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Long-term retention of skills in multi-day training contexts: A review of the literature

Elizabeth A. Sanli [a, *], Heather Carnahan [a, b]

[a] Ocean Safety Research, Marine Institute, Memorial University, P.O. Box 4920, St. John's, NL, A1C 5R3, Canada
[b] School of Human Kinetics and Recreation, Memorial University, St. John's, NL, A1C 5S7, Canada

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ABSTRACT

Multi-day training courses, designed to prepare groups of people to respond should a critical situation arise, include a range of knowledge and skill competencies. Due to infrequent requirements to perform these skills outside of training, and the importance of correct execution in critical situations, understanding the retention, and forgetting of such skills is an important consideration for industry. In an effort to determine the optimal training contexts and optimal retraining period for skills included in multi-day training course, a review of the literature in healthcare, military, and marine and offshore safety and survival contexts provides a body of knowledge regarding the retention, and decay of complex knowledge and skills taught in contexts relevant to multi-day course formats. The present review has identified task factors to consider including the influence of characteristics such as task difficulty, type of skill, and the specificity of training to the work domain. Factors related to the learner include the skill level attained during training, the amount a practice received and subsequent on-the-job exposure to specific skills. There are also indications that for some tasks, we can expect retention of skills for 6 months at best. The authors recommend experimental studies designed to gain understanding of specific training factors during original, refresher, and non-training time periods, which can benefit later retention of potentially life-saving skills taught in multi-day training courses.

Contents

* Corresponding author.
E-mail addresses: Elizabeth.Sanli@mi.mun.ca (E.A. Sanli), hcarnahan@mun.ca (H. Carnahan).

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1. Introduction

In preparation for emergency situations, specific skills are often taught to large groups of people who may need to respond should a critical situation arise. While it is hoped that learners will never need to use these skills outside of training, it is important for tasks to be performed correctly when an actual incident does occur. A conventional delivery format of this safety training is the completion of a training course that culminates in certification (e.g. International Maritime Organization, 2011). Following initial certification, refresher courses or recertification are often required at predetermined intervals. The goal of these refreshers is to stave off the forgetting of important knowledge and motor skills over time. This is especially true for emergency response skills that are most rarely encountered outside of training. Emergency response safety training is found across industrial settings where guidelines and regulations are in place to prepare individuals for job-specific contexts (Taber, 2014).

Consideration of factors such as physical and cognitive design elements as well as social, organizational, and environmental contexts allow us to take an ergonomics approach to understanding how to optimize this type of training (Karwowski, 2005). The present review mainly addresses cognitive ergonomics in terms of memory of skills, considering the roles of perception and information processing (Karwowski, 2005). However, physical ergonomics is addressed in terms of the influence of human characteristics on performance of skills, particularly in the discussion of task difficulty (Karwowski, 2005). Organizational ergonomics is touched on in terms of an attempt to understand the optimization of policies and procedures regarding original and refresher training courses (Karwowski, 2005).

Job-specific safety training spans a range of designs from online training modules, to half-day certifications, to multi-day courses with several practical components. While shorter courses such as cardiopulmonary resuscitation (CPR) training have been extensively examined in the literature, longer, multi-day courses have received relatively little attention. The majority of studies regarding long-term retention of movement skills have been conducted using specific skills in isolation, or a small series of related skills, however, a given multi-day course may have classroom/lecture, demonstration, and practical components, often all on the same day. Students may be required to acquire verbal knowledge as well as practical movement skills in this type of training context and both knowledge and skills can oftentimes be complex (e.g. a series of decision-making rules or a firefighting equipment-preparation task with many steps). While evidence-based training designs (e.g. random practice scheduling, Shea and Morgan, 1979), are to be applauded, caution should be taken in the application of principles of learning simple skills to more complex skills and environments (Wulf and Shea, 2002).

1.1. Tasks in the literature and in training courses

The concepts of task complexity and task difficulty can help us understand the similarities and differences between skills examined in the literature and those included in training within work domains. Questions about long-term retention and forgetting of skills have been extensively examined in the verbal and motor learning literature, revealing some consistent findings across different types of tasks (see Adams, 1987; Arthur et al., 1998; Gardlin and Sitterley, 1972; Hagman and Rose, 1983; Hurlock and Montague, 1982; Naylor and Briggs, 1961; Prophet, 1976a,b, and Schendel et al., 1978 for detailed reviews). Consistently, the amount of original training and/or learning, the retention interval, the type of skill being performed, and opportunities to refresh training are identified as key factors that influence how well skills are retained over time. Despite agreement in these reviews, there are factors relevant to training courses, concerning task complexity, task difficulty, and measuring learning and forgetting over time, which merit a targeted review and discussion. Sections 1.2 and 1.3 provide a brief overview of these factors and their relevance to training courses. Sections 3.1–3.3 review findings from the skill acquisition literature with possible implications for the training of movement skills within the domain of multi-day training. Specifically, this review focuses on literature within the work domain contexts of resuscitation, military training and marine/offshore safety and survival training with implications for understanding retention following multi-day training courses.

1.2. Task complexity and task difficulty

Task complexity has been discussed and measured in a number of different ways in the basic and applied skill learning literature [e.g. number of distinct steps (Shields et al., 1979a), cognitive demands (Lee et al., 1994), and interdependency between specific steps of a skill (Naylor and Briggs, 1963)]. After a review of the continua presented in the skill acquisition literature, Wulf and Shea (2002) concluded that while each continuum may effectively measure the complexity of a specific set of tasks, a single method or measurement of complexity is ineffective for describing a wide range of motor skills (such as the range of skills presented in multi-day training courses). Recommendations of things to consider for teaching complex in comparison to simple tasks, are the opportunity to direct attention to specific aspects of the task and/or environment and a greater opportunity to use observation as a learning tool (Wulf and Shea, 2002).

The challenge point framework (Guadagnoli and Lee, 2004) builds on the work of Wulf and Shea (2002) and others by categorizing task difficulty into two different types; 1) nominal task difficulty and 2) functional task difficulty. Nominal task difficulty refers to the inherent difficulty of a given task, regardless of who is completing the task or under what conditions, while functional task difficulty considers the experience of a performer and the conditions in which a task is performed. Nominal and functional task difficulty can be illustrated by the use of scramble nets, used to allow those in the water to climb onboard a vessel. Nominal task difficulty can differ through the distance required to travel up a scramble net (a shorter distance would have a lower nominal task difficulty than a longer distance to climb), while functional task difficulty will differ based on weather conditions (driving rain would result in a higher functional task difficulty than for the same task on a sunny, warm day) or the experience of the person climbing (someone who has performed this or similar tasks many times would experience a lower functional task difficulty than