

Interdisciplinary Measures of Hard and Soft System Thinking in American and Turkish Communities

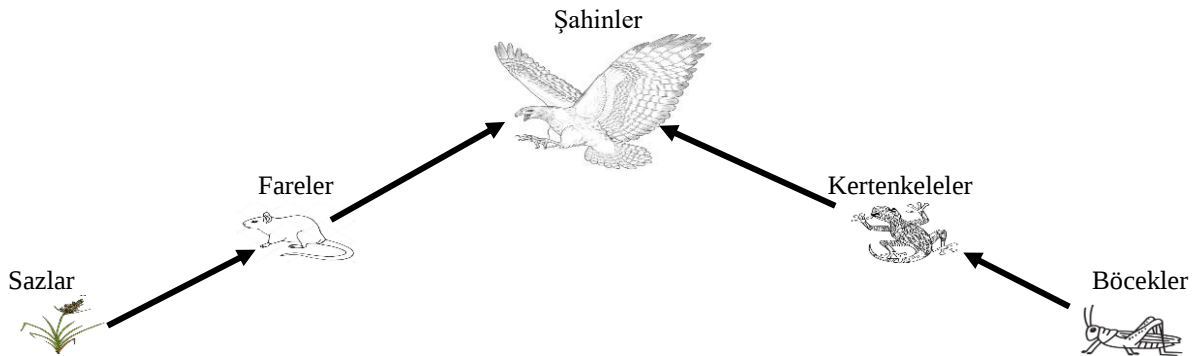
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7. Bir konunun farklı parçalarının birbiri ile nasıl ilişkilendirildiğini görebildiğim zaman, en iyi şekilde öğrenirim	☐	☐	☐	☐	☐	☐	☐
8. Olayların ya da bilgilerin, büyük resimde nasıl görüldüğünü bilmek isterim	☐	☐	☐	☐	☐	☐	☐
9. Sonuçta , bütün problemleri doğru mu veya yanlış mı diye basit parçalara ayırabiliriz	☐	☐	☐	☐	☐	☐	☐
10. Kurallar ve yasalar zaman içinde çok değişmemelidir	☐	☐	☐	☐	☐	☐	☐
11. Her şey sürekli değişmektedir	☐	☐	☐	☐	☐	☐	☐
12. Sadece çok büyük olaylar, ekonomi ve ekosistem gibi büyük sistemleri önemli derecede değiştirebilir	☐	☐	☐	☐	☐	☐	☐
13. Bir gölü besleyen kaynağa yakın bölgeye küçük bir çiftlik daha kurmak bile, gölü kalıcı bir şekilde değişime uğratabilir.	☐	☐	☐	☐	☐	☐	☐
14. Benim sağlığımın, dünyada olup biten olaylarla hiçbir ilgisi yoktur	☐	☐	☐	☐	☐	☐	☐
15. Bir toplumun, bir otorite veya hükümet tarafından planlanmadan da yeni bir düzene kavuşması mümkündür	☐	☐	☐	☐	☐	☐	☐

III. Kedi Senaryosu

Bir yerleşim yeri, Doğa Koruma Kurumu tarafından yönetilen bir doğa koruma alanına sınırdır. Bu koruma alanına erişimi veya hayvanların koruma alanına girip çıkmasını engelleyecek çitler veya kapılar bulunmamaktadır. Koruma alanı, özellikle, yerleşim yerinin sakinlerinden iki grup için popülerdir – bisikletçiler (iyi parkur özelliği gösteren bisiklet yoluna değer verenler ve vahşi yaşama çok dikkat etmeyenler) ve kuş gözlemcileri (koruma alanının meşhur şahin popülasyonuna değer verenler).

Koruma alanında saz (Lat. Carex) bitkileri, böcekler, fareler, kertenkeleler ve şahinlerden oluşan bir besin ağı vardır. Bu organizmaların arasındaki beslenme ilişkisi (besin ağı) aşağıdaki şemada gösterilmiştir. Birincil tüketiciler olarak fareler, saz bitkilerinden beslenir. Kertenkeleler böceklerden beslenir. Şahinler hem fareleri hem de kertenkeleleri temel besin kaynağı olarak tüketirler ve beslenmede bir besini diğer besine kolayca değiştirebilirler. Fareler saz bitkilerinin çokluğunu, kertenkeleler de böceklerin çokluğunu kontrol etmede önemlidir. Bu organizmalarda beslenme zinciri ve her birinin sayısal oranı epeyce bir süredir sabit kalmıştır.



Bob, kısa bir süre önce yerel bir teknoloji firması tarafından işe alınmış ve bu yerleşim yerinden bir ev satın almıştır. Bob'un kedisi Felix, çok başarılı ve seçici bir avcıdır --- fareleri yakalar ve öldürür fakat kertenkele veya kuş avlamaz. Bu yerleşim yerinde (ve koruma alanında) daha önce serbest dolaşan bir kedi bulunmuyordu.

Yukarıdaki metinde açıklanan ilişkileri de düşünerek Bob'un ailesi (kedi Felix de dahil!) mahalleye taşındıktan sonra aşağıdaki organizmaların miktarının **ne kadar değişebileceği hakkında en doğru kararı verin**. Felix'in en az yedi yıl daha yaşayacağını ve zevkle avlanmaya devam edeceğini varsayın! Bu olayın; koruma alanı, koruma alanındaki organizmalar, insanlar ve kuruluşlar üzerindeki **etki derecesini belirtmek** için aşağıdaki **seçenekleri kullanın**.

	Büyük Ölçüde Arttı	Arttı	Aynı Kaldı	Azaldı	Büyük Ölçüde Azaldı	Bilmiyorum
	5	4	3	2	1	0
1. Fareler	☐	☐	☐	☐	☐	☐
2. Şahinler	☐	☐	☐	☐	☐	☐
3. Kertenkeleler	☐	☐	☐	☐	☐	☐
4. Böcekler	☐	☐	☐	☐	☐	☐
5. Bu yılki saz bitkileri	☐	☐	☐	☐	☐	☐
6. Bu yıldan itibaren üç yılda saz bitkileri	☐	☐	☐	☐	☐	☐
7. Bisikletçiler	☐	☐	☐	☐	☐	☐
8. Bu yılki kuş gözlemcileri	☐	☐	☐	☐	☐	☐
9. Bu yıldan itibaren üç yılda kuş gözlemcileri	☐	☐	☐	☐	☐	☐
10. Komşular arasında çatışma	☐	☐	☐	☐	☐	☐
11. Doğa koruma için kaynak oluşturma	☐	☐	☐	☐	☐	☐
12.Yöre sakinlerinin evcil hayvanları kontrol önlemlerini desteklemesi	☐	☐	☐	☐	☐	☐
13. Besin ağının istikrarı	☐	☐	☐	☐	☐	☐

Bir etkide birden fazla faktör sorumlu olabilir. Felix'in koruma alanı üzerindeki etkilerinden aşağıdakiler **ne ölçüde sorumludur?**

	Çok sorumlu	Biraz sorumlu	Hiç sorumlu değil	Bilmiyorum
	3	2	1	0
1. Kedi Felix	☐	☐	☐	☐
2. Bob	☐	☐	☐	☐
3. Şahinler	☐	☐	☐	☐
4. Böcekler	☐	☐	☐	☐
5. Bob'un ailesi	☐	☐	☐	☐
6. Bob'u işe alan teknoloji firması	☐	☐	☐	☐
7. Yerleşim yerinin sakinleri	☐	☐	☐	☐

IV. Eczane Senaryosu

Bir klinik, Rust-Belt bölgesinde düşük gelirli bir mahallede yer almaktadır. Bölge halkı, büyük bir üretim merkezinin kapatılması sonucu süregelen işsizlik yaşamaktadır. Klinik eczanesinin, yerel ve eyalet fonlarındaki kesintilerden ve müşterilerin ödeme yapamamasından kaynaklı yetersiz işletme bütçesinden dolayı yeterli sayıda

Lütfen aşağıdaki ifadeleri, açıklanan bu tıbbi sonuçları düşündüğünüzde, **ne kadar önemli olabileceğini** “1=önemli bir neden değil, ... 7=önemli bir neden” derecelendirmesine göre **değerlendiriniz**. Bir dizi faktör sorumlu olabilir, ancak bu sorunu değerlendirirken size göre hangilerinin daha fazla veya daha az önemli olduğunu önemsiyoruz.

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Dear Participant,

I. Demographic properties

- ## II. System Thinking Scale

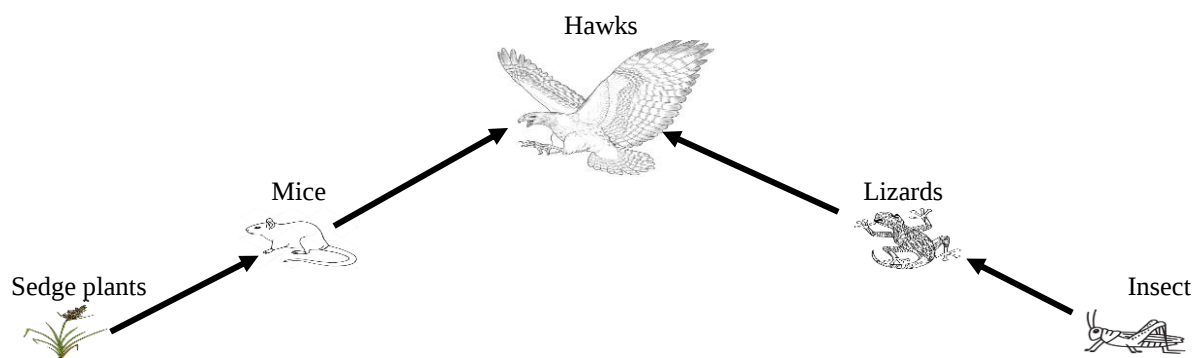
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10. Rules and laws should not change a lot over time	☐	☐	☐	☐	☐	☐	☐
11. Everything is constantly changing	☐	☐	☐	☐	☐	☐	☐
12. Only very large events can significantly change big systems like economies or ecosystems	☐	☐	☐	☐	☐	☐	☐
13. My health has nothing to do with what is happening in the world	☐	☐	☐	☐	☐	☐	☐
14. Adding just one more small farm upstream from a lake can permanently alter that lake	☐	☐	☐	☐	☐	☐	☐
15. It is possible for a community to organize into a new form that was not planned or designed by an authority or government	☐	☐	☐	☐	☐	☐	☐

III. Cat Scenario

A neighborhood borders a nature preserve managed by the Nature Conservancy. There are no fences or gates to block access to this preserve or movement of animals into and out of the preserve. The preserve is particularly popular with two groups of local residents -- bicyclists (who appreciate the well-managed bike paths and don't pay much attention to the wildlife) and birders (who particularly appreciate the hawk population for which the reserve is renowned).

The preserve contains a food web composed of sedge plants, insects, mice, lizards, and hawks. The feeding relationships (food web) among these organisms are as depicted in the diagram below: the mice rely on the sedge plants as their primary food source; the lizards rely on insects for food; the hawks, in turn, rely on both the mice and lizards as their principal food source and can easily shift their diet from one to another. The mice are important for controlling the abundance of sedge and the lizards are important for controlling the abundance of insects. The feeding relationships and therefore the abundance of each of these different organisms has remained fairly stable for some time.



Bob was recently hired by a local technology firm and has purchased a house in the neighborhood. Felix, Bob's cat, is a very successful and selective hunter -- he catches and kills mice but does not hunt either lizards or birds. This neighborhood (and the nature preserve) has not previously had a free-roaming cat.

Consider the relationships described in the text above and then use your best judgment to assess how much each of the following is likely to change in abundance after Bob's family (including Felix the cat!) moves into the neighborhood. Assume that Felix is likely to live for at least another seven years and will

continue to enjoy hunting. Use the choices below to indicate the degree of impact of this event on the preserve, on organisms in the preserve, and on people and organizations.

	Decrease Substantially	Decrease	Stay The Same	Increase	Increase Substantially	I Don't Know
	1	2	3	4	5	0
1. Mice	☐	☐	☐	☐	☐	☐
2. Hawks	☐	☐	☐	☐	☐	☐
3. Lizards	☐	☐	☐	☐	☐	☐
4. Insects	☐	☐	☐	☐	☐	☐
5. Sedge plants this year	☐	☐	☐	☐	☐	☐
6. Sedge plants this three years from now	☐	☐	☐	☐	☐	☐
7. Bicyclists	☐	☐	☐	☐	☐	☐
8. Birders this year	☐	☐	☐	☐	☐	☐
9. Birders three years from now	☐	☐	☐	☐	☐	☐
10. Conflict among neighbors	☐	☐	☐	☐	☐	☐
11. Fundraising for the Nature Conservancy	☐	☐	☐	☐	☐	☐
12. Local neighbors support for pet control measures	☐	☐	☐	☐	☐	☐
13. The stability of the food web	☐	☐	☐	☐	☐	☐

Multiple factors may be responsible for an impact. To what extent are the following responsible for the impacts of Felix on the preserve?

	Very responsible	A little bit responsible	Not at all responsible	I don't know
	3	2	1	0
1. Felix the cat	☐	☐	☐	☐
2. Bob	☐	☐	☐	☐
3. The hawks	☐	☐	☐	☐
4. The insects	☐	☐	☐	☐
5. Bob's family	☐	☐	☐	☐
6. The tech firm that hired Bob	☐	☐	☐	☐
7. Other residents of the neighborhood	☐	☐	☐	☐

IV. Pharmacy Scenario

A clinic is located in a low-income neighborhood in a rust-belt state. The community suffers from chronic unemployment as a result of the loss of a major manufacturing facility. The pharmacy within

Please rate the following items as to how important you feel they might be in explaining the medical outcome with '1' being 'not a major cause' and '7' being an important cause. A number of factors may be responsible but we are interested in which ones you feel are more or less important in answering this question.

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SUPPLEMENT 2

Interdisciplinary Measures of Hard and Soft System Thinking in American and Turkish Communities

We evaluated measure equivalence between our US (N = 578) and Turkish (N = 276) following Pasca et al. (2018); we used ordinal logistic regression to evaluate whether the scales and subscales we computed had the same relationship with each individual item in the two cultural contexts.

For each item, we predicted a participant's answer to that item from their overall score on the scale the item was a part of, and their cultural context. To evaluate differential functioning across cultures, we then added in the interaction term between the scale and cultural context. We looked at whether the interaction terms were significant, and whether the second model provided significantly better fit than the first.

Systems Thinking Scale

Following Pasca et al., (2018), we binned participants' scores on the Systems Thinking Scale into quartiles. Because there were many empty cells, we also combined the lowest four scale responses on each item into a single category.

For the Systems Thinking Scale, only one item (Item 13) had estimated interaction parameters that were significant (Table S1). However, there were no significant differences between the simpler model with main effects and the models that included the interaction term, including the model predicting Item 13 (see Table S2). We thus conclude that the Systems Thinking Scale shows no significant evidence that the items function differently in the two cultural contexts.

ITEM	Parameter 1	Parameter 2	Parameter 3	p	p	p
1	1.005	0.092	0.943	0.493	0.909	0.282
2	0.531	0.226	-0.24	0.723	0.779	0.798
3	-0.495	-0.342	0.335	0.645	0.571	0.591
4	-0.061	-0.16	-0.104	0.944	0.753	0.835
5	1.415	0.422	-0.141	0.23	0.521	0.833
6	-0.305	-0.105	0.034	0.72	0.834	0.944
7	-0.084	-0.164	0.449	0.93	0.766	0.409
8	-0.787	-0.427	0.49	0.439	0.462	0.4
11	0.648	0.703	0.289	0.509	0.209	0.603
12	1.622	0.915	0.636	0.159	0.154	0.316
13	1.99	0.893	1.487	0.039	0.106	0.007
14	-1.762	-0.961	-0.847	0.424	0.4	0.47

Table S2. Comparison of model fit without (Model 1) and with (Model 2) the Country x Scale interaction term						
	Model 1 (main effects only)		Model 2 (main effects + interaction)		Chi Square	p
ITEM	-2 Log Likelihood	df	-2 Log Likelihood	df		
1	83.989	4	80.426	7	3.563	3 ns
2	75.378	4	74.691	7	0.687	3 ns
3	101.696	4	100.01	7	1.686	3 ns
4	109.647	4	109.296	7	0.351	3 ns
5 (recoded)	66.41	4	60.941	7	5.469	3 ns
6	122.773	4	122.474	7	0.299	3 ns
7	96.425	4	94.84	7	1.585	3 ns
8	105.624	4	101.573	7	4.051	3 ns
11	129.971	4	127.044	7	2.927	3 ns
12 (recoded)	69.558	4	67.454	7	2.104	3 ns
13	116.087	4	108.367	7	7.72	3 ns
14 (recoded)	73.496	4	72.646	7	0.85	3 ns

Pharmacy Scenario

We binned participants' scores on the Pharmacy Reductionist Thinking and Systemic Thinking subscales into quartiles. Because there were many empty cells, we also combined the lowest four scale responses on each item into a single category.

The Reductionist Explanations subscale of the Pharmacy Scenario had one item (3) for which all interaction terms were statistically or marginally significant, and one item (5) that had one significant interaction term (see Table S3). However, when comparing model fit between the main-effects model and the model that included interaction terms, there was no difference between the two for item 3 or 5. Instead, item 4 showed better model fit when the interaction term was included (see Table S4). We conclude that these items may function differently in the two cultures, but the evidence is not strong. There was no evidence of differential item functioning for any of the items in the Systemic Explanations subscale.

Table S3. Pharmacy subscale tests of Country x Pharmacy subscale parameter estimates for significance

ITEM							
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Reductionist explanations	Parameter 1	Parameter 2	Parameter 3	p	p	p	p
2	-0.282	-0.104	-0.018	0.761	0.834	0.972	0.972
3	3.417	1.186	0.839	0.035	0.033	0.051	0.051
4	19.755	0.407	-0.075	1	0.386	0.864	0.864
5	2.272	0.364	-0.157	0.031	0.425	0.726	0.726
Systemic explanations	Parameter 1	Parameter 2	Parameter 3	p	p	p	p
6	-1.177	-0.643	-0.126	0.136	0.138	0.789	0.789
7	-0.649	-0.254	-0.75	0.474	0.599	0.151	0.151
8	-0.241	-0.256	0.256	0.813	0.635	0.656	0.656
9	0.767	0.26	-0.311	0.362	0.566	0.525	0.525
10	0.068	-0.1	0.022	0.936	0.828	0.964	0.964
11	-0.311	-0.063	0.509	0.69	0.88	0.254	0.254

Table S4. Comparison of model fit without (Model 1) and with (Model 2) the Country x Pharmacy subscale interaction terms

	Model 1 (main effects only)		Model 2 (main effects + interaction)		Chi Square	df	p
ITEM	-2 Log Likelihood	df	-2 Log Likelihood	df			
Reductionist explanations							
2	149.722	4	149.57	7	0.152	3	ns
3	100.23	4	92.827	7	7.403	3	ns
4	102.108	4	92.556	7	9.552	3	<.05
5	101.447	4	94.209	7	7.238	3	ns
Systemic explanations							
6	118.888	4	115.9	7	2.988	3	ns
7	106.572	4	104.246	7	2.326	3	ns
8	102.058	4	100.679	7	1.379	3	ns
9	112.828	4	109.541	7	3.287	3	ns
10	101.623	4	101.28	7	0.343	3	ns
11	110.407	4	107.903	7	2.504	3	ns

Ripple Scenario

We binned participants' scores on the Ripple Impact Accuracy subscale into quartiles, and the Ripple Responsible subscales into thirds, and followed the procedures outlined above. For the Impact Accuracy subscale, we found that two items (6 and 8) had one significant interaction term each (Table S5). When looking at model fit (Table S6), items 3 and 4 showed better fit when the interaction terms were included. Once again, we see mixed, weak evidence for differential functioning, leading us to conclude that the items largely function equivalently in both cultures.

Table S5. Ripple Impact Accuracy subscale tests of Country x Impact Accuracy parameter estimates for significance

ITEM	Parameter 1	Parameter 2	Parameter 3	p	p	p
1	-1.055	-0.835	-0.001	0.389	.	1
2	1.903	1.065	0.739	0.221	0.182	0.386
3	1.957	0.128	-0.708	0.09	0.82	0.252
4	1.074	0.839	-0.873	0.347	0.18	0.194
5	-1.702	-0.635	-2.463	0.336	0.495	0.076
6	29.787	15.283	-1.244	<.001	.	1
7	0.967	-0.246	1.218	0.659	0.835	0.309
8	1.034	1.007	1.662	0.377	0.136	0.032
9	0.938	-0.176	0.509	0.528	0.794	0.479
10	1.242	0.43	-0.206	0.31	0.53	0.777
11	1.472	0.235	0.393	0.371	0.768	0.651
12	-0.25	-0.262	0.143	0.839	0.692	0.848
13	-1.433	-1.059	-0.204	0.418	0.27	0.865

Table S6. Comparison of model fit without (Model 1) and with (Model 2) the Country x Impact Accuracy interaction terms

	Model 1 (main effects only)		Model 2 (main effects + interaction)		Chi Square	df	p
ITEM	-2 Log Likelihood	df	-2 Log Likelihood	df			
Impact Accuracy							
1	14.222	4	13.952	7	0.27	3	ns
2	34.288	4	32.351	7	1.937	3	ns
3	45.189	4	33.323	7	11.866	3	<.05

4	43.068	4	34.154	7	8.914	3	<.05
5	33.734	4	29.268	7	4.466	3	ns
6	25.171	4	21.773	7	3.398	3	ns
7	36.944	4	30.983	7	5.961	3	ns
8	37.694	4	31.097	7	6.597	3	ns
9	33.7	4	30.891	7	2.809	3	ns
10	33.09	4	31.176	7	1.914	3	ns
11	29.388	4	28.171	7	1.217	3	ns
12	34.344	4	33.804	7	0.54	3	ns
13	31.389	4	29.461	7	1.928	3	ns

The Responsibility subscales showed a similar pattern. Only one interaction parameter was statistically significant (Item 6, of the ambiguous elements subscale, Table S7). Item 5 of the ambiguous elements subscale showed better model fit when the interaction term was included. As above this is weak, mixed evidence that the ambiguous subscale may function differently in the two cultures.

Table S7. Ripple Responsibility subscales tests of Country x subscale parameter estimates for significance

ITEM	Parameter 1	p
Ratings of Responsible Elements		
1	-0.702	0.164
2	0.354	0.468
Ratings of Non-responsible Elements		
3	-0.689	0.321
4	-0.221	0.761
7	1.022	0.157
Ratings of Ambiguous Elements		
5	-0.647	0.112
6	1.287	0.02

Table S8. Comparison of model fit without (Model 1) and with (Model 2) the Country x Responsibility Subscale interaction terms

	Model 1 (main effects only)		Model 2 (main effects + interaction)		Chi Square	df	p
ITEM	-2 Log Likelihood	df	-2 Log Likelihood	df			
Ratings of Responsible Elements							
1	46.058	3	43.871	5	2.187	2	ns
2	55.185	3	54.51	5	0.675	2	ns
Ratings of Non-responsible Elements							
3	42.906	2	41.776	3	1.13	1	ns
4	60.577	2	60.464	3	0.113	1	ns
7	45.561	2	43.332	3	2.229	1	ns
Ratings of Ambiguous Elements							
5	35.015	3	26.536	5	8.479	2	p < .05
6	29.863	3	28.076	5	1.787	2	ns

Summary

There is weak and inconsistent evidence of differential functioning for a small number of items across all scales and subscales. On the whole, we view these results as generally supportive that these measures function in similar ways into the two different cultures.