

## **Recent literature on the psychometric properties of the FLIM with a special emphasis on its validity as a measurement device of fatigue**

### **Objectivity:**

Since the light stimuli are pre-set by the computer and the physical parameters are maintained on a constant level throughout testing, a high *administration objectivity* is achieved. To avoid a reduction of administration objectivity caused by wrong handling, the test cycle is described in detail in the chapters “Instruction phase” and “Test phase”. In the instruction phase, the instruction texts are displayed on the monitor. Computerized analysis guarantees an error-free calculation of test scores and thus a high *evaluation objectivity*. The detailed interpretation section of the manual ensures a high *interpretation objectivity*.

In sum, FLIM clearly fulfils the criterion of objectivity as determined in national and international standards for psychological assessment.

### **Reliability:**

Beside a precise measurement of the variables, several studies demonstrated, that the two main variables of our FLIM, fusion frequency (VF) and flicker frequency (FF), can be considered to be highly reliable measures of fatigue (see table 1).

*Split-half-coefficients according to Guttman, gathered in test version S1*

Age Group	$r_{tt}(VF)$	$r_{tt}(FF)$
18-38 (n = 84)	.96	.97
39-55 (n = 82)	.96	.95
56-80 (n = 79)	.95	.93

Note.  $r_{tt}(VF)$ ,  $r_{tt}(FF)$ : Split-half-reliability coefficients for the fusion and flicker frequency according to Guttman

Similar results have been obtained in studies conducted by Parrot (1982) as well as Levander (1982).

**Validity:**

With regard to the *construct validity*, it is widely agreed that FLIM fulfils the criteria required to operationalize the construct of activation of the central nervous system. This evaluation of the construct validity is based on several studies (Wittling, 1983; Wöllersdorfer & Barolin, 1980; Wurzer & Scherzer, 1992). Schulz, Wilde & Grabietz-Kurfürst (1997) and Schulz & Wilde (1995) recently demonstrated that FLIM is able to discriminate between respondents with daytime sleepiness and healthy ones as well as respondents with daytime sleepiness with or without a proper treatment.

With respect to the *training validity* (Messick, 1995) of FLIM, Smith and Misiak (1976) come to the conclusion that pharmaceuticals which have an activating effect on the central nervous system generally lead to an increase in arousal, while pharmaceuticals which have a sedating effect on the central nervous system lead to a decrease in arousal. This increase or decrease in arousal is also reflected in respondent's scores in the main variables of FLIM.

Furthermore, Grünberger, Saletu, Berner and Stöhr (1982) identified positive correlations between the flicker fusion frequency and the performance in Grünberger's "Fine motor abilities test" as well as the visual echo effect, which is considered as an indicator of activation of the central nervous system in neuropsychological assessment. A negative correlation existed with regard to the main variable reaction time measured with the "Reaction Test (RT)". All correlations were highly significant ( $p \leq 0.01$ ). Wurzer (1992) found that a decrease in arousal coincided with a significant drop in performance in a memory test, an increase of reaction times in the "Reaction Test (RT)" as well as an increase of errors in the attentiveness-stress-test (d2). In sum, these results can be seen as evidence for the *convergent validity* of FLIM as a measure of fatigue and activation of the central nervous system.

Recent evidence regarding the *criterion validity* of FLIM has been reported in a study conducted by Daniel, Fabry and Fickova (1985), who investigated the effect of working shifts. The authors have been able to demonstrate, that respondent's adaptation to their work conditions occurred faster on the subjective, psychological level as indicated by their scores in a well-being questionnaire, than on the actual psycho physiological level, as indicated by their measures in FLIM.

Altogether the results of the cited validation studies indicate that FLIM is a valid and useful measure of fatigue and respondent's level of activation of the central nervous system.