

Interactivity as Super-variable: Definitions, Dimensions, Mediators, and Implications for Theory

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Abstract

In research about the World Wide Web, interactivity is an important variable. However, it has been defined in a number of different ways. Some definitions emphasize the user, while others emphasize the stimulus. Recent theoretical models have identified other variables which may moderate or mediate interactivity's effects. This helps explain these divergent findings, but much remains to be done. Future research should focus on such things as effects of interactivity of a stimulus, the impact of technological and content characteristics, the effect of dimensions of interactivity and whether interactivity plays a different role for different media.

Introduction

The emergence of the World Wide Web, and other digital mass media that allow information to pass to and from users, introduced new variables into the media-audience relationship. In defining a key difference between these newer media and their predecessors as a variable which could be isolated for study, scholars focused on *interactivity*, which was hypothesized to affect attention to, attitudes toward, and recall of mediated messages.¹ However, in the 15 years since the dawn of the Web, differing conceptual and operational definitions of interactivity have led to a body of literature rife with divergent findings regarding interactivity's definition, its role in research, and its effects. As has been noted in recent reviews of the interactivity literature,² some of the confusion comes from lack of agreement as to what interactivity is, whether it resides in users or in media, and how it should be operationalized. While these disagreements have doubtless contributed to the inconsistent findings, some of them may arise from a lack of conceptual clarity regarding *how* increased interactivity may influence the effects of

communication.

In order for mass communication scholarship to move toward one establishing one accepted definition of what interactivity is and is not, and to aid in the development of theory, greater clarity needs to be established regarding not only what factors do and do not constitute interactivity, but also the processes through which interactivity affects down-the-line variables ranging from attitudes and recall to physiological arousal and transportation. This paper will review areas of contention in the academic study of interactivity and their implications for theory development. First, media effects research on interactivity's effects will be reviewed with a focus on inconsistencies in how interactivity has been defined. Secondly, the study will examine the role measurement in the study of interactivity's psychological effects. Finally, two theoretical models of interactivity will be compared, and three specific suggestions for the refinement and development of theory-based approaches to interactivity's effects presented.

Interactivity's Role in Media Research

There are many compelling reasons to study interactivity. Not only has it been theorized to be an important concept governing a changing relationship between individuals and media, but empirical findings show that interactivity influences a variety of attitudes, behaviors and cognitions. As summarized well in recent work Rafaeli and Ariel, empirical studies have shown that interactivity can lead to as diverse outcomes as increased citizen participation,³ a heightened sense of telepresence,⁴ higher communication-processing load,⁵ and more positive scores on a variety of affect and attitude measures. On the other hand, research has linked interactivity to disorientation and high cognitive load,⁶ and even negative effects on attitudes at high levels of interactivity,⁷ resulting in what has been called the "interactivity paradox."⁸

Clearly, despite several decades of research, interactivity remains "an elusive concept... [the elusiveness of which] may result from the common use of the term to identify a loosely defined bundle of attributes rather than a single attribute or phenomenon."⁹ Interactivity's entry in the *International Encyclopedia of Communication* also points to four common elements which emerge in the various definitions of interactivity: directionality of communication, selectivity, responsiveness and awareness. *Directionality of communication* signifies a departure from earlier conceptualizations of media interactions as one-way message transmissions. *Selectivity* refers to choice on the part of the media recipient and the quantity and structure of message of message options which facilitate that choice. *Responsiveness* refers to several dimensions - speed, frequency, or flexibility - that affect how a medium responds to user input. Finally, *awareness* refers to the degree that systems are aware of previous interactions, in accordance with Rafaeli's argument that the best interactive media mimic the message responsiveness and contingency of person-to-person communication¹⁰.

Although most research involving interactivity has utilized some or all of these four attributes, the

inconsistency of findings regarding effects may be attributed to vastly divergent definitions of what interactivity is. In addition to differing attempts to classify the concepts that constitute interactivity, three key areas have been sources of schism: whether interactivity of a medium refers to *user-to-system* or *person-to-person* communication; whether interactivity refers to a *property* of a specific object or of an *experience* with that object, and whether interactivity is a characteristic of *technological features of the medium* or *message content*.

While these three disputes have usually been discussed in isolation, they may be best viewed as different aspects of the same issue, namely a lack of clarity and specificity in defining interactivity. What has resulted is a body of literature that treats interactivity as a super-variable which comprises a number of technological characteristics, some which vary from medium to medium, and others which vary from specific instances or messages communicated via that medium. Although studies have operated under a wide variety of definitions of interactivity, many have shown that varying Web site features while holding other aspects of content constant has affected perceptions of interactivity and hypothesized outcomes.¹¹ If we accept that different stimuli facilitate user reciprocal communication to different degrees, and that this characteristic is important for understanding the psychological effects of these stimuli, a need emerges to examine what specific characteristics of stimuli lead to this variable facilitation.

Defining Interactivity

User-Based and Stimulus-Based Definitions

Scholar Carrie Heeter wrote that “[i]nteractivity is an overused, underdefined concept. Everything a human does to or with another human can be called an interaction. Human interactions that use media are mediated human interactions. Everything a human does to or with a computer is a human-computer interaction.”¹² This quote highlights a key bone of contention in interactivity scholarship: are *interactivity* and *interaction* synonymous, or is interactivity the ability or propensity of a stimulus to facilitate interaction? Some experimental studies have defined interactivity as a characteristic of the Web site or other stimulus being tested, and measured interactivity with items that asked participants to evaluate the stimulus materials.¹³ This approach implies that interactivity is an objective characteristic, and the most psychologically significant variance in interactivity exists between different mediated messages. Other studies have defined interactivity as a property of a user’s experience with a particular stimulus, measuring perceived interactivity by asking participants to rate their experience.¹⁴ This approach implies that interactivity is a subjective characteristic, and that the most psychologically significant variance in interactivity exists between different individuals who have experienced a mediated message.

Situating interactivity as a characteristic that varies between users, rather than messages, has limited applications for the study of new media technologies. Individual differences between users play a key

role in many psychological effects of media effects,¹⁵ but treating these differences as the primary variable of interest de-emphasizes how different message features impact users' processing. User-centered definitions of interactivity have situated the concept either as a perceptual variable (users' perceptions of interactivity) or as a behavioral variable (the extent to which users engage in particular behaviors, such as clicking, with a medium or message). To the extent that individual users of non-linear media will interact differently with a particular interface, and will experience different perceptions of a site, user-centered definitions of interactivity eradicate the notion that an object can have one specific level of interactivity. An alternate approach that might have greater theoretical impact is to measure users' perceptions or behaviors, and examine whether these serve as mediating variables for the effect of stimulus characteristics on psychological outcomes.¹⁶ While situational factors (fatigue, distractions) and individual differences (broad or specific experience with an interface) may influence perceived interactivity and volume of interactions, some component of the variance in both concepts will vary on the basis of one interface to another. The portion of variance that can be ascribed to message difference underlies object-based definitions of interactivity, which have been usually focused either on the message reciprocity provided by an interface¹⁷ or the presence of specific features.

Messages, Features, and Information Control

Although a number of message-based definitions of interactivity has presented, a chief enduring distinction can be made between those that focus on message characteristics and those that focus on the presence or absence of technological features.¹⁸ Message-based operationalizations of interactivity as a property of a medium are inspired by the message exchange that takes place in non-mediated human-to-human communication. Such approaches define interactivity of a particular communication message as directly responsive to, or contingent on, a previous message received. Rafaeli offered three levels of interactivity in what has been called the contingency model: one-way communication from sender A to receiver B; reactive communication in which B returns a response that was based on the first message sent; and, finally, interactive communication in which there are three or more messages sent between two communicators, each responsive to the previous messages sent.¹⁹ When applied to a stimulus, message-based operationalizations focus on the responsiveness of the messages yielded by interactive features with the site. This approach to interactivity has the advantage of yielding three clearly defined levels: low, or non-interactive (a series of one-way messages); medium, or reactive, and high, or interactive.²⁰ These levels are also limited in their ability to account for degree of responsiveness of a message, which may be particularly relevant to technological interfaces that allow multiple forms of user input that may be transmitted concurrently.

Feature-based conceptualizations of interactivity state that certain technological features are inherently interactive, and that the presence, absence, or number of these features is a way to determine the interactivity of the content or platform. For example, a Web site affiliated with a television network might have a feedback form, video player, dozens of text links, and a few image links.²¹ Various feature-based operationalizations of interactivity have been used in experimental studies.²²

The seemingly broad gap between the message-based and feature-based views of interactivity is bridged by studies that define interactivity by the amount and type of control over content given to the user. The interactivity scale developed by Kristof and Satran²³ identified seven ordinal dimensions of a mediated message that could be controlled by a user- pace, sequence, media, variables, transaction, objects and simulation - and classified these as increasing control on the part of the user and interactivity on the part of the interface. Interface elements which allow control over any of these elements result in some contingent message-exchange, and if the user continues to tailor the mediated message in response to seeing the effects of his actions, then such interaction would meet Rafaeli's message-oriented definition of interactivity.

The concept of information control has long been utilized for interface research in information science. Usually operationalized in terms of the presence of features that allow interface users to modify some dimension of content, level of user control has been found to affect knowledge, behaviors, and attitudes. In one Web-based user-control study, Dan Ariely showed that users who are given control over the order in which they view information are more accurate in evaluating that information than those given no control.²⁴ Ariely also highlighted the two distinct ways in which users can control content: selection over content order but not pace, and control over both order and pace. His results show that only in the latter, real-time control condition, which allowed the user what Ariely calls 'dynamic heterogeneity,' did the positive effects of user control on accuracy occur.

While Ariely's experiments were able to separate the value of control over order and pacing, he did not examine other aspects of content presentation. Another study, by Teo and colleagues, used a user-control centered approach to interactivity in studying the variable's effects on attitudes, by creating three conditions of a product Web site which combined several dimensions from the Kristof and Satran scale in an additive fashion.²⁵ The low-interactivity condition allowed users to control pace and sequence only, while the medium-interactivity added three more dimensions, and the high-interactivity condition comprised all seven elements. A number of constraints in experimental design make it difficult to examine the relative effects of each of these dimensions in a single study. The approach shown in the Teo et al. study, however, provides a guideline for testing the effects of more than two levels of interactivity that can be utilized across a number of technical features, media types or messages.

Multi-dimensional Conceptualizations of Interactivity

While user control may provide a unidimensional approach to interactivity that combines aspects of feature-based and message-based views, many researchers have opted to define interactivity as a construct consisting of several lower-order constructs. Rafaeli and Ariel identified control, synchronicity, rapidity and speed, choice variety, directionality, hypertextuality, connectedness, experience and responsiveness all as factors included in conceptualizations of interactivity in at least two different studies²⁶. Other factors proposed in at least one study include non-verbal information,²⁷ use of multiple senses,²⁸ personalization,²⁹ and facilitation of two-way communication.³⁰ Rafaeli and Ariel divided these characteristics as belonging either to a focus on features, a focus on users' activities, or a focus on users' behavior.³¹

The significant variation in proposed dimensions of interactivity that have been proposed by scholars also has implications for how interactivity should be manipulated, and how perceptions of interactivity ought to be measured. Experimental studies testing the effects of interactivity on message-related variables have typically tested it as either a dichotomous (low and high levels),²⁼³² or a trichotomous variable (low, medium, and high levels).³³ This approach seems logical when interactivity is conceptualized in terms of one factor – such as the level of user control over content – which can be manipulated through the use of specific features. However, for multidimensional conceptions of interactivity, in which researchers hypothesize that multiple factors each contribute uniquely to interactivity, it makes little sense to manipulate interactivity by having either high levels of all factors or low levels of all factors. Yet, in most of these studies, these operationalizations did not include manipulating dimensions or factors of interactivity separately, but rather manipulating all the dimensions concurrently to establish clear-cut high and low conditions.

The Role of Measurement in the Study of Interactivity

As discussed above, interactivity has been conceptualized and manipulated in many different ways: multi-dimensional or unidimensional; user-situated or stimulus-situated; feature-based, message-based, or in terms of information control. For the most part, interactivity has been thought of as an attribute of media stimuli, not people. Because of this, the best approximate measures of whether stimulus interactivity was manipulated are those that gauge users' perceptions of interactivity, and whether these perceptions significantly differ across users as a function of the condition to which they are exposed. However, the use of a perceptual measure as a manipulation check includes several pre-suppositions: First, that interactivity is a variable that is consciously perceived by individuals exposed to it; second, that interactivity is effective to the degree to which it can be perceived; and third, that the particular measure of perceived interactivity is valid, reliable, and sensitive to the specific manipulations of interactivity employed.

Measurement of interactivity in media effects research is typically done via a post-exposure measure of perceived interactivity. Research into psychological effects of interactivity requires the use of question items or scales to measure the extent to which users perceive interactivity. There are two primary purposes for which measures of perceived interactivity are utilized in research designs. The first is as a manipulation check to test whether experimental stimuli effectively convey different amounts of interactivity, and the second is as a mediating variable through which manipulations of interactivity affect other variables such as attitudes, attention, and learning.

In studies that focus on manipulating interactivity through the use of different Web site characteristics, measures of perceived interactivity have typically been employed as manipulation checks. Typically, studies have operationalized either two levels (low and high) or three levels (low, medium and high) of objective interactivity, and used respondents' scores on the manipulation check as a means of validating the manipulation. The typical means of measuring perceived interactivity for manipulation check purposes has been a single Likert-type item. Wording for such measures has included "How interactive

would you rate this Web site," presented as a 7-point or 9-point scale³⁴ or as a 5-point scale³⁵ and "How would you rate the interactivity of this site," on a 5-point scale ranging from "Much better than at other sites" to "Much worse than at other sites."³⁶ Such measures are of limited theoretical significance because their variance may be driven by change in user expectations over time, and variance in use of other interactive Web sites.

Approaches to measuring perceived interactivity should be designed for consistency with conceptual definitions of interactivity. Across studies, varying sets of dimensions have been proposed as constituting the interactivity construct. One problem with using perceived interactivity as the primary measure operationalization of interactivity is that doing so gives little insight as to what structural or content elements of the Web site lead audience members to perceive it as interactive. Some have described perceived interactivity as the measure of how well a computer interface recreates the interaction present in face-to-face conversation.³⁷ This conception fails to take into account that users may use different criteria to evaluate non-mediated person-to-person interaction, mediated person-to-person interaction and interaction with information systems such as Web sites.

One potential predictor of perceived interactivity that remains unclear is time spent using interactive features on a site. Some have theorized that the mere presence of interactive features may affect perceptions by triggering positive or negative heuristics.³⁸ On the other hand, other studies have successfully found effects of manipulating interactivity by using identical stimulus materials across conditions but varying the tasks users were instructed to complete on the site. Tao and Bucy found that users who were given prompts to use particular features on identical stimulus materials rated the materials as having different degrees of interactivity.³⁹ These results indicate a strong role for time spent using features in mediating the relationship between objective interactivity on a site and perceived interactivity. These results also may have implications with regard to gender differences in perceived interactivity, in light of studies that have found that men spend more time using interactive features on line than women.⁴⁰

A second issue with using perceived interactivity as the conduit for cognitive effects of interactivity is evidence of limited discriminant validity for perceived interactivity. Perceived interactivity has been shown to differ significantly between groups based on numerous Web site characteristics: the degree to which the Web site is customized to personal aspects of the user,⁴¹ the number of pages into which a site is subdivided,⁴² the presence of features that allow control over visual content,⁴³ and others.

Some studies have focused explicitly on clarifying the concept of perceived interactivity by defining and measuring its component dimensions. The measurement approach taken by McMillan and Hwang focused on three overlapping constructs: two-way communication, control over navigation and choices, and time required.⁴⁴ The authors relied on a multi-step process to generate items that the researchers and experts though measured these three dimensions. The items were then tested in two iterative rounds. After factor analyzing the data from the testing, the authors re-conceptualized these dimensions as *real-time conversation*, *no delay* and *"engaging,"* based on a three-factor oblique solution with 18 of the 28 original items included.

Some have argued for a more parsimonious approach to defining interactivity's underlying dimensions by establishing how interactivity differs from other constructs. Johnson, et al., argued that information control should be viewed as a distinct concept from interactivity.⁴⁵ The authors, who favor a four-facet definition of interactivity that consists of reciprocity, responsiveness, speed of response, and non-verbal information, argue that control should be excluded because it cannot be generalized to all types of interaction, mediated and non-mediated. In addition, they position reciprocity as a *precursor* to information control, though this position is not elaborated upon. The authors developed a 17-item scale to measure four hypothesized dimensions of interactivity, with each item presented on a seven-point scale related to the question presented, including "very low" to "very high," "very slowly" to "very quickly," among others.⁴⁶ However, the authors' claims regarding control would be strengthened if they had manipulated this dimension as well, and were able to position its effects within a causal model. Establishing discriminant validity between interactivity and other constructs would not only facilitate better interactivity research, but also clarify orthogonal technological variables that may be useful in building theories of the effects of new media.

The Role of Interactivity in Theoretical Models of Media Effects

Some of the paradoxical and inconsistent findings regarding interactivity's effects may stem from a lack of theoretical models that explain through what processes interactivity affects the outcome measures of interest. While many early studies focused simply on direct main effects of interactivity, recent work has shown several variables either moderate or mediate the effect of interactivity. These variables are at the heart of two theoretical models that seek to explain the inconsistencies in the interactivity literature by focusing on the specific conditions under which interactivity may play a role, and the processes through which it may do so.

One key potential mediator of interactivity's effects, perceived interactivity, has already been discussed above. The Mediated Moderation Model of Interactivity proposed by Bucy and Tao posits that higher levels of interactivity (operationalized as user interaction with content) affect attitudes by increasing perceived interactivity.⁴⁷ This mechanism is viewed as primarily affective or attitudinal - users who perceive a site as more interactive are more likely to have some of this positivity transfer to the content itself.

It has also been noted that there may be multiple mediators in addition to perceived interactivity,⁴⁸ and one study that utilized a multiple-mediator model found that perceived responsiveness, perceived control, and perceived communication all contribute significantly to mediating the effect of site features on perceived effectiveness.⁴⁹ Implicit in this model is that a number of situational factors may cause an individual's experience with a given stimulus to be perceived as more or less interactive.

An alternate mechanism through which interactivity has been shown to affect perceptions is that of involvement, or motivation to process the message. Involvement has long been considered an important determinant of the degree to which users elaborate upon a message,⁵⁰ a key determinant in persuasion

models.⁵¹ Several studies have shown that participants randomly assigned to higher interactivity conditions reported greater involvement with online advertisements than those in low interactivity conditions.⁵² Interactivity in product advertisements was found to affect consumers' perceived product knowledge, and this effect was largely mediated by involvement.

Other models of interactivity, however, stress that relatively high involvement must be present *a priori* for interactivity to have effects on central processing of a message. Liu and Shrum⁵³ developed an Elaboration Likelihood Model (ELM)-based model of interactivity effects that focuses on the relationship between users' involvement with a particular task or topic, their resulting level of use of interactive elements, and degree of cognitive processing. The model argues that interactivity's effects are the product of a balance between two roles of interactivity: a facilitating role that enhances arousal and reduces search costs for finding desired information, and an inhibiting role that places increased demand on users' cognitive resources. Moderating variables, including users' experience using the Web, may affect the nature of this balance by limiting the ability of less experienced users because of the additional cognitive cost of the interaction. While the mechanism through which Web experience impacts the role of interactivity is not deeply explored in the original paper, its role as a significant moderator suggests that other forms of experience, such as that specific to a particular type of Web site or type of device used to access content, may play similar roles with regard to interactivity's effectiveness.

As tested by Liu and Shrum, the effects of interactivity were moderated by two variables which determined whether users are likely to process the message centrally or peripherally.⁵⁴ First, users' level of involvement with the information or mediated message affected their motivation to process the message; users with a low level of involvement were more likely to process the information peripherally. For users with higher levels of involvement, Internet experience was expected to moderate the effects of interactivity on attitudes. For highly involved, less experienced users, a less interactive site will produce more favorable attitudes toward the Web site and content. For highly involved, more experienced users, a more interactive site will produce more favorable attitudes through a process that may be more perceptual than cognitive.

The differences and similarities of these two process-oriented models are instructive. The ELM approach makes it clear that interactivity may have different types of effects on users, and that these effects can occur differently based on users' involvement with the subject matter and experience with the type of media. More specifically, involvement (or other motivators) and experience (or other ability-related factors) are theorized to affect outcome variables by changing the nature of users' interactions with the content. In the Mediated Moderation Model, these individual difference variables are factored in as potential moderators of the relationship between interactivity of a medium and perceived interactivity. However, by positioning perceived interactivity as a mediator, the model implies that user behavior only matters to the degree that it effects perceptions, ruling out the peripheral effects of interactivity predicted under low involvement in the ELM model.

Both of these theoretical models are relatively recent, and the findings of the studies which support the models have yet to be replicated across content types or media platforms. Nonetheless, the models do provide a robust set of relationships between variables, which can lead to the formation and testing of a variety of hypotheses that may continue to clarify the boundary conditions under which interactivity may have a positive, a negative, or no impact. While these models may continue to be refined or perhaps integrated, clarification in several key aspects of the definition of interactivity will benefit the evolution of interactivity theory.

Directions for Clarifying the Nature and Role of Interactivity

The development and refinement of theoretical models of interactivity's effects will stem from continued research involving more specific manipulations of stimulus interactivity, and perhaps more nuanced measures of perceived interactivity. The three questions below outline specific areas in the literature that these models will likely need to address.

Are beneficial effects of interactivity contingent on actual use of the content? The dual-process model of interactivity proposed by Liu & Shrum⁵⁵ suggests that users may not need to engage with interactive site content for interactivity to have effects, but that the nature of the effects will likely vary in relation to their use. Specifically, if users are motivated and able to engage with interactive content, they will be more likely to use interactive features. Users who use the features will be more likely to elaborate on site content, and thus be more likely to emerge with attitude change in the direction of central arguments presented on the site. However, for users who are not motivated or able to process the content, interactivity may play a role as a cue that affects attitudes toward the site content or to the particular message itself.

The Mediated Moderation Model suggests that interactivity's effects are a result of perceptions of interactivity.⁵⁶ Therefore, use of specific interactive features of a stimulus is only necessary to the degree that it affects perceptions of interactivity. If the mere presence of certain interactive features on a site can affect perceived interactivity, users should still see similar benefits. As hypothesized by Bucy and Tao, these include affective, behavioral, and cognitive measures.⁵⁷

Are all moderators of interactivity effects characteristics of users? Both theoretical models assume that the key variables affecting the relationship between interactivity and outcome measures are characteristics of the interactivity users. Users may perceive the interactivity of a stimulus differently, have different levels of experience using similar stimuli, or have different levels of motivation to engage with a stimulus, and these variables can lead to positive, negative, or no effect on the evaluations of stimulus content. However, both of these models exclude any other characteristics of the medium or message as moderating the impact of interactivity. Just as individuals' lack of experience with a technology may serve to increase the cognitive effort required for interactivity, other properties of a stimulus itself may influence the amount of effort required. For example, the presence of arousing

content, the size and visibility of interface elements, and the clarity of text cues all may facilitate or inhibit interactivity's effects, and should be included in factorial designs. Future studies which isolate other relevant technological characteristics and manipulate them independently of interactivity can help add clarity to the interactivity literature.

Does interactivity mean the same thing across media platforms? Although theories about the impact of interactivity pre-date the existence of the World Wide Web, much of the experimental findings regarding interactivity's impact stem from studies involving Web content as the stimulus materials, and desktop computers as the access devices for using the stimuli. This has included news content,⁵⁸ persuasive content,⁵⁹ and advertising content.⁶⁰ A handful of studies have focused on level of interactivity in movies,⁶¹ television programming,⁶² or video games, typically focusing definitions related to user control. Defining interactivity as a variable that extends across all of these content types and platform may be useful for theoretical models, but this is complicated by the fact that interactivity may have different effects based on the type of information and input afforded by different media. The past five years have seen significant advances in the type of user input that can be used to interact with information. The mass-marketing of motion-sensitive devices including gaming controllers for Nintendo's Wii, handheld media players such as Apple's iPod touch, and numerous "smart" phones has popularized user movement in three dimensions as a form of interacting with information. Wii users can control game characters by tilting their hands, changing leaning while holding the controller, or swinging their arms. On the iPhone, users can shake the device to shuffle playlists, or use specific software applications that transform their device into a motion-sensitive level, pedometer, game controller, and a variety of other tools.

While interactivity may not function the same way when studied across different media types, media modalities, or content types, it is important to distinguish components of the variable, if any, that have cross-media implications. Video games and virtual reality simulations are interactive by definition, but may still vary in degree to which they facilitate interaction. Interfaces for Web, email, and mobile software applications all must permit some level of interaction, but this interaction is usually often based on specific categorical input from the user. The nature of interacting with a pre-set menu by making binary choices may be qualitatively different from interacting with a two- or three-dimensional environment over which one has continuous control. Viewers' ability to interact with television may vary based on what digital selection or recording options they receive from their television provider. The differences in user experiences with, and expectations of, interactivity across media platforms needs to be considered in theoretical models of interactivity's effects.

Conclusion

Sundar proposed that theorizing effects of interactivity should "proceed along the lines of determining the mechanism by which interactivity causes interaction, in terms of both nature and volume."⁶³ Recent theoretical models have followed this suggestion by identifying several variables which may serve to moderating or mediate interactivity's effects. While the identification of these

related variables helps to explain divergent findings in earlier interactivity literature, scholars have a long way to go to “unpack” the cognitive processes that occur when consumers of information are given varying degrees of control over dimensions of the information. To help expand these models, future research should focus on determining whether interactivity of a stimulus has effects that are not contingent on use of interactive elements; the degree to which other technological or content characteristics facilitate or inhibit interactivity’s effects; how individual proposed dimensions of interactivity contribute to perceived effects; and whether interactivity plays a different role across different media types, media devices, and media messages. A necessary component of this may include a more narrowly focused definition of interactivity, and the inclusion or other stimulus characteristics as separately manipulated independent variables.

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