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# The Perceived Hazard of Sound Scheme and Desktop Theme Auditory Elements:
## Experimental Results and Implications for Adaptable User-Interface Design

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### ABSTRACT

The interface concept of adaptable design allows users to select and apply alternative auditory elements to the user interface. This study examines the consistency of the arousal strength of auditory elements that accompany exception messages available in two adaptable design options available for the Microsoft Windows operating system: (1) sound schemes and (2) desktop themes. The auditory elements available in these options differ in composition and sound features. Prior work indicates that such differences could result in differences in the arousal strength communicated by the auditory elements and therefore violate the key user interface design principle of consistency. The auditory elements within IT environments should communicate consistent levels of hazard as measured by arousal strength in order to achieve "hazard matching." Results reveal differences in the arousal strength of the important critical stop auditory element across both sound schemes and desktop themes. Implications of this finding are discussed.

### KEYWORDS

Adaptable Design, Auditory Icons, Earcons, Exception Messages, Hazard Matching, Interface Design, Synthetic Sounds

### 1. INTRODUCTION

A relatively recent design development in information technology is the principle of adaptable user-interface design. Adaptable user-interface design involves the user in the design of the system interface, including visual and auditory features (Akiki, Bandara, Arosha, & Yu, 2014). That is, the user has the ability to tailor the system interface to best meet their individual preferences. For example, the user can alter the appearance of screen graphics and sounds by choosing to install "Desktop Themes" available from Microsoft to their Windows operating system to match their personality or likes (https://support.microsoft.com/en-us/help/14023/windows-desktop-themes-with-custom-sounds). A potential advantage of an adaptable interface is that the user is in control of the individual

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appearance and interface features (Gullà, Cavalieri, Ceccacci, Germani, & Bevilacqua, 2015). This flexibility allows a user to not only alter the interface to their liking, but may also allow the system to be adjusted to multiple users with varied prior knowledge and cognitive abilities (Gudur, Blackler, Popovic, & Mahar, 2014).

However, adaptability of the user interface may result in disadvantages. For example, altering the interface may impact how well the system informs the user of potential problems that arise during the completion of computational tasks during the display of exception messages with accompanying auditory elements. Exception messages are common components of the information technology (IT) user interface and appear over the main window of an IT application program and often inform the user of computing problems, where each problem may possess different levels of "hazard" (Cooper & Reimann, 2014; Galitz, 2007; Shneiderman et al., 2018). Exception messages should communicate different levels of hazard in order to achieve "hazard matching." Hazard matching occurs when the severity of the hazard communicated by the exception message, termed the "arousal strength" of the message, matches the level of hazard faced by the user. Hazard matching is widely recommended as a desirable result in that it improves the informativeness of exception messages and other warnings (Amer & Maris, 2007; Edworthy & Adams, 1996; Edworthy, 1998; Hellier, Wright, Edworthy, & Newstead, 2000; Hellier & Edworthy, 2006; Momtahan & Tansley, 1989; Wogalter & Silver, 1990).

Exception messages are often accompanied by auditory elements as an additional signal to the user. Similar to the other features of exception messages, auditory elements can be designed to catch the attention of the user to warn of potential technical problems if certain actions are taken or conditions occur (Amer & Maris, 2007). Good interface design warrants the design of auditory elements to communicate different levels of severity of a computing problem, thus facilitating hazard matching (Amer, Johnson, Maris, & Neal, 2013). But, if the user alters the auditory element via adaptable design there may be a violation of the effective design rule of consistency (Cooper & Reimann, 2014; Galitz, 2007; Shneiderman et al., 2018). This lack of consistency may degrade the nature of hazard matching due to confusion or misunderstanding. That is, if a given exception message appears on screen that should consistently inform the user of a given computing problem but the associated auditory element changes in a manner that alters the user's perception of the underlying hazard, then consistency is violated.

The purpose of this study is to determine if the auditory elements associated with two adaptable design options available for the Microsoft Windows operating system vary as to their degree of arousal strength. The two adaptable design options examined are: (1) alternative Sound Schemes, and (2) alternative Desktop Themes. The auditory elements within different Sound Schemes and Desktop Themes are composed of different musical sounds, natural sounds, and synthetic sounds and can be applied to the user interface at the discretion of users.

The results of experimental data collected and analyzed reveal that the auditory elements of different Sound Schemes and Desktop Themes do indeed communicate different levels of arousal strength which indicates that the design principle of consistency may be violated if different themes are utilized within a user interface as a result of adaptable design. These findings contribute to both practice and the academic literature. The data reported indicates that it may be possible to increase the degree of consistency by designing auditory elements with the same level of arousal strength across Sound Schemes and Desktop Themes. Moreover, examining the aural component of exception messages study extends researchers' understanding of how non-visual elements of exception messages effect user judgments (Amer & Maris, 2007; Amer et al., 2013; Amer & Johnson, 2018).

The next section of this paper contains a discussion of prior literature and a theoretical discussion leading to the research questions. This is followed by sections explaining the research methodology employed and data analysis of two experiments. One experiment examined the auditory elements available in Microsoft Sound Schemes, and the second experiment examined the auditory elements available in Microsoft Desktop Themes. The paper concludes by highlighting key results and discussing the implications for research and practice.