

Negative Transfer in the Learning of Typing Tasks

Trina C. Kershaw (tkersh1@uic.edu)

Department of Psychology, University of Illinois at Chicago
Chicago, IL 60607 USA

Keywords: Negative transfer; skill; learning; typing.

The Problem of Negative Transfer

Much of what we know about negative transfer is incomplete. The two main theories of negative transfer (Singley & Anderson, 1989; Woltz, Gardner, & Bell, 2000) debate as to whether negative transfer is a real phenomenon. Singley and Anderson argue that prior knowledge structures will not interfere in situations with changed task demands, while Woltz et al. believe that prior knowledge structures will lead to poor learning outcomes in tasks with changed demands. Further, the literature is full of contradictory results concerning negative transfer: Some evidence suggests that individuals are aware of changes and slow down to accommodate them (Gordon, Casabona, & Soechting, 1994; Singley & Anderson), while other evidence suggests that individuals never notice the changes and make fast errors (Besnard & Cacitti, 2005; Woltz et al.). Some studies suggest that negative transfer effects are short lived (see Schmidt & Lee, 1999 for a review) while other studies suggest that negative transfer effects can persist across time or trials (Gordon et al.; Woltz et al.). Finally, most research does not consider the contributions of contextual or individual factors to negative transfer, while individual knowledge levels are a key factor in Woltz et al.'s theory.

Addressing the Problem of Negative Transfer

The experiment aimed to address some of the contradictory findings from the negative transfer literature. First, a complex task, typing, was selected in which individuals can vary greatly. A negative transfer situation was created by switching two pairs of target letters on a computer keyboard layout. Specifically, the **r** and **o**, and the **f** and **y** switched positions. Second, contextual factors such as word frequency were manipulated in the experimental materials. Third, participants practiced the tasks for multiple days, allowing for the tracking of potential negative transfer effects across time. *Negative transfer* was operationally defined as a decrease in performance in response to task changes.

Method

One hundred and two UIC undergraduates participated for one hour per day for four days for course credit. On the first day, participants typed word lists on the typical Qwerty layout; on the second through fourth days, they typed on the switched layout. Their keystrokes were recorded. Participants varied in their level of typing skill, which ranged from 12-84 words per minute.

The word lists contained within-subjects manipulations including letter frequency and word frequency. Half of the words contained a high-frequency target letter (**r** or **o**) and half of the words contained a low-frequency target letter (**f** or **y**). In the frequency list, half of the words were high frequency, and half were low frequency.

Results and Discussion

Reaction time analyses were conducted by using time (ms) to type the target letter correctly as the dependent variable. There was no skill difference in the time needed to type a target letter correctly. High frequency letters and words were typed faster than low frequency letters and words. Participants showed an increase in reaction time on the first switch day, averaging about one second longer than baseline to type a target letter. This reaction time difference decreased across the practice sessions, but even by the third day of practice, participants averaged 400 ms greater than baseline to type a target letter. This result suggests that negative transfer can persist across time. In addition, this result contradicts the findings of Singley and Anderson, who found that participants performed better than baseline after two days of practice.

Error analyses were conducted by coding typing errors into five types: substitution, intrusion, omission, addition, and transposition. Skill differences were shown for intrusion errors, in which the wrong member of a target letter pair is typed (for example, **o** is typed instead of **r**). High skill participants made more intrusion errors than low skill participants. This result is comparable to the findings of Woltz et al., and suggests that prior knowledge structures can interfere in situations where task demands change.

References

- Besnard, D., & Cacitti, L. (2005). Interference changes causing accidents. An empirical study of negative transfer. *International Journal of Human-Computer Studies*, 62, 105-125.
- Gordon, A.M., Casabona, A., & Soechting, J.F. (1994). The learning of novel finger movement sequences. *Journal of Neurophysiology*, 72(4), 1596-1610.
- Schmidt, R.A., & Lee, T.D. (1999). *Motor control and learning: A behavioral emphasis* (3rd edition). Champaign, IL: Human Kinetics Publishers.
- Singley, M.K., & Anderson, J.R. (1989). *The transfer of cognitive skill*. Cambridge, MA: Harvard University Press.
- Woltz, D.J., Gardner, M.K., & Bell, B.G. (2000). Negative transfer errors in sequential skills: Strong-but-wrong sequence application. *JEP: LMC*, 26(3), 601-625.