a subculture. Dar-Nimrod et al. (2012) point to a rebellious element to coolness. They identified a factor which they labeled “contrarian coolness” to describe individuals whose coolness is based on rebelliousness, irony/sarcasm and aggressiveness/toughness. Horton et al. (2012) suggest that coolness comes from being simultaneously social with one's peer groups and anti-social with other groups. Similarly, cool products would be those that go against the mainstream and create a niche user base among a fringe minority. Not only do the products denote a departure from mainstream culture, but also its users may be seen as being edgy and different from the vast majority of users.

According to a PBS documentary, cool is not a birthright; that, in order to stay cool, a product or company has to change with time (Goodman, 2001). It is likely that perceptions of cool are lowered when a cultural object, such as torn jeans, becomes mainstreamed. But, digital devices are typically produced with profit in mind and are intended for mainstream markets. This may prove problematic for understanding how coolness affects perceptions of digital interfaces because they are also commonly found in mainstream markets.

That said, the presence or absence of a potentially cool object in mainstream culture may not, however, be the most accurate way to characterize the subcultural nature of a digital device. The coolness of a digital device could also be due to its utility to a particular subculture. For example, it is possible that a device such as the Kindle may be perceived as less cool because it is used to sell mainstream books to the mass market. However, it may be that the Kindle is perceived as more cool by independent authors and independently owned bookstores because the Kindle may provide an opportunity for authors to distribute content independent of the larger profit constraints that have traditionally prevented less popular works from being distributed. In that respect, it subverts the dominant mainstream of book publishing. In essence, cool devices should help users realize and express their self-identity (Holtzblatt, 2011b), which may include expressing one's affiliation to a larger social group, differentiate oneself from others and other groups, and/or signal a future trend.

Measures that capture these conceptual aspects of the subcultural dimension of coolness include: This device helps people who use it stand apart from the crowd (17), makes people who use it different from other people (18), allows users to express who they really are (19); this product is for people who are a bit ahead of the curve (20); a lot of people do not know about/use this item (21); people who use this product are people I would describe as being different from most others (22), typically up on popular trends (23), unique (24), and would be considered leaders rather than followers (25); If I used this device, it would make me stand apart from others (26); If everyone used this product, it would be less appealing to me (27).

2.1.4. Genuineness

Sometimes, coolness can arise from the authentically “real” or “sincere” nature of the object itself (Conan, 2008), a genuine need to improve the lives of users, with extraordinary attention to detail geared toward making a product great (Levy, 2006). It is possible that users may be able to perceive this genuineness of a product based on its quality (Kerner et al., 2007), with attributions made about the intentions of the producers of the product to improve the lives of the users. The literature on genuineness notes that authenticity (Conan, 2008), attention to detail (Levy, 2006), and desire to improve the life of a user (Kerner et al., 2007) are perceived from a finished product. It is not entirely clear whether genuineness or sincerity are elements of cool or simply prerequisites for a product to be perceived as cool, as illustrated in Levy's (2006) examination of Mercedes. The makers of Mercedes luxury vehicles wanted to create a high quality product that would serve the buyer well. As a result, there were many features of a Mercedes, including many models that had a distinct “click” when a passenger closed the door, a beneficial but unintended consequence of the care taken in the design phase of the vehicle. The audible click did not arise because producers planned on introducing it, but because the door was so well engineered that the entire door frame touched the car frame at the exact same time.

All of this implies that coolness is an unplanned byproduct of a single-minded quest for excellence in product design. As such, this dimension refers to the sincerity of the designers and their interest in serving users rather than being deliberately flashy. Therefore, the following types of measures may capture this aspect of coolness: The designers of this product primarily want to create better products (28), probably found working on the project fulfilling (29), did not take any shortcuts when producing it (30), and primarily want to make money (31), with the last mentioned indicating genuineness in the reverse. Other items include: I think the purpose of this device is to help people (32); The purpose of this device is to be useful (33); This device is the best of its kind (34); and I believe this device is flashy (35), with the last mentioned being reverse-coded.

2.1.5. Preliminary conceptualization

In relation to interfaces of digital devices, coolness can best be thought of as a multidimensional user-based judgment. It is a

perception that acknowledges the uniqueness, attractiveness and (sub)cultural status of a device. This perception also takes into consideration the care with which the producers designed or created the device, and the genuineness of their intentions to innovate rather than simply profit.

2.2. Operational definitions

Researchers aiming to identify current products or trends that may be perceived as cool typically operationalize cool, if at all, in terms of participant perceptions and as a univariate concept consisting of what is cool and excluding what is not. Smith and Wylie's (2004) attempt to determine the brands Chinese college students perceived as cool fall into this category. While they provide a relative ranking of coolness of various brands and products, they stop short of exploring the essential components of the concept.

Qualitative studies that explore how certain products or brands become cool (Goodman, 2001; Kerner et al., 2007) tend to contextualize cool within larger social frameworks, namely marketing strategies and other social forces. Cool is assumed to manifest itself in the consumer's mind as a perception that the brand or product is of a premium quality, distinctly different from what is currently available, and provides the user with a new experience (Kerner et al., 2007; Levy, 2006). Still others have attempted to operationalize cool in the form of a product rather than as a consumer perception. In other words, marketers have tried to make their products fit into existing perceptions of cool. These include the attempt by Levi's to make their product cool by associating it with sex appeal (Friedman and Cuneo, 1999; Garfield, 1999), Microsoft's bid to alter cool through the use of a "cool" expert (Creamer and Cuneo, 2008), Coca-Cola and Xerox's forays into cool through the use of press conferences in Second Life (Bulik, 2007; Wheaton et al., 2007), Maybelline and Gatorade's play on the words "ice" and "frost" to achieve coolness (Pollack, 1997), and Nokia's strategy of having users define cool on a company-sponsored website with the hopes of having users perceive that their products are of interest to "the coolest of the cool users" (Madden, 2007). Such operationalizations are less concerned about defining and using an accurate conceptualization of cool in their research and marketing efforts and more concerned with aligning their products in the minds of users and consumers with the "cool" label based on a general layperson notion of cool.

Qualitative and descriptive analyses of cool objects have dominated the field thus far, but we need to advance operationalizations of cool beyond pointing to cool objects and describing them. Objective and versatile measures are needed to delve more deeply into the *how* and *why* of cool if the concept is to be of any real value in analyzing the "now" of coolness rather than as a *post hoc* review of what is cool about an already successful product. Only then can cool be a true design goal.

The body of work on coolness reviewed thus far, taken as a whole, does offer some insight into the various aspects of coolness and how it may be manipulated and measured. Of primary concern is how to design coolness into an interface, so that it triggers the "coolness heuristic" (Sundar, 2008) among users. The literature suggests that by substantively or cosmetically altering the interface, coolness perceptions of a device can be enhanced. When operationalizing coolness, it is critical to consider the various attributes of coolness described thus far, namely uniqueness, attractiveness, subculture, and genuineness.

2.3. Research question

In order to empirically test the emerging conceptualization, an exploratory factor analysis was conducted to identify the central components of cool, guided by the following research question:

> RQ1: *What is the factor structure of Coolness? Do coolness perceptions align along the dimensions of genuineness, uniqueness, subculture, and attractiveness, as suggested by the literature, or are there other distinct dimensions of coolness?*

3. Study 1

The purpose of this study is both to develop a conceptualization of coolness that would be useful to interface designers and arrive at measures that would be useful to UX researchers. Toward this end, we collected self-report data about user perceptions of cool as well as uncool products and used them in an exploratory factor analysis to investigate the internal structure of cool.

3.1. Participants

A total of 315 undergraduate students from a large U.S. university filled out self-report data on their perceptions of digital devices, software and applications in Spring, 2009. The sample consisted of 213 females (67.6%) and 95 males (30.2%), with seven (2.2%) participants not providing gender data. Their ages ranged from 18 to 25 ($M=19.88$, $SD=1.40$).

3.2. Developing measures

The "meaning analysis" (Chaffee, 1991) undertaken in our explication of coolness perceptions resulted in a total of 35 evaluative statements about coolness under the four broad categories of uniqueness, attractiveness, subculture and genuineness. These statements, listed earlier at the end of each section of our explication, were converted into five-point Likert-type self-report measures for use in this study.

3.3. Procedure

Participants were routed into the study from an unrelated experiment, and randomly assigned to one of 14 separate conditions. They were told that the study was designed to measure their general perceptions of a digital device, application or site. Within each condition, participants were shown a picture of one of 14 products (Digg.com, Facebook.com, Garmin GPS, Google Gmail, Android mobile phone, iPhone, Kindle, Cruzer memory stick, Webmail, MySpace, Playstation 3, Twitter, Wii, or World of Warcraft) and asked to carefully consider their experience with that device or service. After viewing the image, participants navigated to the questionnaire that asked them to indicate their agreement with the 35 Likert-type items describing the qualities of the item they viewed (1 = *Strongly disagree*, 5 = *Strongly agree*). The question order was randomized between participants in order to prevent order effects. Between 16 and 36 participants were assigned to each condition ($M=22.50$, $SD=5.42$).

3.4. Study 1 results

Data gathered from participants were analyzed using principal axis factoring with oblimin rotation. Since the subconcepts of cool are expected to correlate with one another, an oblique rotation method was used instead of orthogonal rotation (Pett et al., 2003).

Items that cross-loaded were dropped from the analysis based on the .60/.40 rule, i.e., the highest loading should be above .60 with all other loadings below .40. The final factor solution yielded

Table 1
Exploratory factor analysis – loadings of significant coolness items from Study 1.

Measurement Items	Factors			
	1	2	3	4
Appearance				
1. This device is fresh	**.83**	.00	.02	.03
2. This device is original	**.77**	−.12	−.05	−.11
3. The device is the best of its kind	**.71**	−.00	.10	−.07
4. This device is unique	**.69**	−.27	−.02	−.08
5. This device is distinct	**.67**	−.07	.03	.00
6. This device is stylish	**.65**	.10	−.04	.24
7. This device is hip	**.63**	.07	.02	.24
8. This device looks great	**.63**	.08	.06	.24
Subculture				
9. People who use this product are people I would describe as being different from others	−.14	−**.85**	−.05	.13
10. This device makes people who use it different from other people	.01	−**.80**	.09	.04
11. If I used this device, it would make me stand apart from others	.04	−**.74**	.07	.03
12. This device helps people stand apart from the crowd	.17	−**.70**	.06	−.03
13. The people who use this product are unique	.16	−**.69**	−.03	−.05
Utility				
14. The purpose of this device is to be useful	−.03	.05	**.94**	.04
15. I think the purpose of this device is to help people	.02	−.10	**.70**	−.02
Negative items				
16. The designers of this device primarily want to make money	.01	−.12	−.09	**.69**
17. Someone will soon try to copy this device	.06	−.08	.13	**.60**

four factors with eigenvalues greater than 1.0. These factors cumulatively accounted for 68.25% of the variance. These four factors were tentatively labeled as follows: Appearance, Subculture/Distinctiveness, Utility, and Negative Items. The individual items for each factor, factor loadings and reliability can be found in Table 1.

The first factor, labeled "appearance," accounted for 40.60% of the variance and was made up of eight items (α=.91, M=3.19, SD=1.06). This factor included two types of items—those related to attractiveness (e.g., as "This device is stylish") and those related to uniqueness (e.g., "This device is unique"). The second factor, labeled "subculture," focused on setting oneself apart from a crowd (α=.90, M=2.45, SD=1.07). The third factor identified in the analysis was "utility," featuring two items that were originally intended to tap into the perceived genuineness of the device, seem to capture user perceptions of the utility of the device (α=.80, M=3.39, SD=1.31). The fourth and final factor identified in our analysis was made up of two negatively valenced items (α=.66, M=3.74, SD=1.18). They seem to have factored together because of their valence and do not suggest a distinct dimension of coolness (see Table 1).

3.5. Study 1 discussion

The key conceptual components of coolness derived from the literature—i.e., genuineness, subculture, attractiveness and uniqueness—did not emerge as separate factors, but they were aligned together in a manner that provides insights into user perceptions of digital devices.

An interesting development was that some of the measures originally intended to tap into the uniqueness of a digital device loaded on the same factor as attractiveness. This finding, along with the emergence of a separate utility factor, suggests that participants' evaluations of attractiveness are distinct from their evaluations of the utility of a product. Furthermore, perceptions based on the appearance of the device seem to be driven by both the aesthetic appeal of the device itself (how it looks and how stylish and hip it is) and its originality (how unique and distinct it is amongst other devices). This is consistent with previous literature suggesting that coolness can be derived from both the attractiveness and the uniqueness of a device—both are often necessary pre-conditions for cool (Levy, 2006).

The presence of the subculture factor is also insightful, in that it suggests a distinction between the device being distinct (which is part of the first factor) and the device making its owner look distinct from other users. Past work has speculated that cool devices help individuals stand apart from the crowd and thereby make the users feel like they are unique. Cool hunters specifically track down individuals who are trendsetters, those that are different from their peers, and use their trends in marketing (Kerner et al., 2007). However, it seems that once a product reaches the mass market, that aspect of cool is no longer a positive consideration in perceptions. This makes sense from a critical standpoint, especially in light of Fiske's (2003) work on subculture trends. Cool products may be intended by their producers to stand out from amongst the crowd of other digital devices, but as these products are intended for the mass markets, users purchase and use them to fit in, not stand out. This perhaps explains why certain products that are not fully adopted are perceived as cool, but when everybody owns them, they lose their coolness.

In hindsight, the utility factor should have been one of our predicted subsets of cool. Modern-day product developers such as Steve Jobs (Levy, 2006) and classical thinkers such as Vitruvius (Smith, 2003) both claim that any object's attractiveness must also be balanced with utility if it is to be of any importance to users. Unfortunately, we only included a few items to capture user perceptions of the utility of a digital device because we had originally hypothesized that these items would load on a genuineness factor, assuming that judgments of cool would be partly based on the perception that the producer created the product not for profit but for helping users.

While this study does provide some sense of the conceptual breakdown of coolness, there are definite limitations to a single-shot survey, especially for conceptualizing such an ethereal concept as cool. Furthermore, due to the unexpected loadings of

certain items, the exact nature of each factor is not clear. Therefore, a second study was launched in order to better understand the factor structure of coolness.

4. Study 2

Coolness measures from Study 1 were supplemented with additional measures so that each factor is represented by a sufficient number of items. While the Subculture factor was only altered in a minor way, more items were added to the Utility factor. Furthermore, the two dominant aspects of the Appearance factor, namely Attractiveness and Originality, were both buttressed with additional items and modeled as two separate factors in a confirmatory factor analysis, in line with our explication. Additionally, as coolness might vary across cultures, this study involved participants from both the United States and South Korea. A team of coders translated the items from English into Korean. Items from the first analysis that either did not load on a factor or were cross-loading between factors were dropped or modified.

The second study consisted of a total of 835 participants, 263 from the United States (31.5%) and 572 from Korea (68.5%) in Fall, 2009 and Spring, 2010. There were 296 male (35.4%), 512 female (61.3%) participants, and 27 (3.2%) that declined to provide gender information. The age of participants ranged from 18 to 43 ($M=19.75$, $SD=2.37$).

Participants were randomly assigned to view images of one of 11 digital devices. As the iPhone was not as popular in Korea as in the United States at the time of study administration, the Haptic phone was used as a substitute for the Korean version of the study. The devices included a Macintosh computer, navigation GPS, PC Windows computer, iPhone/Haptic phone, Playstation 3, turntable, USB storage device, standard email client, Wii, World of Warcraft, and Xbox. Participants were asked to think about what they knew about the device and any prior experience they may have had with the device. They were then asked to rate the device they had viewed for each of the coolness items on a 9-point Likert scale (1=*Strongly disagree* and 9=*Strongly agree*). For a full list of measurement items and expected factors, see Table 2. Item order was randomized across study participants to prevent order effects.

4.1. Study 2 results

A confirmatory factor analysis was conducted to test the four-factor structure shown in Table 2. The initial model, with all 23 items, did not result in a good fit ($\chi^2=2446.33$, $df=224$, $p<.001$; CFI =.83; NFI =.81; AGFI =.74; SRMR =.13; RMSEA =.11, 90% CI =.105–.113). Several items had regression weights that were weak, and modification indices also showed that the model fit could be improved if some items were allowed to cross load on other concepts. Such items were eliminated from the model iteratively in subsequent analyses. The final model consisted of 19 items. While the 19-item model did not meet the chi-square test of fitness, likely due to the large size of the sample ($\chi^2=807.62$, $df=146$, $p<.001$), other fit statistics indicated that the model was a reasonably good fit of the data (CFI =.94; NFI =.92; AGFI =.87; SRMR =.06; RMSEA =.074, 90% CI =.069–.079). The final 19-item model was a significantly better fit than the original model ($\Delta\chi^2=1638.71$, $df=78$, $p<.01$). See Fig. 1 for the model structure and standardized regression weights. Subscale reliability and question wording can be found in Table 2. All subscales were positively correlated with each other.

To test for differences in the model between Korean and U.S. respondents, a multiple group analysis was conducted. First, a multigroup representation of the 19-item model was constructed by allowing the regression weights, error variances, and covariances to vary freely. The model fit for this unconstrained "configural" model ($\chi^2=1105.41$, $df=292$, $p<.001$; CFI =.923; RMSEA =.058, 90% CI =.054–.061) was first compared with that of a model in which all the factor loadings were constrained to be equal across both groups ($\chi^2=1165.87$, $df=307$, $p<.001$; CFI =.919; RMSEA =.058, 90% CI =.054–.062). Considering that the difference in CFI between the two models (ΔCFI=.004) is less than the .01 cutoff proposed by Cheung and Rensvold (2002), we have evidence for measurement invariance. Structural invariance was tested next by adding equality constraints for the six covariances (i.e., by constraining all the covariances between the four factors to be equal for the Korean and US samples). It yielded the following model fit: $\chi^2=1179.14$, $df=313$, $p<.001$; CFI =.918; RMSEA =.058, 90% CI =.054–.061. Again, the ΔCFI of .005 is below the cutoff, thereby allowing us to conclude structural invariance. We followed this up by placing equality constraints on factor variances and found further evidence ($\chi^2=1219.99$, $df=317$, $p<.001$; CFI =.914; RMSEA =.058, 90% CI =.055–.062) for structural invariance across the two groups.

It must be noted that a more stringent test, based on differences in χ^2 between the configural model and the constrained models, suggested noninvariance in the measurement model (i.e., the first of the three tested above, where all the factor loadings
are constrained to be equal), $\Delta\chi^2=60.46$, $df=15$, $p<.001$. Upon probing, equality constraints on three items with the largest differences in loadings between the U.S. and Korean samples (Originality 1, Subculture 5 and Utility 3) were removed iteratively to yield a non-significant $\Delta\chi^2$ of 16.44, $df=12$, $p=.17$. Constraining the factor covariances on top of this did not result in a significantly worse model, $\Delta\chi^2=27.65$, $df=18$, $p=.07$, thus providing evidence for structural invariance across the two samples. In general, the factor structure appears to be quite similar across the two samples. Except for the three items noted above, the average difference in factor loadings across the remaining 16 items is .04. For the three items, the average difference is .25, with the factor loadings always higher in the US sample. What this implies is that the items in question (This device is original; People who use this device would be considered leaders rather than followers; This device would help me get things done) are more reflective of their respective factors (Originality; Subculture; Utility) for Americans than for Koreans. This could be due to cultural differences in the degree to which these items align with other items in the same factor or due to differences in meaning caused by translation of those particular item wordings from English to Korean. When considered in totality though, the differential loading of these three items is insufficient to claim cultural differences in the conceptions and factor structure of coolness. Therefore, all remaining analyses were conducted with the combined dataset.

One of those analyses tested whether the subconcepts of coolness should be treated as distinct dimensions or whether they should be considered as belonging to one dimension. Theoretically, subconcepts of coolness should be correlated, at least to a certain degree. The reasoning here is that if a device is perceived to be cool, it is likely that it will rate higher across these subconcepts than a device that is not perceived to be cool. For example, a device that rates highly on both originality and subcultural appeal would be considered cooler than one that rates highly on just one of these dimensions. That is not to say, however, that the concepts should be perfectly correlated. Perfect correlation would indicate that some items in the scale are redundant, but more importantly, perfectly correlated subconcepts might be an indication that the scale is measuring a unidimensional construct rather than a multidimensional construct.

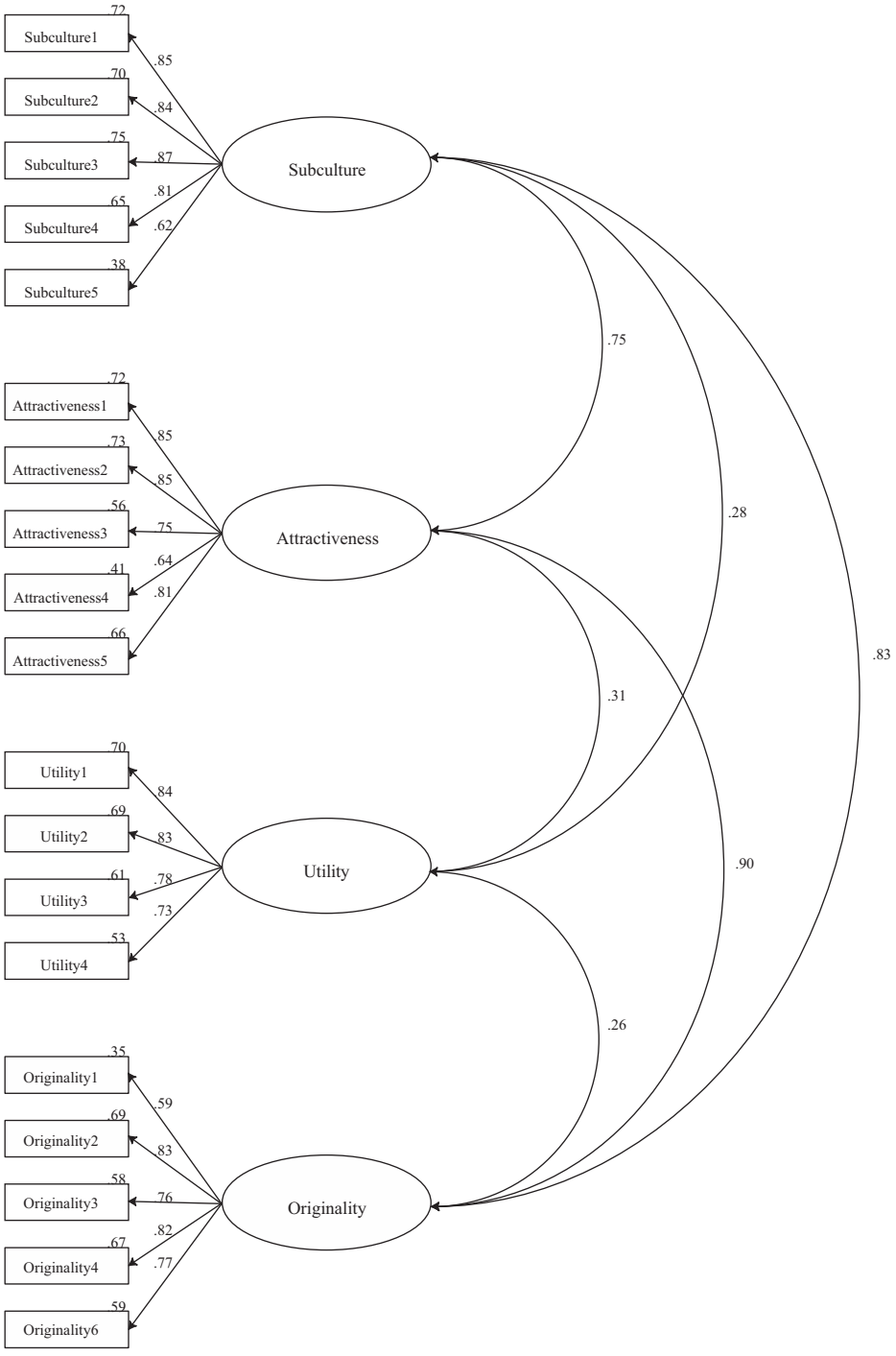

Fig. 1. Final coolness model structure obtained in Study 2. $\chi^2 = 807.62$, $df = 146$, $p < .001$; CFI = .94; RMSEA = .074, 90% CI = .069–.079. *Note*: All parameters are standardized and significant at $p < .01$. See Table 2 for actual wording of items. Error variances are not shown in order to reduce visual clutter.

Therefore, in an effort to assess the dimensionality of the coolness construct, convergent validity and discriminant validity of the latent subconcepts were examined through two sets of tests. Convergent validity was indicated by the presence of a statistically significant correlation between each pair of subconcepts and discriminant validity by a significant decrease in model fit when the correlation between a given pair of subconcepts was constrained to be 1. In other words, if a model in which the subconcepts are assumed to be perfectly related results in a worse fit (i.e., a significant increase in Chi-Square), discriminant validity of the subconcepts is said to be demonstrated. Each pair of subconcepts (e.g., subculture and attractiveness) was constructed as an individual unconstrained model, and compared with its corresponding constrained model in terms of Chi-Square change. All pairs of subconcepts demonstrated convergent validity (Fig. 1) as well as discriminant validity (Table 3), although it appears that utility is the weakest link.

Table 2
Scale items and reliability of coolness items from Study 2.

Subculture α =.89, M=4.15, SD=1.95
This device makes people who use it different from other people (Subculture 1)
If I used this device, it would make me stand apart from others (Subculture 2)
This device helps people who use it stand apart from the crowd (Subculture 3)
People who use this product are unique (Subculture 4)
People who use this device would be considered leaders rather than followers (Subculture 5)
People like me use this device (Subculture 6)*

Attractiveness α =.88 M=4.57, SD=2.04
This device is stylish (Attractiveness 1)
This device is hip (Attractiveness 2)
This device is on the cutting edge (Attractiveness 3)
This device is sexy (Attractiveness 4)
This device is hot (Attractiveness 5)

Utility α =.87, M=4.89, SD=2.10
The purpose of this device is to be useful (Utility 1)
I think the purpose of this device is to help people (Utility 2)
This device would help me get things done (Utility 3)
This device helps me complete tasks more efficiently than other devices of its kind (Utility 4)
Using this device is satisfying (Utility 5)*

Originality α =.87, M=4.62, SD=1.91
This device is original (Originality 1)
This device is unique (Originality 2)
This device is out of the ordinary (Originality 3)
This product stands apart from similar products (Originality 4)
I have never seen something like this before (Originality 5)*
This product is novel (Originality 6)
This product caters to my own needs (Originality 7)*

* Denotes item dropped from final model. Cronbach's alpha for each subscale was computed after dropping the asterisked items.

Table 3
Change in chi-square when covariances between pairs of standardized latent subconcepts of coolness were constrained to one (df=1).

Variable name	1	2	3	4
1. Subculture	–			
2. Attractiveness	628.50**	–		
3. Utility	1476.23**	1444.75**	–	
4. Originality	369.15**	145.81**	1488.09**	–

** Denotes significant difference between constrained and unconstrained model at p <.001. When the equality constraints were placed on the covariances, one by one, on the overall 19-item CFA model, the resulting increases in Chi-Square of the entire model were quite similar to the changes reported in the table above (col. 1: 652.07; 1473.01; 365.69; col. 2: 1442.29; 146.16; col. 3: 1480.54), with CFI decrement greater than .01 in every comparison to the unconstrained four-factor model.

4.2. Study 2 discussion

The large dataset from Study 2 supports a four-factor model of coolness, with the following essential components: Originality, Utility, Attractiveness, and Subculture. However, one of these, Originality, is quite closely associated with both Subculture and Attractiveness, emphasizing the importance of user perceptions of Originality in the overall assessment of coolness. In general, however, an interface is cool if it is novel, attractive, has utility value to the user and helps the user assert his or her uniqueness or subcultural identity. A stylish design is not enough for something to be considered cool. It has to be novel and it has to have the ability to help its owner stand out. Furthermore, it has to be useful and practical, but it appears that this aspect is only weakly related to the other aspects of coolness.

This study also contributes to our understanding of cool by distinguishing between products that are simply more attractive or useful and those that are cool. Coolness should be understood as not solely originating within any one of these subconcepts but rather the presence of each of them in sufficient measure. Simply because a product is better at accomplishing a task (utility) does not mean that it is cool. Rather, coolness is the perception of a device that is not only based on its utility, but also on its ability to provide the user with identity (subculture), create an enjoyable experience through its aesthetic appeal (attractiveness), and stand apart from other devices of a similar nature (originality). These attributes of coolness appear to be culturally invariant, with respondents from US and Korea both showing a similar four-factor structure of coolness perceptions.

The most important contributions of this study are that it provides designers with a useful conceptualization and quantification for a critical user perception that is consistently at the core of digital devices. This study demystifies the common refrain "I know cool when I see it" and helps researchers and practitioners identify, design for and measure perceived coolness. Yet, it does not reify the concept. Even though it identifies four related, but somewhat distinct, sets of perceptions of digital devices, we cannot be sure that these four dimensions are indeed subcomponents of coolness or some other construct. It is unclear to what extent they capture the concept of coolness *per se*. Therefore, it is important to ascertain the content validity of these measures by assessing the degree to which they tap into a general layperson notion of coolness. With this in mind, we launched our next study.

5. Study 3

In order to examine the relationship between the factors obtained in study 2 and the psychological construct of coolness, a constructive replication of Study 2 was conducted in spring and summer of 2012 by adding measures tapping into a holistic notion of cool. Participants from Korea and China were asked to holistically evaluate a device's coolness (e.g., "this product is cool;" "Having this product will make me look cool;" etc.). Then, we conducted a confirmatory factor analysis using the prior approach to determine if the developed scale correlated significantly with the newly created scale measuring holistic coolness of devices. If the previously constructed scale is indeed tapping into coolness, the measures of holistic cool should strongly and significantly covary with the constructed scale.

This study consisted of 317 participants, 274 from Korea (86.4%) and 43 from China (13.6%). There were 169 female (53.3%) participants. The age of participants ranged from 19 to 48 (M=23.29, SD=2.93).

As in Study 2, participants were randomly assigned to view images of one of 18 digital devices. They were then asked to evaluate different aspects of coolness (i.e., subculture, attractiveness, utility and originality) of the device they had viewed by using the measurement items developed in Study 2. In addition, a list of nine questions measuring participants' holistic evaluation of coolness was also administrated: (1) When I first heard of this product, I remember thinking that it would be cool to have one; (2) Having this product will make me look cool; (3) When I think of things that are cool, objects like this come to mind; (4) This product is cool; (5) When I use products like this, my response often is something like "That's cool!"; (6) It's cool how this product works; (7) This product has some cool features; (8) If I made a list of cool products, this product would be on it; (9) This product is more cool than other products that fulfill a similar function. All the items were rated based on a 9-point Likert scale, with 1 being *strongly disagree* and 9 being *strongly agree*.

5.1. Study 3 results

A replication of the 19-item, four-factor model yielded similar fit indices to those found with Study 2 (χ^2=458.33, df=146,

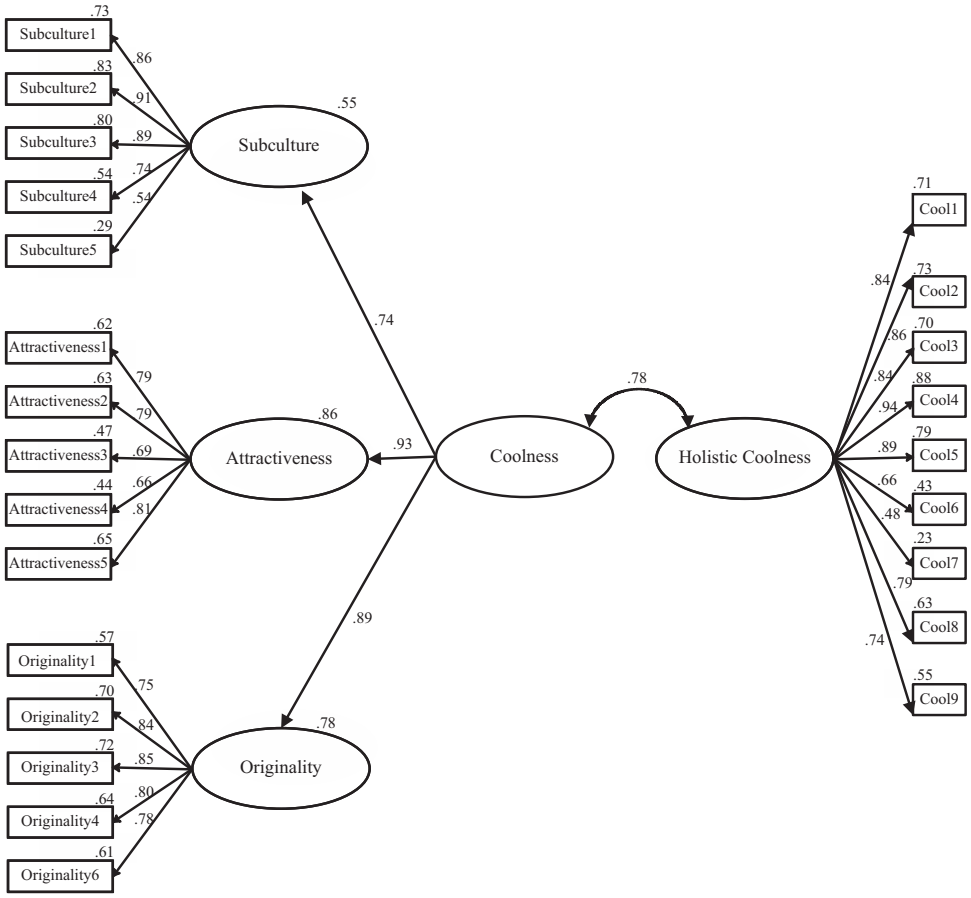

Fig. 2. Final coolness model in Study 3. $\chi^2=484.31$, $df=242$, $p<.001$; CFI =.96; RMSEA =.056, 90% CI =.049–.064. *Note*: All parameters are standardized and significant at $p<.001$. Error variances and covariances between error terms are not shown in order to reduce visual clutter.

$p<.001$; CFI =.93; NFI =.90; AGFI =.82; SRMR =.06; RMSEA =.082, 90% CI =.074–.091). When we iteratively covaried error terms of three sets of items (Attractiveness 2 and Attractiveness 3; Originality 4 and Originality 6; Originality 2 and Subculture 4) based on conceptual rationale and guided by modification indices, we obtained the following fit indices: $\chi^2=348.93$, $df=143$, $p<.001$; CFI =.95; NFI =.92; AGFI =.86; SRMR =.05; RMSEA =.068, 90% CI =.059–.077.

A reflective second-order factor model of coolness based on this was then examined for its covariance with a new latent variable signifying a holistic perception of coolness comprising the nine aforementioned items. The final model—after allowing three pairs of error terms (holistic coolness items 1 and 2, 5 and 6, and 6 and 7) to covary based on theory and modification indices—resulted in a reasonably good fit ($\chi^2=684.29$, $df=339$, $p<.001$; CFI =.95; NFI =.91; AGFI =.84; SRMR =.06; RMSEA =.057, 90% CI =.051–.063). The most important finding from this model is the strong relationship between the two different sets of coolness measures ($\phi=.78$, $p<.001$). Second, it was discovered that utility has a weak relationship to the second order factor of coolness ($\gamma=.06$, *ns*). For this reason, we determined that utility was not contributing any additional variance to the second order construct of coolness and therefore removed it from the model. With utility removed, the model fit improved slightly ($\chi^2=484.31$, $df=242$, $p<.001$; CFI =.96; NFI =.92; AGFI =.85; SRMR =.05; RMSEA =.056, 90% CI =.049–.064), but more importantly, it produced a more parsimonious account of the structure of coolness perceptions (Fig. 2).

Finally, descriptive statistics (means and standard deviations) of each subscale, along with those of the overall coolness index (made up of the three subscales) and holistic coolness index (composed of the nine items directly measuring perceived coolness) were assembled (Table 4) to provide a convenient indication of the face validity of the final factor structure of coolness. We would expect devices that are generally considered cool in popular culture (e.g., iPhone, iPad) to score higher than those considered less cool. The results consistently supported such an expectation. For example, iPad consistently received high scores on subculture ($M=5.81$, $SD=1.49$), attractiveness ($M=6.90$, $SD=.96$), originality ($M=6.21$, $SD=1.49$), overall coolness index ($M=6.31$, $SD=1.24$), and holistic coolness ($M=6.32$, $SD=1.60$) in contrast to technologies such as Webmail, USB drive, and desktop PC, which scored fairly low (generally lower than 4) across all the dimensions. Interestingly, iPhone 4 received higher ratings on all dimensions (e.g., $M=6.10$, $SD=1.45$ for attractiveness and $M=5.79$, $SD=1.69$ for originality) except subculture ($M=4.84$, $SD=1.72$), which reflects the mass diffusion of the smart phone and the consequent loss of its status as a symbol of uniqueness. On the other hand, an old technology, record player, scored higher on subculture ($M=6.52$, $SD=1.30$) than all other dimensions, reflecting its abandonment by the majority and espousal by a niche group of users giving it subcultural appeal in recent years.

In examining the mean scores on the utility scale for each device (see last column in Table 4), we find that this dimension is generally inconsistent with other subconcepts and the overall coolness index. For example, technologies like Webmail, Desktop PC and USB drive that generally scored low on subculture, attractiveness, originality, and the holistic coolness scales received very high scores on utility (e.g., $M=6.0$, $SD=2.26$ for Webmail, $M=6.51$, $SD=1.46$ for Desktop PC and $M=6.77$, $SD=1.43$ for USB drive). This kind of inconsistency between utility and the other

indicators of coolness corroborates our decision to remove utility from the overall factor structure of coolness.

5.2. Discussion

When considered together, the analyses suggest that Attractiveness, Originality and Subcultural Appeal constitute the core perception of coolness in digital devices and interfaces. In other words, an innovation would be considered cool if it is novel, attractive and capable of building a subculture around it. In retrospect, this parsimonious conceptualization of coolness can help explain the appeal of various cool products and designs discussed in our literature review. Most importantly, our work offers a series of direct as well as indirect measures for assessing the degree to which individuals perceive coolness in objects.

Our analyses based on three datasets also clarify the concept of coolness significantly, by progressively tapping into its core meaning and eschewing peripheral aspects such as utility. It is clear from our data that a pure notion of utility has no place in coolness perceptions; that, if anything, utility is a byproduct of the other three aspects. The utility seen by some observers in a product that provides a creative solution to a problem is in itself not an indicator of its coolness; rather, this unique solution is really a reflection of its originality. Similarly, the increased perception of utility arising from a device's aesthetic quality (Tractinsky, 1997) is not what contributes to user perceptions of coolness in that device. It is the attractiveness of the device which makes it cool; usability and utility are potential outgrowths of this initial judgment of coolness, but not necessarily. As Table 4 clearly shows, utility is often at odds with the three major components of coolness identified in the study. In fact, a recent educational study about a high school pilot program to test the use of iPad in classrooms (Culén and Gasparini, 2012) found that students perceived the device as being cool even though most of them felt that it was not as useful in school as they had anticipated at the beginning of the program. Therefore, perceptions of utility that arise from a device's attractiveness are incidental, not central to coolness perceptions. Likewise, the utility derived by members of a subculture in touting a device as a symbol of rebellion is not central to coolness perceptions. It is the ability of the device to build a subculture around it that makes it cool. Recent findings support this finding, as the perception of coolness in other individuals is more stable when examined as a socially distributed concept based on a shared meaning rather than an individual rating (Gerber and Geiman, 2012).

Our examination of coolness primarily used adult samples from the U.S., Korea and China, but the applicability of the final model is not limited to these countries. While what is considered attractive may vary from one culture to another (Norman, 2004), attractiveness seems to be a stable aspect of coolness regardless of cultural context. The same argument can be made for the subconcepts of subculture and originality. We found support for a stable conceptual makeup of cool independent of cultural context while still allowing for a culturally situated application of the scale.

The perceived coolness of a product does have implications for its success in the marketplace because it is believed to play a role in how users view and use technology. Specifically, certain affordances of an interface (e.g., haptic features offered by iPhone) may bias users to skip the effortful process of systematically assessing the device in favor of an affectively driven mental short-cut known as "coolness heuristic" (Sundar, 2008). Broadly speaking, the coolness heuristic is "a conscious acknowledgement of the 'hipness' of the digital device suggested by its newer modalities" (p. 82). The recognition of a device's coolness is theorized by the MAIN model to have two potential effects on evaluations of the device. The first effect is a direct positive evaluation of the product; the second is an increase in expectations for the device. The latter may lead to poorer evaluations because the perceived coolness of the device can raise user expectations of the interaction and its content (Sundar, 2008). Therefore, measuring coolness perceptions can be quite useful for understanding the theoretical mechanisms governing the psychology of both the ready adoption of new innovations and the disenchantment that often follows the adoption.

Other theoretical implications of our three-factor conceptualization of coolness include the examination of coolness as a process. As mentioned earlier, products go through a phase of coolness before they lose their association with cool. Our findings suggest at least three sets of mechanisms by which this could occur. The primary one of course is the loss of subcultural appeal. As a cool product begins to be adopted on a large scale, the exclusivity enjoyed by the early adopters will be lost. According to our data, this would result in a reduction in coolness perceptions for such a product. Likewise, a given interface or design may lose its freshness or originality and therefore be seen as less cool. And, as it becomes commonplace, its attractiveness (indicated by its stylishness, hipness, etc.) will begin to fade away, thus lowering users' perceptions of its coolness.

Methodologically, our research contributes to an empirical approach to studying coolness by offering ready measures for

Table 4
Means of subscales, summed coolness index, and holistic coolness Index for each device (Study 3).

Device	Subculture	Attractiveness	Originality	Coolness index	Holistic coolness	Utility
USB Drive	$M=3.24$, $SD=1.37$	$M=4.01$, $SD=1.46$	$M=3.55$, $SD=1.40$	$M=3.60$, $SD=1.71$	$M=3.34$, $SD=1.20$	$M=6.77$, $SD=1.43$
FourSquare	$M=5.31$, $SD=1.08$	$M=5.32$, $SD=1.56$	$M=5.42$, $SD=1.30$	$M=5.35$, $SD=1.21$	$M=5.20$, $SD=1.35$	$M=5.35$, $SD=1.87$
PlayStation 3	$M=3.86$, $SD=1.92$	$M=4.50$, $SD=1.83$	$M=4.78$, $SD=2.15$	$M=4.53$, $SD=1.75$	$M=4.17$, $SD=1.73$	$M=3.45$, $SD=1.59$
GPS	$M=3.58$, $SD=1.70$	$M=4.35$, $SD=1.87$	$M=4.29$, $SD=1.54$	$M=4.07$, $SD=1.39$	$M=4.11$, $SD=1.68$	$M=7.32$, $SD=1.32$
Instagram	$M=4.77$, $SD=2.14$	$M=5.83$, $SD=2.16$	$M=5.56$, $SD=1.95$	$M=5.39$, $SD=1.66$	$M=5.35$, $SD=1.91$	$M=6.35$, $SD=1.65$
iPad	$M=5.81$, $SD=1.49$	$M=6.90$, $SD=.96$	$M=6.21$, $SD=1.49$	$M=6.31$, $SD=1.24$	$M=6.32$, $SD=1.60$	$M=5.75$, $SD=6.88$
iPhone 4	$M=4.84$, $SD=1.72$	$M=6.10$, $SD=1.45$	$M=5.79$, $SD=1.69$	$M=5.58$, $SD=1.44$	$M=5.51$, $SD=1.60$	$M=5.61$, $SD=1.35$
Kindle	$M=5.63$, $SD=1.13$	$M=4.63$, $SD=1.80$	$M=5.18$, $SD=1.61$	$M=5.15$, $SD=1.18$	$M=4.39$, $SD=1.79$	$M=6.11$, $SD=1.16$
MacBook Air	$M=5.96$, $SD=1.65$	$M=6.53$, $SD=1.47$	$M=6.59$, $SD=1.39$	$M=6.36$, $SD=1.39$	$M=5.89$, $SD=1.48$	$M=5.02$, $SD=1.31$
XBOX 360	$M=4.81$, $SD=1.74$	$M=5.76$, $SD=1.12$	$M=5.10$, $SD=1.69$	$M=5.23$, $SD=1.36$	$M=4.97$, $SD=1.81$	$M=4.25$, $SD=1.93$
Pandora	$M=5.28$, $SD=.80$	$M=5.32$, $SD=1.09$	$M=5.57$, $SD=1.12$	$M=5.39$, $SD=.83$	$M=5.41$, $SD=.94$	$M=5.57$, $SD=.79$
Desktop PC	$M=3.11$, $SD=1.45$	$M=3.13$, $SD=1.47$	$M=3.20$, $SD=1.13$	$M=3.15$, $SD=1.11$	$M=3.47$, $SD=1.36$	$M=6.51$, $SD=1.46$
Prezi	$M=6.04$, $SD=1.66$	$M=5.71$, $SD=1.48$	$M=6.45$, $SD=1.61$	$M=6.06$, $SD=1.49$	$M=5.76$, $SD=1.49$	$M=5.93$, $SD=1.57$
Record Player	$M=6.52$, $SD=1.30$	$M=4.22$, $SD=1.34$	$M=5.80$, $SD=1.44$	$M=5.51$, $SD=.96$	$M=4.08$, $SD=1.65$	$M=3.16$, $SD=1.25$
Webmail	$M=3.56$, $SD=1.09$	$M=3.82$, $SD=1.31$	$M=3.85$, $SD=1.44$	$M=3.75$, $SD=1.08$	$M=4.08$, $SD=1.54$	$M=6.0$, $SD=2.26$
Wii	$M=5.18$, $SD=1.45$	$M=5.84$, $SD=1.42$	$M=6.55$, $SD=1.24$	$M=5.86$, $SD=1.16$	$M=5.35$, $SD=1.67$	$M=3.66$, $SD=1.59$
World of Warcraft	$M=3.92$, $SD=1.77$	$M=5.04$, $SD=1.56$	$M=5.16$, $SD=2.09$	$M=4.71$, $SD=1.50$	$M=3.24$, $SD=1.56$	$M=2.39$, $SD=1.52$
XBOX Kinect	$M=4.74$, $SD=1.68$	$M=5.15$, $SD=1.91$	$M=5.47$, $SD=1.41$	$M=5.12$, $SD=1.48$	$M=4.77$, $SD=1.48$	$M=4.37$, $SD=1.83$

tapping into both a holistic notion of coolness and indirect measures of the concept via the three subcomponents of originality, attractiveness and subcultural appeal. This will likely move the concept of coolness from a purely post-hoc evaluation to a tangible user criterion for use in formative design evaluations. It will also help researchers investigate the relative importance placed on different aspects of coolness by users with different demographic backgrounds and psychographic profiles. Some researchers (e.g., McCrickard et al., 2012) have suggested that factors such as age, gender and experience with technology could play a role in evaluations of coolness. The items and scales provided in this study could be used to assess such differences, if any, and determine the relative importance of different aspects of coolness for different groups of users. For example, younger users may place greater importance on subcultural appeal while older users could be more concerned about the originality of an innovation before they can declare it as cool.

Together, the three factors identified by this study not only provide ready measures for researchers, but also offer a set of user criteria for designers wanting to create cool interfaces or cool devices. Formative evaluations of products under development as well as design reviews of prototypes could use these criteria for enhancing the coolness potential of their interfaces. UX researchers can directly employ the questionnaire items and scales developed here for measuring the perceived coolness of all kinds of devices and applications. Academic researchers can use these measures for determining if the "coolness heuristic" is likely to be triggered by a particular interface or predicted more strongly by certain subconcepts than others. The parsimony of our three-factor solution represents a significant contribution given that current conceptualizations in the field are trending toward an all-inclusive model that lumps almost all positive perceptions of a product under coolness. The absence of cross-cultural differences in the factor structure speaks to the universality of our findings.

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Appendix A. The auxiliary results

See Tables 1–4.

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