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## **An interdependence analysis of commuting decisions**

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### *Abstract*

*The current research advances an interdependence analysis of commuting decisions (i.e. commuting by car versus public transportation), delineating the determinants of an individual's outcomes in terms of own decisions, other commuters' decisions, and the combination or interaction of own and others' decisions (Kelley & Thibaut, 1978). Consistent with hypotheses, findings revealed that a concern with comfort led to a higher overall personal preference for the car, and a lower overall preference*

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*for others to commute by public transportation, when compared to a concern with travel time. Additionally, consistent with the claim that commuter decisions are also guided by considerations broader than a concern with individual outcomes, findings revealed that individuals with prosocial orientations (i.e. those concerned with maximizing collective outcomes) in combination with high levels of trust (i.e. believing in the honesty and cooperative intentions of others) exhibited a greater overall personal preference for public transportation, and a reduced desire to avoid other commuters, relative to individuals with a prosocial orientation and low levels of trust, or a proself orientation (i.e. those concerned primarily with maximizing own outcomes), regardless of levels of trust. Finally, consistent with the current interdependence analysis, intention to commute by car was positively associated with not only overall personal preference for the car, but also with the desire to avoid other commuters.*

## INTRODUCTION

In 1963 the world's problems seemed a lot more significant to me than the graphs, matrices, and other abstractions that confronted me as a student in mathematics. And so I went out to do good in, and to try to understand, the world. Two years later I returned to graduate school, only to learn that the world's problems *were* graphs and matrices, or at least could be better analyzed in terms of them.

Hamburger (1979, p. ix)

With respect to one's impact on the environment, one of the most important decisions an individual must make involves his/her choice of transportation (Stern, 1992). The use of automobiles, while generally convenient, contributes to serious environmental problems including global warming, acid rain, resource depletion, noise pollution, and congestion (Lowe, 1990). Despite these problems, the majority of commuters around the world continue to rely on the car (Newman & Kenworthy, 1989). To gain an understanding of commuting decisions, many past studies have attempted to identify relevant travel attributes and demographic characteristics associated with travel mode choice. Findings from this literature indicate the importance of a variety of variables including cost, convenience, reliability, travel time, and comfort (Bronner, 1982; Fenwick, Heeler, & Simmie, 1983; Norman, 1977; Norman & Louviere, 1974; Paine, Nash, Hille, & Brunner, 1969), socioeconomic status (Flannely & McLeod, 1989), and the number of available automobiles within a household (Flannely & McLeod, 1989; Hsu, 1975). The present paper takes a somewhat different approach to the problem, analysing commuting decisions from the perspective of Kelley and Thibaut's (1978) theory of interdependence. Our primary goal in this regard is to provide a unified framework in which to understand how individual concerns (e.g. travel time and comfort), as well as broader considerations (e.g. concern with collective well-being and trust in others' honesty and cooperative intentions) impact the decision to commute to work by car or public transportation.

## An interdependence analysis of commuting decisions

### Overview

Pollution; resource depletion; and congestion: each problem highlights the fact that commuters are socially interdependent. By definition, interdependence involves two or more decision makers who exercise, to a greater or lesser extent, varying forms of control over their own and others' outcomes. Kelley and Thibaut (1978) identify three types of control underlying interdependent outcomes, each of which has interesting applications of commuting decisions, including own control over one's own outcomes (i.e. *reflexive control*), others' control over one's own outcomes (i.e. *fate control*), and joint control over one's own outcomes (i.e. *behaviour control*). For example, the time required to commute to work by car or public transportation is determined, at least in part, by one's own commuting decision (reflexive control), by how many others choose the car or public transportation (fate control), and by whether one avoids or joins the majority of other commuters (behaviour control).

One useful method for assessing the type and degree of control individuals have over interdependent outcomes is to formally represent such outcomes as a matrix specifying the decision makers, their behavioural alternatives, and the outcomes associated with various self–other choice combinations. For instance, the decision to commute by car or public transportation can be conceptualized as a  $2 \times 2$  outcome matrix in which the rows correspond to a commuter's own decision, and the columns to the decision of most other commuters<sup>1</sup>. Subsequently, using an analysis of variance model (Kelley & Thibaut, 1978), the resulting pattern of outcomes, known as the *interdependence structure*, can be described in terms of reflexive control (i.e. the 'main effect' of own decisions), fate control (i.e. the 'main effect' of others' decisions), and behaviour control (i.e. the 'interaction' of own and others' decisions).

The present paper utilizes this general approach, modifying slightly, Kelley and Thibaut's (1978) control (i.e. variance) components to reflect *directionalized preference indices*, as illustrated in Table 1<sup>2</sup>.

<sup>1</sup>Outcome matrices, while extremely popular among social psychologists (e.g. Pruitt & Kimmel, 1977), have not been without their critics (e.g. Nemeth, 1972). First, it seems unlikely that decision makers think in terms of outcome matrices. Indeed, many of the strongest proponents of this approach readily admit that the matrix is '. . . not intended to stand as a literal representation of lay cognition, emotion, or motivation' but rather, should be thought of as '. . . simply a rich and efficient conceptual tool for identifying and formally representing the essential features of interaction phenomenon. . .' (Rusbult & Van Lange, in press, pp. 7–8). Second, the  $2 \times 2$  matrix is, necessarily, smaller than the  $n$ -dimensional matrix representing all decision makers. But, as Liebrand (1983) has noted, despite the increased anonymity and wider dispersion of negative consequences of one's own behaviour in an  $n$ -person setting, the  $2 \times 2$  and  $n$ -person decision structures are identical. Thus, it seems reasonable to assume here that the  $2 \times 2$  matrix can serve as a useful model of the interdependence structure underlying multi-person commuting decisions.

<sup>2</sup>The distinction is analogous to differentiating (a) the between-groups variance estimates for the row main effect, the column main effect, and the interaction from (b) the mean differences for rows, columns, and diagonals, respectively. To illustrate, using somewhat more applied terms, assume that a commuter, faced with a choice between the car and public transportation, has a large amount of reflexive control over travel comfort (i.e. a main effect of the self). This indicates that one form of transportation, on average, affords more comfort than the other, but it does not indicate which form of transportation the commuter views as most comfortable. In our modification of Kelley and Thibaut's reflexive, fate, and behaviour control components, we retain information regarding the direction of the preference for self, others, and coordination, respectively, as illustrated in Table 1.

Table 1. Three forms of preference underlying commuters' jointly determined outcomes

Commuting as a  $2 \times 2$  matrix

	General form of matrix		Example of outcomes													
	Majority of others		outcomes <sup>a</sup>													
	PT <sup>b</sup> Car															
Sarah PT	<table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 5px;"><math>a_1b_1</math></td> <td style="border: 1px solid black; padding: 5px;"><math>a_1b_2</math></td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;"><math>a_2b_1</math></td> <td style="border: 1px solid black; padding: 5px;"><math>a_2b_2</math></td> </tr> </table>	$a_1b_1$	$a_1b_2$	$a_2b_1$	$a_2b_2$	~	<table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 5px;">10</td> <td style="border: 1px solid black; padding: 5px;">30</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">50</td> <td style="border: 1px solid black; padding: 5px;">20</td> <td style="padding: 5px;">35</td> </tr> <tr> <td style="padding: 5px;">30</td> <td style="padding: 5px;">25</td> <td></td> </tr> </table>	10	30	20	50	20	35	30	25	
$a_1b_1$	$a_1b_2$															
$a_2b_1$	$a_2b_2$															
10	30	20														
50	20	35														
30	25															

Preference indices

- Preference for self<sup>c</sup> =  $35 - 20 = 15$  (prefers self to take the car)
- Preference for others<sup>d</sup> =  $25 - 30 = -5$  (prefers others to take public transportation)
- Preference for coordination<sup>e</sup> =  $40 - 15 = 25$  (prefers to avoid other commuters)

<sup>a</sup>Row chooser's outcomes only; higher values represent more attractive outcomes.

<sup>b</sup>PT = public transportation. <sup>c</sup>Preference for self = (car row average - PT row average). <sup>d</sup>Preference for others = (car column average - PT column average). <sup>e</sup>Preference for coordination =  $[(a_2b_1 + a_1b_2)/2] - [(a_1b_1 + a_2b_2)/2]$ .

The first matrix in Table 1 shows that if 'Sarah' decides to go by car, while the majority of others decide to go by public transportation, Sarah's outcome is  $a_2b_1$ . Sarah's outcome in cell  $a_2b_1$  of the second matrix (i.e. 50; where higher values reflect more attractive outcomes) is the result of three components, including Sarah's own overall satisfaction with the car, her overall satisfaction with others' decision for public transportation, and her satisfaction with avoiding the majority of other commuters. More generally, each outcome in the second matrix reflects a particular combination of Sarah's preference for self, preference for others, and preference for coordination. The *preference for self index* (15), computed as a difference between the car (35) and public transportation (20) row averages, can be interpreted as a commuter's overall preference for the car (positive values) or public transportation (negative values). The *preference for others index* (5), computed as a difference between the car (30) and public transportation (25) column averages, reflects a commuter's overall preference for others to commute by car (positive values) or public transportation (negative values). And, the *preference for coordination index* (25), computed as a difference between the average minor (40) and major (15) diagonals, can be taken as a commuter's preference for coordinating actions in order to avoid (positive values) or join (negative values) other commuters.

*The commuters' interdependence structure*

Frequently, the analysis of real-world interdependence problems starts by assuming, *a priori*, that a certain interdependence structure (or outcome matrix) characterizes a particular real-world problem (for exceptions, see Kollock, 1995; Lumsden, 1973;

Plous, 1993). For example, it seems reasonable to assume that commuting decisions contain elements of a social dilemma, formally defined as a situation in which (a) each individual receives greater outcomes by making a noncooperative decision (i.e. the car) than by making a cooperative decision (i.e. public transportation), irrespective of others' decisions, yet (b) each individual is better off if all make a cooperative rather than a noncooperative decision (*cf.* Dawes, 1980; Messick & Brewer, 1983). Clearly, the adoption of a well-specified interdependence model for a particular problem has its benefits, as it affords tools for conceptualizing, abstracting, and modelling key features of situations that may influence interdependent decision making (for reviews, see Komorita & Parks, 1994; Van Lange & Messick, in press). However, many of these benefits hinge on a researcher's ability to '... properly abstract [a particular] situation' (Hamburger, 1979, p. 83), an ability which may be questioned in light of professional disagreement over the 'appropriate' interdependence model underlying certain real-world problems (e.g. Komorita & Parks, 1994; Liebrand, 1983). Moreover, as outlined below, there are strong theoretical grounds for expecting decision makers to perceive the underlying structure of the same situation differently.

A variety of factors can influence an individual's perception of the interdependence structure—defined in terms of preference for self, others, and coordination—underlying a particular problem. To organize such factors, Kelley and Thibaut (1978) draw a distinction between two types of outcome matrices. The so-called *given matrix*, determined (i.e. 'given') by features of the situation as well as individuals' needs and abilities, represents the outcomes associated with individual concerns (e.g. travel time and comfort). The so-called *effective matrix*, determined by both the given matrix, as well as broader considerations (e.g. concern with collective well-being, and trust in other's honesty and cooperative intentions), represents the matrix of outcomes which individuals ultimately perceive as the structure of interdependence. In reaching a final decision, individuals are said to transform the given into an effective matrix which is more closely linked to actual behaviour. Based on the preceding framework, the current research examines (a) two possible determinants of given matrix preferences, including a concern with travel time and a concern with comfort, (b) two possible determinants of effective matrix preferences, including a commuter's *social value orientation* (i.e. preferences for certain patterns of outcomes to self and others; McClintock, 1978; Messick & McClintock, 1968) and *trust* (i.e. beliefs regarding the honesty and cooperative intentions of others; Yamagishi, 1986), and (c) the relative importance of the given versus effective matrix preferences in predicting commuter intentions.

#### *Determinants of given matrix preferences: individual commuting concerns*

Two individual concerns closely linked to commuting preferences include a concern with comfort and a concern with travel time (e.g. Fenwick *et al.*, 1983; Newman & Kenworthy, 1989; Van Vugt, Meertens, & Van Lange, 1995; Van Vugt, Van Lange, & Meertens in press). How might such concerns influence commuters' preferences for self (i.e. overall, car or public transportation), others (i.e. overall, car or public transportation), and coordination (i.e. join or avoid the majority of other commuters) within the given matrix? First, it seems reasonable to assume that

personal comfort reflects a goal that can be largely achieved by an individual's own decision, and is therefore not likely to be strongly influenced by others' decisions, or a specific combination of own and others' decisions. That is, when comfort is the primary concern, commuters should be fairly independent, rather than interdependent. As such, framing the commuting situation in terms of comfort would be associated primarily with a strong overall self preference for the car. This reasoning is consistent with recent theoretical and empirical work on commuting decisions which suggests that the decision to commute by car or public transportation can be modelled as a trade-off between personal comfort and the environment, with an underlying structure approximating the  $N$ -person Prisoner's Dilemma (Van Vugt *et al.*, 1995). According to this model, each commuter prefers the car, regardless of other commuters' choices—as it is the most personally comfortable option—but if all commuters take the car, everyone is worse off than if all had taken public transportation, as overdependence on cars contributes to serious environmental problems (Lowe, 1990).

By contrast, when travel time is the more prominent concern, individuals are more likely interdependent, and this concern gives rise to an interdependence structure that is substantially different from the one instigated by a concern with comfort. Specifically, while commuting by car tends to be associated with lower travel time than commuting by public transportation, this advantage can turn into a disadvantage depending on other commuters' decisions. Thus, if individuals are concerned with travel time, they should prefer avoiding other commuters, commuting by car if most others are believed to commute by public transportation, and commuting by public transportation if most others are believed to commute by car. This reasoning is consistent with an alternative model of commuting decisions as an accessibility problem with a structure approximating either an  $N$ -person Chicken Dilemma, or a Battle of the Sexes game (e.g. Liebrand, 1983; Van Vugt *et al.*, 1994, 1995). In these models, a commuter's best travel option, to a large extent, depends on the decisions made by other commuters; if a large number of others take public transportation, a commuter is better off taking the car, since the roads should be relatively empty, and public transportation may be crowded and marked by delays caused by heavy demand; alternatively, if most others take the car, a commuter is better off taking public transportation, since this allows the commuter to avoid a traffic jam.

On the basis of the previous reasoning, we predict that commuters will exhibit a higher overall preference for the car, irrespective of other commuters' decisions, when comfort rather than travel time is the primary concern (*hypothesis 1a*). Moreover, we predict that commuters will exhibit a higher preference for avoiding other commuters when travel time rather than comfort is the primary concern (*hypothesis 1b*). Finally, there is also reason to expect that when travel time is the primary concern, commuters will desire other commuters to commute by public transportation rather than by car, regardless of the commuter's own decision. This reasoning is based on the notion that from a travel time perspective (a) individuals will exhibit some tendency to prefer commuting by car, and (b) commuting by car is more strongly influenced by others' commuting decisions than is commuting by public transportation (i.e. delays caused by traffic jams are larger than those caused by overcrowded trains and buses). This pattern is to be contrasted with the idea that personal comfort derived from cars is a goal that can be achieved largely

independent of others' commuting decisions. Thus, we predict that individuals will exhibit a stronger desire for others to commute by public transportation when travel time rather than comfort is the primary concern (*hypothesis 1c*).

*Determinants of effective matrix preferences: social value orientation and trust*

The basis of the hypotheses presented in the preceding section was an explicit link between specific travel-related concerns and certain well-defined interdependence structures. At a more general level, apart from any particular commuting concern, it seems reasonable to assume that the decision to commute by car or public transportation contains elements of a social dilemma, a situation in which individual interests and collective interests are at odds. Although it is often argued that pursuit of individual well-being is the only rational choice in such dilemmas (e.g. Luce & Raiffa, 1957), a notable percentage of people do behave in a collectively-beneficial fashion. One factor consistently found to influence behaviour in social dilemmas is an individual's social value orientation. Individuals with prosocial orientations (i.e. those concerned with maximizing joint outcomes) exercise greater restraint, and exhibit greater cooperation than do individualists (i.e. those concerned with maximizing own outcomes) or competitors (i.e. those concerned with maximizing their relative advantage over others; e.g. Kuhlman & Marshello, 1975; Kramer, McClintock, & Messick, 1986; Liebrand, Wilke, Vogel, & Wolters, 1986; Sattler & Kerr, 1991). Prior research has also revealed that individualists and competitors demonstrate a number of behavioural and cognitive similarities in simulations of commuters' dilemmas (Van Vugt *et al.*, 1995), as well as in experimental games simulating two-person or multiple-person social dilemmas (e.g. Kramer *et al.*, 1986; Van Lange & Liebrand, 1991). Thus, the current research focuses on comparisons of individuals with prosocial orientations and proself orientations (i.e. individualists and competitors; *cf.* Kramer *et al.*, 1986; Van Lange & Liebrand, 1991).

Recently, it has been proposed that social value orientations influence commuters' perception of the interdependence structure underlying commuting decisions (Van Vugt *et al.*, 1995). Prosocials are proposed to view commuting decisions as a trade-off between personal comfort and the environment, whereas proselfs, given their concern with their own well-being, are believed to interpret commuting decisions as an accessibility problem in which they seek to achieve the fastest travel time. How might such interpretations influence commuters' preferences for self, others, and coordination within the effective (or transformed) interdependence structure? First, given their emphasis on collective concerns, prosocials should exhibit a stronger overall preference for public transportation compared to proselfs (*hypothesis 2a*), as public transportation is better for the environment (Lowe, 1990). Second, given their concern with travel time, proselfs should be interested in commuting by car when the majority of others commute by public transportation, and commuting by public transportation when the majority of others commute by car. In contrast, given that prosocials presumably are less concerned with travel time, their preferences should be less influenced by beliefs regarding others' commuting decisions. Thus, we predict that, relative to prosocials, proselfs will exhibit a stronger preference for avoiding other commuters (*hypothesis 2b*). Finally, both prosocials and proselfs have reason to judge others' choice for public transportation favourably; prosocials because

public transportation is better for the environment, and proselves because a majority of public transportation users would mean relatively unobstructed highways. As such, no formal hypothesis is advanced regarding the preference for others' commuting behaviour.

Another factor that is assumed to influence how given matrices are transformed into effective ones is trust, a general belief in the honesty and cooperative intentions of others. Individuals who believe that others hold cooperative intentions or are honest are considerably more cooperative than those who believe that others do not hold such intentions or are not honest (Alcock & Mansell, 1977; Deutsch, 1960; Messick, Wilke, Brewer, Kramer, Zemke, & Lui, 1983; Van Lange & Kuhlman, 1994). Moreover, research has revealed that trust represents preexisting individual differences between people, a variable which also is related to cooperation in social dilemmas (Yamagishi, 1992). However, individuals with high, as opposed to low, trust do not always exhibit greater cooperation (e.g. Parks, 1994), suggesting that trust may be a necessary yet not sufficient requirement for cooperation.

In their goal/expectation theory, Pruitt and Kimmel (1977) assume that two conditions must be met to obtain cooperation: individuals should (a) hold cooperative goals, and (b) expect others to exhibit cooperation. Although this theory has been formulated to account for cooperation in two-person social dilemmas, there is good reason to believe that a similar process is operative in large-scale situations that share elements of social dilemmas. Applied to commuting decisions, it is reasonable to propose that individuals who expect others to make pro-environment decisions (i.e. those with high trust) will also make pro-environment decisions as long as such individuals are concerned with collective outcomes (i.e. if they hold a prosocial orientation). By contrast, individuals with high trust are unlikely to hold pro-environmental preferences, if such individuals tend to consider primarily outcomes for self (i.e. hold a prosel self orientation). What about individuals with a prosocial orientation, but low levels of trust? It seems reasonable to assume that commuters who are generally disposed to make pro-environment decisions but are pessimistic regarding others' willingness to cooperate may feel like a 'sucker' if they are the only ones contributing to a healthy environment. It is also possible that such individuals will fail to make pro-environment decisions out of a concern that their own sacrifices for the environment will make little difference (*cf.* perceived efficacy; Kerr, 1989). Accordingly, we advance the following two predictions. First, we predict that relative to individuals with either prosel self orientations or low trust or both, individuals with both prosocial orientations *and* high trust will exhibit a weaker preference for commuting by car (*hypothesis 3a*). Second, assuming that travel time is a less important individual concern for prosocial individuals with high trust, relative to the other three groups, we predict that prosocial individuals with high trust will exhibit a weaker preference for avoiding other commuters (*hypothesis 3b*).

#### *Predicting intended commuting behaviour from given and effective matrix preferences*

An important assumption underlying the current interdependence analysis is that factors above and beyond simply an individual's overall preference play an important role in an individual's ultimate decision (e.g. intention to commute by



car or public transportation). Focusing on the effective matrix preference indices, an obvious prediction is that a higher overall self-preference for the car will be associated with a stronger intention to commute by car (*hypothesis 4a*). But, to what extent, and in what fashion, should additional features of the effective interdependence structure relate to commuting intentions? First, as others' commuting behaviour represents a feature of the relationship which one cannot personally control, differing preferences for others' commuting behaviour should not predict one's own intention to commute by car versus public transportation. Second, because the desire to avoid other commuters in order to reduce travel time can be interpreted as representing more self-interested preferences, a stronger desire to avoid other commuters should be associated with a stronger intention to commute by car (*hypothesis 4b*). A second assumption underlying the current interdependence analysis is that the effective matrix is more representative of ultimate preferences than is the given matrix. To the extent this assumption is correct, the effective matrix preferences should be more highly predictive of stated intention to commute by care when compared to preferences from either of the given matrices, based respectively on travel time and comfort (*hypothesis 5*).

## METHOD

### Participants and procedure

Participants consisted of daily car and public transportation commuters recruited at Amsterdam's central train station and a gas station along a primary commuting route near Amsterdam (the A-1), between the hours of 7.00–10.00 am and 2.00–6.00 pm. Potential participants were asked if they were on their way to work, and if so, whether they would be willing to complete a short survey on commuting decisions. Those who agreed received a survey with free postage, which they could later complete at home or at work. Of the 360 surveys handed out, 102 were returned (45 from gas stations and 57 from the train station). Respondents included 63 males, 38 females, and one sex-unidentified, with a mean age of 33 years and 2 months.

### Assessment of social value orientation and trust

Participants' social value orientation was assessed using a set of nine, three-alternative decomposed games (Messick & McClintock, 1968), adapted from Van Lange and Kuhlman (1994). As an example, in the first game participants chose between three options offering points to Self and Other: A = 480 Self, 80 Other; B = 540 Self, 280 Other; C = 480 Self, 480 Other. In this game a competitor would choose A (highest relative gain), an individualist B (highest own gain) and a cooperator C (highest joint gain). To be classified, a participant had to demonstrate a consistent preference for one of the three orientations in at least six of the nine games. On this basis, 88 of the 102 participants (86 per cent) were classifiable, including 47 prosocials (30 males, 17 females), 21 individualists (14 males, seven

females), and 20 competitors (11 males, eight females, one sex-unidentified). As outlined in the Introduction, we were primarily interested in—and we thus created—two more general orientations including *prosocials* (cooperators or altruists) and *proselfs* (individualists and competitors), a common convention among researchers of social value orientations (*cf.* Kramer *et al.*, 1986; Van Lange & Liebrand, 1991; Van Vugt *et al.*, 1995). Trust was assessed using a standard 5-item scale, developed by Yamagishi (1986), which contains items addressing both the extent to which participants believe others are generally honest (e.g. most people tell a lie when they can benefit by doing so), and the degree to which trusting others is risky (e.g. those devoted to unselfish causes are often exploited by others). Participants rated the extent to which they agreed with five such statements on a scale from 1 (strongly disagree) to 7 (strongly agree). While the reliability of the scale was less than optimal ( $\alpha = 0.54$ ), we judged it to be acceptable, considering the multifaceted nature of the items, as well as the scale's predictive validity in prior social dilemma research (e.g. Parks, 1994; Yamagishi, 1986; Yamagishi & Sato, 1986). Hence, trust was subsequently dichotomized on the basis of a median split on participants' average response to all five items on the trust scale (median = 3.8 on a 7-point scale). Social value orientation was measured prior to participants' reading of the commuting scenario, while trust was assessed after participants completed the current commuting experiences questionnaire.

### The commuting scenario

The survey contained a series of tasks related to both hypothetical and real-life commuting decisions. Following the assessment of social value orientation, participants read the following<sup>3</sup> hypothetical commuting scenario:

Imagine you are living on the outskirts of a medium size city. You hold a job in the centre of town, working Monday through Friday, from 8 am to 5 pm. Thus, you must commute to and from work during rush hour. In order to get to work you can either use your car—a 1992 compact car with 32,000 kilometres (20,000 miles)—or public transportation. If you take your car, your journey will involve a commute plus a short walk from the parking space to your office. If you take public transportation, your journey will involve a short walk from your home to the train stop, a ride on the train, and a short walk from the train to your office.

When all the costs associated with the car are figured in, including gas, parking etc., commuting by car and commuting by public transportation will

<sup>3</sup>For exploratory purposes, half of the surveys contained a longer scenario explaining that travel time would 'to some extent depend on the behaviour of other commuters', such that matching the behaviour of others could result in more variable travel times. As expected, preference for avoiding other commuters in the travel time matrix was significantly higher in the longer scenario ( $M = 41.24$ ,  $S.D. = 24.36$ ,  $n = 37$ ) than in the shorter scenario described in the Methods section ( $M = 22.74$ ,  $S.D. = 27.02$ ,  $n = 47$ ),  $t(83) = 3.25$ ,  $p < 0.01$ . In addition, preference for others to commute by public transportation—denoted by negative values—in the effective matrix was significantly stronger in the short as opposed to the long scenario ( $M_{\text{short}} = -39.08$ ,  $S.D. = 31.50$ ;  $M_{\text{long}} = 17.76$ ,  $S.D. = 32.92$ ;  $t(87) = 3.10$ ,  $p < 0.01$ ). As the type of scenario was unrelated to social value orientation, trust, and the combination thereof, and the type of scenario did not modify the effects of primary interest, this variable will not be further discussed.

be equally expensive. In addition, while travel time for the two alternatives may vary from day to day, on average, getting to work by car or by public transportation will take the same amount of time.

### Matrix framing

After reading the scenario, participants rank ordered (1 = best, 4 = worst) four possible commuting situations resulting from a combination of their own choice (car, public transportation) and the choice of the majority of others (car, public transportation). The four situations appeared in a  $2 \times 2$  table, the rows denoting the participant's own behaviour, the columns, the behaviour of others; closely paralleling Van Vugt *et al.*, (1995), the majority was defined as 60 per cent of the other commuters. Participants subsequently rated, in a new  $2 \times 2$  table, each of the four situations on a scale from  $-50$  (extremely unattractive) to  $+50$  (extremely attractive). Because they are more continuous, ratings as opposed to ranks were used in the computation of the three preference indices, preference for self, preference for others, and preference for coordination, as outlined in the Introduction. The general terms 'attractive' and 'unattractive' were used to provide participants a wide degree of latitude in interpreting the commuting situation; accordingly, this matrix is taken as an indication of *effective matrix* preferences. Later in the survey—following the scenario questionnaire described below—participants were asked to rank and rate the same four commuting situations, solely in terms of travel time and then comfort, respectively. These two matrices, accordingly labelled the *travel time matrix* and the *comfort matrix*, were taken as indicators of *two different 'framings' of given matrix*. The ranking and rating procedure for these latter matrices was nearly identical to that described earlier for the effective matrix; however, in the case of both the travel time matrix and the comfort matrix, participants entered ranks and ratings in the same matrix. The effective matrix was presented prior to travel time and comfort matrices, as we did not want the latter framings to influence effective matrix preferences.

### Questionnaires

Following the effective matrix rating task, and preceding the travel time and comfort matrix rating tasks, participants completed a *scenario questionnaire*. Using a 7-point Likert scale (1 = not at all, 7 = very much), participants first rated the extent to which five travel attributes including comfort, travel time, flexibility, environmental impact, and public health influenced their ranking and scaling decisions. Participants then indicated the probability 'from 0 to 100' that they would take their car to work in the commuting scenario, assuming they knew nothing about the behaviour of other commuters. Participants also estimated the percentage of other commuters they expected to commute by car.

Following the travel time and comfort matrix tasks, participants answered a number of questions regarding their *current commuting experiences*, including (a) whether they had a car, (b) whether they currently commuted to work, and if so, by what means, (c) what their real-life commuting preference was (1 = very strong

preference for public transportation to 7 = very strong preference for the car) and (d) the probability, from 0 to 100, that they would take public transportation in the future. Respondents were thanked for their participation and debriefed by way of mailed feedback.

## RESULTS

### Effect of matrix on preference for self, others, and coordination

The first purpose of the current study was to demonstrate that personal concerns might influence the nature of the interdependence underlying the decision to commute by car versus public transportation. We conducted a multivariate analysis of variance (MANOVA) examining the influence of matrix frame (travel time versus comfort versus effective matrix) on participants' preference for self, others, and coordination. The three-level within-subject factor of matrix frame was partitioned into two contrasts, one comparing travel time to comfort matrices, the second comparing the effective to the average of travel time and comfort matrices. The travel time versus comfort comparison addresses the determinants of the given matrix; that is, how differing personal commuting concerns may affect the interdependence features perceived by commuters. The effective versus travel time/comfort contrast would provide initial evidence of transformation from given to effective matrix; that is, how preferences shift when commuters are allowed to bring broader considerations to bear on the commuting decision. As expected, the analysis revealed a significant multivariate effect of matrix frame,  $F(6,78) = 14.85$ ,  $p < 0.001$ , indicating that preference for self, others, and coordination were generally affected by participants' most salient concern (i.e. travel time, comfort, or global preference—the effective matrix). Focusing on the determinants of the given matrix, univariate analyses on each preference index revealed that travel time versus comfort matrices influenced both preference for self, and preference for others. Consistent with hypothesis 1a, participants exhibited a significantly higher self preference for the car, irrespective of others' choices, when comfort ( $M = 24.15$ ,  $S.D. = 35.04$ ), rather than travel time ( $M = 9.37$ ,  $S.D. = 37.92$ ), was the primary concern,  $F(1,83) = 14.53$ ,  $p < 0.001$ . However, contrary to hypothesis 1b, participants did not show a higher preference for avoiding other commuters when travel time ( $M = 30.89$ ,  $S.D. = 27.34$ ) as opposed to comfort ( $M = 28.96$ ,  $S.D. = 23.28$ ) was the primary concern,  $F(1,83) = 0.53$ , n.s. Finally, consistent with hypothesis 1c, participants exhibited a significantly higher preference for others to commute by public transportation (denoted by negative values), when travel time ( $M = -15.02$ ,  $S.D. = 26.03$ ) rather than comfort ( $M = 3.86$ ,  $S.D. = 22.54$ ) was the primary concern,  $F(1,83) = 32.86$ ,  $p < 0.001$ . Taken together, these results indicate that differing travel concerns can affect perception of the given matrix.

As initial evidence for a transformation from given to effective matrix, we compared preference for self, others, and coordination in the effective versus travel time and comfort matrices combined. An examination of the means revealed that, relative to the travel time and comfort matrices combined, the effective matrix was characterized by a lower self preference for the car ( $M_E = -2.46$ ,  $S.D. = 36.37$ ,  $M_{TC} = 16.76$ ,  $S.D. = 31.89$ ), a stronger preference for others to commute by

public transportation (denoted by negative values) ( $M_E = -29.96$ ,  $S.D. = 34.07$ ,  $M_{TC} = -5.58$ ,  $S.D. = 19.10$ ), and a lower preference for avoiding other commuters ( $M_E = 19.79$ ,  $S.D. = 27.63$ ,  $M_{TC} = 29.92$ ,  $S.D. = 22.32$ ); respective  $F(1,83)s = 35.15$  for self, 40.44 for others, and 10.55 for coordination (all  $ps < 0.005$ ). These results provide initial support for a transformation of the given matrix, based on individual (i.e. self-interested) concerns and preferences, into an effective matrix based on broader (i.e. collective) concerns.

### Effects of social value orientation and trust on effective matrix preferences

The second purpose of the present study was to examine two possible determinants of effective matrix preferences by examining the roles of social value orientation and trust on the perceived nature of the interdependence underlying the commuting decisions. To test hypotheses 2a and 2b, regarding the main effect of social value orientation, the three effective matrix preference indices (self, others, and coordination) were employed as multiple dependent measures in a 2 (social value orientation: prosocial versus proself)  $\times$  2 (trust: low versus high) MANOVA. This analysis revealed, first, no significant main effect for social value orientation, at either the multivariate ( $F < 1$ ) or the univariate level (all  $Fs < 1$ ), contrary to hypotheses 2a and 2b. The analysis did reveal, however, a multivariate main effect of trust,  $F(3,80) = 3.79$ ,  $p < 0.05$ . Univariate tests revealed a significant main effect of trust on preference for self,  $F(1,82) = 4.41$ ,  $p < 0.05$ , preference for others,  $F(1,82) = 5.46$ ,  $p < 0.05$ , and preference for coordination,  $F(1,82) = 7.90$ ,  $p < 0.01$ . An examination of the means revealed that, relative to individuals low in trust, those high in trust exhibited a stronger self preference for public transportation (denoted by negative values) ( $M_{high} = -9.57$ ,  $S.D. = 32.52$ ;  $M_{low} = 7.07$ ,  $S.D. = 38.54$ ), a stronger preference for others to commute by public transportation (denoted by negative values) ( $M_{high} = -37.49$ ,  $S.D. = 35.65$ ;  $M_{low} = -19.15$ ,  $S.D. = 29.15$ ), and a weaker preference for avoiding other commuters ( $M_{high} = 11.96$ ,  $S.D. = 26.51$ ;  $M_{low} = 31.23$ ,  $S.D. = 29.51$ ). While the trust by social value orientation interaction was not significant at the multivariate level,  $F(3,80) = 2.07$ ,  $p = 0.11$ , univariate analysis revealed two marginally significant interaction effects on preference for self,  $F(1,82) = 3.61$ ,  $p < 0.07$ , and preference for avoiding others,  $F(1,82) = 3.38$ ,  $p < 0.07$ , respectively (the interaction was not significant on the preference for others index,  $F(1,82) < 1$ ).

To test the hypotheses 3a and 3b, preference for self, others, and coordination were next used as multiple dependent measures in a one-way MANOVA, in which the four groups (prosocial/high trust, prosocial/low trust, proself/high trust, proself/low trust) served as a single four-level between-subjects variable. At the multivariate level, results revealed a significant effect only on the contrast between high-trust prosocials and the remaining three groups,  $F(3,80) = 5.45$ ,  $p < 0.005$ . Univariate tests revealed significant effects for this comparison on preference for self, others, and coordination (respective  $Fs(1,82) = 6.12$ ,  $p < 0.05$ ; 4.66,  $p < 0.05$ ; 12.96,  $p < 0.001$ ). Means on each preference index, and the corresponding standard deviations, for the four groups are displayed in Table 2.

Consistent with hypothesis 3a, the top row of Table 2 reveals that high-trust prosocials exhibited a lower self preference for the car—indeed preferring public transportation ( $M = -13.95$ )—compared to the remaining groups combined. In

Table 2. Effective matrix preferences as a function of social value orientation and trust

Preference index		Social value orientation			
		Proself		Prosocial	
		Low trust	High trust	Low trust	High trust
Preference for self <sup>a</sup>	Mean	0.48	-1.09	17.63	-13.95
	<i>S.D.</i>	35.41	41.36	42.17	26.62
Preference for others <sup>b</sup>	Mean	-19.82	-32.97	-17.97	-39.82
	<i>S.D.</i>	33.65	34.73	21.08	36.45
Preference for coordination <sup>c</sup>	Mean	28.69	22.65	35.30	6.44
	<i>S.D.</i>	32.28	24.86	24.96	26.00
	<i>N</i>	24	16	15	31

<sup>a</sup>Preference for self values greater (less) than 0 indicate a personal overall preference for the car (public transportation).

<sup>b</sup>Preference for others values greater (less) than 0 indicate an overall preference for others to commute by car (public transportation).

<sup>c</sup>Preference for coordination values greater (less) than 0 indicate a preference for avoiding (joining) other commuters.

support of hypothesis 3b, the bottom row of Table 2 reveals that high-trust prosocials also exhibited a lower preference for avoiding other commuters when compared to the remaining three groups. While not predicted, a similar pattern was also observed for the preference for others, with high-trust prosocials exhibiting the strongest preference for others to commute by public transportation. Multivariate tests for the remaining contrasts (i.e. low-trust prosocials versus proselfs, and low-versus high-trust proselfs) were all non-significant, as were all univariate tests on each preference index.

### Effective and given matrix preferences and the intention to commute by car

The third purpose of the current study was to assess the relative importance of the effective matrix preferences, and provide evidence in support of the claim that the effective matrix preferences are more predictive of commuting intentions than are those from the given matrix. In pursuit of this goal, we first computed simple correlations between all nine preference indices—self, others, and coordination, from each of the three matrices—and stated probability of taking the car, as shown in the first row of Table 3.

A visual inspection of these correlations reveals that the effective matrix preferences as a set appear to be more closely associated with intention to use the car than do the preferences from either of the given matrices. Further correlations, not reported in the table, revealed reliable relationships between preference for self (PS), preference for others (PO), and preference for coordination (PC) within the effective matrix (PS, PO = 0.44\*\*; PS, PC = 0.23\*; PO, PC = 0.36\*\*; where \* $p < 0.05$ , \*\* $p < 0.01$ , two-tailed), as well as between the effective matrix preferences and those in the comfort and travel time matrices respectively (PS<sub>EC</sub> = 0.62\*\*, PO<sub>EC</sub> = 0.10 n.s.,

Table 3. Correlations between given and effective matrix preference indices, probability of taking the car, and concern with various travel attributes

	P(Car)	Effective matrix preference indices			Given matrix (comfort) preference indices			Given matrix (travel time) preference indices		
		PSe	POe	PCe	PSc	POc	PCc	PSt	POt	PCt
P(Car)	1.00	0.61**	0.32**	0.39**	0.43**	0.19	0.08	0.48**	0.04	0.19
Comfort	0.51**	0.32**	0.21	0.36**	0.28**	0.09	0.32**	0.26*	-0.08	0.31**
Travel time	0.28**	0.21	0.00	0.12	0.31**	-0.12	0.10	0.21	-0.25*	0.03
Flexibility	0.44**	0.44**	0.14	0.21	0.22*	-0.02	0.01	0.22*	-0.03	0.14
Environment	-0.51**	-0.64**	-0.40**	-0.38**	-0.46**	-0.14	-0.06	-0.30**	-0.06	-0.11
Public health	-0.37**	-0.42**	-0.30**	-0.45**	-0.30**	-0.12	-0.15	-0.21	-0.07	-0.25*

Note.  $N=84$ ; P(Car), probability of taking the car; PS, preference for self (higher values indicate a stronger preference for the car); PO, preference for others (higher values indicate a stronger preference for others to commute by car); PC, preference for coordination (higher values indicate a stronger preference for avoiding other commuters). \* $p < 0.05$  \*\* $p < 0.01$ , two-tailed.

$PC_{EC} = 0.34^{**}$ ;  $PS_{ET} = 0.48^{**}$ ,  $PO_{ET} = 0.25^*$ ,  $PC_{ET} = 0.29^{**}$ ; where  $*p < 0.05$ ,  $**p < 0.01$ , two-tailed). The intercorrelations of the effective matrix preferences, and the partial overlap between the given and effective matrix preferences, raise two theoretically-relevant issues. First, given their intercorrelations, it is relevant to ask whether a particular effective matrix preference (say for coordination) is important, once the remaining (effective matrix) preferences have been taken into account. Indeed, one of the main assumptions of the present interdependence approach is that factors above and beyond simply an individual's overall self preference *are* important factors in ultimate commuting intentions. Second, in light of the overlap between the given and effective matrix preferences, it seems reasonable to ask whether the effective matrix preferences—which are assumed to be more closely linked to behaviour—can sufficiently account for intended behaviour, above and beyond the personal preferences expressed in the two given matrices.

To address these issues, we conducted a two-step regression analysis. First, to assess the relative importance of the effective matrix preferences, a simultaneous regression analysis was performed in which stated probability of taking the car in the commuting scenario was regressed on the set of three effective matrix preferences. Consistent with hypothesis 4a, the analysis revealed a significant (positive) relationship between self preference and stated probability of taking the car ( $\beta = 0.56$ ,  $t = 5.99$ ,  $p < 0.001$ ), over and above the effects of preference for others, and preference for coordination. The positive beta weight indicates, as predicted, that a stronger self preference for the car was associated with a higher stated probability of commuting by car. More importantly, and consistent with hypothesis 4b, the analysis also revealed a significant relationship between the preference for coordination index and stated probability estimates ( $\beta = 0.26$ ,  $t = 2.91$ ,  $p < 0.01$ ), over and above the effect of preference for self, and preference for others. The positive beta weight for the preference for coordination index indicates, as predicted, that an increasing desire to avoid other commuters is associated with a higher probability of taking the car. The preference for others index was not reliably related to probability of taking the car, once preference for self, and preference for coordination has been controlled for ( $\beta = -0.02$ ,  $t = -0.16$ , n.s.). As a set, the three effective matrix preferences explained 43.8 per cent of the variance in stated probability of taking the car, overall  $F(3,80) = 20.75$ ,  $p < 0.0001$ , adjusted  $R^2 = 0.42$ .

Hypothesis 5 predicted that the effective matrix preferences would be more closely linked to behaviour than the preferences from either of the given matrices. To determine whether any of the given matrix preferences added to the prediction of intention to commute by car, over and above the effective matrix preferences, the remaining six preference indices (self, others, and coordination, from both travel time and comfort matrices) were entered into the model. Of these, only the preference for self from the travel time matrix proved to be a reliable predictor ( $\beta = 0.33$ ,  $t = 3.20$ ,  $p < 0.005$ ). Furthermore, both preference for self, and preference for coordination from the effective matrix remained significant predictors in the presence of the given matrix preferences (for self preference,  $\beta = 0.38$ ,  $t = 2.91$ ,  $p < 0.005$ ; for coordination preference,  $\beta = 0.19$ ,  $t = 2.04$ ,  $p < 0.05$ ). As a set, the nine preference indices explained 51.9 per cent of the variance in stated probability of taking the car, overall  $F(9,74) = 8.87$ ,  $p < 0.0001$ , adjusted  $R^2 = 0.46$ ;  $F(6,74)$  change = 1.09, n.s. Alternatively, when the given matrix



preferences were entered on a first step— $F(6,77)=6.16$ ,  $p<0.001$ ,  $R^2=0.324$ , adjusted  $R^2=0.272$ —and the main effective matrix preferences were added on a second step,  $F(3,74)$  change = 5.98,  $p<0.01$ . As a set, these latter results provide support for the proposition that the effective matrix is more closely associated with intended behaviour than is the given matrix.

### **Correlational analyses addressing the relationship between the given and effective matrices**

Finally, in a more exploratory vein, to get a broader picture of the transformation from given to effective matrix, we computed correlations between all nine preference indices and participants' stated concern with five travel attributes, as well as their stated probability of commuting by car (see bottom five rows of Table 3). The most noteworthy aspect of these correlations is the way in which the travel attribute–preference index relationships change from the given to effective matrices. First, consistent with the notion that the effective matrix involved a transformation based on collective concerns, participants' stated concern with the environment and public health appears to be more strongly related to the effective, as opposed to the given matrix preferences. By contrast, participants' stated concern with comfort, travel time and flexibility respectively (i.e. individual commuting concerns) appears to be equally related to the given and effective matrix preferences. To determine which of these differences were reliable, we compared the strength of each travel attribute–preference index relationship in the effective matrix with the same travel attribute–preference index relationship in each of the given matrices, following procedures outlined by Steiger (1980). That is, we conducted  $5$  (travel attribute)  $\times$   $3$  (preference index)  $\times$   $2$  (contrast: effective versus travel time, effective versus comfort) = 30 comparisons between dependent correlations. Focusing on the collective concerns (i.e. environment and public health), results revealed that in nine out of the 12 cases, the travel attribute–preference index relationship was significantly stronger ( $p<0.05$ , one-tailed) in the effective, as opposed to either of the given matrices. The exceptions, which all involved the public health attribute, included the (subscripted) comparisons on preference for self<sub>E-C</sub>, preference for others<sub>E-C</sub>, and preference for coordination<sub>E-T</sub>. Turning attention to the individual concerns (i.e. comfort, travel time and flexibility), results revealed that in only four of the 18 cases was the travel attribute–preference index relationship stronger in the effective as opposed to the given matrices; these included one (subscripted) comparison involving the attribute comfort (preference for others<sub>E-T</sub>), and three comparisons involving flexibility (preference for self<sub>E-C</sub>, preference for self<sub>E-T</sub>, and preference for coordination<sub>E-C</sub>). Taken together, these results suggest that the effective matrix indeed involves a transformation based on collective concerns.

## **DISCUSSION**

The current research advanced an interdependence analysis of commuting decisions (i.e. commuting by car versus public transportation), delineating the determinants of

an individual's outcomes—collectively known as the interdependence structure—in terms of own decisions, other commuters' decisions, and the combination or interaction of own and others' decisions (*cf.* Kelley & Thibaut, 1978). Additionally, this analysis postulated two levels of interdependence structures, the first based on personal (i.e. self-interested) commuting concerns such as travel time and comfort (i.e. the given matrix), the second based on broader considerations including social value orientations and trust (i.e. the effective matrix).

Within the given matrix, results generally supported our hypotheses. Compared to a concern with travel time, a concern with comfort was associated a stronger self preference for the car, and a weaker preference for others to commute by public transportation, supporting hypotheses 1a and 1c, respectively. However, in contrast to hypothesis 1b, travel time did not increase the desire to avoid other commuters. Within the effective matrix, we failed to find evidence for the prediction that social value orientation (alone) would influence self preference for the car, and preference for avoiding other commuters, disconfirming hypotheses 2a and 2b, respectively. Nevertheless, findings did support the prediction that prosocials with high trust, relative to the other three groups, would show the greatest personal preference for public transportation (hypothesis 3a), and the lowest concern with avoiding other commuters (hypothesis 3b). This group also demonstrated the greatest preference for others to commute by public transportation. Our findings also supported the claim that not only self preference (hypothesis 4a) but also preference for coordination (hypothesis 4b) make independent contributions in predicting commuting intentions. Finally, the findings revealed some preliminary evidence that given matrix preferences are less predictive of commuting intentions than are effective matrix preferences; that is, after the presumed 'transformation process' on the basis of broader considerations has been taken into account. Taken together, the results of our analysis suggest (a) the validity of distinguishing between two levels of interdependence structures, the first based on personal concerns and preferences, the second based on broader considerations; (b) the importance of accounting for multiple individual differences in the perception of interdependence structures; and (c) the usefulness of moving from a purely individual analysis of commuting behaviour to one recognizing the importance of interdependence among commuters. Each of these conclusions is discussed in turn.

For some time, researchers interested in interdependent decision-making have distinguished between two levels of interdependence structures to account for the fact that, despite the temptation to behave in a purely selfish fashion, some individuals do behave in a collectively-beneficial fashion (e.g. Kelley & Thibaut, 1978). To date, evidence for this transformation process has been promising (e.g. Dehue, McClintock, & Liebrand, 1993; McClintock & Liebrand, 1988; Rusbult, Verette, Whitney, Slovik, & Lipkus, 1991; Van Lange & Kuhlman, 1994), but nonetheless indirect (for an exception, see Yovetich & Rusbult, 1994). The present results provide somewhat more direct evidence in support of such a transformation process: when allowed to interpret commuting decisions broadly, without respect to a particular concern such as comfort or travel time, participants' perception of the interdependence structure revealed notably more cooperative preferences.

The shift toward a more cooperative interdependence structure is even more interesting in light of the fact that this structure (i.e. the effective matrix) was meaningfully related to individual differences in trust (e.g. Yamagishi, 1986), and

more importantly, the combination of trust and social value orientation (Messick & McClintock, 1968). First, relative to individuals with low trust, individuals with high trust exhibited a lower overall preference for the car, a lower concern with avoiding other commuters, and a higher preference for others to commute by public transportation. These results add to a growing body of literature indicating that high levels of trust are associated with higher levels of cooperation in social dilemmas (e.g. Brann & Foddy, 1987; Parks, 1994; Yamagishi, 1986). More importantly, and consistent with our predictions, the present results revealed that social value orientation and trust combined to influence effective matrix preferences. The latter result is important for at least three reasons. First, the combined effect of social value orientation and trust provides support for Pruitt and Kimmel's (1977) goal/expectation theory which states that cooperation in social dilemmas is enhanced to the degree that individuals hold both the goal of cooperating and the expectation that one's cooperation will be reciprocated. The logic underlying the goal/expectation hypothesis has primarily been tested in the context of two-person, experimentally created social dilemmas. As such, the current study helps to extend the social dilemma literature by demonstrating the relevance of this hypothesis in an *n*-person, real-world setting. Second, the present results contribute to more general work on the role of personality in prosocial behaviour. The current work, by demonstrating the combined effect of trust and social value orientation on commuting preferences, suggests the importance of examining multiple dispositional measures when attempting to understand prosocial behaviour (*cf.* Knight, Johnson, Carlo, & Eisenberg, 1994; Snyder & Ickes, 1985; Staub, 1978). Finally, the present findings may have important real-world implications. For instance, past public advertising campaigns emphasizing the importance of behaving in a socially-responsible fashion have not been terribly effective at increasing the use of alternatives to the car (e.g. Baerwald, 1985; Kostyniuk, 1982). The present results suggest that some people (i.e. those with a prosocial orientation) may be more likely to respond to such campaigns, if the campaigns concurrently attempt to bolster the public's trust that other commuters will also 'pitch in'. Encouraging individuals with a proself orientation, on the other hand, to behave in a prosocial fashion may require an additional emphasis on the personal benefits associated with commuting by public transportation, or the personal costs associated with commuting by car (*cf.* Van Vugt *et al.*, 1995).

The final result we wish to discuss centres on the relationship between the effective matrix preferences and commuting intentions. That participants' overall preference for the car versus public transportation predicted stated intention to commute by car is reasonable, and not too surprising. What is more important, however, is that the desire to avoid other commuters was also associated with stated intention to commute by car, over and above, overall commuting preference. This is an important result for two reasons. First, the finding may have interesting policy implications. Specifically, public information campaigns stressing the desirability of avoiding others, on the assumption that people would thus opt for public transportation, may backfire. Indeed, raising the salience of self-serving coordination may increase commuters' desire for the car. Why self-serving coordination is associated with a higher preference for the car, is a good question. One possible answer is that a heightened emphasis on avoiding other commuters increases the desire to exert control over the commuting environment, control which

may be perceived as more likely behind the wheel of a car than on public transportation (*cf.* Van Vugt *et al.*, in press). At a more general level, the unique contribution of coordination preferences supports the importance of assessing more than just an individual's overall preference (i.e. reflexive control). Indeed, one may all too quickly assume that real-life interdependent situations have a structure in which coordination (i.e. behaviour control) is relatively small. The relative absence of behaviour control, for example, can be seen in the more restrictive definition of a social dilemma as a situation in which (a) each individual receives greater individual outcomes by choosing the non-cooperative alternative, *regardless of others' decisions*, yet (b) all individuals would receive larger outcomes if all would choose the cooperative alternative (Dawes, 1980)<sup>4</sup>. While this model of social dilemmas is often applied to a host of real-world problems, a closer inspection might reveal that many of those situations, while sharing some features of social dilemmas (so defined), may be experienced as a situation in which coordination is also important (e.g. the chicken dilemma; Liebrand, 1983). This seems especially relevant in situations like the present one in which there is potential for congestion, and in situations where an optimal level of cooperation can be identified (e.g. escaping from a burning movie theatre, utilizing a replenishable resource, or providing a step-level public good).

Before closing, we wish to outline some strengths and limitations of the present study. The relatively small percentage of commuters who completed the survey—after agreeing to participate—was disappointing. Moreover, it may call into question the representativeness of the sample. It might be argued, for example, that prosocials may have been more willing than proselves to participate in the study (*cf.* McClintock & Allison, 1989). However, the distribution of social value orientations in the present study was consistent with that of other studies using a similar measurement technique (e.g. Van Lange & Kuhlman, 1994). On a different note, the use of a hypothetical commuting scenario, while not uncommon in the transportation literature (e.g. Fenwick *et al.*, 1983; Norman, 1977; Norman & Louviere, 1974; Van Vugt *et al.*, in press), deserves mention. Given our goal of examining perceptions of the given and effective matrices, standardizing the commuting situation via a scenario was necessary and arguably beneficial. Had the commuting situation not been standardized, differences in perceived interdependence structure could not unambiguously have been attributed to social value orientations and trust.

Despite its potential limitations, the present study has a number of strengths. As noted above, the current study helps to extend research on commuting decisions, social dilemmas and prosocial behaviour in general. Moreover, the present study demonstrates an analytic tool which can help advance recent work aimed at understanding real-world interdependence structures. Despite the desirability of such an endeavour, little research has directly examined decision makers' perception of real-world interdependence structures. In one interesting exception, Plous (1993) asked U.S. senators to rate the attractiveness of four possible outcomes of the Nuclear Arms Race: (a) both countries arm, (b) both countries disarm, (c) U.S. arms, Soviet Union disarms, (d) U.S. disarms, Soviets arm. Contrary to the

<sup>4</sup>It should be noted that, even within this restrictive definition of a social dilemma, behaviour control can exist, despite the fact that an individual is always better off choosing the non-cooperative alternative, regardless of others' decisions. The lack of a 'crossing interaction' does not rule out the possibility of some degree of behaviour control. We simply wish to point out that the application of the more restrictive social dilemma model to real-world problems often overlooks the importance of behaviour control.

commonly cited Prisoner's Dilemma model (e.g. Brams, 1985), Plous discovered that the Arms Race reflected a 'Perceptual Dilemma' in which the U.S. most preferred mutual disarmament, while believing that the (then) Soviet Union preferred unilateral armament. The discrepancy between the theoretical and 'empirical' model illustrated in Plous' study is an important one, as the two models are likely to lead to different questions and/or suggestions regarding the underlying mechanisms responsible for behaviour in such contexts. The present analysis helps to extend this line of research in two distinct ways. Whereas Plous' analysis averaged over respondents, the present analysis systematically examined differences in perceived interdependence structures. Furthermore, instead of identifying a particular interdependence structure, such as the Prisoner's Dilemma or the Perceptual Dilemma, the current analysis offered a means of capturing interdependence in terms of three meaningfully interpretable components, an approach we hope will serve as a model for the formal analysis of behaviour in additional interdependent settings. At a more general level, the present results help demonstrate that interdependence theory (Kelley & Thibaut, 1978), which has typically been applied to dyadic interpersonal relationships, can also provide a useful framework in which to understand behaviour in multi-person interdependence contexts such as commuting decisions.

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