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Influences of fear and anxiety on organization of way-finding and spatial orientation

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Participants: 46 voluntary students, 25 female and 21 male were recruited. Method: Way-finding and Spatial Anxiety Questionnaire, allocentric and egocentric reference based mental rotation tasks, Progressive Matrices, Trial Making, Rey-Osterrieth Complex Figure Test, Pieron test, Fear Survey Schedule, and Spielberger Trait Anxiety Inventory. We found that fear had an impact on participants' spatial orientation and route finding activity. Fearful participants suffering from spatial anxiety manifest disturbed exploration, are unable to visualize directions and structure of large scale complexes, and they need intensive effort to maintain the adequate orientation to the navigation signals. It was experimentally demonstrated that participants suffering from spatial anxiety showed intensive landmark identification deficiency. This spatial orientation disturbance is related to spatial anxiety and fears, primarily agoraphobic avoidance but is independent from trait anxiety.

Finding the right way home from an unfamiliar place is organized by a biologically and culturally based set of skills and memory that embodies an environmental knowledge system which is a part of humans' security or safety system formed by environmental learning and exploration. The sense of the space in which we live is closely related to our personal feelings and sentiments that involve a positive or negative attachment to our physical surroundings that creates a certain feeling of comfort, security or anxiety. This affective bond between people and places has been mentioned in several contexts and determined by specific gender and spatial orientation habits. Being in an unfamiliar place (large uninhabited indoor- or outdoor spaces, buildings, supermarkets, or towns) often causes a sense of space disruption and provokes unsteady feelings, anxiety, a specific defensive posture and disturbed exploratory movements (Hart, 1979; Liben, 1988; Hay 1998). These phenomena are manifest primarily in case of involuntary or forced relocation, when the subject does not intend to detach from his/her home surroundings and the connected feelings and does not mobilize locomotion, exploration and effective orientation strategies to define the actual spatial map of the environment (Dabbs et al., 1998). On the other hand, spatial orientation performance depends on the subject's intellectual capacity, visuo-spatial and perceptuo- motor skills and specific gender features as well (Linn & Peterson, 1985; Cornell et al., 1989; Lawton, 1994; Sherry & Hampson, 1997; Schmitz, 1997; McAndrew, 1998).

Other recent studies on anxious and control subject's spatial orientation in real and virtual space have stated that anxiety disrupts participants' spatial orientation and memory performances. Moreover, the specific form of anxiety markedly affects their orientation strategy in real large-scale space (Schmitz, 1997; Kállai et al., 1999), although the relationship between anxiety, cognitive map construction, the representation of spatial knowledge and spatial orientation strategies has not yet been clarified. Internal models of the world influence learning and performance in several ways. The cognitive maps motivating several exploratory strategies generate (a) expectations about the spatial context of objects and acts; (b) depending on the subject's current motivational state, these expectations furnish information needed for the generation of a spatial orientation strategy during approach or avoidance, and influence the manner of cue utilization; (c) the spatial knowledge contained in these representations contributes to the processes, the causal texture of its environment. The expected or unexpected nature of stimuli strongly influences what the subject learns in the actual environmental context (Nadel et al., 1984). Such internal representations of environments could enable a subject to escape from dependence on the immediate stimulating environment. The maps provide information about unseen things and allow for action at a distance and in advance. The organism moves

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Sex Fear ($p<.05$), and Animal Fear ($p<.01$) detected significant differences between the female and male performances (see Table 1). The female participants showed elevated spatial anxiety, agoraphobia, sex, and animal fear but did not differ in trait anxiety. Females also showed lower performance in the allocentric reference based OMRT but did not differ in the egocentric reference based HMRT test. According to the spatial way-finding and orientation scores females showed lower indoor and outdoor orientation scores than males but did not differ in way-finding strategies and other cognitive performances.

Correlation analysis of the entire sample

As we have seen, gender related to agoraphobic avoidance, spatial anxiety, allocentric reference based mental rotation and indoor and outdoor orientation strategies but did not relate to trait anxiety, way-finding strategies and other visuo-spatial and attention performances. The correlation matrix (see Table 2 and Table 3) indicates relation between gender and orientation strategies, spatial anxiety and agoraphobia. According to the gender dependent correlation

Table 1

Gender differences between anxiety, different aspects of fear, spatial orientation, mental rotation, and several cognitive tasks.

Measure	Gender	*M*	*SD*	*t*	*p*
trait anxiety	m	38.79	7.30	-0.18	n.s.
	f	39.16	7.17		
spatial anxiety	m	12.16	2.80	-2.72	**0.01**
	f	14.64	3.49		
indoor orientation	m	15.91	4.42	3.47	**0.001**
	f	12.16	3.06		
outdoor orientation	m	20.91	5.14	3.37	**0.001**
	f	16.48	4.02		
indoor way-finding	m	13.50	2 85	-0.92	n.s.
	f	14.20	2.48		
outdoor way-finding	m	14.25	3.73	0.22	n.s
	f	14.04	2.80		
intelligence	m	48.33	6.21	1.61	n.s.
	f	45.32	6.86		
Piéron sustained visul attention	m	93.06	9.87	-1.30	n.s
	f	95.88	4.35		
OMRT (allocentric reference)	m	17.08	6.11	5.48	**0.001**
	f	9.16	3.77		
HMRT (egocentric referencie)	m	4.83	6.12	-1.55	n.s.
	f	10.08	15.44		
Rey-Osterrieth visual memory	m	28.12	4.49	1.47	n.s
	f	25.92	5.90		
scanA (visual scanning)	m	65.16	22.98	0.99	n.s.
	f	58.72	22.64		
scanB	m	24.95	7.12	-1.43	n.s.
	f	28.24	8.76		
agoraphobia	m	5.83	3.45	-2.49	**0.05**
	f	9.28	5.88		
social fear	m	17.54	5.84	-1.86	n.s.
	f	21.16	7.60		
sex fear	m	6.33	4.78	2.20	**0.05**
	f	9.20	4.31		
animal fear	m	4.37	3.93	-2.80	**0.01**
	f	8.00	5.03		
illness fear	m	5.54	4.25	-0.84	n.s.
	f	6.56	4.16		

Note: male $n = 21$; female $n = 25$. *Deegres of freedom* $= 44$.

Table 2

Correlations between gender, spatial and non spatial skills, spatial orientation and way-finding strategies, trait anxiety and agoraphobic avoidance.*

	trait anxiety	agora-phobia	spatial anxiety	OMRT	HMRT	indoor ori.	outdoor ori.	indoor way-f.	outdoor way-f.
gender	.003	**.368b**	**.314a**	**.589b**	.224	**-.417b**	**-.459b**	.114	-.077
		.394b	.107	-.103	.120	-.175	-.031	.026	.062
trait anxiety		.361	.379	-.157	.331	-.243	-.147	.316	.062
		.444a	-.106	-.007	.049	-.068	.121	-.220	-.151
			.642b	**-.356a**	.001	**-.368a**	-.067	.134	-.021
agoraphobia			**.709b**	-.030	.053	-.279	.027	**.412a**	-.059
			.431a	-.223	-.177	-.021	.243	-.231	-.024
				-.383b	.080	**-.390b**	-.062	**.359a**	.108
spatial anxiety				-.072	-.150	-.338	.049	**.471b**	.145
				-.636b	.046	.225	.146	.227	.086
					-.271	**.405b**	.296	**-.371a**	-.009
OMRT					**-.520b**	.105	.068	**-.450b**	-.018
					-.031	.289	.094	-.227	.033
						-.309	**-.366b**	.009	.077
HMRT						**-.342a**	**-.355a**	.191	-.154
						-.269	-.346	-.122	-.071
							.545b	-.281	-.005
indoor orientation							**.656b**	-.265	.011
							.155	-.214	-.055
								.087	.271
outdoor orientation								.234	-.107
								.064	**.402a**
									.372a
indoor way-f.									**.428b**
									.307

*The correlation coefficients is listed from top to down in the following order: male, female, and entire sample.
a $p<0.05$
b $p<0.01$

pattern, in the next step the entire sample was analyzed by partial correlation statistics.

Partial correlation analyses of the entire sample

We computed partial correlations controlling for gender on the entire sample. Following correlations poved to be significant. 1. Anxiety-fear: correlation between Agoraphobia and Spatial Anxiety ($r(44)=.58$, $p<.001$) was significant. On the other hand, partial correlation between Spatial Anxiety and Indoor Route-Finding Strategy $r(44)=.38$ $p<.01$ was also significant as well as partial correlation between Spatial Anxiety and Indoor Orientation Strategy ($r(44)= -.30$, $p<.05$). 2. Mental rotation: significant partial correlations were found between Object Mental Rotation and Rey-Osterrith Figure Drawing performance ($r(45)=.32$, $p<.05$), and between Hand Mental Rotation and the use of Outdoor Orientation Strategy ($r(44)= -.23$, $p<.05$). 3. Visuo-spatial performance: we found significant partial correlation between Trial Making Performance A and Indoor Orientation Strategy ($r(44)=.34$, $p<.01$), and between Trial Making B and Ourdoor Route-finding strategy ($r(44)=.30$, $p<.05$). 4. Outdoor and indoor strategies: significant relationship was found between Indoor and Outdoor Route-finding Strategies ($r(44)=.36$ $p<.01$), and between Indoor and Outdoor Orientation strategy ($r(44)=.49$, $p.<001$). A significant negative relationship was found between Indoor Route-finding Strategy and Indoor Orientation Strategy ($r(44)= -.29$, $p<.05$).

Table 3

Correlations between gender, spatial and non spatial skills, spatial orientation and way-finding strategies, trait anxiety and agoraphobic avoidance.*

	Piéron	Raven	Rey-Ost.	ScanA	ScanB
Gender	.185	-.199	-.182	-.152	.191
	.149	-.176	.101	-.120	.067
trait anxiety	.320	.060	-.116	.131	.317
	-.190	-.360	.278	-.346	-.136
	.213	-.208	-.076	-.179	.011
Agoraphobia	.222	.043	.047	-.009	.069
	-.053	-.271	.084	-.230	-.248
	.048	-.125	-.053	-.043	.037
spatial anxiety	.104	.096	.012	.143	**.511a**
	-.128	-.117	.053	-.092	-.386
	.095	.212	**.352a**	.047	-.217
OMRT	.381	.063	**.509a**	-.270	-.345
	-.053	.100	.051	.296	.172
	.055	-.117	.001	-.012	-.086
HMRT	.003	-.029	-.247	.015	-.010
	.055	-.105	.146	.018	-.185
	-.233	.276	.134	**.351a**	-.265
Indoor orientation	-.270	.009	.011	.294	-.232
	.124	**.416a**	.061	**.391a**	-.163
	-.300a	.221	.070	.276	-.088
Outdoor orientation	**-.417a**	.088	-.107	.118	-.169
	.060	.194	.051	.382	.128
	-.093	.115	-.196	.093	.232
Indoor way- finding	-.130	.211	-.360	.001	.257
	-.162	.108	-.020	.240	.169
	.094	.187	-.206	.208	.265
Outdoor way- finding	.176	**.559b**	.011	.148	.108
	-.109	-.157	**-.400a**	.283	**.420a**

* *The correlation coefficients is listed from to down in the following order: male, female, and entire sample.*
a $p<0.05$
b $p<0.01$

DISCUSSION

The present study results demonstrated that female participants showed higher level agoraphobic avoidance and spatial anxiety than males but no detectable differences were found in the level of trait anxiety. Females showed disturbed performance in the allocentric reference based mental rotation task but no detectable difference in the egocentric reference based mental rotation task was found. On the other hand, significant gender differences were found in self-report measures of indoor and outdoor orientation strategies. Females performed less indoor and outdoor orientation acts than males but there were no detectable differences in way-finding strategy and other cognitive performances.

Because gender porved to play a significant role in many of the variables analyzed, gender- controlled partials correlation between the measured spatial abilities were examined. We found gender-controlled positive partial correlation between Spatial Anxiety and Indoor Way-Finding Strategy, and negative correlation between Spatial Anxiety and Indoor Orientation Strategy but no significant partial correlation between Spatial Anxiety and Outdoor Orientation Strategy, and Spatial Anxiety and Outdoor Way-Finding Strategy. Allocentric mental rotation correlated with contextual/figural integration task performance but did not correlate with self-reported orientation and way-finding strategies. On the other hand, egocentric mental rotation correlated with outdoor orientation strategy use. The simple version of visual scanning (trial Making A) correlated with indoor orientation strategy, while the compli-

cated version of visual scanning correlated with outdoor way-finding strategy.

In the interpretation of these data, we have to say that the Scales of Outdoor (Orientation and Way-finding) and Indoor (Orientation and Way-finding) Strategies show in part a similar pattern to that found by Lawton (1996). She identified a strong gender independent relationship between Indoor and Outdoor Way-finding Strategies, as well as between Indoor and Outdoor Orientation Strategies. Further, she found significant gender differences inIndoor and Outdoor Orientation Strategy. On the contraty, we did not find gender differences in Indoor and Outdoor way-finding Strategies. According to the results of correlation analysis performed on the entire Hungarian sample, we have to state that way-finding is a gender independent function. At present, we do not have sufficient amount of data to interpret these differences. Further examination on a broader sample and cross-cultural examination in this field is needed.

Spatial anxiety. Present results partially correspond to Lawton earlier findings. Indoor orientation correlated negatively, and indoor way-finding positively to spatial anxiety, but in contrast with Lawton's results outdoor orientation and outdoor way-finding did not correlate to spatial anxiety.

The following interpretations might be applied to these data.

1. Trait anxiety does not play a significant role in the organization of measured indoor and outdoor orientation and way-finding, but the agoraphobic avoidance and spatial anxiety do.

2. Indoor and outdoor orientation strategy use is gender dependent but way-finding is not.

3. Cognitive performance level, measured by progressive matrices, visuo-spatial memory, and sustained attention do not play significant role in control of spatial orientation and way-finding.

4. Visuo-motor coordination is an effective skill to control way-finding strategies.

Individuals are likely to have an assortment of spatial skills rather than a single ability. From this repertoire anxiety selects the appropriate spatial abilities and strategies that provide the safe perceptual conditions for the person in the threatening situation. As we have seen, spatial anxiety is connected with gender and agoraphobic behavior. Phobias are a specific type of anxiety which influences the participants' spatial orientation strategies and way-finding activity. Fearful participants suffering from spatial anxiety restrain from exploration and use of indoor orientation strategies. They report inability to visualize the direction and structure of a large building, do not keep in their mind north, south, east, and west directions in a building, they feel that they do not have anticipated knowledge about the structure of large scale complex, and they need intensive effort to maintain adequate orientation. At the same time, anxiety induces an intensive indoor way-finding strategy. The availability of a person giving guidance, a map indicating their present location, and clearly visible landmarks are highly appreciated. In an earlier study Lawton demonstrated experimentally that participants suffering from spatial anxiety show incorrect landmark identification, pointing confidence and pointing latency. These landmark identification disturbances may manifest themselves in the form of spatial anxiety (Lawton 1996). We found that this spatial orientation disturbance is connected with spatial anxiety and fears, primarily agoraphobic avoidance, but are independent from trait anxiety. Finally, we can say that these findings define a spatial orientation disorder complex where gender, spatial anxiety, agoraphobic avoidance, disturbed indoor orientation strategy and induced indoor way-finding are seen as a fearful environmental orientation unit.

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