

Supplementary material

Public participation in designing the recycling bins to encourage recycling

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S1. Recycling bins in Greece

This section provides photo documentation of different recycling bins for paper (Figure S1) and multiple recycling bins (Figure S2).



Figure S1 Paper recycling bins in Greece [1-4].



Figure S2 Recycling bins at recycling stations in Greek cities



Figure S2 (cont) Recycling bins at recycling stations in Greek cities [5-11].

S2. Findings of the exploratory stage of the research

Figure S3 presents the colour palette used for eliciting the bin colour preference of the respondents.

	1	2	3	4	5	6	7	8
A								
B								
C								
D								
E								

Figure S3 The Microsoft colour palette used in this study.

Figure S4 presents the participants' preferences for the design details and properties of recycling bins, and Figures S5 to S13 illustrate their preferences for the bin's shape, drop slot, and colour per each recycling material.

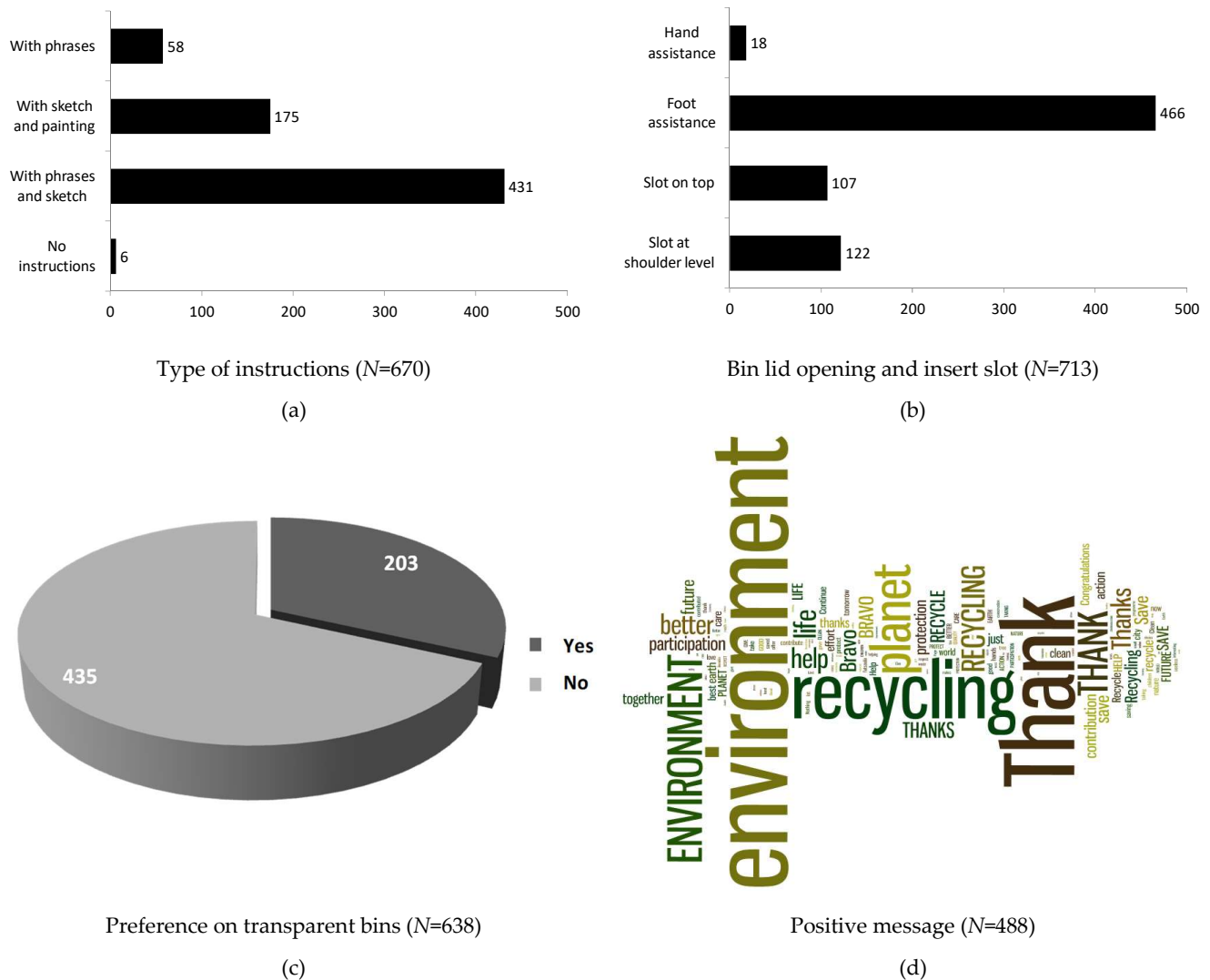


Figure S4 Preference for recycling bins' construction and design properties.

The majority of participants (56.68%) selected the rectangular shape for the paper recycling bin (#1 and #5, 38.04% in vertical and 18.64% in horizontal position, respectively), 60.37% a rectangular (#2 and #5) drop slot (Figure S5a) and white or grey hues, obviously connecting the colour of the material with the recycling bin's colour (Figure S5b).

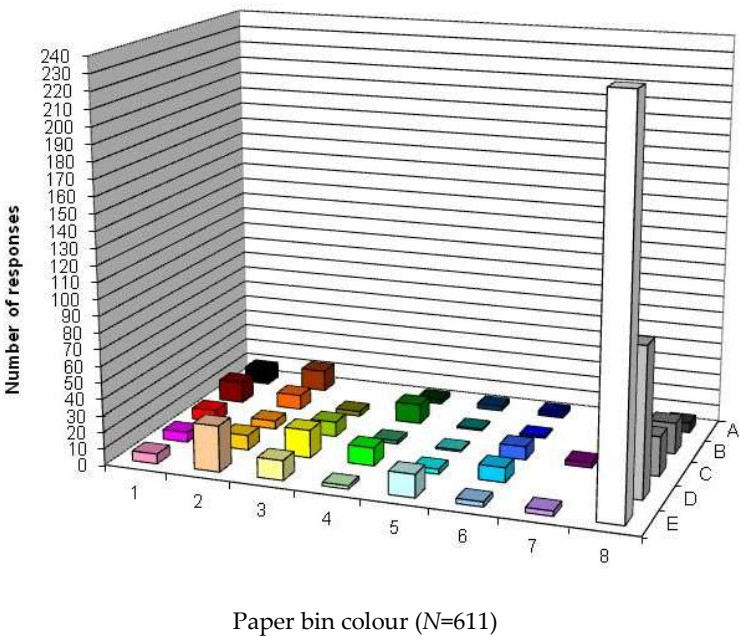
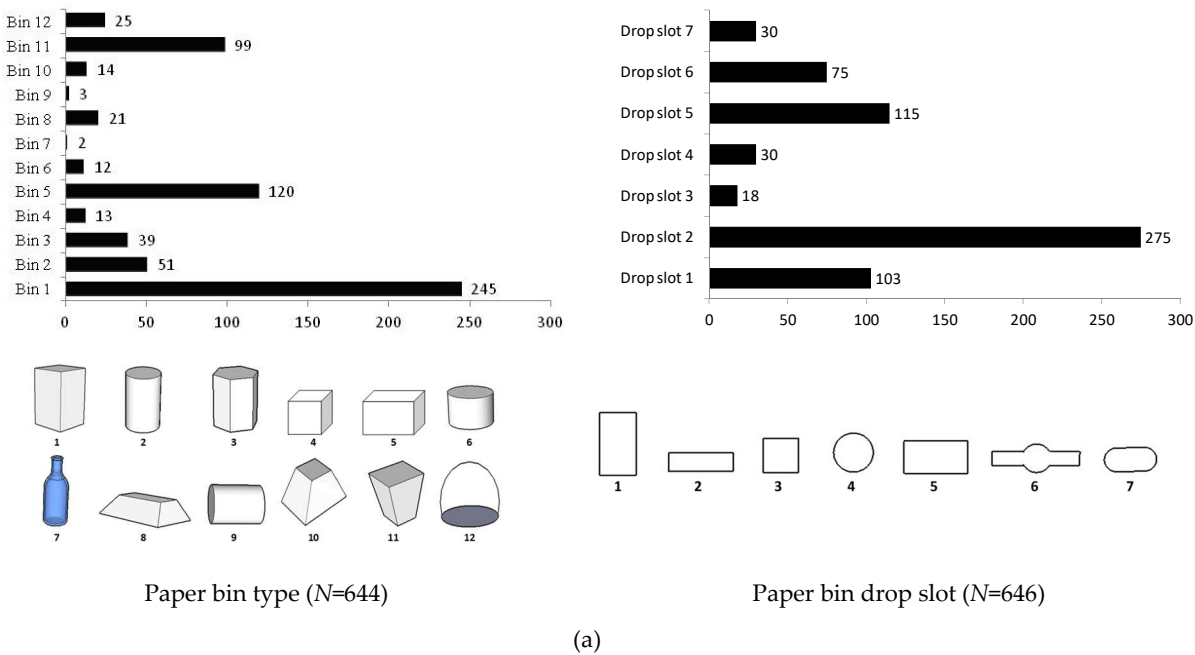
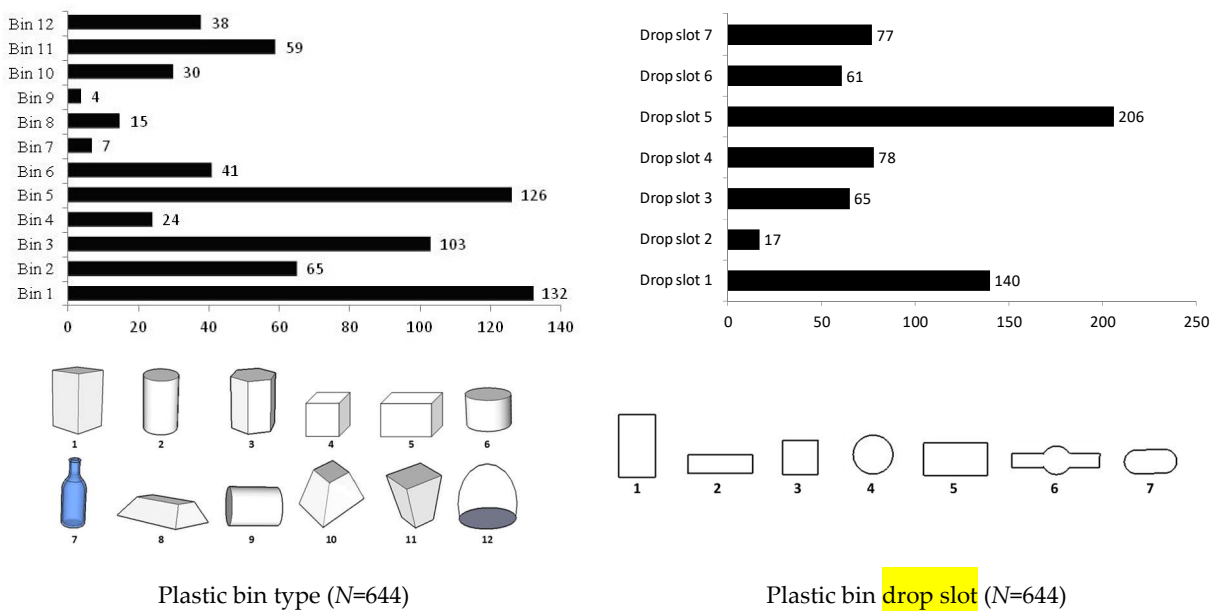
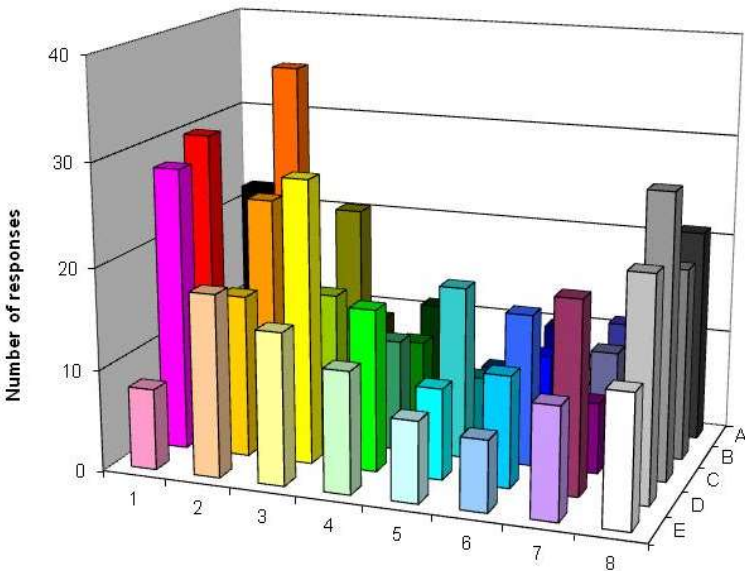


Figure S5 Paper recycling bin preferences.

40.06% of the participants would prefer the rectangular shape for the recycling bin of plastic materials (#1 and #5, 20.50% in vertical and 19.56% in horizontal position, respectively) and 19.57% the one in prismatic shape (#3). 53.73% selected the rectangular drop slot (#5 and #3, 31.99% in horizontal and 21.74% in vertical position, respectively) (Figure S6a). Various hues of orange, yellow and purple were the dominant colours (Figure S6b).



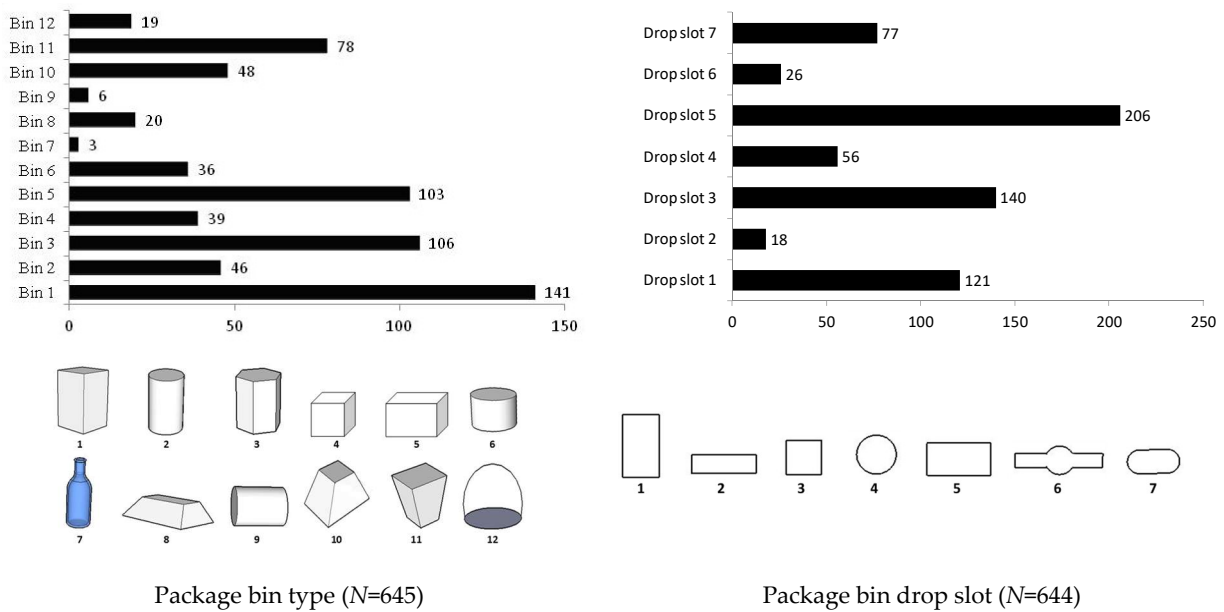
(a)



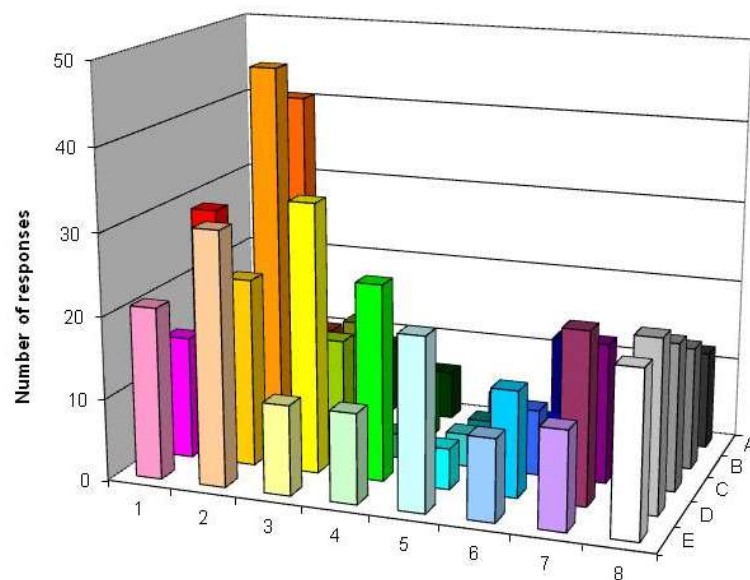
(b)

Figure S6 Plastic recycling bin preferences.

37.83% of the participants selected the rectangular shape (#1 and #5, 21.86% in vertical and 15.97% in horizontal position, respectively) and 16.43% the prismatic bin (#3) for recycling packages. 31.99% selected the rectangular drop slot (#5) and 21.74% a square one (#3) (Figure S7a). Various hues of orange and yellow were the dominant colours (Figure S7b).



(a)



Package bin colour (N=607)

(b)

Figure S7 Package recycling bin preferences.

31.84% of the respondents selected the cylindrical shape (#2) for the recycling bin of aluminium cans and 18.70% the prismatic shape (#3) while the majority 59.63% selected the round drop slot (#4) (Figure S8a). The dominant colours were hues of grey and orange (Figure S8b).

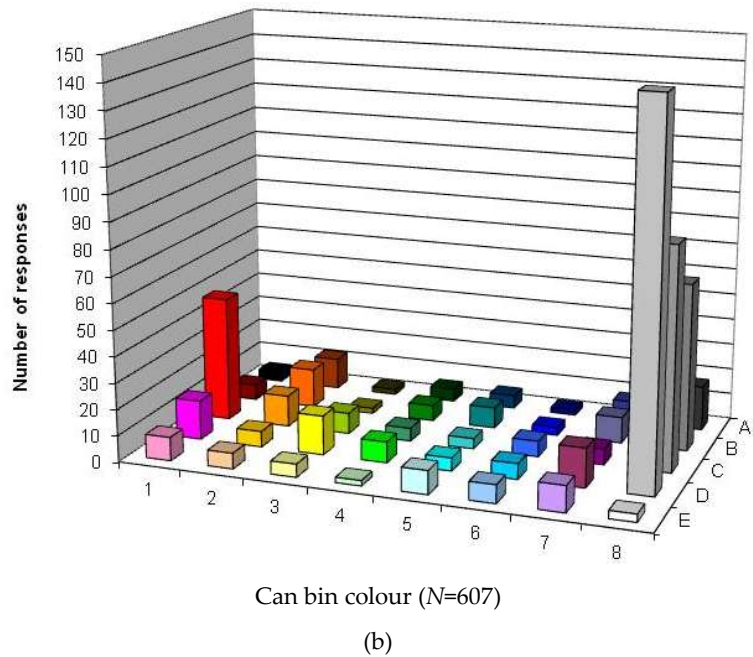
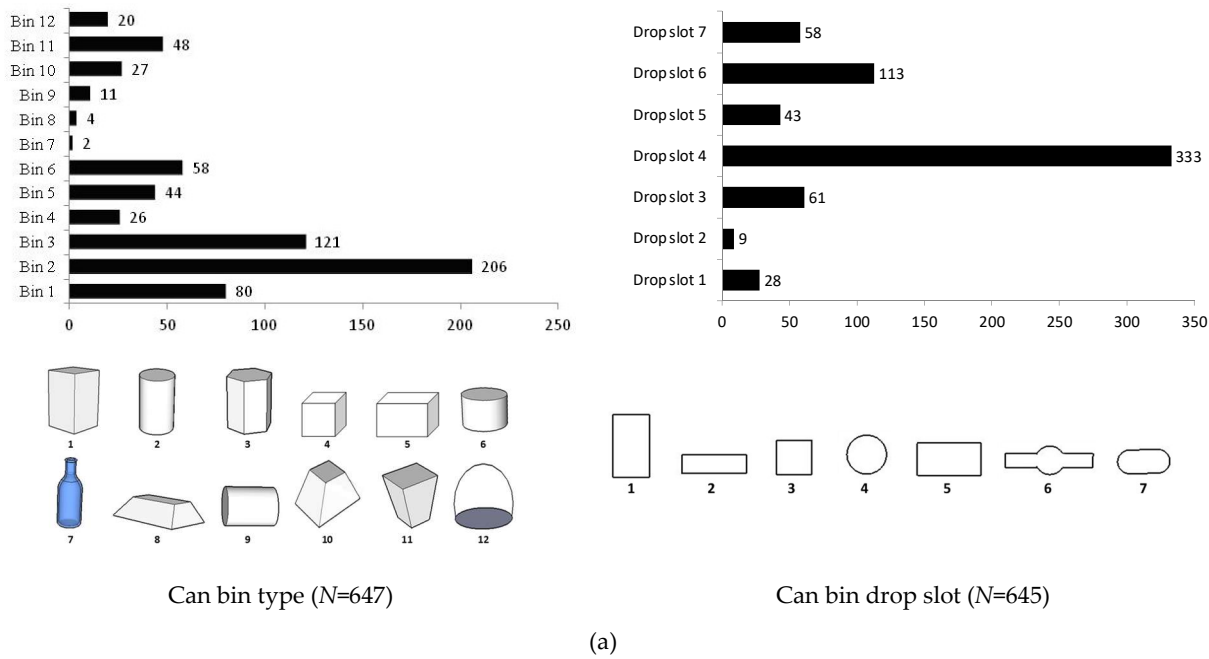
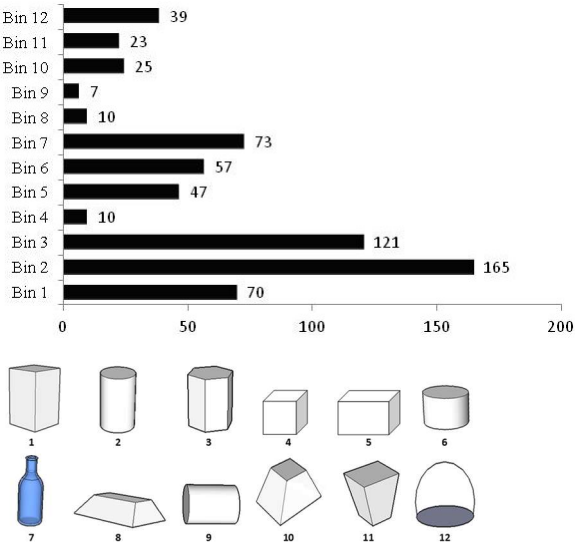
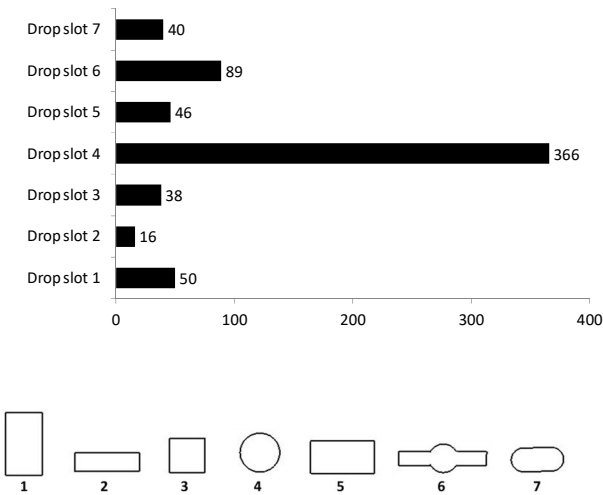


Figure S8 Aluminium, can recycling bin preferences.

25.50% of the respondents selected the cylindrical shape (#2) for the glass recycling bin, another 18.70% the prismatic shape (#3) while 11.28% the bottle-like (#7) and 10.82% the rectangular shape bin (#1). The majority (56.74%) selected the circular shape drop slot (#4) (Figure S9a). The dominant colours were hues of grey and light blue for mixed glass, white, light blue and grey for clear glass, brown hues for brown glass and hues of blue green for blue green glass (Figure S9b).

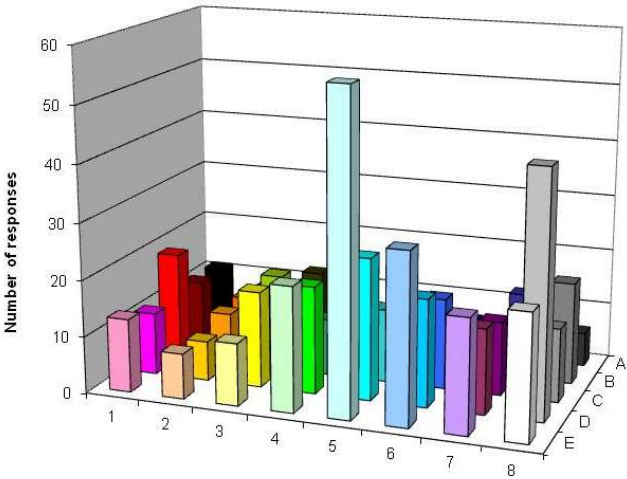


Glass bin type (N=647)

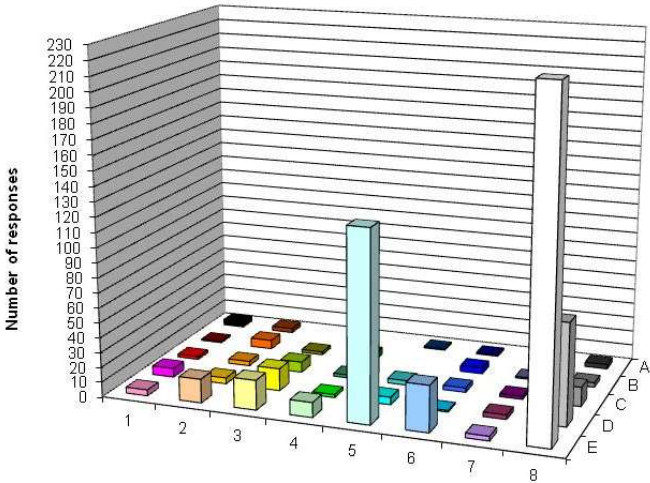


Glass bin drop slot (N=645)

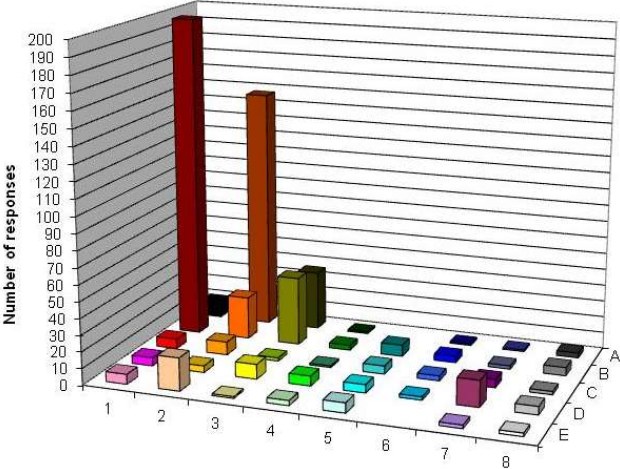
(a)



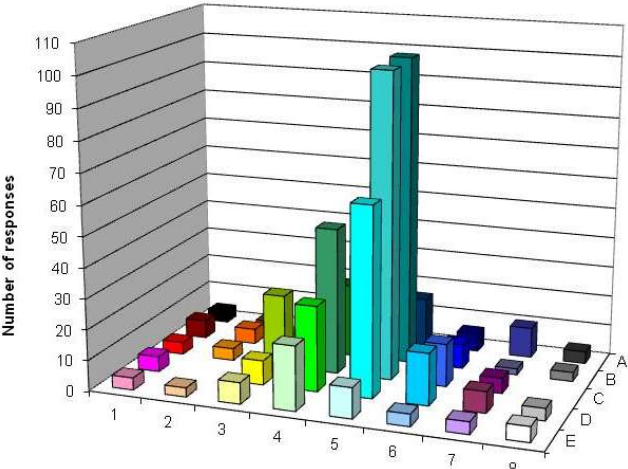
Mixed glass bin colour (N=607)



Clear glass bin colour (N=609)



Brown glass bin colour (N=609)

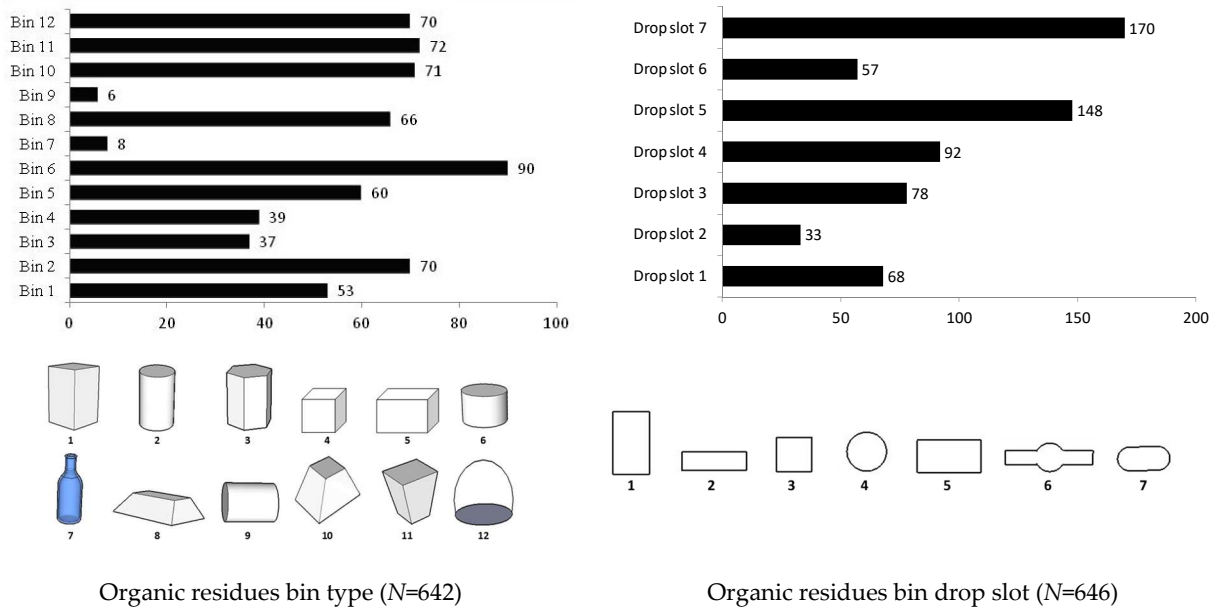


Blue, green glass bin colour (N=607)

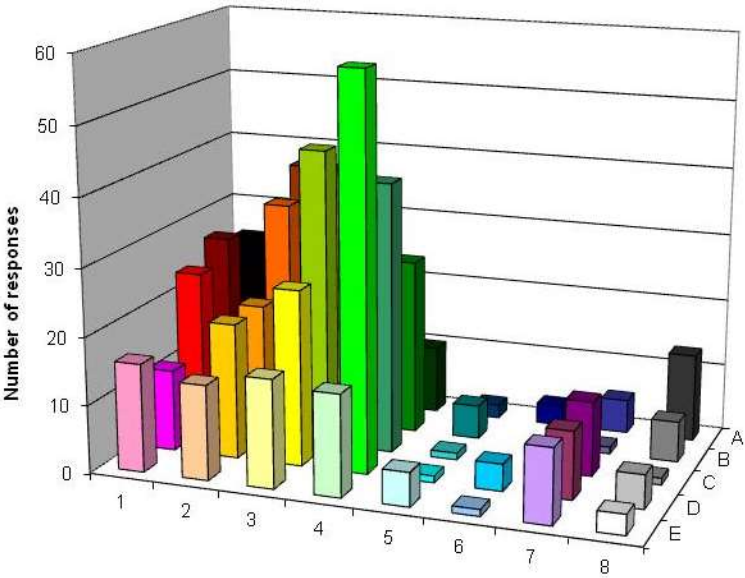
(b)

Figure S9 Glass recycling bins preferences.

It is not clear what type of bin the participants would prefer so as to recycle compostables. Thus, 14.02% selected the cylindrical bin with width greater than its height (#6) and 10.90% the cylindrical bin with height greater than its width (#2), 11.21% the inverted truncated square pyramid (#11), 11.06% the truncated square pyramid (#10) and 10.90% the bell shaped bin (#12). 26.32% selected the ellipsoid (#7), 22.91% the rectangular (#5) and 14.24% the cyclical drop slot (#4) (Figure S10a). The dominant colours were hues of green and brown (Figure S10b).



(a)



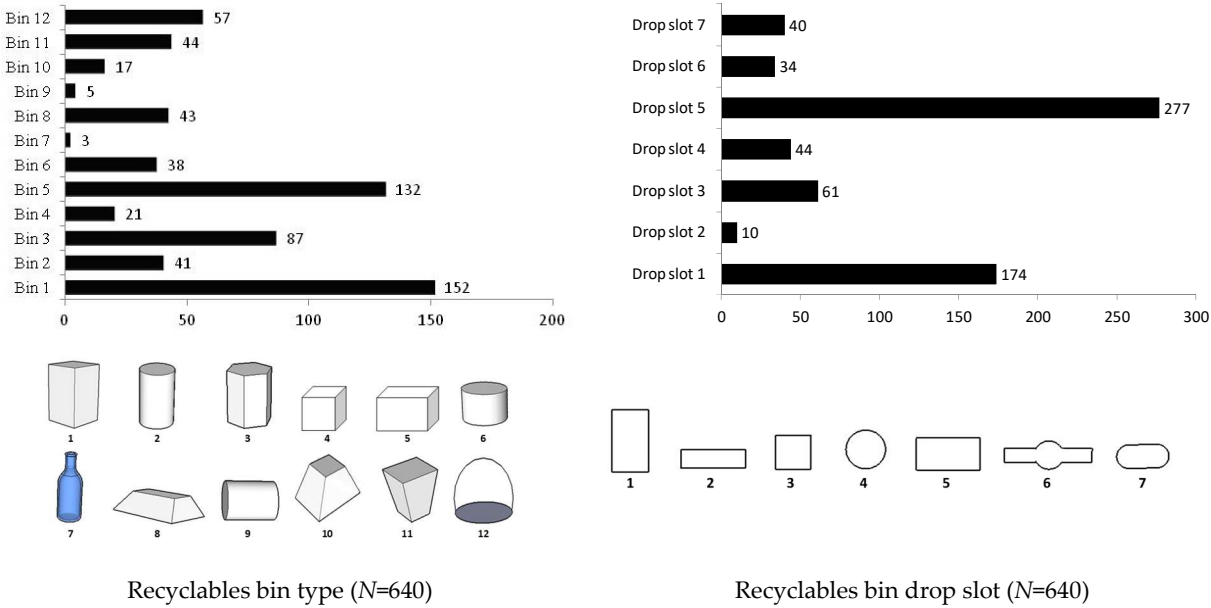
Organic residues bin colour (N=607)

(b)

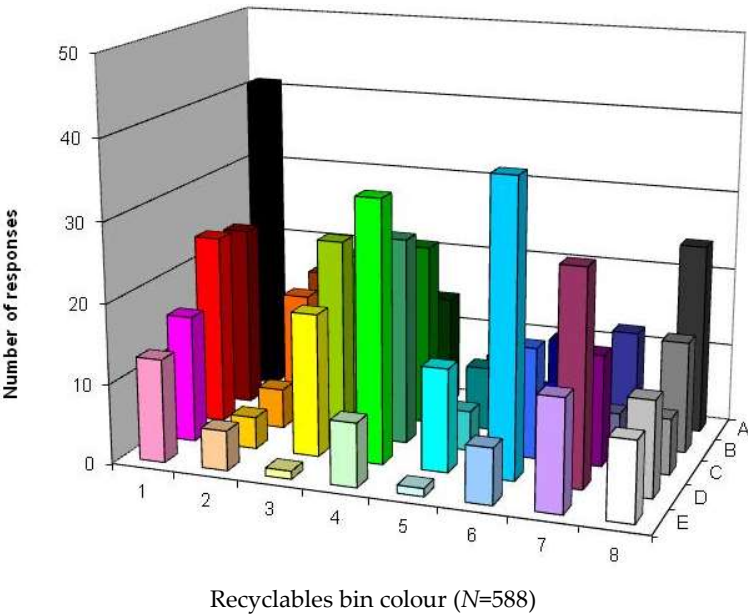
Figure S10 Organics recycling bin preferences.

44.38% of the respondents selected the rectangular bin (#1 and #5, 23.75% in vertical and 20.63% in horizontal position, respectively) and 13.59% the bin in prismatic shape (#3) for comingled recyclables. 70.47% selected the rectangular drop slot (#5 and #1, 43.28% in horizontal

and 27.19% in vertical position, respectively) (Figure S11a). The dominant colours were various hues of blue and green but also purple and black (Figure S11b).



(a)



(b)

Figure S11 Comingle recyclables bin preferences.

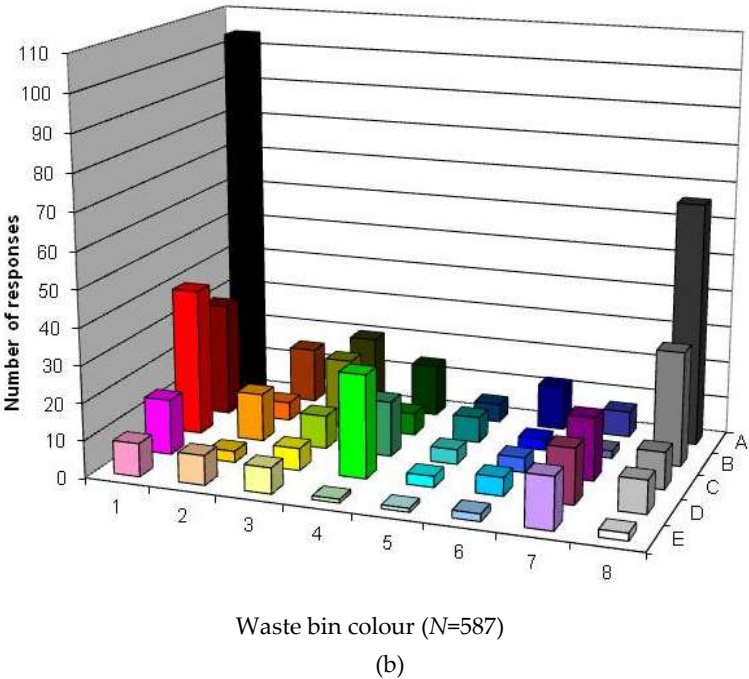
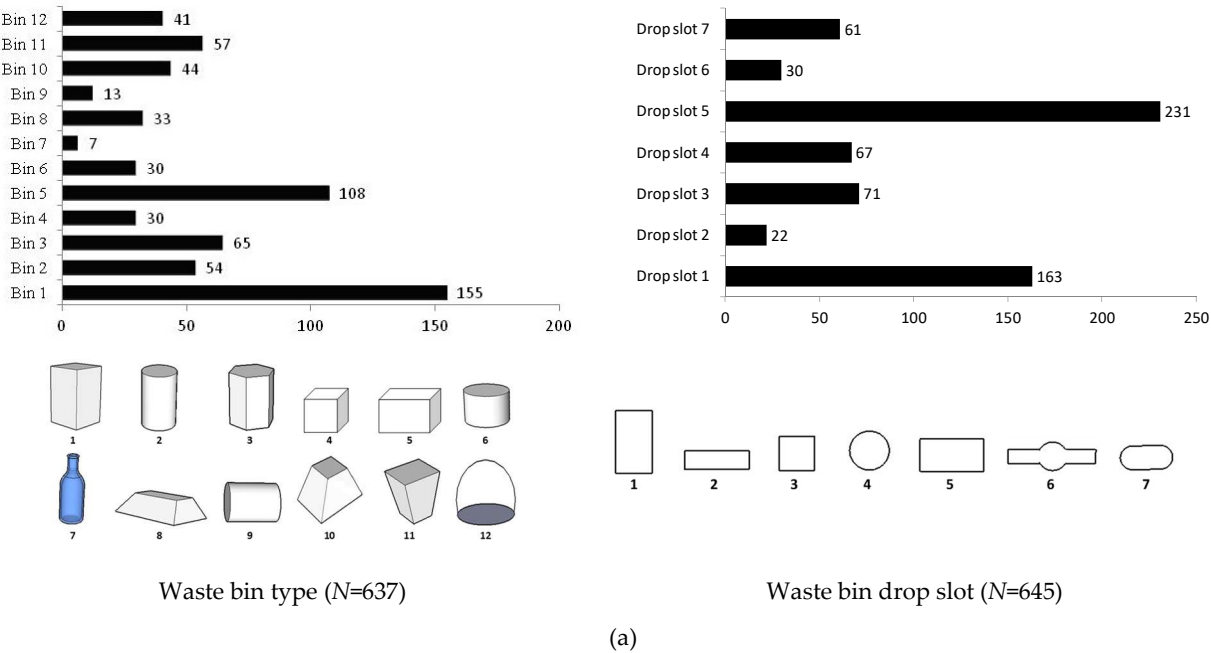


Figure S12 Waste bin preferences.

The majority selected the rectangular multi-bin (#1) (53.29%) and 31.03% the cylindrical multi-bin (#2) (Figure S13).

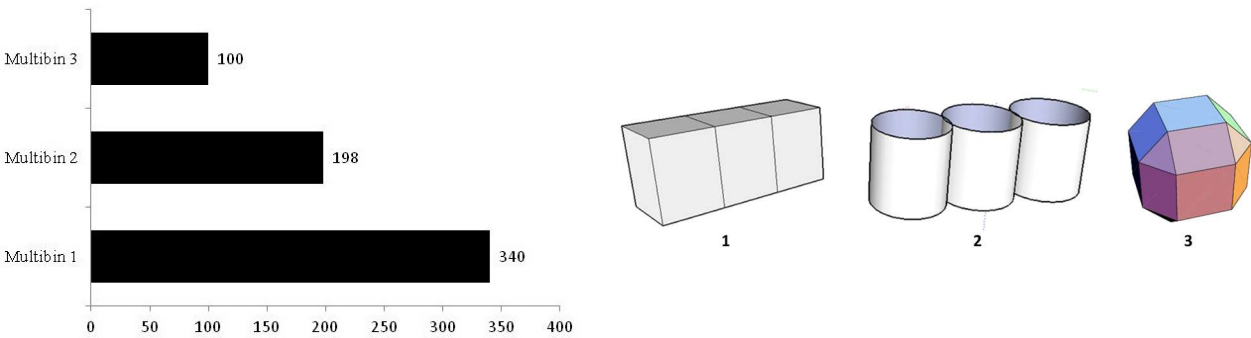


Figure S13 Multi-bin type preferences (N=638).

S3. The bins designed according to the exploratory stage findings

The six-bin card per material designed with the findings of the exploratory stage are presented in this section of the supplementary material (Figures S14-S22).

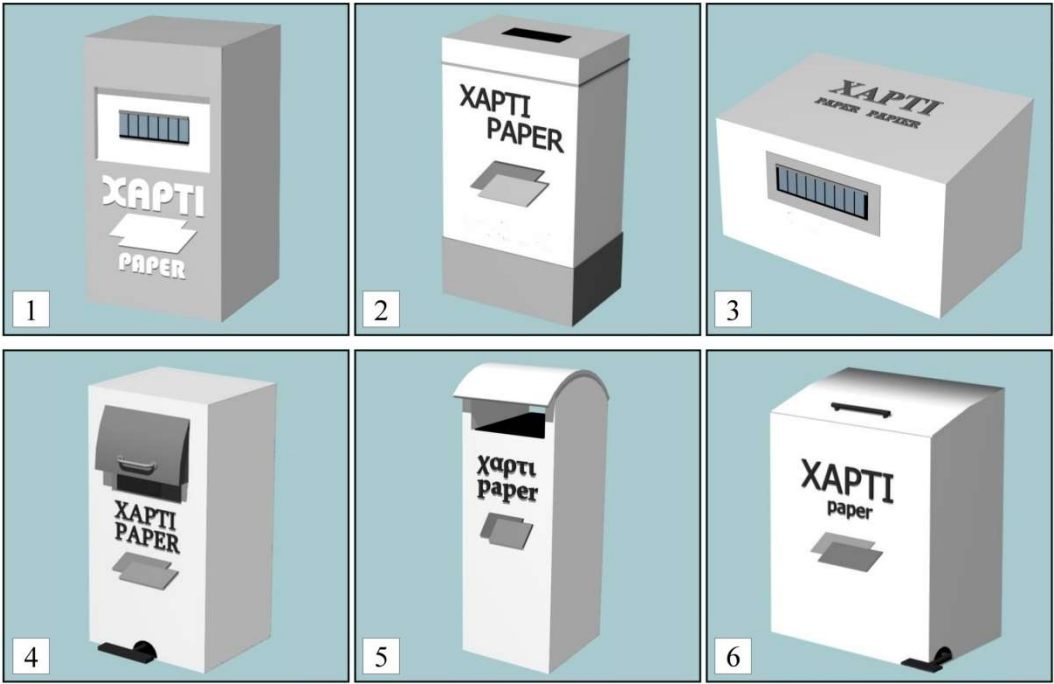


Figure S14 Six paper recycling bins designed from the findings of the exploratory stage.



Figure S15 Six plastic recycling bins designed from the findings of the exploratory stage.

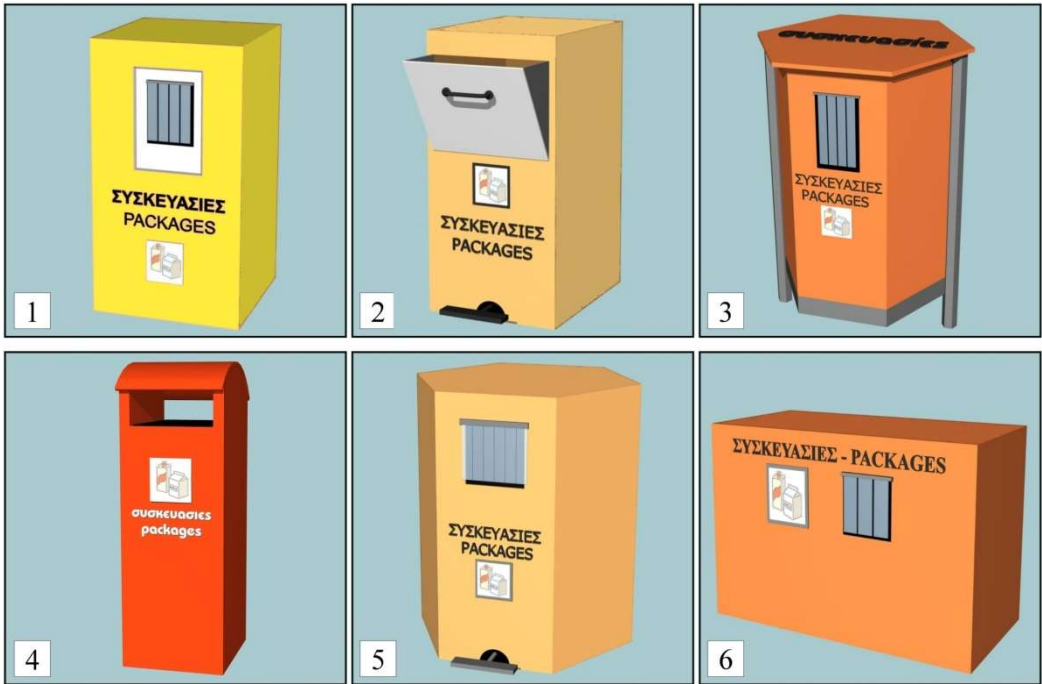


Figure S16 Six package recycling bins designed from the findings of the exploratory stage.



Figure S17 Six aluminium can recycling bins designed from the findings of the exploratory stage.

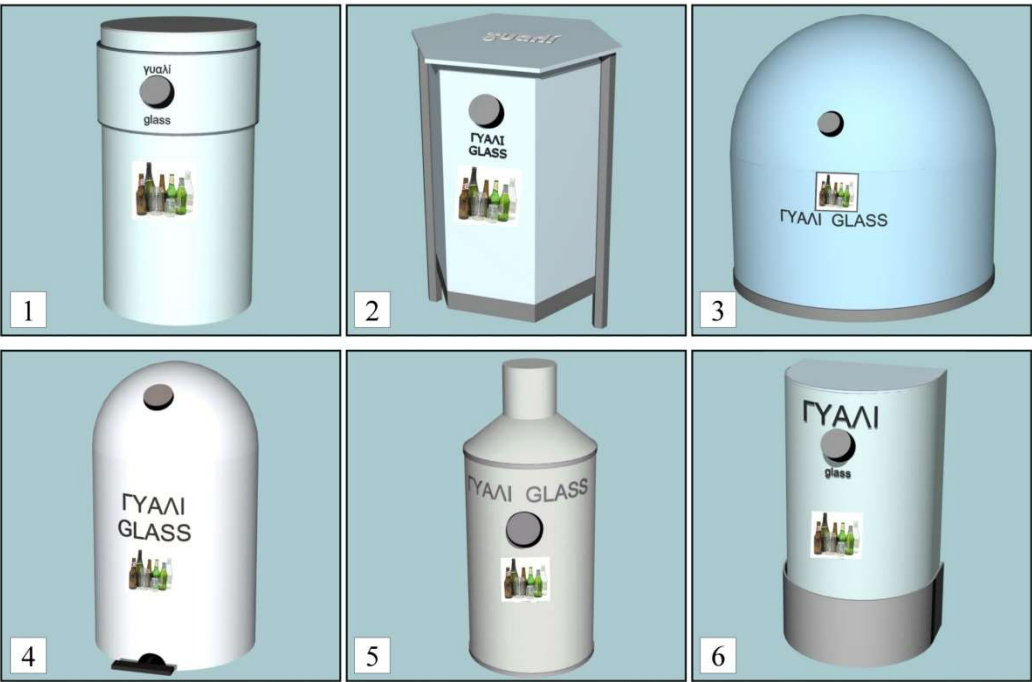


Figure S18a Six mixed glass recycling bins designed from the findings of the exploratory stage.

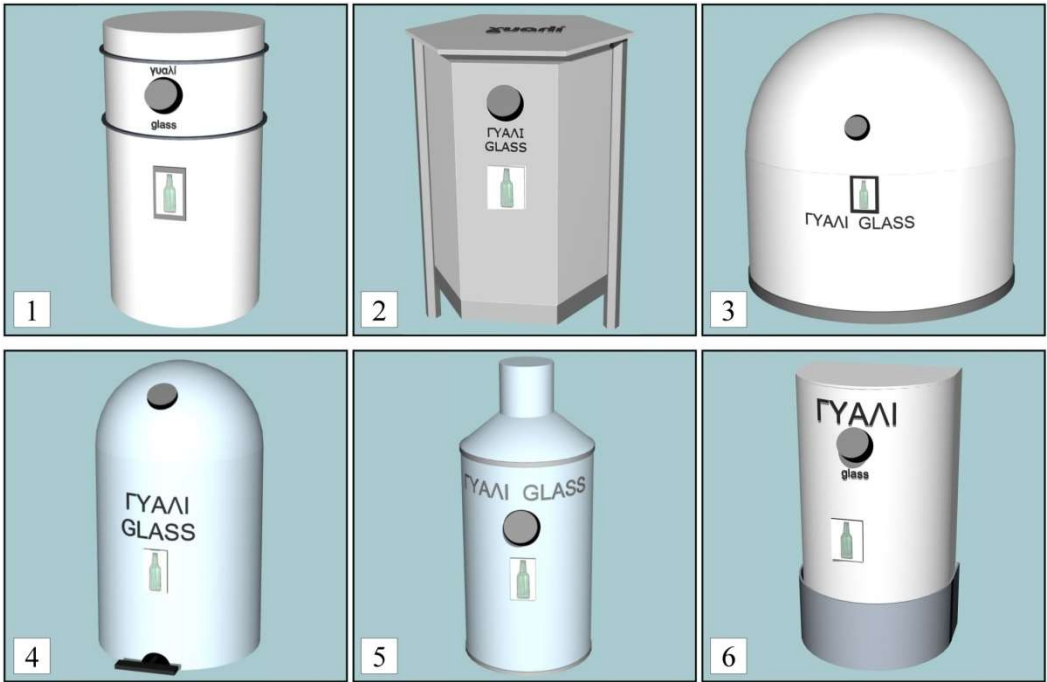


Figure S18b Six clear glass recycling bins designed from the findings of the exploratory stage.



Figure S18c Six brown glass recycling bins designed from the findings of the exploratory stage.



Figure S18d Six blue, green glass recycling bins designed from the findings of the exploratory stage.

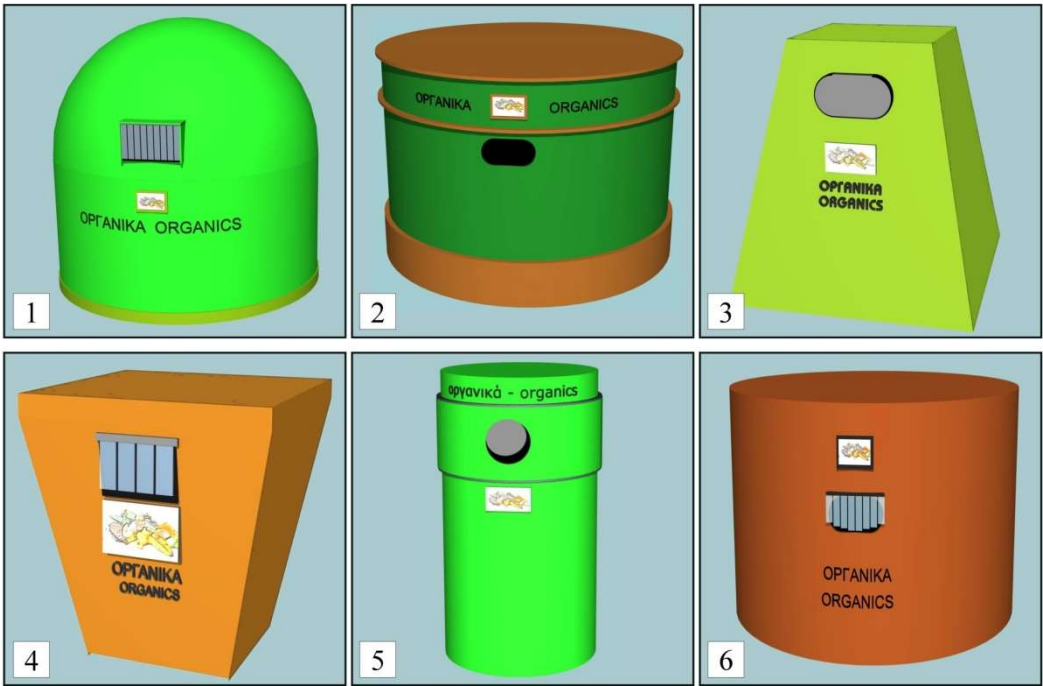


Figure S19 Six organics recycling bins designed from the findings of the exploratory stage.



Figure S20 Six recyclables bins designed from the findings of the exploratory stage.



Figure S21 Six waste bins designed from the findings of the exploratory stage.

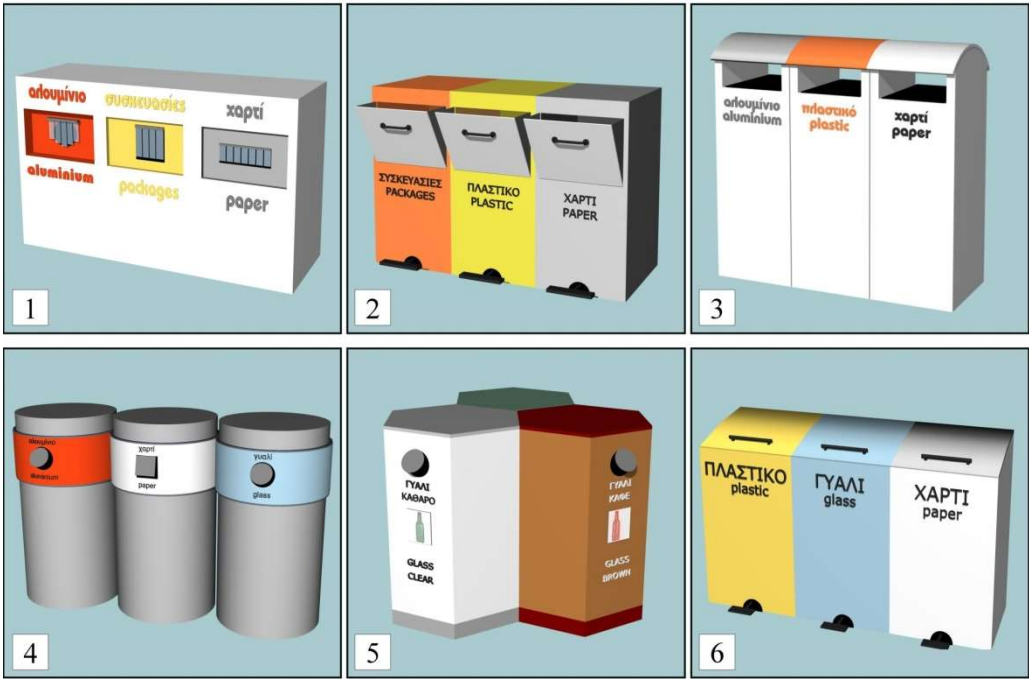


Figure S22 Six multi-bins designed from the findings of the exploratory stage.

S4. Findings of the validation stage of the research

This section presents the primary results and analysis of the validation stage of the research. Each set of the six bins received a score ranging from one to six. Table S1 gives the scores of each paper recycling bin numbered in Figure 3 of the paper. The paper recycling bins 5 and 4 received a total score of 1754 points [(55x1) + (50x2) + (44x3) + (72x4) + (75x5) + (134x6)] (M=4.08) and 1697 [(41x1) + (65x2) + (52x3) + (77x4) + (108x5) + (87x6)] (M=3.95), respectively.

Table S1. Votes for each paper recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	64	80	71	70	79	66	1508
2	50	77	110	86	73	34	1447
3	147	89	67	50	38	39	1150
4	41	65	52	77	108	87	1697
5	55	50	44	72	75	134	1754
6	72	69	86	77	57	69	1475

Table S2 gives the scores of each plastic recycling bin numbered in Figure 4 of the paper. The plastic recycling bins 4 and 5 received a total score of 1740 points [(34x1) + (58x2) + (78x3) + (54x4) + (96x5) + (110x6)] (M=4.05) and 1738 [(62x1) + (53x2) + (45x3) + (49x4) + (87x5) + (134x6)] (M=4.04), respectively.

Table S2. Votes for each plastic recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	69	76	68	90	69	58	1478
2	71	99	92	78	52	38	1345
3	131	86	75	68	41	29	1179
4	34	58	78	54	96	110	1740
5	62	53	45	49	87	134	1738
6	62	57	72	92	86	61	1556

Table S3 gives the scores of each package recycling bin numbered in Figure 5 of the paper. The package recycling bin 2 received a total score of 1756 points $[(36 \times 1) + (51 \times 2) + (72 \times 3) + (61 \times 4) + (102 \times 5) + (108 \times 6)]$ ($M=4.08$).

Table S3. Votes for each package recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	75	83	86	74	65	47	1402
2	36	51	72	61	102	108	1756
3	43	77	96	88	82	44	1511
4	67	74	62	72	76	79	1543
5	57	68	63	80	63	99	1611
6	152	77	50	55	43	53	1209

Table S4 gives the scores of each aluminum-can recycling bin numbered in Figure 6 of the paper. The aluminium recycling bins 5, 6 and 4 received a total score of 1596 points $[(68 \times 1) + (52 \times 2) + (69 \times 3) + (82 \times 4) + (65 \times 5) + (94 \times 6)]$ ($M=3.71$), 1587 $[(63 \times 1) + (65 \times 2) + (58 \times 3) + (70 \times 4) + (104 \times 5) + (70 \times 6)]$ ($M=3.69$) and 1583 $[(56 \times 1) + (70 \times 2) + (75 \times 3) + (72 \times 4) + (68 \times 5) + (89 \times 6)]$ ($M=3.68$), respectively.

Table S4. Votes for each aluminium recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	88	73	65	59	67	78	1468
2	76	98	72	71	64	49	1386
3	79	72	92	77	61	49	1406
4	56	70	75	72	68	89	1583
5	68	52	69	82	65	94	1596
6	63	65	58	70	104	70	1587

Table S5 gives the scores of each mixed glass recycling bin numbered in Figure 7a of the paper. The mixed glass recycling bins 3, 4 and 1 received a total score of 1652 points $[(64 \times 1) + (61 \times 2) + (63 \times 3) + (59 \times 4) + (57 \times 5) + (126 \times 6)]$ ($M=3.84$), 1631 $[(39 \times 1) + (70 \times 2) + (70 \times 3) + (81 \times 4) + (102 \times 5) + (68 \times 6)]$ ($M=3.79$) and 1561 $[(62 \times 1) + (60 \times 2) + (89 \times 3) + (67 \times 4) + (68 \times 5) + (84 \times 6)]$ ($M=3.63$), respectively.

Table S5. Votes for each mixed glass recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	62	60	89	67	68	84	1561
2	77	80	70	78	61	64	1448
3	64	61	63	59	57	126	1652
4	39	70	70	81	102	68	1631
5	118	76	55	71	55	55	1324
6	71	82	83	75	86	33	1412

Table S6 gives the scores of each clear glass recycling bin numbered in Figure 7b of the paper. The clear glass recycling bins 4, 3 and 1 received a total score of 1641 points $[(40 \times 1) + (62 \times 2) + (67 \times 3) + (98 \times 4) + (94 \times 5) + (69 \times 6)]$ ($M=3.82$), 1622 $[(66 \times 1) + (67 \times 2) + (58 \times 3) + (56 \times 4) + (74 \times 5) + (109 \times 6)]$ ($M=3.77$) and 1571 $[(53 \times 1) + (62 \times 2) + (95 \times 3) + (68 \times 4) + (75 \times 5) + (77 \times 6)]$ ($M=3.65$), respectively.

Table S6. Votes for each clear glass recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	53	62	95	68	75	77	1571
2	81	73	65	75	59	77	1479
3	66	67	58	56	74	109	1622
4	40	62	67	98	94	69	1641
5	128	79	54	59	53	57	1291
6	61	86	91	77	74	41	1430

Table S7 gives the scores of each brown glass recycling bin numbered in Figure 7c of the paper. The brown glass recycling bins 3, 4 and 2 received a total score of 1621 points $[(61 \times 1) + (60 \times 2) + (66 \times 3) + (72 \times 4) + (72 \times 5) + (99 \times 6)]$ ($M=3.77$), 1581 $[(42 \times 1) + (78 \times 2) + (78 \times 3) + (82 \times 4) + (79 \times 5) + (71 \times 6)]$ ($M=3.68$) and 1541 $[(70 \times 1) + (72 \times 2) + (61 \times 3) + (79 \times 4) + (60 \times 5) + (88 \times 6)]$ ($M=3.58$), respectively.

Table S7. Votes for each brown glass recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	70	60	83	73	83	61	1512
2	70	72	61	79	60	88	1541
3	61	60	66	72	72	99	1621
4	42	78	78	82	79	71	1581
5	123	81	64	54	58	50	1283
6	65	79	77	70	79	60	1489

Table S8 gives the scores of each green glass recycling bin numbered in Figure 7d of the paper. The green glass recycling bins 4, 1 and 3 received a total score of 1596 points $[(51 \times 1) + (58 \times 2) + (84 \times 3) + (84 \times 4) + (77 \times 5) + (76 \times 6)]$ ($M=3.71$), 1568 $[(51 \times 1) + (59 \times 2) + (95 \times 3) + (77 \times 4) + (82 \times 5) + (66 \times 6)]$ ($M=3.65$) and 1563 $[(68 \times 1) + (67 \times 2) + (70 \times 3) + (70 \times 4) + (59 \times 5) + (96 \times 6)]$ ($M=3.63$), respectively.

Table S8. Votes for each green glass recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	51	59	95	77	82	66	1568
2	69	80	58	67	72	84	1535
3	68	67	70	70	59	96	1563
4	51	58	84	84	77	76	1596
5	116	91	54	55	57	57	1307
6	75	77	66	79	81	52	1460

Table S9 gives the scores of each organics recycling bin numbered in Figure 8 of the paper. The compostables bins 2, 3, 1 and 4 received a total score of 1629 points $[(60 \times 1) + (55 \times 2) + (73 \times 3) + (70 \times 4) + (72 \times 5) + (100 \times 6)]$ ($M=3.79$), 1531 $[(66 \times 1) + (77 \times 2) + (66 \times 3) + (67 \times 4) + (79 \times 5) + (75 \times 6)]$ ($M=3.56$), 1506 $[(76 \times 1) + (57 \times 2) + (85 \times 3) + (72 \times 4) + (67 \times 5) + (73 \times 6)]$ ($M=3.50$) and 1503 $[(71 \times 1) + (80 \times 2) + (58 \times 3) + (79 \times 4) + (70 \times 5) + (72 \times 6)]$ ($M=3.50$), respectively.

Table S9. Votes for each organics recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	76	57	85	72	67	73	1506
2	60	55	73	70	72	100	1629
3	66	77	66	67	79	75	1531
4	71	80	58	79	70	72	1503
5	96	79	71	67	55	62	1382
6	61	83	76	76	86	48	1477

Table S10 gives the scores of each recycling bin numbered in Figure 9 of the paper. The comingled recyclables bins 5 and 2 received a total score of 1678 points $[(56 \times 1) + (58 \times 2) + (54 \times 3) + (72 \times 4) + (84 \times 5) + (106 \times 6)]$ ($M=3.90$) and 1642 $[(42 \times 1) + (72 \times 2) + (72 \times 3) + (72 \times 4) + (80 \times 5) + (92 \times 6)]$ ($M=3.82$), respectively.

Table S10. Votes for each comingled recycling bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	56	83	82	75	74	60	1498
2	42	72	72	72	80	92	1642
3	78	60	84	70	69	69	1489
4	92	97	74	64	58	45	1324
5	56	58	54	72	84	106	1678
6	106	59	63	78	66	58	1403

Table S11 gives the scores of each waste bin numbered in Figure 10 of the paper. The waste bins 5 and 4 received a total score of 1665 points $[(48 \times 1) + (82 \times 2) + (48 \times 3) + (58 \times 4) + (87 \times 5) + (107 \times 6)]$ ($M=3.87$) and 1641 $[(51 \times 1) + (76 \times 2) + (60 \times 3) + (53 \times 4) + (94 \times 5) + (96 \times 6)]$ ($M=3.82$), respectively.

Table S11. Votes for each waste bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	59	67	72	94	80	58	1533
2	72	89	99	88	52	30	1339
3	100	72	73	67	51	67	1388
4	51	76	60	53	94	96	1641
5	48	82	48	58	87	107	1665
6	100	45	77	71	65	72	1462

Table S12 gives the scores of each multi-bin numbered in Figure 11 of the paper. The multi-bins 2, 5 and 6 received a total score of 1641 points $[(38 \times 1) + (73 \times 2) + (72 \times 3) + (80 \times 4) + (81 \times 5) + (86 \times 6)]$ ($M=3.82$), 1621 $[(73 \times 1) + (53 \times 2) + (61 \times 3) + (64 \times 4) + (71 \times 5) + (108 \times 6)]$ ($M=3.77$) and 1530 $[(76 \times 1) + (51 \times 2) + (77 \times 3) + (75 \times 4) + (85 \times 5) + (66 \times 6)]$ ($M=3.56$), respectively.

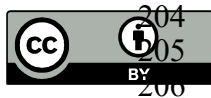
Table S12. Votes for each multi-bin.

Bin number	Score						Total
	1	2	3	4	5	6	
1	92	75	77	73	68	45	1375
2	38	73	72	80	81	86	1641
3	78	78	80	70	62	62	1436
4	73	98	64	70	62	63	1429
5	73	53	61	64	71	108	1621
6	76	51	77	75	85	66	1530

References

1. Tsiribasi, E. Recycling. http://tsirimpasieleni.Blogspot.Gr/2011_01_01_archive.Html (accessed 23.08.2017).
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