Supplementary Material

Altruistic Preferences in the Dictator Game: Replication of Andreoni and Miller (2002) in Japan

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Letters on Evolutionary Behavioral Science

More Details on Revealed Preference Theory

In the main text, we do not provide a definition of “strictly” in the generalized axiom of revealed preference (GARP). In this section, we complement the main text with further details on revealed preference theory. The apple–orange example, which is described in the main text, assumes the following: budget constraint = 1,000 JPY, $p^i = (200, 100)$, and $x^i = (4, 2)$. Under this budget constraint of 1,000 JPY and p^i, the red area in Figure S1 represents x (i.e., all purchasable combinations of apples and oranges). The red point in Figure S1 represents $x^i = (4, 2)$. For example, $x^j = (2, 4)$, shown as a gray point, is inside the red triangle (in other words, $p^i x^j = 800 < 1000 = p^i x^i$). Therefore, your choice of $x^i = (4, 2)$ implies that you preferred x^i to x^j. Note that any point inside the red triangle satisfies $p^i x \leq 1000$. Therefore, your choice of $x^i = (4, 2)$ implies that x^i (i.e., the red point) is *directly revealed preferred* to any point in the red area. Figure S1 also helps to understand the meaning of “strictly” in GARP, which is implied by $p^i x^i > p^i x$ (see the introduction section of the main text). The hypotenuse of the red triangle represents a subset of x whose total price is equal to 1000 JPY (i.e., p^i × choices on the hypotenuse = 1000). In other words, if we remove the hypotenuse choices from x (this reduced set is denoted as x^*), then $p^i x^* < 1000$. Therefore, it is obvious that $p^i x^i$ (=1000) > $p^i x^*$. This inequality implies that x^i is *strictly directly revealed preferred* to x^*.

The second choice in the apple–orange example is $x^j = (2, 4)$ under the budget constraint of 1,000 JPY and $p^j = (100, 200)$. This choice is indicated by the blue point in Figure S2. The blue triangle represents all possible combinations of the quantities of apples and oranges in this problem.

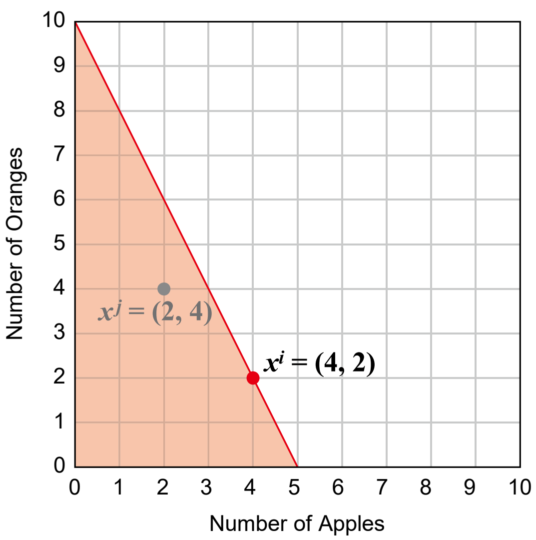

Figure S1. Graphical illustration of the first choice in the apple–orange example.

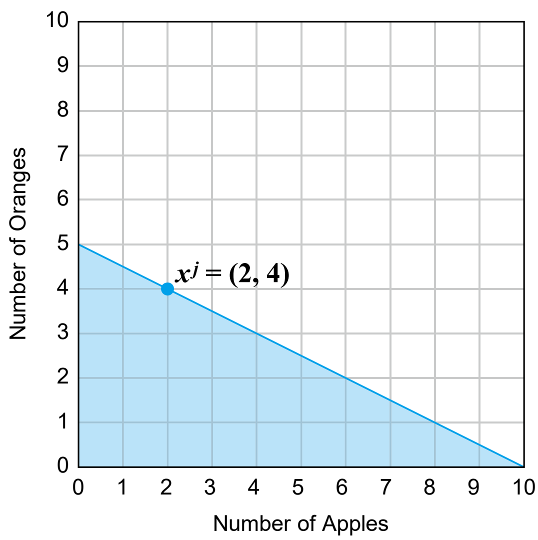

Figure S2. Graphical illustration of the second choice in the apple–orange example.

An example of mutually inconsistent choices is graphically illustrated in Figure S3. The two choices (red and blue points) are mutually inconsistent when the red point is inside the blue triangle and the blue point is inside the red triangle. Intuitively, the inconsistency is easy to understand, as this person purchases more apples when they are more expensive than oranges (i.e., p^i) and more oranges when they are more expensive than apples (i.e., p^j). Figure S4 illustrates two choices that are not mutually inconsistent. Because the blue point is outside the red triangle, the first choice does *not* imply that x^i is directly revealed preferred to x^j; and because the red point is outside the blue triangle, the second choice does *not* imply that x^j is directly revealed preferred to x^i. Intuitively, these two choices can be rationalized by assuming that the person likes apples and oranges equally, and tries to mix these two fruits and increase their total number.

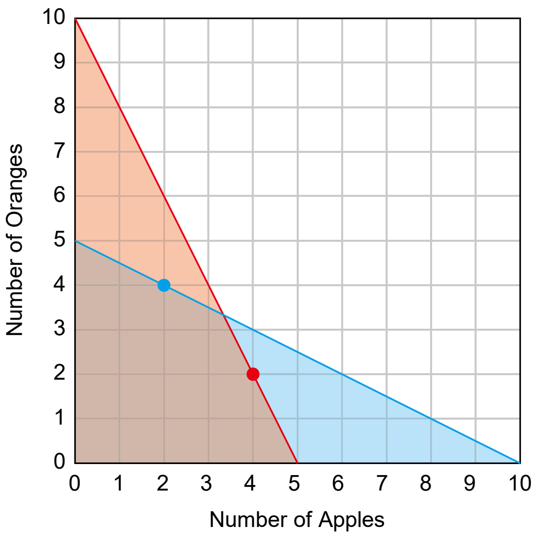

Figure S3. An example of mutually inconsistent choices.

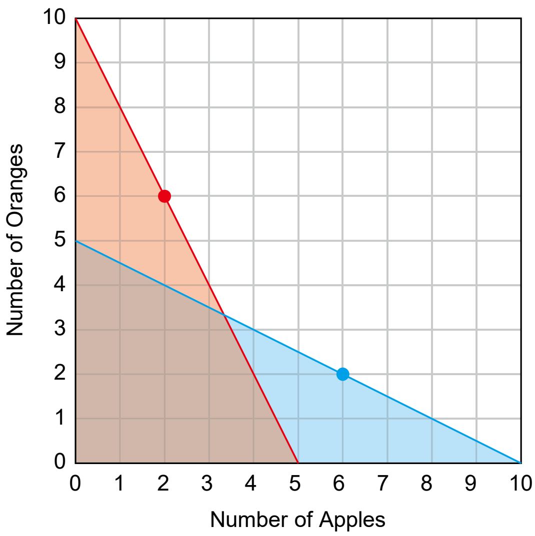

Figure S4. An example of two choices that are not mutually inconsistent.

Critical Cost Efficiency Index

The Critical Cost Efficiency Index (CCEI), developed by Afriat (1972), can be used to evaluate the severity of GARP violations. The index e ($0 \leq e \leq 1$) is used to relax the budget constraint. Remember that $p^i x^i \geq p^i x$ implies that x^i is directly revealed preferred to x. If $p^i x^i$ is multiplied by a sufficiently small coefficient e (i.e., $ep^i x^i$), the inequality can be reversed: $ep^i x^i < p^i x$. Graphically, this is equivalent to shifting the hypotenuse to the left (see Figure S5). If the directly revealed preferrence relationships are "nominally" eliminated from the data by e, GARP violations are less likely to occur. Andreoni and Miller (2002) computed the minimal CCEI to eliminate all GARP violations from each participant's data. Following Varian's (1994) proposal, Andreoni and Miller (2002) used a threshold of CCEI (e) = 0.95. If a participant's data required a CCEI smaller than 0.95 to eliminate their GARP violations, this participant's GARP violations were considered severe.

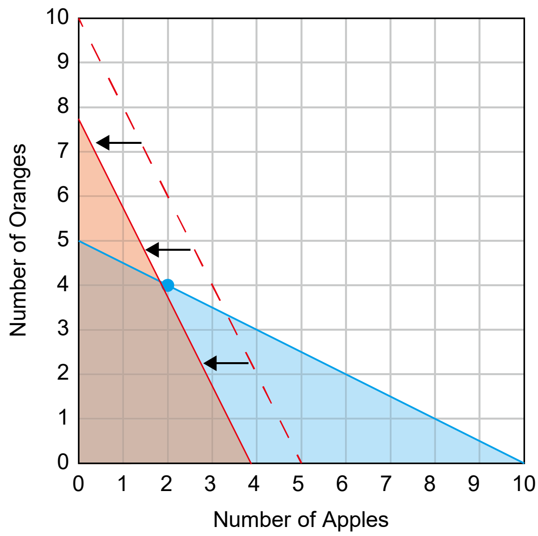

Figure S5. Graphical illustration of the effect of the CCEI.

Prototypical Allocations of the Three Types of Preferences

Figure S6 graphically shows prototypical allocations of the three types of preference function. Players of the Selfish type allocate all tokens to themselves to maximize their own payoffs. This pattern is shown in Figure S6a, in which all allocation decisions (indicated by circles) are located on the horizontal axis (i.e., giving 0 to the other). (The numbers in the circles correspond to the game numbers in Table 1.) Players of the Leontief type always allocate the tokens to make the final payoffs of the self and the other equal. This pattern is illustrated in Figure S6b, in which all circles are located on the *y* (other) = *x* (self) line. Players of the Perfect Substitutes type give all tokens to the player earning more from each token to maximize the final payoffs as a pair. This pattern is illustrated in Figure S6c, in which it is predicted that the allocator gives all tokens to the self when the slope is greater than −1 (less steep games), but gives all tokens to the other when the slope is lesser than −1 (steeper games). For Perfect Substitutes, games 6, 7, and 9 (see Table 1) are irrelevant because each token is valued 1 JPY for both players (the slope is equal to −1). Accordingly, in Figure S6c, these three games are indicated by gray dashed lines, and there are no corresponding circles to these three games.

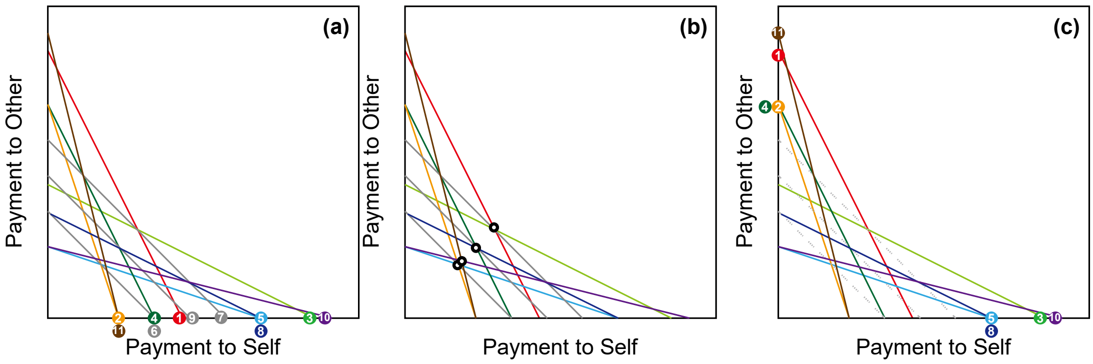

Figure S6. Prototypical preferences of (a) Selfish, (b) Leontief, and (c) Perfect Substitutes.

References

Afriat, S. N. (1972). Efficiency estimation of production functions. International Economic Review, 13, 568-598. https://dx.doi.org/10.2307/2525845

Andreoni, J. & Miller, J. (2002). Giving according to GARP: An experimental test of the consistency of preferences for altruism. Econometrica, 70, 737-753. https://doi.org/10.1111/1468-0262.00302

Varian, H. R. (1994). Goodness-of-fit for revealed preference tests. University Library of Munich, Germany. https://ideas.repec.org/p/wpa/wuwpem/9401001.html