# Factors Influencing Skill Fade

## Introduction

An effective competence management system ensures that an adequate level of knowledge and skill has been achieved on satisfactory completion of training. This level of competence, however, may not be maintained in the workplace.

One of the principal factors that influences the rate of competence deterioration, or skill decay, is the frequency at which a task is performed. Tasks which are performed infrequently are more prone to skill decay than those tasks performed frequently. For trainers establishing or evaluating refresher training programmes, the challenge is to determine what level of task frequency is enough to maintain competence and what else can be done to minimise skill decay. This is discussed in the following paragraphs.

## Task requirements

Consider the following skills: catching a ball, and speaking a foreign language. The first of these skills, once acquired, is unlikely to be forgotten. The second one rapidly deteriorates unless frequently practised. These are examples of how the nature of a task can influence the rate of skill decay.

In 1992, Wisher investigated the decay of skills and knowledge in a sample of 20,000 reservist soldiers called up for active duty in Kuwait during Operation Desert Storm. As expected, reservist soldiers were found to have experienced greater overall skill decay than regular soldiers. Interestingly, however, different types of skill were shown to decay at dissimilar rates. Motor skills, such as lifting, were found to show signs of decay after about 10 months. In contrast, cognitive skills, such as recall of procedures, tended to decay within about 6 months.

Other studies have shown similar findings. Back in 1975, the Naval Education and Training (NAVEDTRA) Command categorised tasks by their proneness to skill decay (see table below).

| Proneness to Decay | Nature of Task |
|---|---|
| 1 (least prone) | Attitude learning |
| 2 | Gross motor skills |
| 3 | Continuous movement |
| 4 | Positioning movement |
| 5 | Detecting |
| 6 | Making decisions |
| 7 | Recalling bodies of knowledge |
| 8 | Classifying/recognising patterns |
| 9 | Recalling procedures |
| 10 (most prone) | Voice communications |

NAVEDTRA's Categorisation of Tasks Prone to Decay

Another issue that influences skill decay is the formation of a task. Typically, the more complex a task is, the shorter the retention period. The number of steps in a task, the built-in logic between task steps and the nature of these steps (e.g. do they require cognitive or motor skills?) all play a part in determining how complex a task is. For example, it has been found that safety steps are more likely to be forgotten in the workplace, as these often do not follow logically from preceding steps.

So what can trainers do to mitigate some of the risks associated with skill fade created by task requirements?

1. **Understand Task Requirements**. The following checklist can be used to identify those parts of a task most at risk of skill fade:

a. What tasks need to be performed?
b. What knowledge, skills (cognitive and physical) and attitudes are required of the individual/team to perform the tasks?
c. What conditions are the tasks performed in?
d. What standard do the tasks need to be performed to?
e. How difficult/complex are the tasks?
f. How frequently are the tasks performed?

2. **Identify Potential Mitigation Strategies**. From understanding the requirements of a task, a trainer can begin to identify what measures can be introduced to reduce the effect of skill fade. Training and assessment measures must be considered (refer to the section on Training and Assessment), but other interventions may be appropriate, including:
    a. Job Aids – These are a useful reminder tool that individuals can refer to during everyday and emergency activities. They have successfully been employed in military aviation, in the form of Flight Reference Cards (FRC), to assist with the recall of procedures. FRC provide aircrew with a list of definitive checks and drills for normal and emergency operations. The success of a job aid lies in whether it is fit for purpose - does it contain the correct information, with the appropriate level of detail that can be easily accessed and used?
    b. Re-ordering task steps – If possible, tasks could be redesigned to ensure that there is a logical flow between task steps.

**Equipment design**

An area which tends to be ignored is the relationship between equipment design and skill fade. Design can influence skill fade in a number of ways, including how it meets with individuals' expectations, whether it provides appropriate feedback, and the compatibility between displays and the information being presented.

Consider, for example, an analogue car speedometer, whose design is closely related to its performance. We expect the dial to rotate clockwise as speed increases. The movement of the dial provides an indication of acceleration, and perhaps a visual cue of the need to change gear. Finally, the markings on the dial enable us to determine current speed with a glance. Such intuitive design is unlikely to exacerbate skill fade. If any of these design conventions was not followed, however (such as using a non-linear scale, or rotating anti-clockwise as speed increases), the equipment might become the cause of significant skill fade concerns. Such equipment, which is not fit for the purpose intended, can increase the rate of skill decay by placing additional demands on memory and workload.

Trainers don't usually have the opportunity to influence equipment design. In these cases, the following measures could be introduced to reduce skill fade, in addition to training and assessment:

1. **User Guides**. Providing users with guidance on how to use and interact with equipment, including the operation of controls and the format, content and response of displays can be particularly beneficial. As with other job aids, these must be fit for purpose if they are to be effective in reducing the effect of skill decay.
2. **Reminders and Signs** – Providing reminders at key points, e.g. 'push' or 'pull' can help individuals to remember procedures or individual actions.

**Individual factors**

Even within a single work role people differ in terms of their educational background, experience, age and personality. It is important to identify which of these factors influence skill decay for the tasks being performed.

Consideration should be given to differences in the learning abilities of individuals. Lower ability learners are less likely to remember abstract, theoretical material. Trainers working with

such individuals or groups should pay particular attention to the need for training to be clearly relevant, appropriately contextualised and supported by examples of practical application. This is important in safety-related training, which is often regarded as an additional burden performed to make the task ‘safe’, rather than being seen as a necessary part of the task itself.

In mixed ability groups, more able learners would be expected to reach a higher level of competence than their peers, given the same quantity of training. Studies have, however, suggested that if mixed ability groups are trained to the same standard, they subsequently show little difference in the rates of skill decay.

The level of experience an operator has in performing a task can influence their skill decay. A study looking at proneness to skill decay among military pilots after a year of no flying found that pilots with a higher number of flying hours were less prone to skill decay than those with fewer flying hours. In these instances, experience serves to consolidate knowledge and skills in memory, enabling them to be retained for longer periods without being lost.

Several studies have highlighted the effects age can have on performance. The effect of age varies depending on the nature of the task. For example, visual acuity decreases in older people (this may be correctable with spectacles or contact lenses). Conversely, older workers typically are more reliable and conscientious, and have experience to mitigate physiological decline. In most safety critical industries, an individual’s competence is assessed more frequently as they get older. A good competence management system will provide methods for monitoring and assessing performance appropriate to the workforce and the tasks they are required to perform.

Whilst a company may do all they can to ensure that individuals maintain the required knowledge and skills to do their jobs, some individuals’ performance will still be unsatisfactory, and their skills will still decay. Such individuals are typically the ones who deliberately choose not to follow procedures, usually because they believe the way they do it is ‘better’. If they do not practise the required skills, provided in training, it is likely that these will decay. In such cases, training or other mitigating strategies may not be successful, and disciplinary action may be required to ensure compliance.

So what can trainers do to mitigate the risks associated with skill fade posed by individual differences, in addition to training and assessment?

1. **Recruitment and Selection**. Trainers, or more usually their companies, can ensure that recruitment and selection processes identify personnel with the appropriate technical and personal qualities for the roles they are destined to fill on completion of training.
2. **Competency Management System**. – Companies can ensure that they employ a competency management system capable of effectively monitoring, assessing and managing the performance of all employees.

**Training and Assessment**

Training clearly influences skill decay, but how can it its effect be improved?

The type and timing of initial training plays its part in skill retention. Consider, for example, an individual who attends a training course and learns a new set of skills, which they then do not use in the workplace for several months after initial training. These skills are likely to decay before their first use. This is known as the training-to-performance lag time. As this increases, so to does the effect of skill fade. Training courses should therefore be scheduled to minimise the training-to-performance lag time.

Skill decay can also be reduced by replicating appropriate elements of the working environment in training. This does not necessarily mean that an individual needs to have a high-fidelity training device (e.g. a simulator) to learn a task. Rather, essential elements of the operational environment (this might involve a particular physical representation, visual cues,

or sounds) should be identified and provided in the training environment. A Training Needs Analysis (TNA) is a useful series of techniques that can be used to assist in identifying the most appropriate media for training an individual. This might involve, for example, a combination of traditional classroom-based training, computer based training and use of the actual equipment in a variety of working environments. Training devices that require an individual to initiate actions and provide responses to cues, based on recall from memory, have been shown to be particularly effective in increasing the retention of procedural tasks. This is true for both initial and refresher training.

Practice sessions can also be beneficial. During these sessions, it is helpful to provide a variety of realistic case studies or problems, representative of the range of real-world experiences, for the individual to work through. It has been shown that individuals who experience fewer opportunities to participate in practice sessions are less able to transfer skills from training to the work environment. Regular practice sessions are also an effective means of retaining skills.

A technique that has been widely discussed in skill fade literature is 'overlearning'. Overlearning involves deliberately overtraining a task past a set criterion. At its simplest, this could be providing additional training days to reinforce the learning of a task and may involve repeating the task several times, as this increases skill acquisition. This technique has been found to be particularly beneficial in enhancing the retention of cognitive tasks. It appears that the greater the degree of overlearning provided, the greater the retention period attained.

Consideration should also be given to 'Just in Time Training', in which a person is provided with the information they need for doing their job just when it is required, and 'On-the-Job' training, which is self-explanatory.

An effective competence management system should ensure that standards are achieved. It should also ensure that refresher training is not just conducted on a periodic basis, but that that it is based on assessment of individual requirements.

If an individual appears to be experiencing skill decay, they can be tested. Physical skills can be observed in the workplace or with appropriate simulation. Cognitive skills and knowledge should be checked with recall tests, rather than recognition tests (in their 1998 paper, Arthur *et al* identified that recognition tests reported less skill decay than recall tests). An example of a recognition test is a multiple-choice questionnaire. In contrast to this, a recall test will ask an open question, with space for an answer.

Frequent testing of tasks supported by job aids is unlikely to be necessary, and is not recommended, given that they are designed to minimise the need for task memorisation.

## Conclusion

This article has introduced a number of factors, in addition to frequency of task performance, that can influence skill decay. All of these must be considered if skill fade is to be successfully mitigated.

## References


1. Arthur, W Jr, Bennett, W Jr, Stanuch, P.L. and McNelly, T.L (1998). Factors that influence skill decay and retention: A quantitative review and analysis. Human Performance, 11(1), pp 57-101.
2. Batsakes, P.J. and Fisk, A.D. (1997). Ageing and retention of newly acquired skill: does performance predict retention of underlying learning? Proceedings of the Human Factors and Ergonomics Society 41st Annual Meeting.
3. Branson, R.K., Rayner, G.T., Cox, J.L., Furman, J.P., King, F.J., Hannum, W.H. (1975). Interservice procedures for instructional systems development. (5 vols.) (TRADOC Pam 350-30 NAVEDTRA 106A). Ft. Monroe, VA: U.S. Army Training and Doctrine Command.

4. Driskell, J.E., Willis, R.P. and Copper, C. (1992). Effect of Overlearning on Retention. Journal of Applied Psychology, Vol. 77, No. 5, 615-622.
5. Johnson, S. (1981). Effect of Training Device on Retention and Transfer of a Procedural Task. Human Factors, 23(3), 257-272.
6. Rigg, K.E., Gray, B.B and Tillman, B.W. (1982). Estimating skill retention from initial training. Proceedings of the Human Factors Society 26th Annual Meeting, pp 263-265.
7. Ruffner, J.W., Wick, D.T. and Bickley W.R. (1984). Retention of Helicopter Flight Skills: Is there a "critical period" for proficiency loss? Proceedings of the Human Factors Society 28th Annual Meeting, pp 370 to 374.
8. Rullo, J.C. and McDonald, B. (1990). Factors related to skill degradation and their implications for refresher training. Proceedings of the Human Factors Society 34th Annual Meeting.
9. Whalley, S.T., (1988). Minimizing the cause of human error. In Tenth Advances in Reliability Technology Symposium. Eds G.P Libberton. London: Elsevier.
10. Wisher, R. (1992). The Role of Complexity on Retention of Psychomotor and Procedural Skills. Proceedings of the Human Factors Society 36th Annual Meeting.