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Dual-task interference can be reduced by cognitive and physical training

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OBJECTIVE
Dual-task interference (DTI) is an impairment in performance when simultaneously performing two tasks such as cognitive and motor tasks. The aims of this study were (1) to identify the factors affecting DTI in healthy participants, and (2) to analyze the relative implications to decrease DTI.

METHODS
A total of 46 healthy farmers performed the following three computerized experiments: (1) cognitive (CT): release button 1 (BT1) as rapidly as possible when the font color of a word and its meaning were congruent (Go), (2) motor (MT): release BT1 and then tap button 2 (BT2) 10 times as rapidly as possible if the symbol "○" was presented (Go), and (3) dual tasks (DT): combination of CT and MT elements. The reaction time (RT) of correct releases (RTCR) of BT1 in all tasks was measured, and the RTCR ratios in CT and MT were divided by the RTCR of DT to obtain the DTI values. Additionally, general and agriculture working characteristics, psycho-cognitive status, and physical performance status were assessed. Data were analyzed by correlation analysis and multiple linear regression analysis (stepwise) to determine the explanatory factors of DTI.

RESULTS
The ratios of RTCR in CT (%CT/DT, 78.6±13.0%, $p<0.001$) and MT (%MT/DT, 74.2±10.1%, $p<0.001$) were significantly decreased compared to that of DT (100%). The results revealed that in the female group, %MT/DT (up to 100% means lesser cognitive DTI) showed significant correlations with the Korean version of the Mini-Mental State Examination (MMSE-KC) from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) score ($r=0.392$, $p=0.027$) and exercise time (hrs) per year ($r=0.371$, $p=0.037$). Regression analysis showed that MMSE-KC score ($\beta=0.356$, $p<0.05$) and exercise time per year ($\beta=0.333$, $p<0.05$) remained as explanatory factors of %MT/DT.

CONCLUSIONS
We developed a computerized program that can measure the performances of single/dual-task, and quantify the DTI. The results of this study showed that cognitive DTI is related to cognitive level and exercise duration. Based on these results, the training programs to overcome DTI might include specific cognitive and physical training protocols.

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Table 1. Pearson's correlation coefficients between ratio of computerized single/dual tests and demographic data

		Total (n=46)				Male (n=14)				Female (n=32)			
		%CT/DT		%MT/DT		%CT/DT		%MT/DT		%CT/DT		%MT/DT	
		Pearson Correlation	p-value	Pearson Correlation	p-value	Pearson Correlation	p-value	Pearson Correlation	p-value	Pearson Correlation	p-value	Pearson Correlation	p-value
General characteristics	Age	.061	.689	-.122	.420	.462	.096	.037	.901	-.044	.810	-.227	.212
	Education period (yr)	-.119	.432	.222	.138	.033	.910	.260	.370	-.122	.506	.212	.243
Agriculture Characteristics	Farming period (yr)	.010	.945	-.076	.614	-.164	.575	.065	.825	.069	.706	-.148	.419
	Farm working time per year (hr)	-.021	.891	-.003	.985	-.010	.973	.001	.996	-.012	.950	-.015	.935
	Housekeeping time per year (hr)	.214	.154	-.036	.814	-.103	.725	.193	.509	.248	.170	-.038	.838
	Exercise time per year (hr)	.029	.850	.211	.159	-.148	.613	.003	.992	.125	.494	.371*	.037*
	Total working time per year (hr)	.100	.510	.009	.954	-.089	.761	.043	.885	.152	.407	.013	.945
Psycho-cognitive status	MMSE-KC (0-30)	-.220	.142	.303*	.041*	.187	.521	.072	.806	-.323	.071	.392*	.027*
	GNG reaction time	.040	.790	-.289	.051	.018	.951	-.254	.382	.034	.851	-.305	.089
	K-BDI (0-63)	.150	.319	-.008	.956	-.220	.449	.199	.495	.203	.266	-.039	.833
	Stress (0-10)	-.148	.328	-.056	.710	-.180	.538	-.219	.452	-.139	.447	-.007	.970
	FSS(1-7)	-.047	.756	.036	.812	-.226	.436	.147	.615	.017	.926	-.017	.925
	PPT(N)	-.181	.230	-.019	.901	.247	.394	.333	.244	-.263	.146	-.170	.351
Physical performance status	Grip strength (kg)	-.134	.375	.007	.964	-.308	.284	-.099	.736	-.026	.889	-.031	.866
	Finger tapping reaction time	.108	.474	-.173	.251	-.211	.468	.198	.497	.167	.360	-.282	.117
	SPPB (0-12)	-.099	.511	.028	.856	-.417	.138	.322	.261	.066	.719	-.177	.334

CR, correct response; CT, cognitive task; DT, dual task; MT, motor task; MMSE-KC, Korean version of the mini-mental state examination; GNG, Go/no go task; K-BDI, Korean version of beck depression inventory; FSS, fatigue severity scale; PPT, pain pressure threshold; SPPB, Short Physical Performance Battery

Table 1. Pearson's correlation coefficients between ratio of computerized single/dual tests and demographic data

Table 2. Stepwise multiple linear regression analysis with %MT/DT as a dependent variable performed in all (n = 46) and female(n=32) subjects.

		%MT/DT						
		R^2	F(p)	B	Std.Error	Beta	t-value	p-value	VIF
Total (n=46)	MMSE-KC (0-30)	.092	4.454 *	1.333	.632	.303	2.110	.041	1.000
Female (n=32)	MMSE-KC (0-30)	.263	5.176 *	1.352	.609	.356	2.221	.034	1.012
	Exercise time per year (hr)			.023	.011	.333	2.077	.047	1.012

Table 2. Stepwise multiple linear regression analysis with %MT/DT as a dependent variable performed in all (n = 46) and female(n=32) subjects.