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Research Report

Don't miss your train! Just follow the computer screen animation: Comprehension processes of animated public information graphics

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ABSTRACT

Computer graphic animated information displays have the potential to communicate public information in situations where normal announcement types are ineffective. This study used eye tracking techniques to analyze comprehension mechanism of event-related information on railway traffic disruptions presented via different graphic formats presented on computer screen. 86 participants were asked to understand series of traffic disruption messages delivered via four purely visual formats: Static simultaneous, Static sequential, Animated simultaneous and Animated sequential. Across these four conditions, and contrary to the most common materials used in the studies on animation comprehension, the sequentiality and the animated properties of the entities of the presentation were not confounded. Results revealed the Animated sequential displays were the most effective presentation type. Eye tracking data showed why an animation facilitates comprehension of public information graphics: it enhances processing strategies which provide the best condition for segmenting and composing the causal chain of the events provided in the message.

1. Introduction

The growth of technology has seen computers become widely used to deliver real time public information messages on platforms ranging from large displays screen to individual mobile devices. Such displays are increasingly common in railway stations, airports, bus terminals and city centers. Information that is useful or even critical to the public can change frequently and suddenly. Today's global society is highly dependent on various forms of travel and any disruptions to those services can have major consequences. Travelers therefore need access to efficient, effective information sources so that they can respond rapidly and appropriately to such disruptions. Recent major travel disruptions in Europe exposed severe shortcomings in existing ways of presenting information that exacerbated an already chaotic situation.

Unfortunately, the design of important public information to be displayed on electronic screens is rarely based on empirical studies. Rather, the basis for their design tends to be intuition or traditional text-based approaches such as those that have evolved for railway station loudspeaker announcements and information boards. An overarching motivation for the research reported in this paper is to provide information that could guide the design of more effective and efficient railway disruption messages for the National French Railway Organization (SNCF).

The present paper explores the potential of dynamic *graphics*-based display screens, composed of series of dynamic pictographs, as alternatives to current spoken or written approaches for presenting public information about train traffic disruptions. Such information should be readily available and comprehensible to a broad cross-section of travelers[1] including the elderly, those with hearing impediments, and foreign travelers who are not familiar with the local language. Graphic messages could also assist travelers in general who cannot hear the usual loudspeaker announcements properly because of ambient station noise or their distance from loudspeakers. The experimental study presented here investigated the effect of different types of graphic design format on the comprehension of traveler action messages.

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[1] This research is closely aligned with the European program, *"Access 2 all" (www.access-to-all.eu)* which concerns "mobility schemes ensuring public transport accessibility for all users", 2010.

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1.1. Visual alternatives to traditional spoken announcements: how to convey train announcements "non-verbally"?

The conventional spoken railway announcements typically follow a standard format. In French stations, the texts that are spoken for these announcements are structured in terms of a succession of related events such as: *"Your attention please. Contrary to the information that has been displayed, the Regional Train (TER) number 3458 for Paris, will not start from platform B but will start instead from platform D. Please take the stairs to access platform D"*. The formulaic nature of these announcement texts gives them much in common with script schemas (Armbruster, 1996; Mandler, 1984). In some railway systems, disruptions can be a part of the everyday context of train travel. Travelers often have to comprehend and respond appropriately to disruption-related information under considerable time pressure. How to convey train announcements non-verbally? Graphic messages, cycling on computer screens distributed around the station could be an effective alternative to traditional spoken or written announcements (Fig. 1).

In railway stations, announcement texts for the most common disruption-related loudspeaker messages are structured as an ordered sequence. Examples of messages include switching of a railway platform, delay of a train, cancellation of a train, reduction of services due to a strike, or consequences of extreme weather (snow, ice, etc.); and a message related to general safety, passing of a nonstop high speed train on the railway near the passengers. Regular train travelers typically possess knowledge structures in long term memory that represent such event-related information as scripts (event schemas) that include various slots. The content of most messages that travelers hear in train stations may also be thought of in terms of categorical slots that can be populated with specific types of information. A typical structure is: (i) a warning (*"your attention please"*) (ii) the cause of the disruption ("*because of the snow*") (iii) the effect of that disruption (*"the regional train number1556 for Paris, will be delayed by 15 min"*) and (iv) the action that the traveler should take as a result (*"for further information please check the central panel situated in the main hall"*). Depending of the type of disruption, this series of four event slots may or may not all be filled. For example, in the following message, the causal event is not given: "*Your attention please, contrary to the information displayed previously, the Regional Train (TER) number 3458 for Paris, will not start from platform B but will start from platform D, please take the underground pathway*". Each event slot could be defined as an "episode" which applies on different (but limited in numbers) objects (such as a train, a platform, a stair, and city name panels). Regular train travelers in France are often exposed to such messages and so typically develop knowledge structures in long term memory representing relevant event-related information as scripts for various scenarios. In order to convey train announcements, which are (well) known events episodes with their usual objects, series of dynamic visual icons or dynamic pictographs could be developed.

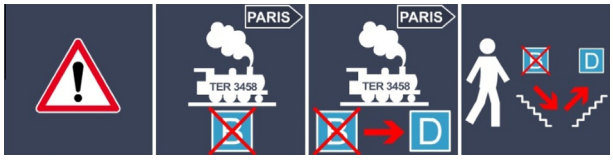

Fig. 1. Example experimental graphic that corresponds to the following announcement text: "*Your attention please (picture 1). Contrary to the information that has been displayed, the Regional Train (TER) number 3458 for Paris will not start from platform B (picture 2) but will start instead from platform D (picture 3). Please take the stairs to access platform D (picture 4)*".

In everyday life, single static pictographs are widely (and efficiently) used in different domains such as traffic and road signs, public areas, human–machine interfaces, industrial areas (for safety purposes), and healthcare centers. Previous studies in this field of "information design" and or "iconic communication" have been focused mostly on taxonomies of pictographs and on the testing of their usability (Bodenreider, 2004; Familant & Detweiler, 1993; Isherwood, McDougall, & Curry, 2007; Rogers, 1989; Yazdani & Barker, 2000; Zwaga, Boersema, & Hoonhout, 1999). Conveying information with pictographs "relies on pre-established code and convention" (Nakamura & Zeng-Treitler, 2012, p. 535) and implies the meaningful relation between the referent and the pictorial representation is quite transparent, direct or known. In the example of the train disruptions, the meanings of the referents in the context of the railway station are common. Such familiarity could help in understanding the graphic representation of the events and objects of the disruption.

In previous studies on visual pictographic representations, three levels of external pictorial representations of the referent have been identified (see the recent taxonomy by Nakamura and Zeng-Treitler (2012), and the reviews in the book by Zwaga et al. (1999). (i) Direct representations use the visual similarity between a pictograph and its referent (for example, the picture of TGV train to refer to a TGV); (ii) arbitrary representations use social convention (for example the letter P to refer to a parking area, the letter I to refer to an information point); (iii) indirect representations use semantic relation, and semantic association, between a pictograph and its referent (for example, the picture of a fork and a knife to represent the concept of restaurant, or the picture of a clock to represent time and delays, see Fig. 2, first message). Different subcategories of semantic association were recently proposed by Nakamura and Zeng-Treitler (2012) in the domain of healthcare: comparison or contrast, exemplification, semantic narrowing, physical decomposition, temporal decomposition, body language, metaphor and contiguity.

The visual alternatives to spoken disruption messages built in this study were closely in line with recent taxonomies and associated recommendations. However, in previous studies, and in everyday situations as well (i) one graphic representation is usually presented alone in a single picture format (but see exceptions with series of static simultaneous pictographs in Dewar & Arthur, 1999, or in Nakamura & Zeng-Treitler, 2012); (ii) further, pictographs refer mostly to entities and objects (more than 86% of the pictographs used in the study by Nakamura and Zeng-Treitler (2012), cf. page 542) and rarely to dynamic events and actions; (iii) until now, the presentation of the graphic is always (at least mostly) static. Finally, very few studies on pictographic communication were focused on comprehension mechanism.

Because train messages are composed of series of predetermined categorical slots, each message must be presented with a series of several pictures, instead of a single pictograph. In the present study, we used a composition of (dynamic) pictographs to depict complete messages which convey a complex meaning about train disruptions. Further, in the train messages, events usually described via the loudspeaker announcements, have key dynamic dimensions. They do not deliver information about static statement like do a majority of the pictographs printed on physical panels (Nakamura & Zeng-Treitler, 2012). Finally, train messages are structured according to a fixed temporal sequence. How to use visual graphics to present a sequence of dynamic concepts? It could be relevant to follow "the syntax structure" of the loudspeaker well known messages and also to build sequences of graphics in which the relation between the referent and the representation would be as close as possible.

The goal of the two research questions investigated in the present article was to study (i) whether it helps comprehension of vi-